Effects of a Tai Chi/Qigong Intervention on Body Composition, Sleep Quality, and Emotional Eating in Midlife and Older Women

by

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ABSTRACT

Weight gain and unfavorable body composition are prevalent among midlife and older women; shifts in these characteristics can have detrimental implications on emotional and physical health and longevity. Efforts to attenuate weight-related factors detailing the potential development of obesity are traditionally driven by manipulation of nutrition and/or physical activity; however, sustained results are limited. Novel and integrative approaches are needed to reduce the burden of adverse changes in weight and associated consequences.

This dissertation is built around a model of effects of Tai Chi/Qigong in body composition and a pilot test of this intervention and model factors in a group of midlife/older women ($N = 36$). Three resulting manuscripts include: 1) a proposed biobehavioral model detailing how a Tai Chi/Qigong intervention may improve weight-related outcomes through psychological, behavioral, and physiological pathways, 2) a paper examining pre- to post- intervention differences in the primary outcomes of percent body fat, sleep quality, and emotional eating and the exploratory outcomes of perceived stress, mood state, mindfulness, self-compassion and body awareness; and 3) an exploratory analysis examining correlations between primary (sleep quality, emotional eating), exploratory (perceived stress, mood state, mindfulness, self-compassion and body awareness), and neurophysiological (heart rate variability) outcomes of interest—further, regression models were conducted to explore the predictive value of the independent variables on the dependent variables and associated changes.

In manuscript two, dependent t-tests were used to assess pre/post-differences (percent body fat and survey measures); this single group study (8-weeks of Tai Chi/Qigong) did not have a control group. Results of manuscript two demonstrate significant changes in sleep quality ($p = .04$), perceived stress ($p = .05$), and body awareness ($p = .01$). Findings of manuscript three indicate changes in the dependent variable of sleep quality were partially explained by perceived stress (adjusted $R^2 = 13.4\%$) and changes in the dependent variable of emotional eating were significantly explained by self-compassion (adjusted $R^2 = 42.1\%$). In the context of weight gain and unfavorable body composition in midlife/older women, results of this pilot study, using a standardized Tai Chi/Qigong intervention, indicate that select psycho-emotional factors may be important to explore further.

DEDICATION

In sweet, loving memory of Dr. Jane C. Hurley—I simply never would have made it here without you. For years, we talked about completing our PhD programs and helping people—you valiantly and heroically accomplished both. Your life was far too short, but so beautifully and authentically lived. You were gold, Sweet Jane—and I wish you were here.

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CHAPTER 1

INTRODUCTION

Weight gain and adverse changes in body composition (e.g. increased central adiposity, fat mass, percent body fat) are prevalent among midlife women and may contribute to a host of obesity-related diseases (Al-Safi & Poltasky, 2015; Davis et al., 2012; Teede, Lomard, & Deeks, 2010). The preponderance of research has established correlations between obesity and type 2 diabetes, hypertension, particular neurological disorders, certain types of cancer, cardiometabolic diseases, and decreased life expectancy (Al-Zadjali, Keeler, Larkey, & Albertini, 2010; Keller et al., 2010; Teede et al., 2010; Warburton, Nicol, & Bredin, 2006; Davis et al., 2012). Obesity is most commonly defined as having a body mass index (BMI) that is greater than 30 kg/m^2 (Teede et al., 2010); it is currently estimated that, in the United States, 30% of the female adult population is obese (Flegal, Kit, Orpana, & Graubard, 2013). Although the complex etiology is not fully understood, midlife women are at an increased risk for becoming obese and consequentially confronted with associated health issues. Lifestyle interventions, primarily focused on nutrition and physical activity, have been the cornerstone of efforts to mitigate weight gain and improve body composition (McAuley & Blissmer, 2012); however, research demonstrates a lack of sustained change and improved predictors of long-term health (Teede et al., 2010). A growing body of research supports the application of particular mind-body practices to reduce weight (Koithan 2009; Alert et al., 2013) and improve body composition (Khan, Marlow, & Head, 2008; Chang & Chen, 2016). The current dissertation focuses on a complementary,

or alternative mind-body intervention to address changes in body composition in the context of obesity and biobehavioral factors in midlife and older women.

Literature Review

Obesity.

Adverse changes in body composition may lead to obesity which is associated with numerous chronic diseases and may, in part, underwrite the story leading to mortality. The links between obesity and detrimental health conditions are alarming. Obesity has been repeatedly associated with type 2 diabetes, hypertension, stroke, certain types of cancer (i.e., breast), cardiovascular disease, metabolic syndrome, and decreased life expectancy (Davis et al., 2012; Sowers et al., 2007). In addition to these well-known medical conditions, research represents a consistent correlation between obesity and psychosocial symptomology/diagnoses including depression, anxiety, and low self-esteem (Davis et al., 2012; Teede et al., 2010). Furthermore, obesity is a risk factor for certain neurocognitive diseases (via dysregulation of leptin) such as dementia and Alzheimer's disease (Antsey, Cherbuin, Budge & Young, 2010; Davis et al., 2012). The consequences of identified issues may severely impact women's physical health, mental well-being, and overall longevity. Overweight and/or obesity status are well-known predictors of significant long-term health problems (Elfhag & Rossner, 2005); it is paramount that research continues to understand, investigate, and mitigate these potentially life-threatening issues.

Midlife and menopause.

For many women, the experience of "midlife" or the "midlife transition" is fraught with a multitude of challenges and is recognized as a "high-risk time" for weight gain (Teede et al., 2010). The specific age range for midlife varies; however, it is readily accepted that midlife includes the time during which menopause occurs. Menopause is the transitionary process during which women's menses permanently cease for at least 12 months (Sternfeld, Bhat, Wang, Sharp, & Quesenberry, 2005) and the reproductive cycle ends (Keller et al., 2010). Sowers et al. (2007), make the distinction that: "Premenopause was identified as no decreased regularity in menstrual bleeding during the previous year. Other classifications were early perimenopause (decreased menses regularity in the 3 months before the interview, late perimenopause (no menses for 3-11 months), and post menopause (no menses for 12 or more months)" (p. 896). Midlife for women is met with the experience of perimenopause, menopause, and post-menopause- all of which are associated with "unfavorable changes in body composition" (Davis et al., 2012, p. 420). The onset and duration of menopause varies although the process usually occurs between the ages of 45 and 55 years old (Al-Safi & Polotsky, 2015; Keller et al., 2010) with both physiological and psychological changes approximately 3-5 years before permanent menses cessation (Al-Safi & Polotsky, 2015). The majority of research demonstrates a strong and consistent correlation between midlife and weight gain (Davis et al., 2012; Sowers et al., 2007)—this is of significant concern due to the associated health outcomes and disease diagnoses associated with weight gain and adverse changes in body composition. Specifically, the midlife or menopausal period is correlated with the

redistribution of abdominal fat, or central adiposity (Teede et al., 2010). It is suggested that weight gain in midlife women- and the potential development of obesity- are driven by a multifaceted model including age, genetics, environmental factors, physical activity levels, eating behaviors, psychological well-being, and changes in hormones (Keller et al., 2010). Women report a number of physiological, physical, and psychological symptoms during this time, and often, in the post-menopausal (cessation of menses for 12 months of more) stage as well (Baldo, Schneider, & Slyter, 2003; Elavsky & McAuley, 2005). Well-documented developmental phases create a cascade of neuroendocrine, cardiometabolic and psychological changes in women during midlife (Elavsky & McAuley, 2005; Schneider et al., 2003; Sternfeld et al., 2005).

Beyond menopause- older women.

In general, post-menopausal women experience markedly high rates of overweight and obesity (Foster-Schubert et al., 2012). The population of older, or aging, women (beyond midlife) are uniquely susceptible to weight gain and adverse changes in body composition (i.e., increased fat mass); placing this population at an increased risk to develop cardiometabolic diseases (i.e., hypertension, diabetes, stroke) (Chung, Kang, Lee, Lee, & Lee, 2012). There is a steady and significant decline in body composition profiles (i.e., increased fat mass, decreased fat-free mass) with age (Hughes, Frontera, Roubenoff, Evans, & Singh, 2002). Unfavorable changes in body composition have a significant impact of cardiovascular risk factors and disease, as well as physical capabilities in the aging and elderly population (Chung et al., 2012). Midlife and older women share similar unfavorable changes in body composition, these shifts (i.e.,

hormonal, behavioral, physiological, psychological) threaten to compromise quality of life and associated health outcomes.

Body composition.

Body composition analysis, or body composition (BC), assesses body weight as differentiated by "body components, organs and tissues" (Mueller, Geiler, & Bosy-Westphal, 2019, p.406); more specifically measuring the amount of water, protein, fat, and minerals (Jebb, Cole, Doman, Murgatrody, & Prentice, 2000; Wells & Fewtrell, 2006). BC acts as an indicator and predictor of weight-related status; there are various valid and reliable means to assess body composition- skinfold thickness, body mass index (BMI), waist circumference, bioelectrical impedance analysis (BIA), dual energy x-ray absorptiometry (DXA), densitometry, isotope dilution, magnetic resonance imaging (MRI)- each with strengths and limitations (Wells & Fewtrell, 2006). BMI (calculated as weight(kg)/height(m)^2) (Wells & Fewtrell, 2006) is the most frequently used categorical strategy to determine weight status (underweight, normal weight, overweight and obesity) (Flegal et al., 2013); however, BMI changes may not be sensitive to change over limited time, therefore, for purposes of the current study, it was not anticipated that BMI would change significantly over an 8-week period with a gentle, low-intensity movement intervention and therefore it was not selected as the measurement of body composition. More sophisticated multi-compartment models subsist; however, are oftentimes cost-prohibitive and not feasible for large population studies. Body Mass Index (BMI) (formula= weight in kilograms divided by height in meters squared) (Shah & Braverman, 2012) is the most frequent and commonly used means to assess body composition.

Categorically, BMI determines weight status (i.e., overweight ≥ 25 kg/m^2, and obese ≥ 30 kg/m^2) and serves as an indicator of potential physiological and pathological diagnoses. BMI, while suitable for epidemiological studies, is inherently limited as it lacks precision to distinguish between fat-mass and fat-free mass. Fat-mass or percent body fat is a more exact and accurate predictor of deleterious health outcomes associated with unfavorable changes in body composition.

Although weight gain and increased BMI are correlated with long-term health consequences (i.e., type 2 diabetes, certain types of cancer, cardiovascular disease), percent body fat, fat mass, and lean mass distribution can improve without changes in weight (Sternfeld et al., 2005). Independent of weight, the measures of body composition may, in part, predict health outcomes such as hypertension, type 2 diabetes, stroke, certain types of cancer, and cardiovascular disease (Al-Safi & Polotsky, 2015; Davis et al., 2012; Foster-Schubert et al., 2012).

Bioelectrical impedance analysis (BIA), and respective devices, are widely accepted and readily used to measure body composition. BIA output is considered to be a "2-component model" measuring two primary components of body composition: 1) fat mass and 2) fat-free mass (Mueller et al., 2019). Fat mass refers to fat only, or energy stores, and is comprised of a "homogenous composition" (Jebb et al., 2000); conversely, fat-free mass is heterogenous, being comprised of water, protein, and minerals (Mueller et al., 2019). BIA measurements are acquired by the action of a small electric current which runs through the "total body fluid" (Mueller et al., 2019) resulting in measures of fat mass and fat-free mass. The impedance of the body to passing electrical current is

related to the amount of water in the body; as water is only present in fat-free mass, the remaining value is determined by subtraction from the total weight, which equals the fat mass (Andreoli, Garaci, Cafarelli, & Guglielmi, 2016). The amount of fat mass is also calculated into a percentage—the percentage is stratified into a category of established weight-based status (e.g., normal weight, overweight, obese). The onset of weight gain and compromised body composition during midlife is a predictable and potentially critical correlate of associated cardiometabolic and neurocognitive diseases; assessing and tracking body composition serves as a baseline and reference point for improved health outcomes over time.

Physical activity.

Physical activity (PA) plays a significant role in health maintenance and disease prevention during and beyond menopause (Stojanovska, Apostolopoulos, Polman, & Borkoles, 2014). The benefits of regular PA are well supported and notably include decreased stress, weight, fat-mass, anxiety, depression, risk of cancer, heart disease, high blood pressure, type 2 diabetes, and neurocognitive decline (Stojanovska et al., 2014; Warburton, Nicol, & Bredin, 2006). Additionally, regular PA helps to improve: sleep quality/patterns, energy, mood states, bone density, metabolism, and overall quality of life (Stojanovska et al., 2014; Warburton et al., 2006). It is suggested, per The Physical Activity Guidelines for Americans (PAGA), that adults meet the following recommendations for purposes of public health, "…adults [should] obtain at least 150 minutes/week of moderate-intensity physical activity (MPA), 75 minutes/week of vigorous-intensity physical activity (VPA), or a combination of moderate and vigorous

physical activity (MVPA)" (Tucker, Welk, & Beyler, 2011). Despite the heavily cited benefits of physical activity (Warburton et al., 2006), it is estimated that only 10% of the US adult population meets these guidelines (Stojanovska et al., 2014). An abundance of research demonstrates a positive correlation between exercise and weight loss such that increased exercise or physical activity may lead to a decrease in body weight (e.g., Al-Zadjali et al. 2010; McAuley & Blissmer, 2012). More specifically, research has demonstrated a positive effect of physical activity on body composition in menopausal women (Andreoli et al., 2016).

Lifestyle interventions focused on physical activity for improved health have been implemented extensively across various populations targeting different outcomes; however, there have been limited studies that report the prevention of weight gain (Teede et al., 2010) or the achievement of long-term weight loss and improved body composition. It has been suggested that a multifaceted approach to weight-related issues, including psychological, physiological, and behavioral elements, may most effectively attenuate associated health complications and improve quality of life (Elhag & Rossen, 2005). Modifiable lifestyle behaviors can be manipulated through interventions to yield successful outcomes. A significant body of work has been dedicated to understanding how physical activity can contribute to weight loss, weight gain prevention, and weight maintenance; additionally, similar work demonstrates that physical activity has the potential to make significant improvements in body composition (Catenacci & Wyatt, 2007; Donnelly et al., 2009; Swift, Johannsen, Lavie, Earnest, & Church, 2014). Incontrovertible evidence supports the suggestion that regular physical activity can make

a significant contribution to the prevention of cardiometabolic, neurocognitive, and psychological diseases (Warbuton et al., 2006); however, adoption of and adherence to PA "prescriptions" are rarely sustained. More current research suggests that a multifaceted, mind-body approach may better achieve sustained lifestyle behavior changes leading to improved health outcomes, quality of life, and increased longevity (Lauche & Cramer, 2018).

Additional variables related to body composition.

The construct of body composition can be affected by numerous factors, including but not limited to psychological, behavioral, and physiological components. Additionally, factors related to genetics, medical conditions, and environment may impact weight and body composition. Based on previous literature, we selected specific variables related to body composition: emotional eating, mindfulness, self-compassion, and body awareness. Each is discussed in greater detail in following sections as they relate to Tai Chi and Qigong; however, for the purposes of framing the project, each is defined here. Emotional eating is described as eating in response to a negative emotion (i.e., stress, sadness) (Arnow, Kenardy, & Argras, 1995). Lack of ability to regulate and respond to negative emotions is often "dealt" with via consumption of "comfort foods" (i.e., high fat, high sugar foods (Gibson, 2006); over time, the behavior of emotional eating (sporadically or habitually) may lead to increased weight and unfavorable shifts in body composition.

To date, science lacks an agreed-upon, universal operational definition of mindfulness. Jon Kabat-Zinn (1994), considered the pioneer of mindfulness in Western

culture and the founder of Mindfulness-Based Stress Reduction (MBSR), defines mindfulness as: "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally." Kabat-Zinn's description is widely and readily accepted by scholars and researchers alike; as such, it is the definition accepted for the current paper. Mindfulness, a simple word, is nevertheless a complex concept to understand. Disparate models of mindfulness suggest varied definitions and constituents, yet unanimously include the core components of being: 1) attentive, 2) aware, and 3) non-judgmental. Regardless of variance among mindfulness models, all declare a comparably aligned intention and objective: to enhance self-regulation. Mindfulness may enhance the ability to tune into what one needs (i.e., psychologically, physiologically) and respond with more healthy decisions related to factors impacting body composition (i.e., sleep, food).

Self-compassion is understood as being kind to oneself, as one would to a best friend, in a time of suffering. Self-compassion is comprised of three positive and three negative psychological components. The three positives are: self-kindness, common humanity, and mindfulness; the three negatives are self-judgement, isolation, and over-identification; combined, these elements define and give shape to the experience of self-compassion. Self-compassion as a practice, disposition, and experience may help to improve how one cares for oneself with regards to various factors which may influence body composition (i.e., sleep, physical activity, eating behaviors). A growing body of research demonstrates that self-compassion supports healthy eating behaviors and weight-related outcomes (Breines, Toole, Tu, & Chen, 2014; Mantzios, M. & Wilson, J.C., 2014).

Conceptually, body awareness is more challenging to define, but is purported to include "…attentional focus on and awareness of internal body sensations" (Mehling et al., 2009, p. 1). Body awareness is a concept that can be considered as in two different domains: adaptive or maladaptive. In the adaptive sense, body awareness heightens sensitivity to what one is experiencing and the needs of the body. The maladaptive aspect of body awareness is demonstrated when one hyper-focuses on a "negative" aspect of feeling, which tends to amplify these negative feelings (Mehling et al., 2009).

Meditative movement.

Meditative movement (MM) is an established category of exercise that incorporates elements of both the mind and body (Larkey, Jahnke, Etnier, & Gonzalez, 2009) and specifically includes "…the regulation of both breath and mind coordinated with the regulation of the body" (Janhke, Larkey, Rogers, Etnier, & Lin, 2010, p.3). MM is comprised of four foundational components: 1) a focus on the breath, 2) body posture alignment and/or movement, 3) a clear/calm mind, and 4) a deep state of relaxation (Larkey et al., 2016; Larkey, James, Belyea, Jeong, & Smith, 2018). MM includes practices such as Tai Chi, Qigong, and different types of yoga—and is generally considered a gentle, low-intensity form of exercise; however, particular types of yoga may be more vigorous (Larkey et al., 2016, Larkey et al., 2018).

Tai Chi Easy (TCE), a form of MM, is a combination of practices from Tai Chi and Qigong which share philosophical roots, principles, and practices (Larkey et al., 2016; Healer Within Foundation, 2017) in Traditional Chinese Medicine (Wu, Kwon, Lan, & Tiang, 2015) and have been practiced for centuries in the East (Wang et al.,

2010). TCE exercises are a series of movements that are repeated in order each week, combining the four elements of MM. TCE exercises flow together as a series of movements and breath to cultivate "Qi" and promote self-healing (Larkey et al., 2016). Jahnke et al. (2010) summarize the intention of the practices:

> This combination of self-awareness with self-correction of the posture and movement of the body, the flow of breath, and stilling of the mind, are thought to comprise a state which activates the natural self-regulatory (self-healing) capacity, stimulating the balanced release of endogenous neurohormones and a wide array of natural health recovery mechanisms which are evoked by the intentful integration of body and mind (p. 3).

TCE was developed by Dr. Roger Jahnke from the Institute of Integral Qigong and Tai Chi (IIQTC) (California) (Jahnke, 2002), and was further established into a standardized, manualized protocol used in health-related research (Jahnke, Larkey, & Rogers, 2010). (See Appendix A). TCE, as a form of MM, combines deep breathing, focus on posture and/or movement, clearing of the mind, and a deep state of relaxation (Larkey, Jahnke, Etnier, & Gonzalez, 2009). This mind-body practice provides a low-impact, low-intensity, gentle movement program which can be practiced standing or sitting. The exercises are combined in a progressive sequence with each exercise being repeated numerous times before moving onto the next movement. Modifications and "advancements" are provided for each movement, but participants are strongly

encouraged to "listen to your body" and go "only as far as you feel comfortable." MM can be taught as an alternative or complementary approach to physical activity through mind-body movements that are linked together.

Benefits of Tai Chi/Qigong: psychological and physiological.

A growing body of literature readily demonstrates the effectiveness of Tai Chi (TC) and/or Qigong (QG) practices, both of which promote healing and increased vitality and may further improve a myriad of physiological, physical, and medical outcomes (Janke et al., 2010; Wang et al., 2010; Wang et al., 2013). TC has been shown to improve physical outcomes such as balance, strength, flexibility, pain (Wang et al., 2010; Wang et al., 2013). TC has shown positive results within various medical populations including participants with type 2 diabetes, arthritis, breast cancer, fibromyalgia, human immunodeficiency virus (HIV) (Wang et al., 2013). Physiologically, TC has demonstrated effectiveness in improving outcomes related to respiratory and cardiovascular function (Wang et al., 2010; Wang et al., 2013) and immune function (Wang et al., 2013). QG has effectively helped treat medically-related conditions such as high blood pressure, type 2 diabetes, cancer, cardiovascular disease, fibromyalgia, and Parkinson's disease (Wang et al., 2012; Wang et al., 2014). QG has been shown to help make improvements in the respiratory system and immune function (Wang et al., 2012).

Historically, there has been far less research examining psychological outcomes in the context of TC and QG interventions. However, a series of systematic reviews and meta-analyses were conducted (in English and Chinese databases) in 2010, 2012, 2013, and 2014—all exploring psychological outcomes in the context of TC and QG

interventions (Wang et al., 2010; Wang et al., 2012; Wang et al., 2013; Wang et al., 2014).

A 2010 systematic review and meta-analysis by Wang and colleagues explored TC interventions on psychological well-being and various related outcomes demonstrating that of the 21 trials reviewed (a mix of RCTs and non-RCTs), there were significant improvements in subjective stress, anxiety, depression, mood, and self-esteem. This review suggests that TC may be an "effective therapeutic modality to improve psychological well-being" (Wang et al., 2010, p. 14). Published three years later by a different team of researchers, another systematic review and meta-analysis explored psychological outcomes in the context of TC interventions (Wang et al., 2013). The referenced 2013 review included 42 studies (37 RCTs, 5 quasi-experimental studies), results from the review and meta-analysis indicated improvements in subjective measures of stress, depression, anxiety, mood, self-esteem, exercise self-efficacy, and quality of life (Wang et al., 2013).

A 2012 systematic review and meta-analysis by Wang and colleagues aimed to assess the effects of QG practices on psychological well-being outcomes. This study included 15 studies (14 RCTs, one quasi-experimental study) with a mixed population of healthy participants and participants with chronic medical conditions (i.e., diabetes, hypertension). Of the 15 included studies, the most frequently improved psychological outcomes were decreased depression and increased mood; followed by reduced anxiety. Additionally, findings reported decreased (perceived) stress, improved quality of life, and increased exercise self-efficacy. Following this work, a 2014 systematic review and

meta-analysis by Wang and colleagues used seven RCTs to explore psychological outcomes in the context of QG interventions. Particular psychological outcomes of interest were perceived stress and state anxiety; results indicated the QG had a beneficial effect on both stress and anxiety in the intervention groups.

Additionally, results testing both TC and QG interventions support improved physiological, physical, and psychological outcomes across various populations (Janke et al., 2010). A 2010 systematic review (Jahnke et al.) details numerous health-related outcomes in the contextual framework of TC and QG interventions. Physiologically, the practices of TC/QG have been shown to improve bone health (i.e., attenuate bone loss, reduce fracture incidents, increase bone mineral density), improve cardiopulmonary outcomes (i.e., reduced blood pressure, reduced heart rate, increased heart rate variability, improve lipid profiles, increase VO_{2max}). Psychologically, these specific practices of TC/QG have been shown to improve quality of life (i.e., perceived health, social relationships), self-efficacy, mood state, and decrease anxiety, depression and stress (Jahnke et al., 2010). A burgeoning body of research supports the idea that both TC and QG may improve a range of psychological outcomes across populations leading to enhanced health and well-being.

Based on statistical findings of current literature we suggest that the practices of TC/QG may have positive effects on factors related to body composition (i.e., perceived stress, mood state). A 2018 (Larkey et al.) systematic review and meta-analysis explored the outcome of body composition in the context of TC/QG practices to understand the potential effect on weight management and associated outcomes (i.e., body composition).

Study results indicated improved measures in body composition in 41.7% of the studies (N = 1621 across 24 studies) when compared to various types of control groups. Further, results from the meta-analysis, in which effect sizes from 12 different TC/QG studies were combined, demonstrated a small-to-medium (small= < 0.20; medium= 0.50) effect size, SMD= -0.39 (95% CI = - 0.73-0.04) in active TC/QG interventions compared to inactive control groups. This indicated that the mean standard deviation reduced by one-third with respect to body mass index or weight loss; although not a large effect, results may hold clinical promise. Findings from this systematic review and meta-analysis demonstrate a trend in the predicted direction for changed body composition and weight reduction in the context of TC/QG interventions. We suggest that further research exploring the variables related to body composition, potential mechanisms of change, and predictors of such change are necessary to better understand and establish the relationship between body composition and TC/QG.

Theory

Tai Chi and Qigong are grounded in the theory of Traditional Chinese Medicine (TCM) (Jahnke, Larkey, Rogers, Etnier, & Lin, 2010; Larkey, Jahnke, Etnier, & Gonzalez, 2009). In the context of intervention design and implementation, the theory of TCM is not yet well translated into the scientific method; there are complex elements for which it is a challenge to provide (scientific) operational definition and meaningful measurements (i.e., meridians, acupoints). Jiang and Zou (2013) postulate the following:

> TCM hypothesizes that the meridian system is the path to transport Qi and blood of the body and connects the Zang-fu organs, surface, and different parts of the body. TCM's meridian theory is unique.

Jahnke (2002) suggests that the principles of TCM (theory) are primarily applied through TCM-specific MM practices (Tai Chi/Qigong including the breath focused meditation with movement), through dietary intake, and through transmission of Qi to balance the elements of wood, water, metal, air and fire to generate a healthy state. Each element is associated with internal organs and emotions and it is thought that application of certain colors, elements, visualizations and movements may balance the physical and emotional body. The Tai Chi/Qigong practice is designed to independently bring about balance of these elements and guide one towards a deep state of relaxation through the combined experience of awareness of breath, posture/body movement, and a clear/calm mind. The other components, that is, intake of herbs and selected foods, and delivery of Qi through external practitioners' therapeutic Qi-emission practice, all are seen to work together to enhance the Qi state and balance (Jahnke, 2002).

Here, we propose that the self-regulation theory may, contextually, help understand the interplay between the practices of Tai Chi/Qigong, potential mechanisms (i.e., psycho-emotional, behavioral variables), and varied outcomes related to body composition. The self-regulation theory is considered a "personal management" system, or a way of consciously conducting oneself (Bandura, 1991). Self-regulation theory suggests that one can drive thoughts, behaviors, and feelings with respect to an identified and intended goal (Baumeister, 2004). Therefore, it is logical, in the context of weight

gain and adverse changes in body composition, that the components of self-regulation theory may support constructive behaviors (i.e., increased physical activity, improved sleep quality) as well as assist in emotional regulation, all of which are aligned with the desired outcomes.

Purpose

The purpose of the current pilot study was to test whether the primary outcomes of percent body fat, sleep quality, and emotional eating and of the exploratory outcomes of perceived stress, mindfulness, self-compassion, mood state, body awareness, and biomarkers of stress would improve following a single group 8-week TCE intervention with a population of midlife/older women.

Primary Aims

1. To examine changes in percent body fat from pre- to post- TCE intervention in a population of midlife/older women.

   HYPOTHESIS 1: Percent body fat will decrease from pre- to post- intervention.

2. To examine changes in sleep quality from pre- to post- TCE intervention in a population of midlife/older women.

   HYPOTHESIS 2: Sleep quality will improve from pre- to post- TCE intervention in a population of midlife/older women.

3. To examine changes in emotional eating from pre- to post- TCE intervention in a population of midlife/older women.

   HYPOTHESIS 3: Emotional eating will improve (decrease) from pre- to post- TCE intervention in a population of midlife/older women.

Exploratory Aims

4. To examine changes in select psycho-emotional wellness factors (perceived stress, mindfulness, mood state, self-compassion, body awareness) from pre- to post- TCE intervention.

   HYPOTHESIS 4: The selected psycho-emotional factors (perceived stress, mood state, mindfulness, self-compassion, body awareness), will improve from pre- to post- TCE intervention.

5. To determine the associations between select psycho-emotional wellness factors (perceived stress, mood state, mindfulness, self-compassion, body awareness) and the neurophysiological factor of heart rate variability predict changes in 1) sleep quality and 2) emotional eating.

   HYPOTHESIS 5: The selected psycho-emotional wellness factors (perceived stress, mood state, mindfulness, self-compassion, body awareness) and the neurophysiological factor of heart rate variability will predict changes in 1) sleep quality and 2) emotional eating

STUDY DESIGN AND METHODOLOGY

Procedures

The study was conducted as a pilot single-group pretest/posttest design examining the effects of a standardized 8-week TCE intervention, using a modified class time (30 minutes instead of 60 minutes) on the primary outcome of improved body composition in midlife/older women. We assessed whether TCE improved psycho-emotional wellness factors associated with body composition (perceived stress, mood state, mindfulness,

self-compassion, body awareness). Additionally, study analysis intended to explore the potential correlations between primary and exploratory variables and, further, explore the predictor value of exploratory variables on sleep quality and emotional eating. This study was unfunded and as no such participant compensation was provided. All study materials, procedures, and protocol were approved prior to the start of the study by the Arizona State University IRB.

Inclusion/Exclusion Criteria

Inclusion criteria: females, 45-75 years of age, able to participate in low-intensity exercise for 8 weeks. Exclusion criteria: women who were unable to stand for 10-minutes and/or were unable to walk. Interested individuals were asked to complete a brief (5-minute) phone screen to determine eligibility based on age and ability to participate in and commit to a gentle movement group for 8-weeks. (See Appendix B). Additionally, participants were asked if they preferred morning or evening classes and to inform research staff about any days of the week that they could not participate. Eligible individuals were invited to schedule an appointment to sign informed consent and do baseline data collection with trained research staff.

Recruitment and Setting

Study recruitment was conducted on the Downtown Arizona State University campus (where the data collection and intervention took place). Recruitment materials (full-page flyers and flyers with tear-away study contact information) were created by study staff and included content specific to class focus (TCE), participation requirement (1 hour of data collection pre- and post- intervention) class structure (8-weeks, 30-minute

classes) class dates, time, location, study contact info and eligibility age range. Flyers contained a positive health-related image from the internet (i.e., people practicing Tai Chi). (See Appendix C). New flyers were created for each cohort with edits only to class specifics and the selected graphic image; study staff distributed and hung flyers on the Downtown campus and surrounding business establishments. Recruitment efforts were further pursued on a study-specific Facebook page. Regularly scheduled Facebook posts promoted the study per cohort; posts displayed information contained on the (cohort) appropriate flyer. Additional messages used to recruit participants on Facebook were related to "stress reduction" and "Tai Chi" classes. The Facebook page was only used for recruitment purposes, not as an ongoing means of active engagement between participants and staff.

All intervention components occurred on the Arizona State University Downtown Campus. Consent signing and data collection (pre- and post- intervention) were conducted in private university offices and/or classrooms. The 8 weeks of TCE classes were held in a private university space located on the Downtown Campus in Taylor Place on the first floor; this location had a private entrance from the sidewalk with parking nearby. As this study was unfunded, cost of participant parking was not covered; however, many of the participants worked on campus and walked to the TCE class on their lunch break or before work. The intervention space had large windows with direct sunlight which was used to light the room in place of the overhead fluorescent lights—this was conducive to creating a calm, relaxed environment for the class.

Data Collection

Individuals who were eligible after completing the phone screening procedures were invited to schedule a data collection appointment with study staff on the Downtown Arizona State University. Study staff reviewed the consent form with participants detailing the study components and engagement time, voluntary participation, and contact information. (See Appendix D). Upon complete review and agreement, both participant and study staff signed and dated two copies of the consent form: one copy for the study and one copy for the participant to keep. Data collection occurred in reserved, private classrooms in one of two buildings affiliated with the College of Nursing and Health Innovation on the Downtown campus. Participants were scheduled to attend consent signing and data collection at individual times to prevent overlap and ensure participant privacy. Trained research staff (Barrett Honors College student interns) conducted all of the data collection (pre- and post- intervention).

Measurements

Baseline data collection took approximately one hour and began with collection of demographic data. (See Appendix E). Heart rate variability data was collected first (See Appendix F). The majority of the appointment was allocated for participant self-report questionnaires related to psychosocial variables: Three-Factor Eating Questionnaire- Revised 18 (TFEQ-R18), Cognitive and Affective Mindfulness Scale-Revised (CAMS-R), Body Awareness Questionnaire (BAQ), Profile of Mood States (POMS), Perceived Stress Scale-10 (PSS-10), Pittsburgh Sleep Quality Index (PSQI), and the Self-Compassion Scale (SCS); all self-report questionnaires were valid and

reliable measures (see Table 1 for questionnaire details). Questionnaires were given to the participants as hard copy (paper). (See Appendix G).

Table 1.1 Pretest/posttest self-repost surveys measures

Measure	Description
PSQI	Pittsburgh Sleep Quality Index (PSQI) measures sleep quality over previous month; yields seven component scores: sleep quality, sleep latency, sleep duration, habitual sleep efficacy, sleep disturbances, use of sleep medication, and daytime dysfunction. Global score is the sum of seven component scores. High internal consistency, Cronbach's α= .83 (Buysse et al., 1989).
POMS-SF	Profile of Mood States Short Form (POMS-SF) measures six mood states: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. Total Mood Disturbance score is the sum of all six subscale scores; vigor-activity score being negatively weighted. High internal consistency, Cronbach's α= .87 (Curran, Andrykowski, & Studts, 1995).
PSS	Perceived Stress Scale 10 (PSS-10) measures subjective stress over previous month; total score is calculated by summing up the total of the 10 items, with items 4, 5, 7, and 8 being negatively weighted. High internal consistency, Cronbach's α= .89 (Cohen, Kamarck, & Mermelstein, 1983).
TFEQ	Three-Factor Eating Questionnaire Revised-18 (TFEQ-18) measures an individual's current eating behaviors: restrained eating, uncontrolled eating, and emotional eating. Subscale scores only, no global score. High internal consistency, Cronbach's α= .87 (de Lauzon et al., 2004).
CAMS-R	Cognitive and Affective Mindfulness Scale-Revised 10-item version (CAMS-R) measures four domains of mindfulness including attention, present focus, awareness, and acceptance. Yields one total score. High internal consistency, Cronbach's α = .78 (Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2006).
BAQ	Body Awareness Questionnaire (BAQ) measures four components: 1) Note Response or Changes in Body Process, 2) Predict Body Reaction, 3) Sleep-Wake Cycle, 4) Onset of Illness. Includes 18-items with global score. High internal consistency, (Cronbach's α= .82) (Shields, S.A., Mallory, M.E., & Simon, A., 1989).
SCS	Self-Compassion Scale (SCS) measures self-compassion and subscales: self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification. Total score is computed by summing all six subscale scores with self-judgment, isolation, and over-identification negatively weighted. High internal consistency, subscales: Cronbach's α= .75 - .81; total measure, Cronbach's α= .92 (Neff, 2003).

Participant height was measured using a portable, snap-together stadiometer (Seca, model #217, California) with a right angle for measurement while standing against a pole with centimeters listed. Participants were offered a chair to sit in and then were asked to remove their shoes and empty their pockets. Participants were then asked to step onto the stadiometer foot bed with their back against the pole erectly with their feet together, and their chin level. Research staff brought the right angle comfortably to the top of the participant's head for height measurement. Participants were then asked to step off the foot bed and then back on, and the measurement was collected twice in a row and averaged if different. These two measurements were recorded by hand into each participant file.

To measure body composition (body mass index, impedance, fat percentage, fat mass, fat-free mass, and total body water), a Tanita bioelectrical impedance scale (TBF-310GS Total Body Composition Analyzer, Illinois) was used. The Tanita bioelectrical impedance scale is a widely used and valid measure of body composition (Jebb, Cole, Doman, Murgatrody, & Prentice, 2000). The Tanita scale is portable, non-invasive, easy to administer, and additionally, does not have any size restrictions. Before each use, research staff cleaned the foot plate of the scale with a medical grade antibacterial wipe. Participants first asked if they had a "pacemaker or any other electronic medical device"—if yes, Tanita data collection was not conducted. If participants did not have a pacemaker or electronic medical device, they were asked to remove socks and shoes and stand on the specified metal-sole foot plate of the Tanita scale. Research staff, trained in Tanita assessment, entered participant height (collected previously with a stadiometer),

sex, athletic status ("standard" option entered for all) and adjustment for clothing (2-pound adjustment entered for all). Participants were asked to stay on the scale until the automated Tanita printout was complete detailing body composition measurements (body mass index, impedance, fat percentage, fat mass, fat-free mass, and total body water) and basal metabolic rate, and once completed participants were asked to step off the scale. Tanita measures were repeated a second time immediately after the first measure to check for any variability—averages were calculated as needed. Tanita measures were manually recorded in the participants' files with the accompanied printout stapled to the file.

Heart rate variability (HRV) was measured using HeartMath (EmWave ProPlus, California) equipment and emWave 2 devices. (See Appendix F). At baseline (and again post-intervention), three specific tests were used to collect HRV/HRC measurements: 1) "3 minutes at the bus" measuring low, medium, high coherence percentage and heart rate, 2) "1 minute ball breathing" measuring beats per minute, R-R interval, Mean Heart Rate Range (MHRR), Standard Deviation of Normal to Normal (SDNN), Root Mean Square of Successive Differences (RMSSD) and normalized coherence; and 3) "3 minute heart focused breathing" measuring low, medium, high coherence percentage scores and heart rate. Each of the measures were collected via standardized HeartMath protocol. (See Appendix H).

Intervention Protocol and Procedures

TCE is a form of Meditative Movement (MM) created by Dr. Roger Jahnke from the Institute of Integral Qigong and Tai Chi (IIQTC) (California) and further developed into a standardized, manualized protocol used in health-related research. TCE, as a form

of MM, combines deep breathing, focus on posture and/or movement, clearing of the mind and a deep state of relaxation (Larkey, Jahnke, Etnier, & Gonzalez, 2009). Teaching TCE includes a focus on a set of simple movements with all of these elements incorporated, as well as quiet moments in between the movements to focus on breathing practices, and a set of self-massage techniques. This mind-body practice provides a low-impact, low-intensity, gentle movement program which can be practiced standing or sitting (Jahnke, Larkey, & Rogers, 2010). Additionally, TCE is cost-effective, does not require any equipment and is easily adaptable to multiple, diverse populations. The exercises are combined in a progressive sequence with each exercise being repeated numerous times before moving onto the next movement. Modifications and "advancements" are provided for each movement, but participants are strongly encouraged to "listen to your body" and go "only as far as you feel comfortable." Instruction was provided throughout each class (8-weeks), 30 minutes per class. Although the full TCE class was designed for 60 minutes, for purposes of retention and to reduce participant (time) burden, we utilized a modified version, with 30, not 60, minute classes. There were two instructors for the current study; both were certified TCE Practice Leaders through the Institute of Integral Qigong and Tai Chi. TCE Practice Leaders have completed at least 25 hours of training which consists of studying the TCE Practice Leader Training Manual, reading the associated books, one-on-one teach-backs with IIQTC affiliated instructor, teaching to "mock" group classes, and practicing the methods guided by a training DVD. Each class began and ended with the three intentful corrections which guide participants to focus on their body by aligning posture, a focus

on the breath and a clearing of the mind; in addition, between each of the movements, participants were guided back to a brief return to the three intentful corrections, as a place of pause and re-centering. Due to the modified class time (30 minutes), the study protocol focused on the first six TCE exercises in the series (twisting at the waist, flowing motion, side bending, crushing stones, gathering from heaven and earth, and smoothing the energies). (See Appendix A). Each of the six exercises were once a week (in class) for 8-weeks, each movement was instructed/practiced for approximately 3-4 minutes. Participants were informed that they could perform all of the exercises standing up, sitting down, or while leaning on a chair/wall when needed for balance. Participants were informed and reminded that the class was to help them reduce stress, increase well-being, and connect with a sense of self-care/self-healing. At the end of the first class, participants were given a TCE DVD and paper log for tracking at-home practice. Participants were encouraged to practice daily and asked to bring in their practice logs each week. (See Appendix I). Research staff kept track of weekly attendance using an attendance sign-in sheet. (See Appendix J). At the end of the last class (week 8), participants were asked to schedule an appointment for post-intervention data collection (within the following week). With the exception of demographics, baseline data collection was replicated at the posttest.

Data Analysis Plan

Data analysis: To test our aims and determine intervention effectiveness we used IBM Statistical Package for the Social Sciences (SPSS)-24. Descriptive statistics and frequencies were run and examined to check quality and distribution of data and to

characterize the population based on collected demographics. The current study had five hypotheses, which were analyzed in the following way:

H1: *Percent body fat will decrease from pre- to post- intervention,*

Change in percent body fat was assessed with paired sample t-tests used to determine pre/post differences in the group.

H2: *Sleep quality will improve from pre- to post- TCE intervention in a population of midlife/older women.*

Change in sleep quality was assessed with paired sample t-tests to determine pre/post differences in the group.

H3: *Emotional eating will decrease from pre- to post- TCE intervention in a population of midlife/older women.*

Change in emotional eating was assessed with paired sample t-tests to determine pre/post differences in the group.

H4: *The select psycho-emotional factors (perceived stress, mood state mindfulness, self-compassion, body awareness), will improve from pre to post-TCE intervention.*

Change in psycho-emotional factors was assessed with paired sample t-tests to determine pre/post differences in the group.

H5: *The select psycho-emotional wellness factors (perceived stress, mood state, mindfulness, self-compassion, body awareness) and the neurophysiological factor of heart rate variability will partially predict changes in 1) sleep quality and 2) emotional eating.*

Separate linear (backward stepwise) regression models were used to examine select wellness factors predict changes in 1) sleep quality and 2) emotional eating.

As a conceptual and statistical approach to understanding the causal pathways or mechanisms leading to (potential) change in body composition from pre- to post-intervention, we planned to create two separate single-mediator models for the primary aims and an additional two models for the exploratory aims. However, it was determined in our primary outcomes analysis (pre-/post- intervention differences on change in percent body fat) that there was not a significant change—without a change in the primary outcome, we were unable to say, or test, what may have caused the (unfound) change. Mediation models would have allowed us to test the biobehavioral model constructed for manuscript #1 and better understand what may have been driving the change. Both sleep quality (Jennings, Muldoon, Hall, Buysse, & Manuck, 2007; Rahe, Czira, Teismann, & Berger, 2015) and emotional eating (Konttinen, Haukkala, Sarlio-Lahteenkorva, Silventoinen, & Jousilahti, 2009; Provencher, Drapeau, Tremblay, Despres, & Lemieux, 2003) have been repeatedly associated with body composition across literature; therefore, analyses were redirected to explore regression models with the dependent variables of sleep quality and emotional eating. Regression analyses were selected in place of the previously proposed mediation models to explore the relationship between sleep quality, emotional eating and the psycho-behavioral wellness factors of perceived stress, mood state, mindfulness, self-compassion, body awareness, and the neurophysiological measure of HRV. Within these models we hoped to: 1) determine if

the independent variables (perceived stress, mood state, mindfulness, self-compassion, body awareness) predicted the outcomes related to body composition (sleep quality, emotional eating); 2) determine which independent variables significantly predicted the outcome (dependent) variables, and 3) determine the proportion that each significant independent variable explained the variance in the dependent variable. For purposes of the current dissertation flow of logic and data decision making, the (originally) proposed meditation models remain in the document.

The proposed study was conceived as a single group pretest/posttest design in which all participants received the MM intervention and no control group. The consideration of running a mediation analysis to detect a potential causal chain, it was necessary to select an otherwise measured variable to act as the independent variable. The mediating models were constructed to explain the mediating (or indirect) effect of 1) sleep quality on improved body composition (See Figure 1) and 2) emotional eating on improved body composition (See Figure 2) in the context of a meditative movement intervention with midlife women.

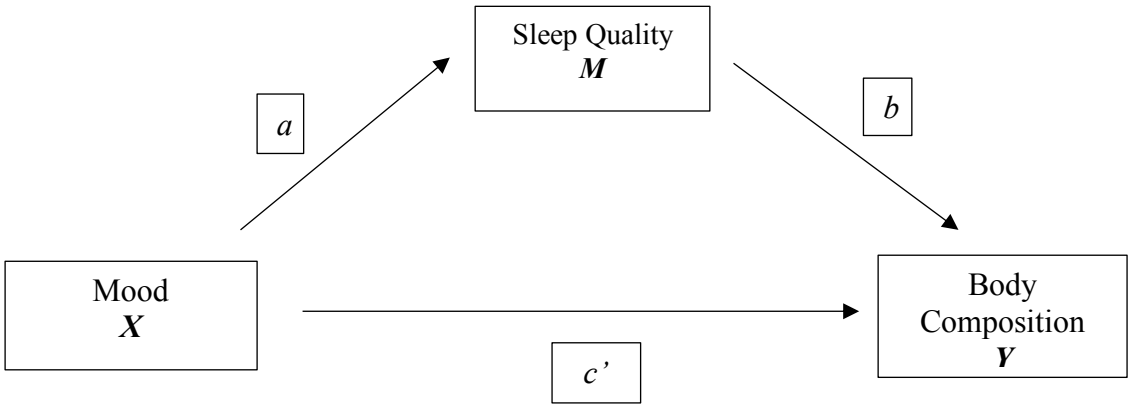


Figure 1.1. Mediation model explaining how *X* (mood) affects *Y* (body composition) indirectly through *M* (sleep quality).

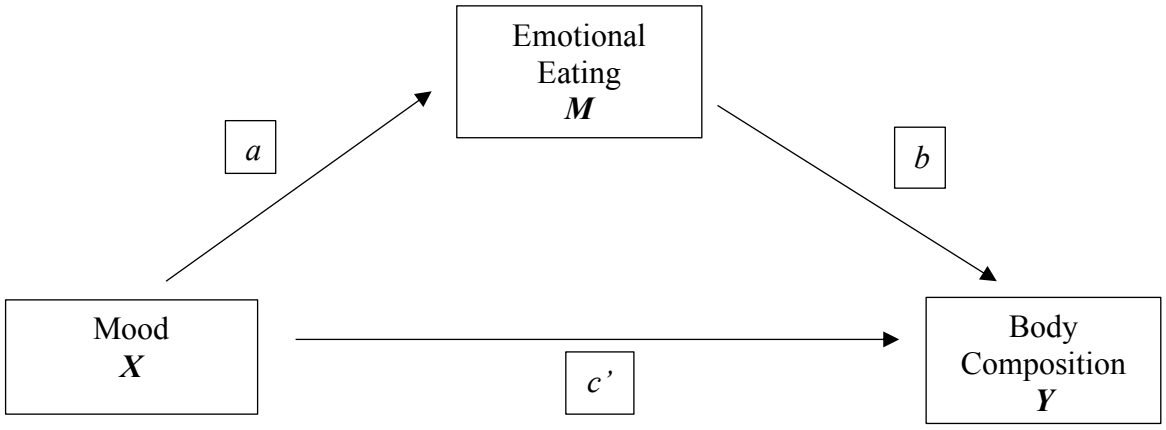


Figure 1.2. Mediation model explaining how *X* (mood) affects *Y* (body composition) indirectly through *M* (emotional eating).

Both mediation models postulated "mood" as the inputted independent variable because of the primary role emotions have been described as having effects on the mediators and outcomes. In the predicted causal pathway, it was anticipated that perceived stress would be the first variable to change and was therefore selected as the "replacement" independent variable. Such that "…the independent variable causes the mediator which then causes the dependent variable" (MacKinnon & Luecken, 2008, p.8) in the presented models, perceived stress serves as the independent variable and 1) sleep quality and then 2) emotional eating serve as (compared) mediating variables causes the change in the dependent variable, improved body composition. Mediation models imply three separate regression equations (where ***X***= independent variable, ***M***= mediating variable, ***Y***= dependent variable) exploring the effects of: *1*) ***X*** on ***Y***, *2*) ***X*** on ***M***, and *3*) ***X*** on ***Y***, while controlling for ***M***. A mediating variable, also considered a "third variable" (MacKinnon & Luecken, 2008), is considered an agent of change or that which "transmits" the effect that the independent variable has on the dependent variable (Lockhart, MacKinnon, & Ohrich, 2011; MacKinnon, Cox, & Baraldi, 2012). The concept of mediation allows us to better understand *how* the intervention changes the outcome (MacKinnon et al., 2012), among shared and varied domains (i.e., psychological, biological, behavioral) of human functioning and experience (Lockhart et al., 2011). Preacher & Hayes (2004) note that in mediation "Deeper understanding is gained when we comprehend the process that *produces* the effect" (p. 717). MacKinnon and Luecken (2008) declare that mediation analysis is a "…more sophisticated understanding of interdependencies between psychological processes and health" (p. 99).

Fundamental to the concept of mediation is the assumption that proper "temporal precedence" (MacKinnon et al., 2012) or "ordered chain of relations" (Lockhart et al., 2011) exists. Experimental or intervention studies allow us to manipulate and assure temporal sequence- such that *X* (independent variable, in this case intervention versus control) precedes *M* (mediating variable) and both precede *Y* (dependent or outcome variable) demonstrating both a potential causal pathway and a suggested mechanism of change (Lockhart et al., 2011; MacKinnon & Luecken, 2008).

Development of a mediation model, selected variables and respective analysis should be driven by evidence-based theoretical underpinnings appropriate to the anticipated relationships. Purposely, mediation analysis is often chosen for this very reason- it addresses theoretical query regarding "processes by which effects occur" (MacKinnon et al., 2012). The work of MacKinnon et al. (2012) discussed two theories related to the concept of mediation: the action theory and the conceptual theory. Specifically, action theory explores "how the manipulation will affect the mediator" and conceptual theory explores "how the mediators are related to the outcome of interest" (MacKinnon et al., 2012). Together, these theories explain and support the single variable mediation effect proposed in the current study such that the independent variable affects the mediator (emotional eating) and that the mediator is related to the primary outcome (body composition); suggested regression equations would hold true in this model such that: *1*) ***X*** on ***Y***, *2*) ***X*** on ***M***, and *3*) ***X*** on ***Y***, while controlling for ***M.*** In order to aptly address conceptual issues related to mediation models, variables must be selected based on theories and literature specific to the anticipated relationships and field of

inquiry. When possible, selection of variables and the direction of suggested relationships should be based upon current empirical findings (MacKinnon et al., 2012); theory-driven targeted mediators will best support the hypothesized—and temporally appropriate—relationships among variables (Lockhart et al., 2011) demonstrating a confident causal pathway.

The following dissertation aimed to assess change in percent body fat; yet if not achieved, the focus would shift to interim factors expected to be associated with percent body fat. We explored outcomes related to body composition (sleep quality and emotional eating) and psycho-emotional wellness factors (perceived stress, mood state, mindfulness, self-compassion, and body awareness) in a population of midlife/older women in the context an 8-week TC/QG intervention. Chapter Two (manuscript #1) frames and discusses a biobehavioral model detailing the components of TC/QG and potential mechanisms that may influence the outcomes of interest (body composition, sleep quality, emotional eating, perceived stress, mood state, mindfulness, self-compassion, and body awareness). Chapter Three (manuscript #2) assesses changes in primary outcomes (percent body fat, sleep quality, emotional eating) and exploratory outcomes (perceived stress, mood state, mindfulness, self-compassion, and body awareness) from pre- to post- 8-week TC/QG intervention. Chapter Four (manuscript #3) explores perceived stress, mood state, mindfulness, self-compassion, and body awareness as predictors of sleep quality and emotional eating (both recognized as factors associated with body composition). Chapter Five synthesizes the work presented in chapters 2, 3, 4, and discusses direction for continued research to further understand the science and

mechanisms of TC/QG and potential implications on body composition and associated psycho-emotional wellness factors in midlife/older women.

CHAPTER 2

MANUSCRIPT #1: MECHANISMS OF CHANGED BODY COMPOSITION IN MENOPAUSAL WOMEN PRACTICING TAI CHI/QIGONG: A BIOBEHAVIORAL MODEL

INTRODUCTION

A host of psychological, behavioral, and physiological, variables contribute to the well-known changes in body composition during the transition into and throughout menopause. Women experiencing menopause are highly susceptible to weight gain and increased percent body fat (Lovejoy, 2003; Toth, Tehernof, & Poehlman, 2000)—potentially contributing to the development of obesity. Large shifts in body composition, or the cumulative effect of small shifts over time, may significantly increase the likelihood of associated, detrimental health outcomes. Obesity is strongly correlated with cardiovascular disease, type 2 diabetes, certain types of cancer, osteoarthritis, psychological diagnoses (i.e., depression, anxiety), and increased mortality (Davis et al., 2012; Dixon, 2010). Recent data from 2018 (DeVito, French, & Goldacre) reports that approximately 40% of the female population ages 40-59 years old are obese; a disproportionately elevated figure associated with grave health outcomes.

The transition into and through menopause is marked, in part, with the irregularity of menstrual cycles (i.e., frequency, duration) and characteristically includes symptoms of hot flashes, night sweats, sleep disturbances/disorders, mood fluctuations, and, as noted above, irregular periods (Poehlman, 2002; Yeh & Chang, 2011). Perimenopause is marked by a shift in sex hormones and irregular menstrual cycles, which may take place

over years (Honor, 2018; Santoro & Taylor, 2011). Menopause is the "permanent end of menstruation caused by the disappearance of ovarian follicular activity" Tuson et al., 2015, p.1). The final menstrual period (FMP) is recognized once a year of menses cessation has occurred (Santoro & Taylor, 2011). A strong body of research demonstrates that this transition, perimenopause through menopause, "is associated with unfavorable changes in body composition, abdominal fat deposition and general health outcomes" (Davis et al., 2012, p. 420) and further "…accelerating fat accretion and erosion of fat-free mass…resulting in deleterious changes in body composition" (Poehlman et al., 2002). Body composition, at a basic level, is understood as the relationship between the amounts of fat mass and fat-free mass (Fosbol & Zerahn, 2015) expressed as ratios or percentages for each. Body mass index and percent body fat are frequently used measures of body composition with established cut points; for women having a body mass index $\geq 30 kg/m^2$ or percent body fat ≥35% indicates being obese (Ortega, Sui, Lavie, & Blair, 2016; Shah & Braverman, 2011). It has been established that menopause-related hormonal fluctuations (i.e., decreased estrogen, increased androgens) contribute to weight gain, shifts in body composition and potentially set the stage for the development of obesity (Lovejoy, 2003). The transition from perimenopause through menopause into postmenopause has been associated with a weight gain mean ranging from 5-10 pounds (Lovejoy, 2003). Studies have demonstrated that percent body fat can be upwards of 30% higher in populations of postmenopausal women as compared to matched premenopausal controls (Toth et al., 2000). Decreased energy expenditure (i.e., decreased physical activity, increased

sedentary time) and increased energy intake (i.e., caloric consumption) are characteristic of menopause and may contribute to at-risk body composition and the development of obesity (Lovejoy, 2003).

Traditional approaches to weight loss and management of healthy body composition (i.e., healthy percentages of fat-free mass and fat mass) have focused on a two-part paradigm: 1) nutrition (i.e., decreased caloric intake, improved food choices), and 2) exercise (i.e., increased physical activity, decreased sedentary time) (Foster-Schubert et al., 2012). Obesity is considered a disease of "chronic nutrient overload" (Dixon, 2010, p. 105), and excess body fat (Flegal et al., 2009)—therefore diet and exercise are appropriate components to address; however, research demonstrates limited long-term efficacy.

To address obesity using only these two options for intervention may not take into account the fullest understanding of the factors that go into the shift toward obesity in the first place. The etiology of obesity has proven inherently complex and may best be addressed by a multifactorial model and subsequent aptly developed interventions. Mind-body approaches and comprehensive understanding of domains, beyond eating behaviors and physical activity, such as, but not limited to, social support, coping mechanisms, life phase stressors (i.e., shifts in employment, changes in family paradigm), lifestyle behaviors may all contribute to the development of obesity. As such, examining interventions that address some of these additional factors may be important.

Recent research has shifted to explore a more novel approach to weight loss and improved body composition: mind-body interventions (MBIs) (Davis et al., 2012). In a

broad sense, MBIs purport to combine elements of the mind and body which are integral to the well-being of the whole person. Meditative Movement (MM) is considered both a mind-body practice and also a category of exercise (Larkey et al., 2009; Larkey et al., 2016). MM combines specific mind-body elements: 1) a focus on the breath, 2) body posture alignment and/or movement, 3) a clear/calm mind, and 4) a deep state of relaxation (Larkey et al., 2009; Larkey et al., 2014; Larkey et al., 2018). MM includes practices such as Tai Chi, Qigong, and various styles of yoga (Larkey et al., 2009; Larkey et al., 2014) that are typically considered to be low-impact and low-intensity (Larkey et al., 2018). Multiple studies using various types of yoga interventions have shown improvement in weight-related outcomes and body composition (Bernstein et al., 2013; Innes & Selfe, 2016; Kristal et al., 2005). Recent work suggests that MM interventions also may improve body composition and weight-related outcomes (Janelsins et al., 2011; Komelski, Blieszner, & Miyazaki, 2016; Smith, James, Jeong, & Larkey, 2018). A 2010 study using a 12-week TC/QG intervention demonstrated significant improvements in BMI and waist circumference (Liu et al., 2010). A 2018 (Larkey, James, Belyea, Jeong, & Smith) systematic review and meta-analysis explored the outcome of body composition in the context of TC/QG practices to understand the potential effect on weight management and associated outcomes (i.e., body composition). Study results indicated improved measures in body composition in 41.7% of the 24 studies. Further, results from the meta-analysis, in which effect sizes from 12 different TC/QG studies (selected based on having an inactive control) were combined, demonstrated a small-to-medium (small= < 0.20; medium= 0.50) effect size, SMD= -0.3881 (95% CI = - 0.732-

0.044) in active TC/QG interventions indicating that the mean standard deviation reduced by one-third with respect to body mass index or weight loss; although not a large effect, results were significant and show promise for continued testing to clarify the conditions that are most likely to achieve effects. The ways in which TC/QG "work" to achieve these results, however, have not been fully clarified to date. The first step in this work is to examine the range of effects of TC/QG, and then to address which of these changes may most likely (based on evidence on factors associated with body composition) make a difference in menopausal weight gain dynamics.

Broadly speaking, TC and Qigong have been systematically tested for effects on both psychological, behavioral, and physiological outcomes, with rapid increases in the research over the past two decades (Liu et al., 2010; Jahnke et al., 2010; Wang et al., 2010; Wang et al., 2014).

A burgeoning body of research supports the idea that both TC and QG may improve a range of psychological outcomes across various populations leading to enhanced health and well-being (Jahnke et al., 2010; Yeung, Chan, Cheung, & Zou, 2018). A 2015 systematic review demonstrated that 12 of the 17 reviewed studies with Tai Chi interventions showed improvements in anxiety and related quality of life factors (Sharma & Haider). A 2010 systematic review and meta-analysis by Wang and colleagues explored TC interventions on psychological well-being and various related outcomes demonstrating that of the 21 trials reviewed (a mix of RCTs and non-RCTs), there were significant improvements in subjective stress, anxiety, depression, mood, and self-esteem. This review suggests that TC may be an "effective therapeutic modality to

improve psychological well-being" (Wang et al. 2010, p. 14). Particular psychological outcomes of interest were perceived stress and state anxiety; results indicated the QG had a beneficial effect on both stress and anxiety in the intervention groups. Psychologically, these specific practices of TC/QG have been shown to improve quality of life (i.e., perceived health, social relationships), mood state, and decrease anxiety, depression and stress (Jahnke et al., 2010; Liu et al., 2010).

Tai Chi and Qigong are considered forms of Meditative Movement, which is a recognized and established category of physical exercise (Larkey, Jahnke, Etnier, & Gonzales, 2009). Although the practices are typically considered to be low-intensity and low-impact, studies have shown improvement (increases) in overall levels of physical condition in response to practice (Larkey, Roe, Smith, & Millstine, 2016). Further, Tai Chi practices have been shown to improve self-efficacy in older adults, which is related to increased exercise behavior (Li, McAuley, Harmer, Cuncan, & Chaumeton, 2001). Practices of Tai Chi and Qigong have been repeatedly demonstrated to be associated with sleep quality across populations (Fang et al., 2016). A robust and detailed 2016 systematic review (Fang et al.) of Meditative Movement (Tai Chi, Qigong, yoga) highlighted improved sleep behaviors, notably sleep quality, in the 17 high-quality (Jadad score ≥ 3) reviewed studies. A recent 2016 (Wang et al.) randomized controlled pilot study ($N = 52$) showed improvements in sleep quality from pre- to post- Tai Chi/Qigong intervention when compared to the control group. Additionally, a 2015 systematic review and meta-analysis exploring Tai Chi interventions among older populations, showed improvements in the behavior of sleep quality (Du et al., 2015).

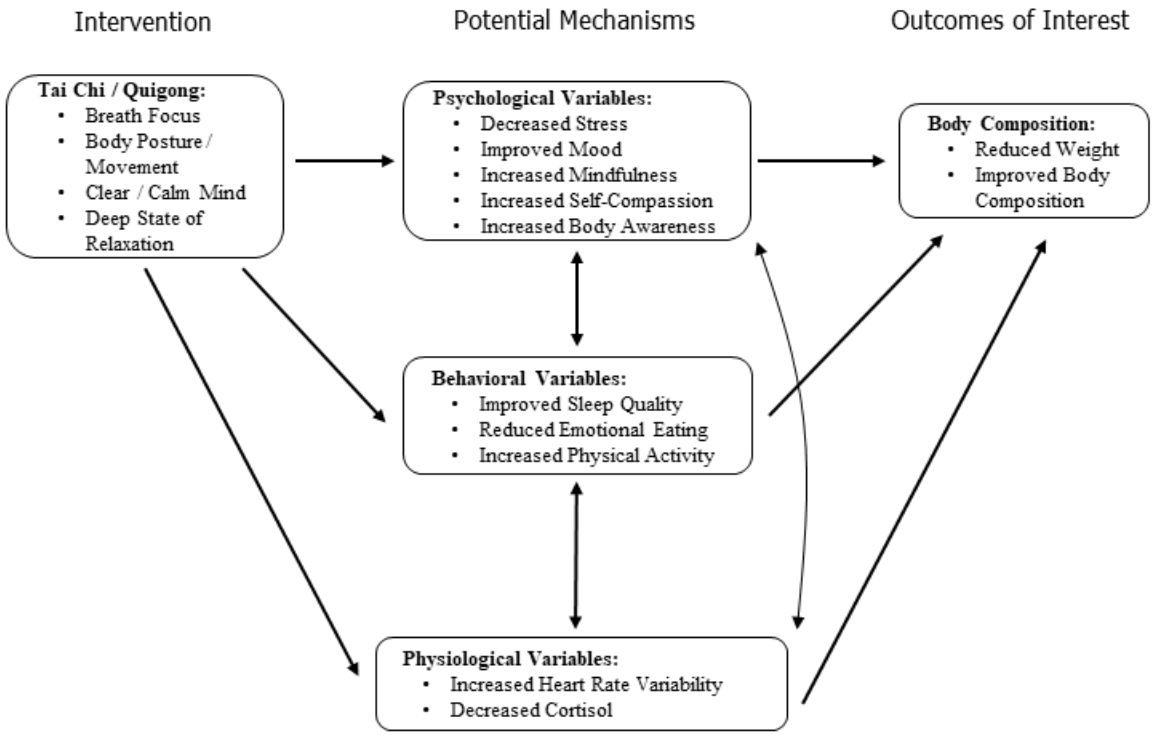
Although a less explored relationship, Tai Chi and Qigong practices also have demonstrated associations with eating behaviors. A recent qualitative study conducted with eating disorder inpatients demonstrated the incorporated Qigong program helped promote relaxation and awareness which, it is suggested in this context, would lead to more healthful eating behaviors (Gueguen et al., 2017).

Physiological outcomes include generalized effects on mobility, balance (Leung, Chan, Tsang, Tsang, & William, 2011), joint inflammation as well as more specific disease-focused changes in blood pressure (Liu et al., 2010), diabetes, Parkinson's disease (Tsang, 2013) osteoporosis, insulin resistance (Chow et al., 2018; Liu et al., 2010), osteoarthritis (Chang, Chen, Lee, Lin, & Lai, 2016), lung function and dyspnea (Kantangong, Ranpanich, Deesomchok, Sungkarat, & Siviroj, 2019). For purposes of this paper, we focus more on the psychological and behavioral outcomes that more directly relate to body composition (as well as a selection of physiological impacts such as heart rate variability and stress related hormones).

Menopause is clearly associated with weight gain and adverse changes in body composition, which may compromise physical health and emotional well-being during the transition, and persistently over time. Menopause is imminent and likely to be experienced by the majority of the female population, worldwide, at the chronologically appropriate time. Continued efforts to improve this transition and well-being are paramount. Research suggests it would be beneficial to understand factors across disparate domains (psychological, behavioral, physiological) that may be amenable to improved body composition during the menopausal transition.

The current article proposes a multifactorial and multidimensional model detailing mechanistic pathways, supporting Tai Chi/Qigong as a novel means to potentially amend weight gain and deleterious shifts in body composition over the phase of menopause (See Figure 1). Our model suggests that Tai Chi and Qigong interventions (incorporating breath focus, posture/body movement, clear/calm mind, and deep state of relaxation) may be related to weight reduction and improved body composition, such that these interventions may contribute to the outcome of interest. Further, we suggest that Tai Chi and Qigong interventions are related to the psychological, behavioral, and physiological variables, such that previous research has demonstrated meaningful relationships. Lastly, we suggest that the mechanisms (listed as individual variables) are related to the outcomes of reduced weight and improved body composition. Overall, the map of our model suggests the following: 1) the intervention is related to the mechanisms and the outcomes, 2) the mechanisms (psychological, behavioral, physiological variables) are related to the outcomes, 3) the mechanisms, as separated by category and listed as individual variables, are related to each other, and 4) the mechanisms may help drive the changes between the intervention and the outcomes.

Figure 2.1. Proposed pathways of change leading from Tai Chi/Qigong to improved body composition outcomes.



First, we propose a model identifying each of the four components and second, suggest, within detailed domains (i.e., psychological, physiological, behavioral), how such components may potentially initiate and support mechanisms of change related to body composition. With respect to healthy weight and improved body composition, alternative mind-body approaches may offer longstanding solutions and substantive promise for health, well-being, and longevity. The proposed model suggests that components of Tai Chi/Qigong may act autonomously and/or synergistically as part of a larger model to initiate and promote desired change in body composition. A growing body of literature readily demonstrates the effectiveness of Tai Chi (TC) and/or Qigong (QG) practices, both of which promote healing and increased vitality and may further improve a myriad of physiological, physical, and medical outcomes (Innes et al., 2008; Janke et al., 2010; Klein, Baumgarden, & Schneider, 2019; Wang et al., 2010; Wang et al., 2013).

Psychological Model Factors and Body Composition in Menopause

A host of psychological factors may contribute to weight gain and adverse body composition throughout the duration of menopause. While notably, factors such as stress and mood are strongly correlated with weight gain/adverse body composition, increasingly, additional psycho-emotional factors are being considered in this complex equation. Here we select and discuss the following psycho-emotional variables in the context of adverse body composition in the perimenopause population: perceived stress, mood state, mindfulness, self-compassion, and body awareness.

Stress and mood.

Stress and weight gain/adverse body composition in the menopausal population hold a strong correlation such that increased stress often contributes to increased weight and unfavorable body composition (Schreiber & Dautovich, 2017). The subjective phenomenon of stress is a highly individualized experience based on sociohistorical context and available intra/interpersonal resources; however, it is readily understood that stress taxes both the mind and body. Stress and mood are often examined together in menopause literature—elevated levels of stress contribute to worsened mood (i.e., anxiety, depression). High stress during menopause has been shown to worsen the symptomology (i.e., hot flashes, night sweats, sleep disturbance, mood) (Bauld & Brown, 2009), which may contribute to increased weight over time. More specifically, stress and mood have been shown to be predictors of weight gain and adverse changes in body composition throughout the menopause transition (Sammel et al., 2003; Schreiber & Dautovich, 2017). Stress, and negative mood, may lead to the behavior of increased eating, driven, in part, by increased glucocorticoids (steroid hormones) and insulin, both of which may motivate and promote food consumption (Dallman, 2009). Generally speaking, not only specific to menopause, chronic stress greatly impacts the (neuroendocrine) hypothalamic-pituitary adrenal (HPA) axis (Alexander et al., 2014), which is strongly correlated with weight gain (Bose, Olivan, & Laferrere, 2009). The HPA, when dysregulated through various instigators—stress and negative mood—releases cortisol which may drive negative biological and behavioral shifts contributing to weight gain and adverse changes in body composition, including central adiposity

(Bose, Olivan, & Laferrere, 2009). Numerous studies support the relationship between Tai Chi and/or Qigong and reduced stress, as both a subjective self-report measure of stress (Sandland & Norlander, 2000; Wang et al., 2010) and further as an objective measure assessed through cortisol (Esch, Duckstein, Welke, Stefano, & Braun, 2007; Lee, Kang, Lim, & Lee, 2004).

Mindfulness and self-compassion.

Although less well-studied, research is beginning to explore the constructs of mindfulness and self-compassion in the menopause population. Mindfulness has varied definitions, but is commonly understood as a way of being in the present moment, non-judgmentally and with awareness (Ludwig & Kabat-Zinn, 2008). Self-compassion, as defined by Neff (2003), can be summarized as being kind to oneself, or treating oneself like one would a best friend in a time of suffering.

There is increasing literature suggesting that mindfulness helps alleviate symptoms in the menopausal population. A 2011 randomized controlled trial ($N = 110$) demonstrated that participating in the Mindfulness Based Stress Reduction program reduced hot flashes and night sweats, and additionally, significantly decreased stress and anxiety, and significantly improved sleep quality (Carmody et al., 2011)—the latter of which are all correlated with weight gain and body composition. A recent 2019 (Sood et al.) cross sectional study ($N = 1744$), demonstrated that higher levels of mindfulness were associated with lower levels of perceived stress and menopause symptoms. Larkey et al. (2018) recently published a randomized controlled trial ($N = 36$) with post-menopausal, obese women enrolled in a mindful eating program; study results demonstrated

intervention participants had reductions in weight, body mass index, and associated biomarkers (i.e., interleukin-6, C-reactive protein). Such practices are demonstrating appear to support healthy weight and body composition in menopausal women. Mindfulness interventions may effectively increase awareness of emotion and conscious behavioral response, supporting women to make more healthy choices in response to stress throughout the varied passage of menopause.

A 2014 cross sectional study (Brown, Bryant, Brown, Bei, & Judd) with women between the ages of 40 and 60 years old (categorized into four stages based on menses regularity) ($N = 206$), demonstrated that self-compassion may attenuate the effect of hot flushes on daily life and depression symptoms. A follow up study in 2015 (Zessin, Dickhauser, & Garbade) showed that self-compassion contributed to overall well-being (i.e., emotional balance, life satisfaction, depression) in menopausal women. Components of improved well-being may increase coping skills and resiliency (the ability to recover from difficulties), and also lead to more healthy self-care choices which may reduce weight-related outcomes during menopause. Limited but promising work has been conducted with menopause and self-compassion; however, the premise of such is to help one care for one's self and it therefore may help buffer the various challenging experiences, psychological and physical, of menopause.

Behavioral Model Factors and Body Composition in Menopause

Sleep quality and physical activity.

The physiological process and behavior of sleep is imperative to physical health, emotional well-being, and homeostatic regulation (i.e., metabolism) and should be

understood as a risk factor in the trajectory and potentially harmful outcome of obesity (Rhae, 2015). A strong body of research establishes well-known sleep issues during menopause (Eichling & Sahni, 2005; Freedman & Roehrs, 2007; Young, Rabago, Zgierska, Autin, & Finn, 2003). Lack of sleep, (i.e., duration) or poor sleep, (i.e., quality of sleep, sleep satisfaction) can have potentially significant and deleterious health outcomes, and are both considered risk factors, or predictors, of weight gain, high-risk body composition, and obesity (Markwald et al., 2013; Chaput et al., 2014). Rhae et al. (2015) demonstrated an association between poor sleep quality, high body fat and obesity in an adult population. There are multiple mechanisms suggesting proposed pathways between compromised sleep and weight gain (Chaput, 2014: Markwald et al., 2013).

It is generally understood that reduced or fragmented sleep leads to increased caloric consumption (i.e., number of times snacking, high carbohydrate consumption) and decreased physical activity (i.e., reduced exercise, increased sedentary time) (Chaput, 2014; Gonnissen, 2013). Decades of research demonstrate that physical activity is related to weight management and body composition (Hughes, Frontera, Roubenoff, Evans, & Singh, 2002; Irwin et al., 2003). Specific to the menopausal population, there is frequently a decline in the amount of physical activity which may contribute to the unfavorable shifts in body composition (Dubnov, Brzezinski, & Berry, 2003). In the context of poor sleep quality, there is often a physiological adaptation to provide more energy by consuming more calories in an attempt to override the negative effects of inadequate sleep (Markwald et al., 2014). This excess consumption is frequently coupled with a decline in physical activity—as structured exercise and/or daily movement—

reducing the overall energy expenditure (Rhae et al., 2015). The imbalance of increased calories, decreased movement, and increased sedentary behavior may play a significant role in the relationship between poor sleep quality and weight gain (Rhae et al., 2015). Additionally, compromised sleep may impair cognitive processes such that there is a shift in inhibited/disinhibited food behaviors, driven by non-homeostatic brain mechanisms (i.e., mood, comfort seeking) (Chaput, 2014; Markwald et al., 2014). Compromised emotional shifts related to food consumption (i.e., anxiety, depression) also have been associated with poor sleep behaviors in menopausal women (Joffe, Massler, & Sharkey, 2010).

Emotional eating.

Emotional eating is defined as eating in response to negative emotions and is linked to weight gain, increased BMI, and obesity (Tan & Chow, 2013). The psychosomatic theory of obesity is a framework which postulates the idea that individuals eat in response to negative or uncomfortable emotions and may not be able to discern between emotional states and physiological hunger (Canetti, Bachar, & Berry, 2002). Specifically, a 2013 study (Mangweth-Matzek et al.) explored eating disorders and menopausal women (categorized as premenopause, perimenopause, or postmenopause) between the ages of 40 and 60 years old ($N = 436$) and noted high rates of negative body image issues and diagnostic eating disorders. The first line of defense against this factor's impact on weight is emotional regulation, that is, finding cognitive or behavioral practices that help reduce emotional distress. Also, discernment of emotion and awareness of response may help attenuate the obesity-related behavior of emotional eating.

Appetite regulation (i.e., hunger, satiety) is considered a neuroendocrine and metabolic process by which the hunger hormones—leptin and ghrelin—are secreted and inform the body of caloric needs to maintain, or regain, homeostasis (Knutson, 2007). Mechanistically, leptin and ghrelin are the key elements driving the sensations of hunger and satiety, both of which directly influence food consumption (e.g., quantity and quality) by facilitating opposing effects; leptin is appetite inhibiting and ghrelin is appetite stimulating (Chaput, 2014; Knutson, 2007). Compromised sleep may contribute to the dysregulation of key appetite hormones; however, recent research has demonstrated that in response to poor sleep quality, the maladaptive behavior of caloric uptake (overeating) is primarily driven by hedonic (characterized by pleasure), not homeostatic factors (Chaput, 2014), suggesting that this maladaptive behavior stems from a psychological response. Eating initiated by psychological, not physiological cues is potentially denotative of an underlying mind-body disconnect which may, in part, drive emotional eating.

Physiological Model Factors and Body Composition in Menopause

Heart Rate Variability.

Heart Rate Variability (HRV) is considered a physiological phenomenon that indicates the time period between consecutive heartbeats (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). Specifically, as noted by Acharaya et al. (2006), HRV is purported to "…reflect the heart's ability to adapt to changing circumstances by detecting and quickly responding to unpredictable stimuli" (p. 1031). HRV is a measure of both psychological and physiological health, as understood through the autonomic nervous

system (ANS), and can be a predictor of long-term health (Mouridsen et al., 2012). Although an oversimplified statement, given the complexities and intricacies, HRV can be viewed as a measure of balance and regulation between the parasympathetic (i.e., relaxation response) and sympathetic nervous systems (i.e., fight-or-flight response) (Shaffer, McCraty, & Zerr, 2014).

HRV decreases with age, and therefore may naturally worsen over menopause (Moodithaya & Avadhany, 2009). In a 2009 study (Moodithaya & Avadhany) with menopausal women, researchers highlighted that postmenopausal women had significantly "worse" values of HRV (i.e., lower high frequency power and higher low frequency power in spectral analyses). It is suggested that in addition to age, changes in the neuroendocrine system (i.e., lower levels of estrogen) may impact HRV. Research from 2012 (Mouridsen et al.) reports that, in a group of postmenopausal women, weight loss (5% of bodyweight) improved HRV parameters. Such that HRV is, at large, an assessment of stress, stress response, and homeostatic regulation, it is logical that it would be associated with weight status and body composition—many of the same biological and physiological measures drive shifts in related outcomes.

Cortisol.

Generally speaking, not only specific to menopause, chronic stress greatly impacts the (neuroendocrine) hypothalamic-pituitary adrenal (HPA) axis (Alexander et al., 2014), which is strongly correlated with weight gain (Bose, Olivan, & Laferrere, 2009). The HPA, when dysregulated through various instigators—stress and negative mood—releases cortisol which may drive negative biological and behavioral shifts

contributing to weight gain and adverse changes in body composition, including central adiposity (Bose, Olivan, & Laferrere, 2009). Increased levels, or overexposure of cortisol, are correlated with increased weight and unfavorable body composition, particularly increased central adiposity (Epel et al., 2000). As a component of body composition, central adiposity is additionally an indicator or deleterious health-related outcomes (Wells & Victoria, 2005).

DISCUSSION

The proposed model selects what might be considered the most likely candidates for how weight gain develops during the time of peri-menopause and evaluates evidence that situates variables into fixed categories (psychological, behavioral, physiological); however, we acknowledge the interaction between such potential mechanisms, such that all are connected. We identify the interconnectedness of variables, also acting as mechanisms, with bidirectional arrows of recursive effects (See Figure 1) among all three categories. For purposes of our model, we define singular pathways, but each, some more than others, are linked closely and may interdependently help drive the desired change of weight loss and improved body composition. In the context of Tai Chi/Qigong, we suggest that the combined practice elements, leading to a "deep sense of relaxation," may help reduce stress and improve mood, therefore leading to less weight gain and healthy body composition. There is an ongoing need to develop effective strategies to lessen the burden of deleterious weight gain and adverse body composition changes during menopause. Further, it is imperative to support women currently in the menopausal stage, and also to develop preventative measures to help establish behaviors

which may curb consequential symptomology, most notably weight gain and unfavorable body composition. Practices of Tai Chi and Qigong may offer a mind-body alternative to traditionally prescribed protocols (i.e., medication, diet, exercise), and may further support long-term integrative benefits. Additionally, Tai Chi and Qigong are considered to be low-intensity, low-cost, and safe across diverse populations.

We acknowledge that there are a number of pathways that may support the practices of Tai Chi/Qigong improving weight-related outcomes and body composition; however, based on previous empirical findings, we selectively incorporated variables in the psychological, behavioral, and physiological domains that hold the most promise for explanatory power. While each of the variables may, in part, explain some portion of the pathway leading to the desired change, we also highlight the theory of self-regulation as an underpinning theoretical framework which may explain change driven by the variables. Collectively the model of effect variables, stress, mood state, mindfulness, self-compassion, body awareness, sleep quality, emotional eating, physical activity, and heart rate variability, may all be driven and supported by factors addressed in the theory of self-regulation. Each of the previously discussed variables are modifiable through cognitive awareness and behavioral choice.

Conclusion

Our proposed model highlights specific pathways detailing how Tai Chi/Qigong interventions potentially reduce weight and improve body composition through psychological, behavioral, and physiological model effects. The components of Tai Chi/Qigong—breath focus, posture/movement, clear mind, deep relaxation—may support

desired shifts in body composition directly through practice, and/or, also indirectly through psychological, behavioral, and physiological factors acting as mechanisms to facilitate the desired changes. Well-designed studies with rigorous methodology are needed to test the proposed model of effects and continue to develop strategies to abate or to address the negative health impacts of unfavorable shifts in body composition throughout menopause.

CHAPTER 3

MANUSCRIPT #2: PILOT STUDY OF A TAI CHI/QIGONG INTERVENTION ON BODY COMPOSITION, SLEEP QUALITY, AND EMOTIONAL EATING IN MIDLIFE/OLDER WOMEN

INTRODUCTION

Weight gain and adverse changes in body composition (e.g. increased central adiposity, fat mass and body fat percentage) are prevalent among midlife and older women and may contribute to innumerable obesity-related diseases (Al-Safi & Poltasky, 2015; Davis, Castelo-Branco, Chedraui, Lumsden, Nappi, Shah, & Villaseca, 2012; Lovejoy, 2009; Teede, Lomard, & Deeks, 2010). An ever-growing body of research confirms relationships between obesity and type 2 diabetes, hypertension, neurological disorders, cardiometabolic diseases, decreased life expectancy, (Al-Zadjali et al., 2010; Davis et al., 2012; Keller, Larkey, Distefano, Bohehm-Smoth, Recordes, K., Robillard, A….O'Brian, 2010; Teede, Lombard, & Deeks, 2010; Warburton, Nicol, & Bredin, 2006) and psychological disorders (i.e., anxiety, depression) (Luppion et al. 2010). Obesity, defined as having a body mass index (BMI) greater than 30 kg/m^2 (Teede et al., 2010), currently affects an approximate 30% of the female adult population in the United States (Flegal, Kit, Orpana, & Graubard, 2013). It is well-established that midlife and older women are at a markedly increased risk for unfavorable changes in body composition and development of obesity, potentially contributing to life-threatening health issues. Lifestyle interventions focused on diet and physical activity have long been the cornerstone of efforts to attenuate these sequela (McAuley & Blissmer, 2012).

Nonetheless, research continues to demonstrate that most interventional strategies lack sustained change (i.e., weight reduction, decreased BMI) (Teede et al., 2010).

BMI (calculated as weight(kg)/height(m)^2) (Wells et al., 2006), is the most common measure of body composition and is used to indicate weight status, underweight, overweight and/or obesity, among populations and in epidemiological studies. However, BMI lacks the ability to distinguish between fat mass and fat-free mass, therefore limiting its ability to elaborate potentially more important and sensitive aspects of body composition (Toomey et al., 2015; Wells et al., 2006, Dixon, 2010). Percent body fat, an additional measure of body composition, provides an assessment of the total amount of body fat (percent of adiposity) as opposed to the fat-free mass (i.e., muscle, bone, water). This measurement also serves as a more precise illustration of risk factors related to health issues (i.e., type 2 diabetes, stroke, certain types of cancer, and cardiovascular disease) (Al-Safi & Polotsky, 2015; Davis et al., 2012; Foster-Schubert et al., 2012). Independent of body weight, percent body fat may improve (decrease) and therefore reduce disease risk (Toomey et al., 2015).

Weight gain and compromised body composition stem from a complex and multi-faceted etiology (i.e., genetics, environment, lifestyle, hormones) most commonly approached through diet and exercise manipulation. More recent work incorporates complementary or alternative approaches. Such strategies offer non-pharmacological approaches to psychological and physiological health obstacles. Mind-body interventions have been empirically tested and proven efficacious to address weight-related outcomes with increasing consistency (Carriere, Khoury, Gunak, & Knauper, 2018; Larkey, James,

Belyeaa, Jeong, & Smith, 2018). With respect to physical activity, the discerning components between conventional and mind-body programs are the intentional focus on the body with the breath and mind; ultimately creating a deep-felt sense of relaxation (Larkey et al., 2009; Larkey et al., 2018).

Meditative Movement and Body Composition

Meditative Movement (MM), an established category of exercise, incorporates elements of both the mind and the body (Larkey et al., 2009; Larkey et al., 2016) and is comprised of four essential components: 1) a focus on the breath, 2) body posture alignment and/or movement, 3) a clear/calm mind, and 4) a deep state of relaxation (Larkey et al., 2009; Larkey et al., 2018). As a practice, MM includes, but is not limited to, Tai Chi, Qigong, and various styles of yoga (Larkey et al., 2009). Tai Chi and Qigong have repeatedly demonstrated efficacious health-related outcomes in both physical (i.e., bone health, immune function, cardiopulmonary health) and psychological domains (i.e., depression, anxiety) (Jahnke, Larkey, Rogers, Etnier, & Lin, 2010; Wu et al., 2015).

More recently, research suggests that MM interventions may contribute to beneficial changes in body composition and weight-related outcomes (Cramer, Thoms, Anheyer, Lauche, & Dobos, 2016; Komelski, Blieszner, & Miyazaki, 2016; Larkey et al., 2018;). It is well-documented that increased energy expenditure and decreased energy consumption may benefit body composition; however, additional and less direct factors (i.e., sleep quality, emotional status) may conjointly or independently influence this shift. It is suggested that the distinct components of MM, may benefit body composition both directly (i.e., decreased sedentary time) and indirectly (i.e., improved sleep quality).

Meditative movement effects on factors associated with body composition.

A growing body of research indicates that MM may affect various factors associated with body composition outcomes including perceived stress, mood state, anxiety (Wang et al., 2013), depression, exercise self-efficacy (Wang et al., 2014), quality of life and sleep quality (Jahnke et al., 2010). Numerous studies have demonstrated that MM may be effective at improving sleep quality in various populations (Wang et al., 2016; Wu et al., 2015). A 2015 systematic review and meta-analysis exploring MM (Tai Chi, Qigong, yoga) interventions (N = 1225) reported a moderate effect on improved sleep quality in a sampling of elderly participants (Wu et al., 2015). Additionally, a 2016 systematic review of MM (Tai Chi, Qigong, yoga) interventions (N = 927) reported statistically significant improvements in the domain of sleep quality in a mixed group of adults (Wang et al., 2016)

Lack of sleep (i.e., duration) or poor sleep (i.e., quality of sleep, sleep satisfaction) are considered risk factors, or predictors, of weight gain, high-risk body composition, and obesity (Chaput et al., 2014; Markwald et al., 2013). A strong body of research supports the idea that poor sleep quality leads to increased caloric consumption (i.e., number of times snacking, high carbohydrate consumption) and decreased physical activity (i.e., reduced physical activity, increased sedentary time) (Chaput, 2014; Gonnissen, 2013). The subsequent imbalance of increased calories, decreased movement, and increased sedentary behavior may play a significant role in the relationship between poor sleep quality and weight gain (Rhae et al., 2015).

While poor sleep quality may partially contribute to dysregulation of key appetite hormones (i.e., leptin, ghrelin) and consequential caloric consumption, recent research suggests this behavior is primarily driven by psychological, not physiological, responses (Chaput, 2014). Eating behaviors initiated by psychological cues are potentially indicative of an underlying mind-body disconnection—or lack of awareness—which may encourage emotional eating. Emotional eating is defined as eating in response to negative emotions and is linked to weight gain, increased BMI, and obesity (Tan & Chow, 2013). Increased awareness of emotions and responses may help curb the maladaptive behavior of emotional eating. The collective components of MM (breath focus, body posture/movement, a clear/calm mind, and deep state of relaxation) then, may support increased sleep quality and reduce emotional eating, leading to an improvement in body composition.

In addition to the core factors of sleep quality and emotional eating, additional psycho-emotional variables (perceived stress, mood state, mindfulness, self-compassion, and body awareness) have been shown to be related to body composition. Previous work conceptualizing a biobehavioral model details suggested relationships and mechanisms of change between the intervention of Tai Chi/Qigong and reduced weight/improved body composition through the pathway of select psychological, behavioral, and physiological factors (citation: Mechanisms of Changed Body Composition in Menopausal Women: A Biobehavioral Model, dissertation manuscript to be submitted). Associations have been established between body composition and perceived stress (Kyrou, Chrousus, & Tsigos, 2006; Torres & Nowson, 2007), mood state, or specifically, total mood disturbance,

(Osei-Tutu & Campagna, 2005; Ahnesi, 2008). Further, mood state is associated with disturbed sleep quality (Baker, Simpson, & Dawson, 1997; Wang, Wang, Chang, & Lin, 2007) and the behavior of emotional eating (Bekker, van de Meerendonk, & Mollerus, 2003). Mindfulness, the practice of paying attention to the present moment in a non-judgmental way, has shown promise in improving body composition and weight loss (note: the application and practice of *mindfulness* is different from *mindful eating:* the broad construct of mindfulness is intended to be, potentially, applied to all/any components of the everyday life; mindful eating is a specific construct applied only to the behavior of eating) (Daubemier, 2011; Palmeira, Cunha, & Pinto-Gouveia, 2019). Strong associations have been demonstrated between mindfulness and sleep quality in various adult populations (Black, O'Reilly, Olmstead, Breen, & Irwin, 2015; Hulsheger, Feinholdt, & Nobold, 2015) and between mindfulness and decreased emotional eating (O'Reilly, Cook Spruijt-Metz, D., & Black, 2014; Palmeira et al., 2019). Self-compassion is strongly correlated with body mass index (Taylor, Daiss, & Krietsch, 2015) and eating behaviors (James et al., 2016). Recent literature further shows that self-compassion can act as a moderator between body mass index and eating disorders (Kelly, Vimalakanthan, & Miller, 2014). The close relationship between self-compassion and care for self, in the context of eating behaviors, positions the practice of self-compassion as a beneficial tool to potentially reduce emotional eating and improve body composition. Recent work has demonstrated the effectiveness of self-compassion interventions on improved sleep quality (Butz & Stahlberg, 2018; Hu, Wang, Sun, Areta-Garcia, & Purol, 2018). A 2013 (Martin, Prichard, Hutchinson, & Wilson) study suggests that increased

body awareness may be an advantageous means to address high-risk eating behaviors. While there is less literature supporting the concept of body awareness in the context of the primary outcomes, the current study sought to explore this variable which is directly related to the TC/QG intervention.

Tai Chi/Qigong: a Meditative Movement Practice

The current study utilized a specific MM program—Tai Chi Easy (TCE), created by Dr. Roger Jahnke from the Institute of Integral Qigong and Tai Chi (IIQTC) in California (Jahnke, Larkey, & Rogers, 2010). TCE has been carefully crafted over years to make it an "easily accessible and replicable" program and further "suitable to be taught by nonprofessional teachers" (those without substantial practice in traditional Chinese medical/martial arts) (Jahnke, Larkey, & Rogers, 2010, p. 273). TCE combines practices of Tai Chi and Qigong, which share philosophical roots in Traditional Chinese Medicine (Jahnke, 2002; Larkey et al., 2009; Healer Within Foundation, 2017). TCE is a standardized and manualized protocol which has been empirically tested with breast cancer survivors, showing a significant reduction in fatigue) (Larkey et al., 2014), and improvements in sleep, emotional distress and reduced BMI (Larkey, Roe, Smith, & Millstine, 2016). TCE has also been shown to reduce stress and improve sleep across a national sample of older community dwelling adults (Jahnke, Larkey, & Rogers, 2010). TCE is a low-impact, low-intensity (Smith, Larkey, Wherry, Ainsworth, & Swan, 2015) series of exercises incorporating breath focus, body alignment/movement, a calm mind, and is ultimately intended to invoke a deep sense of relaxation and cultivate "Qi" (Larkey et al., 2016). TCE exercises can be practiced standing or seated and are combined in a

progressive sequence, each exercise is repeated numerous times before moving onto the next. TCE is considered a modified version of Tai Chi such that the number of exercises is reduced and simplified (Jahnke, Larkey, Rogers, Etnier, & Lin, 2010). Thus, the small but growing body of evidence suggests that TCE has the requisite components of MM that are expected to have effects on sleep and emotional factors related to body composition.

The purpose of this pretest/posttest study was to evaluate intervention differences in the primary outcomes of percent body fat, sleep quality, and emotional eating in a sample of midlife/older women. Additionally, exploratory variables (mindfulness, body awareness, mood states, perceived stress, and self-compassion) related to body composition were assessed from pre- to post- intervention to examine mean differences. It was hypothesized that from pre- to post- intervention, percent body fat would decrease, sleep quality would increase, and emotional eating would decrease. Hypotheses for the exploratory variables suggested that select psycho-behavioral wellness factors (perceived stress, mood state, mindfulness, self-compassion, and body awareness) would each respectively improve.

MATERIALS AND METHODS

Study Design Overview

The current pilot study was conducted as a single group pretest/posttest intervention with assessments at baseline (one week prior to study start) and post study completion (within one week after the last class). All participants received the same

intervention (8-weeks of TCE delivered in a 30-minute weekly class) and there was no control group.

Recruitment and Sample

Study recruitment was conducted on the ASU Downtown Phoenix campus and surrounding businesses. Recruitment flyers detailed study specifics including eligibility information and study name, "Move Well." A Facebook page was created to promulgate recruitment efforts. Regularly scheduled Facebook posts promoted the study prior to each cohort; and posts displayed information contained on the flyer with contact information. Interested potential participants initiated by calling the study number provided and/or responding via the email link in the Facebook page. Once phone contact was made, eligibility screening was conducted by phone.

Study participants ($N = 51$) were all females (targeted population) in a large metropolitan area in the Southwest part of the United States. Inclusion criteria required that participants: 1) were able to participate in a low-intensity gentle movement group for 8 weeks, 2) speak/understand English, and 3) attend classes on the ASU Downtown Phoenix campus, 4) female, and 5) between the ages of 45 and 75 years old (and therefore considered to be in a "midlife" or "older" age bracket). Exclusion criteria included women who were: 1) outside of the targeted age range, 2) unable to stand up for 10-minutes, 3) unable to walk. Participants with and without previous meditative movement and/or meditation practice were included in the study. To determine eligibility status, interested participants were asked to complete a brief 5-minute phone screener with trained research staff.

Survey Procedures

Individuals that were eligible at phone screen were invited to schedule a data collection appointment with study staff on the ASU Downtown Phoenix campus. Study staff reviewed the consent form with participants; upon signing, participants began data collection procedures. All data collection occurred in private classrooms or offices on the ASU Downtown Phoenix campus. Participants attended consent signing and data collection at individual times to prevent overlap and ensure participant privacy. Trained research staff conducted data collection (pre- and post- intervention) which took place between October 2015 and December 2017; data were collected over the course of six cohorts of classes (ranging from 5-12 participants).

Measures

Pre- and post- intervention data were collected on ASU Downtown Phoenix campus in private offices with trained study staff. Baseline data collection took approximately one hour and included demographics, psychometric self-report questionnaires, and height/weight to calculate BMI. Post-study data collection replicated that at baseline with the exception of demographics.

Demographics.

To characterize the study population, demographic and other descriptive measures were collected, including age, weight, date of last menses, weight lost/gained in previous 30 days, bariatric surgery (yes/no), previous "meditative movement" and/or meditation practice (yes/no; duration), highest level of education, race, ethnicity, list of current

medications and/or supplements. (See Table 1 for demographics and descriptive characteristics).

Body composition and self-report measures.

Body composition.

Body composition was measured using a Tanita bioelectrical impedance scale. Height was first measured with a stadiometer and then weight and body fat percentage was electronically calculated when the participant stepped on the Tanita scale. Tanita measures were repeated twice in a row to check for variability and ensure accuracy.

Self-report measures.

All surveys listed below were completed as hard copies by participants and were tracked using participant ID numbers.

The Three-Factor Eating Questionnaire- Revised 18 (TFEQ-R18) measures the eating behaviors or dietary practices of cognitive restraint, uncontrolled eating, and emotional eating; it is comprised of three subscales scores and does not yield a composite total (de Lauzon, 2004); here the focus was the emotional eating subscale. The 18-items are scored on a 4-point Likert-type scale (such that higher scores indicate stronger eating behavior). TFEQ-18 reports strong reliability for the subscale: emotional eating, Cronbach's $\alpha = .87$ (de Lauzon et al., 2004).

The Pittsburgh Sleep Quality Index (PSQI) measures subjective sleep quality over the previous month (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). PSQI is comprised of seven components: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime disturbances.

PSQI contains 19 items which yield a global score ranging from 0 (high sleep quality) to 21 (low sleep quality) (Rhae et al., 2015). PSQI reports strong reliability (Cronbach's α= .83) (Buysse et al., 1989).

To measure the construct of mindfulness, the Cognitive and Affective Mindfulness Scale- Revised (CAMS-R) was used (Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2006). CAMS-R yields one total mindfulness score, but is comprised of the following four components: attention, present focus, awareness, and acceptance/non-judgment. CAMS-R-10 is scored on a 4-point Likert-type scale ranging from 1= rarely/not at all to 4= almost always—additionally, the scale demonstrates high internal consistency (Cronbach's α = .78).

The Body Awareness Questionnaire (BAQ) was used to measure participant's attentiveness to their bodily processes. BAQ is an 18-item survey using a 7-point Likert-type scale ranging from 1= not at all true of me to 7= very true of me. BAQ yields one global score, but is constructed based on the following four factors: 1) Note Response or Changes in Body Process, 2) Predict Body Reaction, 3) Sleep-Wake Cycle, 4) Onset of Illness. BAQ has strong internal consistency (Cronbach's α= .82) (Shields, Mallory, & Simon, 1989).

The Profile of Moods- Short Form was used to evaluate the "transient, distinct mood states" (Shacham, 1983) in the current moment. The 37-item survey is measured using a 5-point Likert-type scale ranging from 1= not at all to 5= extremely. POMS is comprised of six subscales: Tension-Anxiety, Anger-Hostility, Vigor-Activity, Fatigue-

Inertia, Depression-Dejection, Confusion-Bewilderment; subscale scores yield strong internal consistency (Cronbach's α= .80-.90).

Stress was measured using the Perceived Stress Scale-10 (PSS-10) (Roberti, Harrington, & Storch, 2006). The PSS-10 measures the degree to which respondents appraise their life as unpredictable, uncontrollable, and overloading over the past month and is scored on a 5-point Likert-type scale ranging from 1= never to 4= very often. Higher scores indicate higher stress levels. The PSS-10 has strong internal consistency (Cronbach's α= .89).

The Self-Compassion Scale (SCS) was used to measure self-compassion. The 26-item SCS is comprised of 6 subscales (self-kindness, common humanity, mindfulness, self-judgment, isolation, over-identification); the scale yields both a total score and 6 subscale scores. The scale uses a 5-point Likert scale, 1-5 (0= almost never to 5= almost always). A higher total score indicates higher self-compassion. SCS subscales demonstrate strong internal consistency (Cronbach's α= .75 - .81).

Procedures

Prior to the start of the study, all materials, procedures, and the TCE intervention protocol were approved by the Arizona State University IRB (ID: 00005974). The study design, a single group pretest/posttest, meant that all enrolled and consented participants received the standardized Tai Chi Easy (TCE) intervention (Jahnke, Larkey, & Rogers, 2010). TCE exercises were taught standing up, but participants were informed that if they chose to, they could be seated and/or use a chair for balance.

Intervention

For intervention purposes, six of the TCE protocol exercises were included—each repeated (with verbal instruction) numerous times before moving onto the next exercise. The weekly TCE classes taught over 8-weeks were held in a private classroom/ community space on the ASU Downtown Phoenix campus. All classes were taught by TCE Practice Leaders certified through the Institute of Integral Qigong and Tai Chi and had completed a minimum of 25 hours of standardized training with required supervision. The intervention space had large windows with direct sunlight which was used to light the room in place of the overhead fluorescent lights—this was conducive to creating a calm, relaxed environment for the class; additionally, instrumental Tai Chi music played for the duration of each class.

Each class began and ended with the three intentful corrections, a series of focused instructions which guided participants to focus on their body to align posture, attention to their breath and clearing of the mind; in addition, in between each of the movements, participants were guided to briefly return to the three intentful corrections as a place of pause and re-centering. Due to limited class time (30 minutes), the study protocol focused on six previously selected TCE exercises: 1) twisting at the waist, 2) flowing motion, 3) side bending, 4) crushing stones, 5) gathering from heaven and earth, and 6) smoothing the energies. Each of the six exercises were repeated in each session over the weekly classes (delivered over 8 weeks) and each movement was instructed and practiced for approximately 3-4 minutes each time. Participants were reminded that the class was intended to help them reduce stress, increase well-being, and connect with a

sense of self-care and self-healing. At the end of the first class, participants were given a TCE DVD and paper log for tracking at-home practice. Participants were encouraged to practice daily and asked to bring in their practice logs each week. At the end of week 8, participants were asked to schedule a post-intervention data collection appointment within the following week with study staff.

Statistical Analysis

The sample's demographic characteristics, descriptive data, age, education, race, and ethnicity were described using mean and standard deviation or frequencies and proportions as appropriate. Paired-sample t-tests were used to explore differences in the primary (percent body fat, sleep quality, emotional eating) and exploratory (perceived stress, mood state, self-compassion, mindfulness, body awareness) outcomes from pre- to post- intervention. Detected outliers were further inspected and determined not to be extreme and therefore remained in the final analysis; the assumption of normality was not violated. All analyses were all conducted with IBM Statistical Package for the Social Sciences (SPSS)-24, with the statistical significance level set at $p \leq .05$.

RESULTS

Participant Characteristics

Table 1 displays the demographic characteristics of the study population ($N = 51$). The majority of the women in the study were white (80.4%) and had attended four years of college or more (70.6%). The mean age of participants was 53.7 years old (SD = 7.5). Study enrollment, over the course of all six cohorts was 52 participants; however, one participant dropped out prior to baseline data collection.

Table 3.1. Demographic characteristics of study population, N = 51

Education	%
High school or less	5.9
Some college	21.6
4-yr college or greater	70.6
Ethnicity	
Hispanic/Latino of any race	15.7
Race	
American Indian or Alaska Native	2.0
Asian	3.9
Native Hawaiian or other Pacific Islander	2.0
Black or African American	5.9
White	80.4

Over the course of the study, 15 women dropped out and/or did not complete post-intervention data collection, yielding $N = 36$ for the purposes of outcome analyses. This was a participant attrition rate of 31%, as detailed in Figure 3.1.

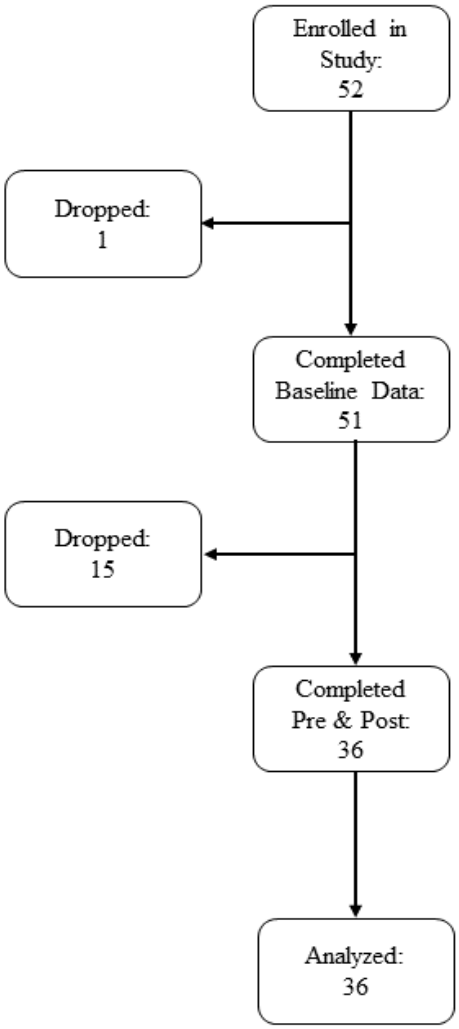


Figure 3.1. Participant flow chart.

Primary Outcomes

All results (primary and secondary) are reported in Table 2. Change in percent body fat (decrease) did not reach statistical significance, $p = .30$, $M = 0.35$, 95% CI [-0.32, 1.0]. The measure of sleep quality demonstrated statistically significant improvement over the course of the intervention, $p = .04$, $M = -0.88$, 95% CI [-1.71, -0.04]. Emotional eating improved, however, not to the conventional $p \leq 0.05$ level, $p = .08$, $M = -0.16$, 95% CI [-0.34, 0.02].

Table 3.2: Mean Difference Pre- to Post- Intervention, 95% CI, p-value

Outcome	Mean Difference (95% CI)	p
Primary Variable		
% Body Fat	0.35 (-0.32, 1.0)	0.30
Sleep Quality	-0.88* (-1.71, - 0.04)	0.04
Emotional Eating	-0.16 (-0.34, 0.02)	0.08
Exploratory Variable		
Perceived Stress	-2.36* (-4.76, 0.04)	0.05
Mood Disturbance	-0.27 (-1.29, .76)	0.60
Mindfulness	1.16 (-.05, 2.4)	0.06
Self-Compassion	0.18 (-0.03, 0.40)	0.10
Body Awareness	0.36* (0.08, 0.63)	0.01

* Significant at $p \leq 0.05$

Exploratory Outcomes

Change in mindfulness approached significance, $p = .06$, $M = 1.16$, 95% CI [-0.05, 2.4]. The difference in body awareness was statistically significant, $p = .01$, $M = 0.36$, 95% CI [0.08, 0.63]. Total mood disturbance did not reach significance, $p = .60$, $M = -0.27$, 95% CI [-1.29, .75]. Perceived stress was reduced significantly, $p = .05$,

M = -2.36, 95% CI [-4.76, 0.04]. Self-compassion did not reach significance, $p = .1$, *M* = 0.18, 95% CI [-0.03, 0.40].

DISCUSSION

The purpose of this single-group pilot study was to explore preliminary effects from pre- to post- 8-week TCE intervention on the primary outcomes of percent body fat, sleep quality, and emotional eating in a group of midlife/older women. We hypothesized that percent body fat would decrease, sleep quality would improve, and emotional eating would decrease. Further, we hypothesized that associated psycho-behavioral wellness factors (perceived stress, mood state, mindfulness, self-compassion, and body awareness) would, respectively, each improve.

Percent body fat did not show improvement over the 8-week intervention—likely for many reasons. Over the course of the 8-week intervention, there was a very small, non-significant change, and it was not in the expected direction. The current study had a small sample study (*N* = 36) and was underpowered; with a larger and more diverse population sample and with an intervention that was more intensive and longer, we may have seen a significant, or trending towards significant, decreased change in body composition. Also, it is likely that body composition changes and/or weight loss in response to MM takes long than 8-weeks and requires greater intervention class time (≥ one hour) and frequency of classes. Additionally, verified (at-home) practice, outside of the intervention may contribute to shifts in the desired changes. A 2018 systematic review and meta-analysis (Larkey et al.) reviewed 24 Tai Chi and Qigong interventions ranging in study length from 6 to 52 week and the majority being of 12-weeks duration.

The intervention classes met one to three times a week and most frequently lasted for 60 minutes. A loss of weight or improved BMI of small-to-medium effect size was found for participants in the TC and QG interventions groups. Study results demonstrated that 42% of the 24 studies yielded improved body composition outcomes; although not all statistically significant, there was a steady trend in direction for improved measures of body composition and/or weight loss within the intervention populations. A small-to-medium effect size was determined, indicating that participants in the TC and QG interventions lost weight or improved their BMI compared to inactive controls.

Finally, there may have been attenuated and unreliable results due to the use of the Tanita scale. This instrument used to measure percent body fat, is a bioelectric impedance analysis measurement which is highly sensitive to hydration status as well as digestion and absorption (Tanita, 2010). Hydration status was not evaluated or accounted for when data were collected (i.e., information regarding fluid/food intake, physical activity participation and sweat loss, stage of menstrual cycle). More controlled conditions (i.e., day of month, time of day) for percent body fat data collection (Tanita) may better reflect accurate and sensitive changes in body composition.

Sleep quality, as measured by PSQI, demonstrated a statistically significant change ($p = .04$) indicating that from pre- to post- intervention sleep quality scores decreased, which is an indication of improved sleep, by 0.9 points 95% CI [-1.71, -0.04]. Although PSQI lacks clinical cut-points, the magnitude of this change is suggestive of relevance with regards to the behavior of sleep quality. Improvement in sleep quality in the context of MM interventions has been documented numerous times (Wang et al.,

2016; Wu et al., 2015); the current findings are well supported statistically, logically, and theoretically. Within the category of Meditative Movement, including Tai Chi/Qigong interventions, such as the one in the current study, have delivered efficacious results with respect to sleep quality (and other sleep-related domains) in various populations (i.e., older adults with cognitive impairment, elderly people, multiple cancer survivor's populations) (Chan et al., 2016; Wu et al., 2015; Jahnke, R.A., Larkey, L.K., & Rogers, C., 2010; Wayne et al., 2018). In two different biobehavioral models (Larkey, Vega-Lopez, Keller, McClain, Ainsworth, Ohri-Vachaspati, Smith, & Jeong, 2014; Mechanisms of Changed Body Composition in Menopausal Women: A Biobehavioral Model, dissertation manuscript to be submitted) it is suggested that the components of MM (breath focus, body posture/alignment, calm/clear mind, deep state of relaxation) may initiate mechanisms that influence and improve quality of sleep. In fact, a number of studies have indicated this, showing improved sleep in response to Tai Chi and Qigong (Du et al., 2015; Irwin, Olmstead, & Motivala, 2008) consistently across a number of populations. Improved quality of sleep over time may support healthy body composition by decreasing sedentary time, increasing physical activity, improving (decreasing) inflammatory responses, and improving eating behaviors (i.e., less high-caloric food, less frequent periods of eating).

Change in emotional eating, as measured by the TFEQ, approached significance ($p = 0.08$). This measure is not diagnostic, but rather evaluates one's subjective behavior of emotional eating. From pre- to post study, emotional eating decreased by .2 points, 95% CI [-0.34, 0.02]. A decrease in emotional eating is a shift in the right direction, as it

indicates reduced incidence of eating in response to negative emotions. The limited duration of the current study and class time (30 minutes once a week for 8-weeks), again, may have led to smaller changes than might have been seen using a more intensive intervention.. Emotional eating is typically considered to be a behavior that leads to a pattern, which occurs over (a non-specific) period of time; therefore, it is possible that with more TCE instruction and practice, this behavior may have shifted more significantly.

As evaluated by CAMS, the improvement in the measure of mindfulness closely approached significance (p = .06). CAMS is considered a multi-component measurement of mindfulness (attention, present-focus, awareness, acceptance), yet yields only one total score (Flegal et al., 2010). Mindfulness programs and interventions typically take place over weeks with a direct focus on the elements and operational definition of mindfulness. TCE includes particular components similar to that of mindfulness (i.e., focus on the breath and the present moment, calm/clear mind)—an overlap which may be strong enough to shift and increase mindfulness. Although not quite statistically significant, the current study showed improved mindfulness from pre- to post- intervention as in increased 1.2 points 95% CI [-0.05, 2.4] on CAMS.

There was a significant exploratory outcome of body awareness, as measured by BAQ (p = .01). The foundation of the TCE intervention is an integration of both mind and body practices, with a strong focus on the physical body (i.e., posture, body movement, connection between breath and body, physical practices); therefore, the change in body awareness from pre- to post- intervention seems appropriate. The TCE

intervention used in the current study combined elements of Tai Chi and Qigong, incorporating a dynamic assimilation and flow between the mind and body. Synthesis of such components may promote—and potentially help regulate—an enhanced sense of body awareness via increased interoception (Farb et al., 2015; Yeung, Chan, Cheung, & Zou, 2018). Interoception is understood as "…the process of receiving, accessing and appraising internal bodily signals" (Farb et al., 2015, p. 1) and is further supported by the definition from Mehling et al. (2009) as "…the processing of sensory input from inside the body in contrast to exteroception, the processing of input from outside the body (p. 2). Increased body awareness may better inform individuals of what their body needs and when through enhanced sensitivity, non-reactivity, and regulation—such strategies may ultimately help attenuate weight gain and improve measurements of body composition. In the specific context of Tai Chi and Qigong, Yeung et al. (2018) suggest that paying direct attention to sensations (i.e., breath, body) may increase awareness and sensitivity to emotions which may initiate certain behavioral (avoidance) responses. "Contemplative practices that attend to interoceptive sensations enhance nonreactivity to aversive thoughts and impulses and provide time for automatic processes to restore homeostasis and for generating adaptive regulatory insights" (Yeung et al., 2018, p. 41). Interestingly, there is a lack of literature that explores body awareness in the context of body composition and related variables—most of the work is directed at body image and/or body dissatisfaction. Enhanced awareness of one's body may help support acceptance and further support changes or actions needed to take to improve health related to body composition. The majority of programs designed to address and attenuate

deleterious eating behaviors focus on cognitive and/or emotional elements, but neglect the connection to one's physical body and merging of both mind and body—not simply one or the other. Mind-body approaches such as TC/QG interventions may better support improved eating behaviors related to body composition as compared to mindfulness-based or psycho-educational interventions.

Change in perceived stress was statistically significant from pre- to post-intervention ($p = .05$). The focus, intention, and practices of TCE strongly lend themselves to reduced stress. MM as a category of exercise and TCE as a standardized MM intervention incorporate: 1) breath focus, 2) body posture/alignment, 3) calm/clear mind, and 4) deep state of relaxation. We suggest that, independently, any of the four MM components may lead to improvements (reduction) in perceived stress; however, the synergistic combination of all four components together may produce definitive changes in perceived stress. The mean change in perceived stress over the 8-week intervention was -2.36 points, 95% CI [-4.76, 0.04].

Limitations

The current pilot study has limitations, as noted. The study was conducted as a single group pretest/posttest intervention such that all participants received the same intervention; there was no control group. Constraints of this quasi-experimental design limit the ability to demonstrate efficacy. Additionally, the study was only conducted at one location on a large metropolitan university campus. Specific to the primary outcome of body fat percentage, no anthropometric data (i.e., waist circumference) were collected which may have provided a stronger measurement of central adiposity, often prevalent in

the current population. Although participants were asked when they had their last menstrual cycle, there were no categorical or diagnostic cut-points (i.e., perimenopause, menopause) nor hormonal tests to identify status and potential confounding health factors (i.e., neuroendocrine fluctuation). Potential side effects of medications such as those that affect sleep, hunger, or weight were not evaluated. Lastly, the study lacked long-term follow up, limiting the potential to explore late-emerging outcomes which are particularly relevant to weight-related changes (i.e., weight loss/gain, maintenance).

Conclusion

Although this was a single-group pilot study, to our knowledge this is the first study to examine a TCE intervention in a mixed group of midlife/older women, assessing body composition and related psycho-behavioral wellness factors. We did not see a decrease in percent body fat in this 8-week intervention; however, our results demonstrate significant improvements in sleep quality and select wellness factors of 1) body awareness and 2) perceived stress. Additionally, results showed trends in improved direction for emotional eating, mindfulness, and self-compassion, all factors that have been shown to be related to weight management. Over time and/or with more sustained practice, it is possible that TCE may initiate and facilitate a shift towards improved body composition. Our preliminary results from the current pilot study are limited, but promising; further work is needed to better understand how the mind-body intervention of TCE may improve body composition and related factors.

CHAPTER 4

MANUSCRIPT #3: PSYCHO-EMOTIONAL AND NEUROPHYSIOLOGICAL PREDICTORS OF BODY COMPOSITION IN MIDLIFE/OLDER WOMEN PARTICIPATING IN A TAI CHI/QIGONG INTERVENTION: AN EXPLORATORY ANALYSIS

INTRODUCTION

Midlife and older women (i.e., into and beyond menopause) are at an elevated risk for weight gain and adverse changes in body composition (i.e., increased fat mass, decreased fat-free mass) which may contribute to the development of obesity and deleterious health outcomes (Hagerman, 2011; Krumm et al., 2006). Although chronologically distinct times in a woman's life, both midlife (menopause) and post-menopause are considered a high-risk period for weight gain and changes to body composition which pose a threat to overall health and well-being (Foster-Schubert et al., 2012; Teede et al., 2010). Body composition, a measure—or ratio—of the amount of fat mass and fat-free mass, is an indicator of cardiometabolic risk factors (i.e., type 2 diabetes, hypertension) (Al-Zadjali, Keeler, Larkey, & Albertini, 2010; Keller, et al., 2010) and further, is associated with mortality (Biggard et al., 2005). Efforts to improve body composition are most frequently targeted via manipulation of physical activity and/or nutrition (Rodriguez, Di Marco, & Langley, 2009); however, a number of other psychological, behavioral, and physiological factors contribute to the complexity of this construct and associated outcomes.

Research repeatedly suggests that poor sleep quality is strongly associated with weight gain, compromised body composition, and obesity (Jennings, Muldoon, Hall, Buysse, & Manuck, 2007; Rahe, Czira, Teismann, & Berger, 2015). The restorative behavior and process of sleep, specifically the domain of sleep quality, helps to regulate physiological considerations such as neuroendocrine (i.e., cortisol, leptin, ghrelin) and glucose metabolic function (i.e., insulin sensitivity)—which play significant roles in weight management and body composition. Additionally, poor sleep quality contributes to maladaptive weight-related behaviors including increased caloric consumption, decreased physical activity, and increased sedentary time (Beccuti & Pannain, 2011). Sleep quality is paramount to healthy and/or improved body composition.

Emotional eating, the behavior of eating in response to negative emotions, (Arnow, Kenardy, & Agras, 1995) is strongly associated with weight gain and adverse changes in body composition (Konttinen, Haukkala, Sarlio-Lahteenkorva, Silventoinen, & Jousilahti, 2009; Torres & Nowson, 2007). Emotional eating may be triggered by a multitude of negative, or undesirable emotions (i.e., stress, sadness, anxiety, low self-esteem)—in the absence of sufficient awareness and adequate self-regulatory responses (i.e., healthy coping skills), and over time, the behavior of emotional eating may become a habitual pattern contributing to weight gain and unfavorable body composition.

Psycho-emotional and/or neurophysiological factors may contribute to poor sleep quality and/or increased emotional eating, leading to shifts in weight gain and body composition. The behavior of sleep has been readily associated with mood states and emotions—a relationship which is considered bidirectional, such that there is reciprocity

in one affecting the other: improved sleep equates improved mood and vice versa (Kahn, Shepped, & Sadeh, 2013). A 2007 systematic review (Winbush, Gross, & Kreitzer) demonstrated that participants in a mindfulness-based stress reduction (MBSR) intervention had improvements in both sleep quality and sleep duration. Further, sleep quality has been associated with the state and experience of being self-compassionate (i.e., being kind to oneself) such that higher self-compassion may help buffer the effects of daily stress, and therefore improve sleep quality (Hu, Wang, Sun, Arteta-Garcia, & Purol, 2018). For approximately 70% of adults, the experience of stress prompts increased food consumption (Adam & Epel, 2007); this adverse reaction is then met with cognitive restraint which is considered a "stable disposition to limit food intake" (Bellisle & Dalix 2001, p.197). Cognitive restraint then further perpetuates the stress/food cycle such that restraint or restriction is then countered with disinhibition. When stress increases, food consumption (typically high caloric selections) increases, which increases stress…and so on. A 2014 systematic review with 14 mindfulness-based studies (Ketterman, Kleinman, Hood, Nackers, & Corsica) found that participation in mindfulness meditation resulted in decreased incidents of binge eating and emotional eating—both of which can contribute significantly to unfavorable body composition and the development of obesity. A growing body of literature highlights the relationship between eating behaviors and self-compassion, suggesting higher levels of self-compassion may attenuate maladaptive eating behaviors (i.e., emotional eating, cognitive restraint) (Adams & Leary, 2007; James et al., 2016; Katterman et al., 2014).

A rapidly growing field of science supports mind-body interventions to improve psycho-emotional factors (Kim, Schneider, Kravitz, Mermier, & Burge, 2013) as well as weight loss and body composition outcomes (Alert et al., 2013; Elder et al., 2007; Larkey, James, Belyea, Jeong, & Smith, 2018). One such modality is Meditative Movement (MM). MM, an established category of exercise, is comprised of four elements: 1) a focus on the breath, 2) body posture and/or movement, 3) a clear/calm mind, and 4) a deep state of relaxation (Larkey, Jahnke, Etnier, & Gonzalez, 2009). MM includes practices such as Tai Chi, Qigong, and yoga—all of which have demonstrated improved physical and psychological health across multiple populations (Jahnke, Larkey, Rogers, Etnier, & Lin, 2010). In the current work, we explore selected predictors in the context of an integrated Tai Chi Easy (TCE) program combining elements and practices of both Tai Chi and Qigong developed by Dr. Roger Jahnke (Healer Within Foundation, 2017).

Heart Rate Variability (HRV) is a measurement of the time intervals in between each (consecutive) heartbeat (McCraty & Schaffer, 2015; Zou et al., 2018). This psychophysiological or neurophysiological measure is a reflection of the autonomic nervous system's (ANS) response to environmental, psychological, and physiological changes (McCraty & Schaffer, 2015). The ANS includes both the sympathetic (fight or flight response) and parasympathetic (relaxation response) nervous systems, which are responsible for neurophysiological and psycho-emotional reactions and balance. The regulatory functions and measurements of HRV are indicative of particular health outcomes (i.e., blood pressure, anxiety) and have been demonstrated to improve with

physical activity and breath awareness training (Kemp & Quintana, 2013). Specifically, improved HRV has been associated with weight loss and body composition (Sjoberg, Brinkworth, Wycherley, Noakes, & Saint, 2011). It is suggested that particular mind-body interventions may characteristically promote stress reduction and modulate vagal tone (parasympathetic response). Recent work is beginning to explore and explicate the potential shift of physically-engaged mind-body exercises (i.e., yoga, Tai Chi, Qigong) on the parameters of HRV and related health outcomes. Improved HRV promotes one's ability to effectively respond to perceived threats and challenges and maintain or return to a homeostatic-like biochemical architecture.

In the context of body composition, we position HRV as a factor that may be related to the outcome. Improved HRV has previously been associated with weight loss and body composition (Sjoberg et al., 2011). And is further associated with sleep quality (Burton, Rahman, Kadota, Lloyd, & Vollmer-Conna, 2010; Myllymaki et al., 2012) and negative eating behaviors (i.e., food cravings, bingeing) (Friederich et al., 2009; Meule, Freund, Skirde, Vogele, & Kubler, 2012). In the framework of self-regulation and the ability to temper emotional responses and make healthy choices, improved HRV may increase emotional resiliency and create a stronger baseline to cope with negatively perceived emotions and stress (through enhanced vagal tone) which may otherwise initiate maladaptive reactions related to food (i.e., emotional eating, excess caloric consumption) contributing to unfavorable shifts in body composition.

The purpose of the current study was to: 1) examine the correlations between psycho-emotional (perceived stress, mood state, mindfulness, self-compassion, and body

awareness) and neurophysiological factors (heart rate variability) and the primary predictors (sleep quality and emotional eating) related to body composition, and 2) to determine if the psycho-emotional and/or neurophysiological factors act as predictors of change in components associated with body composition (sleep quality, emotional eating). We hypothesized that various psycho-emotional and neurophysiological factors would be correlated with the dependent variables of sleep quality and emotional eating. Further, we hypothesized that one or more of the independent variables (perceived stress, mood state, mindfulness, self-compassion, body awareness) would predict changes in the dependent variables (sleep quality, emotional eating) and explain a portion of the change.

METHODS

Procedures and Participants

Recruitment and eligibility screening.

Study recruitment was conducted on the ASU Downtown Phoenix campus and surrounding businesses. Recruitment flyers detailed study specifics including eligibility information and study name, "Move Well." A Facebook page was created to promulgate recruitment efforts. Regularly scheduled Facebook posts promoted the study prior to each cohort; and posts displayed information contained on the flyer with contact information. Interested potential participants initiated by calling the study number provided and/or responding via the email link in the Facebook page. Once phone contact was made, eligibility screening was conducted by phone.

To determine study eligibility, potential participants completed a brief 5-minute phone screener with research staff. Inclusion criteria required that participants were: 1)

female, between the ages of 45 and 75 years old, 2) were able to participate in a low-intensity gentle movement group for 8 weeks, 3) could speak/understand English, and 4) were able to attend classes on the ASU Downtown Phoenix campus. The study was open to the general public, not limited to ASU staff, faculty, or students. Exclusion criteria included women who were: 1) outside of the targeted age range, 2) unable to stand up for 10-minutes, 3) were unable to walk. Eligible individuals were invited to schedule a data collection appointment; study staff reviewed the consent form with participants; upon signing, participants began data collection procedures. All data collection occurred in private rooms on the ASU Downtown Phoenix campus. Study participants ($N = 51$) were all females (targeted population) in a large metropolitan area in the Southwest part of the United States and between the ages of 45 and 75 years old, and were therefore considered to be in a "midlife" or "older" age bracket. Data collection (pre- and post- intervention) and intervention took place between October 2015 and December 2017 over the course of six cohorts (ranging from 5-12 participants).

Intervention

The pilot study was conducted as a single group pretest/posttest intervention. All participants received the same intervention 8-weeks of a TCE class (taught be certified instructors) for 30-minutes, one time per week; there was no control group. TCE exercises were taught standing up, but participants were informed that if they chose to, they could be seated and/or use a chair for balance. All participants received a TCE DVD for at-home practice. Prior to the start of the study, all materials, procedures, and

intervention protocol were approved by the Arizona State University IRB (ID: 00005974).

Measures

All measures were collected pre- and post- 8-week TCE intervention. Baseline data collection took place within the week prior to study start and post-data collection took place within one-week after the last class of the intervention (week 8).

Self-report measures.

To measure subjective sleep quality over the previous month, Pittsburgh Sleep Quality Index (PSQI) was used (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). PSQI includes seven measured components: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime disturbances. PSQI contains 19 items which yield a global score ranging from 0 (high sleep quality) to 21 (low sleep quality); lower scores on the PSQI indicate higher or improved levels of sleep quality (Rhae et al., 2015). PSQI reports strong internal consistency (Cronbach's $\alpha = .83$) (Buysse et al., 1989).

The subjective behavior of emotional eating was measured using the Emotional Eating (EE) subscale of the Three Factor Eating Questionnaire-18 (TFEQ-18). All 18-items are scored on a 4-point Likert-type scale yielding three subscales scores. Specifically, the EE subscale is comprised of questions three questions with a score range of 3-12; higher scores indicate stronger incident eating behavior. Emotional eating demonstrates strong internal consistency, Cronbach's $\alpha = .87$ (de Lauzon et al., 2004).

The concept of perceived stress was measured with the Perceived Stress Scale-10 (PSS-10) (Cohen, Kamarck, & Mermelstein, 1983; Roberti, Harrington, & Storch, 2006). The PSS-10 measures the degree to which respondents consider their life to be "unpredictable, uncontrollable, and overloading" over the previous month. PSS-10 is scored on a 5-point Likert-type scale ranging from 0 = never to 4 = very often. Scores range from 10 to 40; higher scores indicate higher stress levels. The PSS-10 has strong internal consistency (Cronbach's α= .89).

The Profile of Moods- Short Form (POMS-SF) was used to evaluate the "transient, distinct mood states" (Shacham, 1983) in the current moment. The shortened 37-item survey uses a 5-point Likert-type scale ranging from 1= not at all to 5 = extremely. POMS is comprised of six subscales: Tension-Anxiety, Anger-Hostility, Vigor-Activity, Fatigue-Inertia, Depression-Dejection, Confusion-Bewilderment; subscale scores yield strong internal consistency (Cronbach's α= .76-.91). POMS-SF yields seven scores—six independent subscale scores and one global scale measuring "total mood disturbance" (Cronbach's α= .87) (Curran, Andrykowski, & Studts, 1995).

Mindfulness, as a multi-component construct, was measured with the Cognitive and Affective Mindfulness Scale- Revised (CAMS-R) (Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2006). CAMS-R is comprised of 12-items and measures the following four components as experienced in general on a daily basis: 1) attention, 2) present focus, 3) awareness, and 4) acceptance/non-judgement. Although CAMS-R has distinctly measurable components, it yields only one total (mindfulness) score. CAMS-R-10 is scored on a 4-point Likert-type scale ranging from 1= rarely/not at all to 4=

almost always; higher scores indicate higher levels of mindfulness. The scale demonstrates high internal consistency (Cronbach's α = .78).

Self-compassion was measured using the Self-Compassion Scale (Neff, 2003). The full 26-item SCS includes six subscales—the first three are considered "positive" psychological constructs and the remaining three are considered "negative" psychological constructs: self-kindness, common humanity, mindfulness; and self-judgment, isolation, over-identification. SCS yields six subscale scores and one overall total self-compassion score. The scale uses a 5-point Likert scale, 0= almost never to 5= almost always; higher total self-compassion scores indicate higher self-compassion. The subscales of the SCS demonstrate strong internal consistency (Cronbach's α= .75 - .81) as does the scale as one total measure (Cronbach's α= .92).

To measure participant's attentiveness to their bodily processes, the Body Awareness Questionnaire (BAQ) was used. The BAQ is comprised of 18-items which use a 7-point Likert-type scale ranging from 1 = not at all true of me, to 7 = very true of me. BAQ is constructed based on the following four components: 1) Note Response or Changes in Body Process, 2) Predict Body Reaction, 3) Sleep-Wake Cycle, 4) Onset of Illness, yet, has only one global score. BAQ has strong internal consistency (Cronbach's α= .82) (Shields, Mallory, & Simon, 1989).

Neurophysiological measure.

Heart rate variability (HRV) was assessed using HeartMath emWave Pro-Plus equipment (Boulder Creek, CA), and was measured using the frequency domain. As a baseline and post-intervention measure of HRV, we used the standard HeartMath

procedure for the neutral-state baseline assessment ("Seated at the Bus"). We used a modified version of this protocol such that the time was for 3-minutes instead of 10-minutes. Participants were asked to sit quietly, and study staff attached a small HeartMath ear sensor (without earrings in). Study staff read the following brief script: "For the next three minutes, I'd like you to sit quietly with your eyes open, kind of like you are waiting at a bus stop for the bus. Please avoid using any relaxation techniques such as meditation. And also avoid any intense mental activity. I will let you know when the time is up" (Kim, Rath, McCraty, Zemon, Cavalo, & Foley, 2015). Additionally, participants were asked not to use their cell phone during this time.

DATA ANALYSIS

All statistical analyses were conducted using IBM Statistical Package for the Social Sciences (SPSS)-24. Demographic variables: age, race, ethnicity, education level, were described using mean and standard deviation or frequency and proportion, as appropriate. All data were previously cleaned and the distribution of continuous variables determined to be normal. HRV data (interbeat intervals) were recorded using the EmWave Pro conversions to high, low frequency and total power, and percentages of coherence, a frequency pattern between (add in Hz range). All data were previously cleaned and determined normally distributed. Change scores were computed (pre-subtracted from post- intervention) and used for the analyses. Correlations between the primary outcomes (sleep quality and emotional eating) and predictors of interest (perceived stress, mood state, mindfulness, self-compassion and body awareness) were quantified using Pearson's correlation coefficients; subsequently, linear regression

models were run to explore relationships between the dependent and independent variables.

Correlation Coefficients

Variables entered into the correlation analysis were selected based on previous literature supporting relationships demonstrated by statistical significance, such that there was previous evidence of correlation among variables in certain contexts. Pearson's product-moment correlations between primary outcomes and putative predictors were calculated. As a less conservative approach, correlations were considered meaningfully related when p values were equal to or less than $p = 0.20$ and were considered for taking forward to further examine associations. In the context of an exploratory analysis, a less conservative approach was selected to provide increased visibility of potentially significant, or of-interest, correlated variables. The strength, or effect size, of the correlations were interpreted using the following cut-off values: $r \geq 0.1 – 0.3$ = small; $r \geq 0.3 – 0.5$ = medium; $r = 0.5 – 1.0$ = large (Cohen, 1988).

Regression Analyses

To explore relationships between the dependent variables and independent variables, and further, to explore potential predictive value of the independent variables on the changes in dependent variable scores (post-intervention), multivariate linear regression models were fitted. All variables were continuous. Specifically, using the backwards method in SPSS, regression analyses were run entering all putative predictor variables that had correlations with p-values of 0.20 or less. The algorithm then tested all entered variables, removing the one that made the least contribution to the model until

the level of statistical significance for predictors in the final model was set at $p = \leq 0.05$. The backwards regression was done only using the putative predictor variables with Pearson correlation p-values of $\leq = 0.20$; to these final models for each dependent outcome variable, age was entered to adjust for this variable. To evaluate the model Adjusted R^2 was used. To further understand the contributions of the predictor variables, we examined the standardized coefficients (Beta), which converts the different variables to the same scale (Pallant, 2016).

RESULTS

The survey score means for primary behavioral and exploratory variables (psycho-emotional and neurophysiological) for pre, post, and change in score, as well as range of scores are presented in Table 4.1.

Table 4.1: Means, Pre and Post, and Change Scores of Primary and Exploratory Variables

Variable	Pre	Post	Change
Primary:			
Sleep Quality	6.38	4.56	-0.88
Emotional Eating	2.02	1.88	-0.16
Exploratory: Psychoemotional			
Perceived Stress	15.00	12.49	-2.36
Total Mood Disturbance	5.22	4.74	-0.27
Mindfulness	27.92	29.22	1.16
Self-Compassion	3.34	3.54	0.18
Body Awareness	4.54	4.84	0.36
Exploratory: Neurophysiological			
Low Frequency	1,111.01	546.68	201.28
High Frequency	707.49	347.34	48.21
Total Power	1,911.02	947.18	249.75

Pearson's Correlation Coefficients

The correlations between putative predictors and dependent/outcome variables are displayed in Table 4.2.

Table 4.2: Pearson's Correlation Coefficients of Primary and Exploratory Variables

Variable	1	2	3	4	5	6	7	8	9	10
Primary:										
1. Sleep Quality	-	0.03	**0.46**	**0.45**	-0.03	**-0.30**	**-0.43**	0.21	0.11	0.23
2. Emotional Eating	0.03	-	**0.37**	**0.30**	**-0.41**	**-0.66**	**-0.29**	-0.04	-0.23	-0.14
Exploratory: Psychoemotional										
3. Perceived Stress	**0.46**	**0.37**	-	**0.60**	**-0.23**	**-0.38**	**-0.48**	**-0.29**	0.23	-0.15
4. Total Mood Disturbance	**0.45**	**0.30**	**0.60**	-	**-0.31**	**-0.24**	**-0.30**	-0.20	0.20	-0.08
5. Mindfulness	-0.03	**-0.41**	**-0.23**	**-0.31**	-	**0.30**	**0.35**	-0.11	-0.23	-0.22
6. Self-Compassion	**-0.30**	**-0.66**	**-0.38**	**-0.24**	**0.30**	-	**0.46**	0.24	0.25	0.32
7. Body Awareness	**-0.43**	**-0.29**	**-0.48**	**-0.30**	**0.35**	**0.46**	-	0.13	-0.10	0.07
Exploratory: Neurophysiological										
8. Low Frequency	0.21	-0.04	**-0.29**	-0.20	-0.11	0.24	0.13	-	-0.03	**0.88**
9. High Frequency	0.11	-0.23	0.23	0.20	-0.23	0.25	-0.10	-0.03	-	**0.45**
10. Total Power	0.23	-0.14	-0.15	-0.08	-0.22	**0.32**	0.07	**0.88**	**0.45**	-

Bolded values are significant at ≤ 0.2

Sleep quality showed a weak and positive correlation with perceived stress, r = 0.46, p = 0.03. Sleep quality and mood state (total mood disturbance) also demonstrated a weak and positive correlation, r = 0.48, p = 0.03. Sleep quality was weakly and negatively correlated with self-compassion r = -0.30, p = 0.18. Lastly, sleep quality was showed a weak and negative correlation with body awareness r = -0.43, p = 0.05.

There was a weak and positive correlation between emotional eating and perceived stress, r = 0.37, p = 0.03. Emotional eating and mood state (total mood disturbance) showed a weak and positive correlation, r = 0.30, p = 0.07. Emotional eating and mindfulness were weakly and negatively correlated, r = -0.41, p = 0.01. There was a moderate and negative correlation between self-compassion and emotional eating, r

= -0.66, p = < 0.01. Finally, results showed a weak and negative correlation between body awareness and emotional eating, r = -0.29, p = 0.10.

Regression models

In the regression models fitted in this study (Table 3), multicollinearity (highly correlated independent variables, $r > 0.7$) (Pallant, 2016) was not an issue; therefore, was not a threat to the regression models and none of the independent variables had to be eliminated for these reasons. There were no observed outliers in the psycho-emotional variables, and as such, no data were removed. However, there were outliers in the HRV data, and data were eliminated for two participants for the following: low frequency, high frequency, and total power.

Table 4.3: Summary of Linear Regression Analyses for Variables Predicting Sleep Quality, Emotional Eating

		95% CI B		Standardized	
Variable	Raw B	Lower	Upper	B	p
Sleep Quality					
Age	0.019	-0.097	0.135	0.458	0.738
Change in Perceieved Stress	0.152	0.015	0.290	0.067	0.032
Emotional Eating					
Age	0.006	-0.015	0.026	0.079	0.569
Change in Self Compassion	-0.615	-0.867	-0.363	-0.682	0.000

Backward linear regression analyses resulted in only one independent variable, perceived stress, as approaching statistically significance as a predictor of sleep quality, $F(2, 20) = 2.71$, $p = 0.09$. While stress did not meet the generally accepted $p \leq 0.05$ threshold after backwards stepwise regression with the predictors, when adjusted for age, perceived stress was a significant predictor of sleep quality, Beta=0.46, 95% CI [0.02,

0.29], $p = .03$ with an adjusted R^2 value suggesting stress and age explained 13.4% of the variance in change in sleep quality.

In the case of emotional eating, only self-compassion was a significant predictor, $F(2, 31) = 12.54$, $p < .01$

Backward linear regression analyses resulted in only one independent variable, self-compassion, as a statistically significant predictor of the variance in the dependent variable of emotional eating, $F(2, 31) = 12.54$, Beta= -0.68, 95% CI [-0.87, -0.36], $p = < .01$. The final model then included self-compassion and age with the adjusted R^2 value indicating that 42.1% of the variance in emotional eating was explained by self-compassion and age.

DISCUSSION

The purpose of this study was to explore correlations between psycho-emotional and neurophysiological factors and the primary predictors of sleep quality and emotional eating on changes in body composition. Further, we aimed to determine if these independent variables of interest were significant predictors of the sleep quality and/or emotional eating outcomes, potentially explaining variance in the changed pre- to post-intervention scores. Findings for correlations and regression models partially support the study hypotheses.

Sleep quality demonstrated a weak and positive relationship with both perceived stress and mood disturbance. The expected direction of these correlations is well supported by previous research (Alvaro, Roberts, & Harris, 2013). Additionally, sleep quality was negatively correlated with self-compassion, a relationship which is becoming

more well recognized in literature (Hu, Wang, Sun, Arteta-Garcia, & Purol, 2018), such that as the sleep quality score decreases (indicating an improvement), self-compassion increases. Although less studied, sleep quality showed a negative correlation with body awareness (i.e., decreased sleep scores representing improved sleep were related to increased body awareness).

Emotional eating had a positive correlation with perceived stress and mood state which is strongly supported by previous research across populations (Bekker, van de Meerendonk, & Mollerus, 2003; Wallis & Hetherington, 2009). Emotional eating and mindfulness were negatively correlated such that with increased mindfulness there was decreased emotional eating—findings that are also aligned with previous results (Katterman, Kleinman, Hood, Nackers, & Corsica, 2014). Further, emotional eating showed a negative correlation with self-compassion—as self-compassion increased, emotional eating decreased. These findings are aligned with recent and relevant work related to eating behaviors in the context of self-compassion interventions (Adams & Leary, 2007; Webb & Forman, 2013). Finally, there was a negative association between emotional eating and body awareness, such that higher body awareness was correlated with decreased emotional eating. The concept of body awareness involves "…attentional focus on and awareness of internal body sensations" (Mehling et al., 2009, p.1) and is imperative to understand in the context of emotional eating. Body awareness is viewed as adaptive or maladaptive. In the adaptive domain, body awareness heightens sensitivity to what one's internal experience is and recognizes bodily needs. The maladaptive domain of body awareness is demonstrated when one hyper-focuses on a "negative"

(bodily) sensation or feeling, which tends to amplify and exacerbate these negative feelings (Mehling et al., 2009). In the framework of a mind-body intervention, we suggest that emotional eating (eating in response to negative emotion) and body awareness (attention/awareness to body sensations) may serve to inform and support each other such that heightened awareness of each may facilitate more healthy choices—if one is aware of the emotional experience (i.e., stress) *and* their bodily sensation (i.e., aching) one may then be able to tune to what they need. Awareness may be the link between emotional eating and body awareness that helps promoted improved self-regulatory behaviors.

The results of the regression analysis suggested that 1) perceived stress explained some of the variance in sleep quality and 2) self-compassion explained a relatively large amount of the variance in emotional eating. Other research supports these findings, as the measure of perceived stress is unquestionably related to sleep quality, such that increased stress (i.e., perception, elevated hormones) inhibits and/or interferes with healthy sleep quality (Sadeh, Keinan, Daon, 2004). Self-compassion, the attitude of being kind to and caring for oneself, is aptly positioned to enhance self-regulatory responses which may attenuate the maladaptive behavior of emotional eating. The direct practices of self-compassion are intended to create a felt-sense of kindness and caring in a way that is non-judgmental in the present moment; importantly this construct is, by definition, placed in the context of suffering, such that one brings this way of being to oneself when met with challenging and/or difficult situations. Bringing (kind) attention

to oneself when struggling with difficult emotions may help to attenuate the, oftentimes, habituated and maladaptive response of emotional eating.

With respect to the construct of emotional eating, self-compassion was a statistically significant predictor in the final model. Self-compassion, the attitude of being kind to and caring for oneself, is aptly positioned to enhance self-regulatory responses which may attenuate the maladaptive behavior of emotional eating.

Limitations

The current pilot study has noted limitations. First, the results and interpretation are limited by the small sample size ($N = 36$). Secondly, lack of a control group limits the ability to potentially demonstrate causality of changes from pre- to post- intervention. Although the nature of a pilot study is typically limited, lack of a control group inhibits the ability to 1) demonstrate efficacy, 2) compare (intervention) results to that of a population who did not receive the intervention, and therefore, 3) be unable to examine mediators in the context of comparison group. The limited duration (8-weeks for 30 mins) and frequency (one class per week), with some participants attending less than the full set of classes, may have compromised the ability to see changes in body composition (percent body fat)—a longer intervention with a control group may have highlighted more robust changes, correlations, and potential to explore predictors as mediators driving the change. Lastly, there are additional variables not explored in the correlation matrix and therefore not entered into the regression models. There are a host of variables that are related to the body composition factors of sleep quality and emotional eating—it is possible that factors such as physical activity, dietary intake, use of medications, prior

medical diagnosis may have factored into the regression models and explained additional variance in the dependent variables.

Conclusion

The complexity and importance of adverse body composition and obesity are evident from the body of research that shows multiple poor health sequelae. While considerable efforts in physical activity and dietary intake interventions have been put forth to attenuate both, sustained results are limited. Findings from the current study suggest that various psycho-emotional factors (i.e., stress, mood, self-compassion) are correlated with sleep quality and emotional eating, both of which are strongly related to body composition. Further, our results demonstrated that perceived stress and self-compassion act as significant predictors on the outcomes of sleep quality and emotional eating. Additional research to better understand these relationships may guide interventions to test for efficacy and examine mediators in a more robust way, as well as future programming to improve body composition in midlife and older women.

CHAPTER 5

DISCUSSION

The purpose of this three-manuscript dissertation was to build a model of effects mapping how the practices of tai chi/qigong may initiate and/or promote well-being factors related to weight gain and unfavorable body composition in midlife/older women, and further, to explore this model by examining predictors and outcomes in a pilot study using a modified (30 minutes instead of 60 minutes) 8-week TCE intervention. To our knowledge, this is the first study to investigate a modified TCE intervention in midlife/older women exploring body composition outcomes and associated psycho-emotional/neurophysiological variables. The short- and long-term impacts of increased weight and adverse body composition, particularly during midlife, may contribute to obesity and related cardiometabolic disorders; such compromised health can set the stage for reduced quality of life, correlated medical diagnoses, and early death. Efforts to turn the tide are paramount.

SUMMARY OF MAJOR FINDINGS

In manuscript one, our biobehavioral model set the stage for testing potential relationships and mechanisms between the intervention and the outcomes related to body composition. Here we proposed that the intervention (TCE) was related to the variables selected as potential mechanisms (psychological, behavioral, physiological), and was additionally related to the outcomes of interest (i.e., weight reduction, improved body composition). Our model further detailed that the psychological, behavioral, and physiological variables, acting as potential mechanisms between the intervention and the

outcome, are also directly, and independently, related to the outcome of body composition.

In manuscript two, which explored the primary outcomes of interest (percent body fat, sleep quality, and emotional eating), we determined that there was not a statistically significant change in percent body fat; however, given the limited length of time (8 weeks) and the class frequency/duration, this was not surprising. We did see significant changes in sleep quality from pre- to post- intervention—this finding aligns with current research such that results from multiple studies demonstrate Tai Chi and Qigong improving sleep quality. The behavior of emotional eating approached statistical significance; here again, the short timeframe may have precluded more substantial change. Isolated incidents of emotional eating are not considered to be detrimental to body composition, rather, it is the habituated response which becomes a pattern (of eating in response to negative emotions) that is potentially problematic. The habit and pattern of emotional eating take time to establish and time to reverse. The exploratory outcomes resulted in significant changes in perceived stress and body awareness.

In manuscript three we saw strong correlations among factors known to be related to body composition (sleep quality and emotional eating) and specific psycho-emotional variables. Sleep quality was significantly correlated with perceived stress, mood state, self-compassion, and body awareness. Emotional eating was significantly correlated with perceived stress, mood state, mindfulness, self-compassion, and body awareness. In addition to significant correlations, results demonstrated predictive values such that

perceived stress predicted the variance in sleep quality and self-compassion predicted variance in emotional eating.

Moving forward, it is recommended that studies are designed with rigorous methodology detailing intervention protocols and with specific attention to Tai Chi/Qigong practices (i.e., type of exercise, breath/body components). Further, here we suggest that interventions increase time of intervention—by overall duration, frequency of classes, or length of class time. Importantly, it is recommended that at-home practice time be digitally tracked either via an app-based platform or a study specific website; with respect to Tai Chi/Qigong practice, dose response may facilitate understanding the potential individual shifts in body composition.

INTEGRATION OF STUDIES

The current dissertation was structured to develop a foundational model of effects to support testing preliminary outcomes and predictor values related to body composition in midlife and older women participating in a Tai Chi/Qigong intervention. Overall, the intention was to develop a comprehensive and cohesive body of work with three self-sustaining manuscripts that created a strong and integrated project model. The project design was such that the manuscripts built upon each other, each supporting the previous one while succinctly moving the project forward as a whole. Additionally, as an elemental way to look at the project framework, we aimed to establish the following: 1) what to test, 2) how to test it, and 3) what the relationships look like. The results of the three manuscripts provide preliminary evidence of a Tai Chi/Qigong intervention shifting

body composition in a healthy direction (i.e., reduced fat mass, increased fat-free mass) in a population of midlife/older women.

IMPLICATIONS FOR FUTURE WORK

Findings from this dissertation help define appropriate next steps in research. Here we highlight preliminary design ideas for a future TCE study that, if findings are significant, would provide more robust and meaningful results. Additionally, we will briefly explore how qualitative research may help to better understand program acceptability.

Given the inherent constraints of the current pilot study, we suggest the following be considered for a subsequent intervention. In order to demonstrate effectiveness and causality with temporal order, a randomized controlled trial with a control group (i.e., wait-list control group, psycho-educational control group) must be conducted. A comparison group would allow us to better isolate the intervention (TCE), and also understand the impact it has on the selected outcomes. A strong study design with rigorous methodology, following CONSORT guidelines, (Schulz, Altman, & Moher, 2010) would be the appropriate next step in the process of deeper understanding of TCE as an effective intervention related to body composition. Research notes that one of the resounding themes in mind-body interventions is the lack of rigorous and transparent methodology (Innes et al., 2008), which inhibits the interpretation, generalizability, and dissemination of results. In manuscript two, our primary outcome of interest, percent body fat, did not show a significant change from pre- to post- intervention; therefore, we could not conduct mediation analyses (to test what was driving the change); however, in

manuscript three, our regression analysis began to demonstrate the predictive value of related psycho-emotional factors. In a larger, and appropriately powered randomized controlled trial, potential for findings of significant effects would further allow us to conduct mediation analyses, testing the biobehavioral model in manuscript one.

Methodological considerations to be addressed include selected self-report survey measures, rigor of biomarker data collection, and importance of reported at-home practice. Here, we used the Three Factor Eating Questionnaire – Emotional Eating Subscale to explore the behavior of emotional eating, a subscale which consists of three items. To better understand the complexity and breadth of emotional eating we would propose to use the Emotional Eating Scale which measures the "desire" or "urge" to eat in response to 25 varied emotions (i.e., sad, uneasy, irritated) and has been validated across multiple populations (Arnow et al., 1995). Additionally, the anthropometric measure of waist circumference (a measure of central adiposity) would provide valuable baseline data as reference which is easy to collect, has minimal cost, and is a significant predictor of cardiometabolic disease risk. Lastly, although participants were given paper logs to record at-home practice, and were encouraged to practice daily, few handed them in weekly. Participants verbally reported varying amounts of practice, but there was very limited evidence of practice to measure or compare. This study was unfunded; yet, with a funding mechanism, it may have been possible to provide graduated incentives (i.e., monetary rewards) for attendance of time points (pre- and post- intervention) and completed logs. Lastly, one of the primary criticisms of mind-body interventions is lack of follow-up, or lack of longitudinal study measures. Data collection for this dissertation

was collected only at baseline and post-intervention; follow-up measures would be highly informative, and as such, incentives may help support this effort.

Additionally, due to the sensitivity of changes in body composition, and potential length of time for targeted shifts in change, understanding women's experience of perceived and/or felt changes in their body may provide a more comprehensive description of the experience and, perhaps, begin to identify mechanisms at-work which may take longer than 8-weeks to see (quantitatively). Findings of this dissertation may have been strengthened with the addition of qualitative inquisition and analysis. The integration of focus groups would allow researchers to capture individual and shared experiences of participating in the intervention. It would have provided insight and direction to know which elements of the TCE intervention participants connected with—physical activity, deep breathing, calming the mind, deep state of relaxation, social engagement, accountability, self-care, self-healing—or perhaps additional elements not evident, but experienced by participants.

POINTS OF INTEREST

Although the premise of mind-body interventions is purported to synergistically integrate elements of the mind and body, a large portion of the studies reviewed (over the course of the dissertation) focused on mind *or* body, most commonly the mind. Details of mind-body interventions seem to be greatly driven by cognitive aspects of the application and testing (i.e., mental awareness and attention); while these elements and practices can be largely beneficial, at a rudimentary level, they lack the other half of the whole. Conversationally speaking, programs and interventions that have a "neck up"

approach, although well intended, may potentially and inadvertently, drive the mind-body *disconnect.* For example, and specific to this dissertation, mind-body interventions designed to address emotional eating often approach the issue and aim to improve outcomes through practices such as meditation (without focus on or in the body). Although grossly individual and largely influenced by socio-historical context; there is often benefit to this strategy. However, the behavior of emotional eating, and varied maladaptive eating behaviors are often associated with body "issues" (i.e., body disconnect, negative body image, body dissatisfaction); therefore, programs that further endorse this disconnect may negate the wisdom of a (truly integrated) mind-body intervention.

STRENGTHS AND LIMITATIONS

The current project addressed an important population of midlife/older women, most of whom experience the process and transition of menopause. The vast majority of the biologically female population will experience menopause and, to a varying degree, the associated changes (i.e., psychological, physiological, hormonal). Given the prevalence of this population and the importance of the associated weight-related outcomes with respect to both short-term and long-term implications, focus in this area of research is of significant importance.

The utilization of a Tai Chi and Qigong intervention demonstrates a novel approach to an age-old problem. The issues surrounding weight gain and unfavorable shifts in body composition have been well-established for decades; however, traditional approaches such as caloric restriction and/or increased physical activity have resulted in

limited lasting outcomes. Here we suggest that an innovative approach, such as Tai Chi/Qigong, may offer additional integrative mind/body strategies to shift body composition in a favorable direction. Combining core components of both the mind and the body may uniquely support desired change and lasting results.

The current study provided great detail to methodological procedures throughout the entirety of the intervention and study. A common criticism of Tai Chi and Qigong interventions is lack of methodological transparency for purposes of replication, efficacy, and ultimately, to move the sciences forward and be of benefit to a wider population. We detailed study design, selected measures, and protocol procedures (i.e., class length, time, exercises). Additionally, the two instructors were certified to teach the TCE protocol through the same institution, under the guidance of the same trainer, serving, in part, to ensure standardized delivery of intervention components. Lastly, we used valid and reliable scales that had been used previously with the current midlife/older women population. While there were notable strengths of our study, it was not without limitations.

The current project was designed as a single-group intervention pretest/posttest pilot study. Inherently, pilot studies come with precautionary measures, including smaller sample size and less rigorous study design. The primary limitation of the current study is lack of a control group- without which neither effectiveness nor causation can be determined. Additionally, the study was only conducted in one location inhibiting generalizability in various and diverse populations.

With respect to the current study population (ages 45-75 years old), a more narrow age range may have been advantageous for better understanding the various psycho-emotional and neurophysiological components contributing to compromised body composition and the explored mechanisms within more specified populations (i.e., midlife, older adults). Although midlife and older women face many of the same health-related changes, more refined study population parameters would allow for more specifically targeted outcomes. Notably, lack of menopausal status was a limitation of the current study. Demographic questionnaires inquired about "date of last menstrual cycle" but did not further seek to understand the frequency with which menses had occurred during the last calendar year to determine menopausal status. Lack of known menopausal status prevented the ability to understand comprehensive and complex faculties of neuroendocrine events. Further, although participants were asked if they were taking medications, these data did not act as eligibility criteria, nor were potential confounding implications accounted for.

The study size was small ($N = 36$) and therefore may have limited some of the detectable findings. The abbreviated, or modified, TCE protocol (30 minutes once a week) may have hindered the potential strength of the findings. Mind-body interventions are often modeled after the Mindfulness-Based Stress Reduction (MBSR) program and intervention, which is 8-weeks, so while our study was aligned with the bulk of research for duration, the shortened class time may have contributed to lack of significant findings and small effect sizes. For example, a small 2010 TC/QG study showed significant improvements in body composition measures of BMI and waist circumference in an

intervention conducted for 12 weeks, meeting 1 to 1.5 hours, three times a week (Liu, Miller, Burton, & Brown, 2010); dose response may be a significant factor in this equation.

CONCLUSION

Preliminary results of our pilot study indicate trends shifting in the right direction towards improved psycho-emotional factors related to weight gain and unfavorable body composition. Our biobehavioral model details pathways that offer a description of how the components of TCE (breath focus, posture/body movement, clear/calm mind, deep state of relaxation) may drive psychological, behavioral, and physiological variables which are associated with weight reduction and improved body composition.

Primary outcomes of percent body fat and emotional eating did not yield the anticipated results; however, our findings demonstrated statistically significant differences in the primary outcome of sleep quality and additionally the exploratory outcomes of perceived stress and body awareness. Further, regression models suggest that perceived stress and self-compassion may predict variance in the outcomes of sleep quality and emotional eating. Collectively, results from our study indicate positive changes in psycho-emotional and behavioral factors related to weight gain and improved body composition in the context TC/QG intervention. Randomized controlled trials with rigorous methodology are warranted to continue this important line of work and help improve measures of body composition in midlife and older women.

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APPENDIX A

TAI CHI EASY (TCE) MANUAL

The Three Intentful Corrections. The three intentful corrections are common to all of the Rejuvenating Movement exercises. These guidelines are designed to be thoughtfully incorporated throughout the practice. Using these three areas of focus triggers the relaxation response and immune function, tonifies and settles the energy, and nourished organs and glands.

First Intentful Correction – Adjust and regulate your body posture and movement.

Sit or stand fully upright, or lie outstretched. Visualize a connection lifting the top of your head into the sky. Next visualize a connection from your sacrum to the center of the earth. The upward lift and the downward pull opens the center of the body and fills the body with energy. Adjusting your posture optimizes the inner flow of blood and lymph in your body.

Second Intentful Correction – Adjust and deepen your breath.

The breath is the most powerful tool for gathering energy and is the easiest to practice. Inhale slowly through your nose, and hold your breath for a count of one, one thousand; two, one thousand; three, one thousand. Allow your breath to be deep, slow and relaxed, but not urgent. On the exhalation, relax even more.

Third Intentful Correction – Clear your mind.

A proverb states, "When mind is distracted, the energy scatters." Briefly, or for as long as you wish, focus your mind on something simple like clouds drifting along the sky, a prairie of grass in the breeze, water moving in the river or as waves against the shore. Smile gently.

The 6 QG/TCE Movements:

Twisting at the Waist. Starting from the place of the three intentful corrections, begin to pivot your hips gently around your center axis, twisting around, allowing your body to follow so that your whole trunk moves as one unit. Let the strength out of your arms so that they simply follow your body, swinging from one side to the other. Keep the core of your body aligned, spine lengthened, as you twist around the centerline. Allow your head to turn as far around on each turn as is comfortable. Once you feel a nice easy flow with this motion, you may let your hands slap against your body with each turn. As you progress, you may dip your knees slightly as you face forward, and then straighten up a bit as you turn back—then notice that your hands may slap a little higher on each turn until you are gently striking your upper lungs with the front hand and kidney area with the back hand. To come to a close, slow the twisting down until you come to a rest and then stand still, readjust to the three intentful corrections, and feel the quiet inside.

Flowing motion. Standing in the open posture, inhale slowly and deep and turn your palms forward. Gently rock forward, lifting your body weight onto your toes. Swing the arms upwards and forwards, to the height of your heart or shoulders, with elbows slightly bent. Remember to feel free to do this movement in a way that is comfortable to you, and respectful of your body's limitation. Let your mind be free of concerns. As you exhale turn your palms downwards, and lower the arms. Slowly sink the body weight down so the feet are flat on the ground. When the hands pass the legs allow them to continue to

swing to the back and lift your toes as high as possible, rocking back on the feet if possible.

Breathe deeply but do not strain. Repeat movement, building up a gentle rhythm. Once you get the flowing motion going, you will notice you can rest in the rhythm and flow. After rocking back and forth on your heels for a few repetitions, continue the arm movements except now add in the following controlled leg positioning. As your arms come up, bring your feet together. When your arms are coming up for a second time, step out to the right and shift your weight to your right foot. As the arms come back down, bring your left leg together with your right and balance your weight. You'll repeat the same thing, except going left this time. Alternate between each side, keeping the movement controlled.

Right and Left Bending of the Spine. Beginning from the open posture, bend the upper body to the right and exhale. Allow the right arm to drop like spaghetti along the right leg. Dangle the head towards the right shoulder, like a melon on a vine. The left arm should drop gently across the front of the body. Slowly return to center as you inhale. Then bend the upper body to the left side as you exhale. Allow the left arm to drop like spaghetti alongside the left leg. Dangle the head towards the left shoulder. The right arm should drop gently across the front body. Slowly return to center as you inhale. Continue alternately bending to both sides with deep, relaxed breaths. After a few repetitions, add in the arm movements from the figure below. As you bend to the right, use your right hand for stability on your thigh and bring your left arm over your head. When bending

left, use the left hand for stability against the thigh as the right arm comes overhead.

Front and Back Bending Spine (Crushing Stone). From the open posture, inhale and raise the hands upwards, with the arms bent at the elbow at approximately a 90 degree angle. The palms face the body as the arms rise. As the arms reach chest level, turn the palms downwards. When the arms come above the shoulders, the palms face upwards, the elbows still bent as if you are holding up the sky. The fingers are outstretched but relaxed. Look skyward at your hands with your eyes wide open. Allow your tailbone to tilt backward, so that the curve of your spine is like a bow with the belly and chest forward. On the exhalation, the arms come forward and down, with the palms turning slowly towards the face. Clench your hands into fists firmly pressing the knuckles of each hand against each other. At the same time, contract the muscles across your whole body. Bend your head forward, and round your shoulders forward. Let your exhalation be forceful and full. Repeat. On the inhalation, let your mind, body and spirit feel calm and easy. On the exhalation, contract everything.

Smoothing the Energies. Start by rubbing your palms together until they feel warm. Then as if you are washing your face, starting at the neck and chin, pass your hands up and over the cheeks, eyes and forehead. Pass the hands over the top of your head, then down the back of your head, neck and shoulders. Visualize that you are standing in a pool of healing waters. Move your hands around the front of the shoulders, under the armpits, and reach around your back as high as possible. Continue down the spine, over the sacrum and down

the back of your legs. As you bend over, take care to stay in your comfort zone. Keep your knees bent if you have back problems. Bring your hands around the front of your ankles, across the tops of your toes and move your hands up the inside of the legs. If you are unable to touch your toes, even with your knees bent, reach down only as far as you can comfortably. Moving your hands upwards, bathe the front of your legs, pelvis, belly and chest. When your hands are in front of your heart, just let them start to follow over your neck and face again to cycle into the next repetition (we're not rubbing them together like on the first round). Allow your breath to be full and deep and drift deeper into relaxation. If you have thoughts, let them pass like watching clouds pass, and then begin again. After you have done several rounds take a moment to center yourself with the hands resting on the rib cage. From this position, we'll go directly into energizing the organs.

Gathering from Heaven and Earth. With arms in front of the chest, open arms to a 45-degree angle, palms facing each other. Bend the knees and lower the arms so that the palms are facing up. Sink down by gradually bending at the knees while making a scooping motion with both hands gathering from the resources of the Earth below. Slowly stand up while moving arms up towards the sky gathering from the Heavens while gently looking up. Scoop the palms towards the heart center. Repeat this cycle of movements as many times as you wish. Notice that you are bringing the Earth's resources and the resources of the Heavens to the heart center.

APPENDIX B

FLYER

GOT STRESS?

Are you experiencing stress? Are you tired? Have low energy?
If so, check out the Move Well Study!

We are conducting research in the Phoenix area to understand how Tai Chi may help reduce stress levels and improve overall feelings of well-being!

If you are a female over the age of 45, come join a quick weekly 30-minute Tai Chi class!

Participation will include:
- 30-minute Tai Chi classes for 8-weeks
- Health-related data collection 3 times (approximately 1 hour)

If you are interested or want more information, please contact Dara James at dara.james@asu.edu or (602) 496-2325.

ASU Arizona State University

Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325 | Move Well Study 602-496-2325

APPENDIX C

MOVE WELL PHONE SCREENER ELIGIBILITY FORM

Date: _____ Time: _____ AM/ PM Screener's Initials:_____ ID#_____

Contact Information

Name: _____

Address: _____

City/State: _____ Zip: _____

Best telephone number to reach you: _____H W C

Email Address: _____

Question	**Response**	**Notes Staff use only**
Q1) **What is your date of birth?**	*Write:* Month/Day/Year ___/_____/_____	
Q2) **What is your current age***?*	AGE:_____ years	
Q3) **Are you able to stand up for 10 minutes and walk short distances?**	*Circle:* Yes No	
	Circle: Yes No	

Q4) **Are you able to participate in a program of gentle movement?**		
Q5) **Are you able to attend a 30- minute class once a week for 8 weeks?**	*Circle:* Yes No	

Would you prefer attending a morning or an after-work class? _____

Are there any days of the week that would NOT work for you? _____

Comments: _____

APPENDIX D

INFORMED CONSENT FORM

Title of research study: Move Well

Investigator: Dr. Linda Larkey

Why am I being invited to take part in a research study? We are inviting you to take part in this research study because you are a woman aged 45-75 who is interested in exploring what might improve your stress.

Why is this research being done? We are testing Meditative Movement as a way to improve stress and wellness

How long will the research last? You will participate for 8 weeks, plus a meeting prior to the start of classes and again 8-weeks after classes end for a total of 16 weeks.

How many people will be studied? We expect about 60 women will participate.

What happens if I say yes, I want to be in this research? Once you have agreed to join the study you will meet with study staff:

- Approximately one week prior to starting classes for data collection (this meeting will take about 60 minutes).You will be scheduled for 8-week Meditative Movement classes
- At the last of the 8-week classes you will meet with study staff for data collection (this meeting will take about 60 minutes)
- During class 4 or 5 heart rate variability and coherence will be assessed while in motion
- 16 weeks after the first class you will meet with study staff for final data collection (this meeting will take about 60 minutes)
- To complete all data, you will be asked to meet with study staff on the ASU downtown campus in the College of Nursing and Health Innovation buildings.
- At these meeting, we will collect the following information about you:
- Questionnaires that ask about your current level of stress, depression, anxiety, eating patterns, body image, sleep quality, physical activity levels, mindfulness and self-compassion.
- Body composition using bioelectrical impendence (BIA), and weight.
- A heart rate variability and coherence assessment, which will involve placing a small sensor on your earlobe in order to assess the rhythm of your heart beat.

- A sample of your saliva (collected at home 3 times a day for 2 days) to look at a stress hormone; these will be taken before classes start and at the end of the 8-week class sessions.

The Meditative Movement classes will be held at the Lincoln Family downtown YMCA building or at ASU campus buildings. Each week you will be asked to complete a log including the days and amount of Meditative Movement practice you have completed and any other physical activity that you may have engaged in. Logs will be collected each week at the instructor-led class or via email.

You will also receive a DVD of the exercises you learn in class to take home with you, and you will be asked to practice the exercises at home most days when you are not in class, however much is comfortable for you. One of the study coordinators may call you once a week to encourage you, to answer any questions, and to offer help and support.

What happens if I say yes, but I change my mind later? You can leave the study at any time and it will not be held against you in any way.

Is there any way being in this study could be bad for me? Problems are not expected with the gentle movements you will be practicing. But, as with any movements, muscles may become strained or injury may occur. Also, deep breathing may cause dizziness and it is possible that you may fall during standing exercises. The instructor will coach you

carefully to avoid such problems. You will be asked to let the instructor know if you are not feeling well, or if you feel uncomfortable about anything in this study. If you are experiencing pain, shortness of breath or pressure in your chest while practicing, you will be referred to your physician to decide about further participate.

Will being in this study help me in any way? We cannot promise any benefits to you or others from your taking part in this research. However, you will be doing physical activity in this study, and as such you may experience decreases in cardiovascular and metabolic risks as with any exercise.

What happens to the information collected for the research? Efforts will be made to limit the use and disclosure of your personal information, including research study records, to people who have a need to review this information. All data will be identified by a unique, anonymous ID number, except for the master file that will be the only place where we will link ID numbers to participant names. This master list will be stored separately from all other files and will be password protected in a locked office. The master list and all participant data will be destroyed within five years of the end of the study to further protect your confidentiality. The results of this project may be published or presented, but the researchers will not identify you. We cannot guarantee complete confidentiality; for example, other women within your class may learn your name due to your participation in class.

Who can I talk to? If you have questions, concerns, or complaints, call the Principal Investigator, Dr. Linda Larkey at 602-496-0740.

This research has been reviewed and approved by the Social Behavioral IRB. You may talk to them at (480) 965-6788 or by email at research.integrity@asu.edu if:

Your questions, concerns, or complaints are not being answered by the research team.

You cannot reach the research team.

You want to talk to someone besides the research team.

You have questions about your rights as a research participant.

You want to get information or provide input about this research.

Please sign and print your name below. Your signature documents your permission to take part in this research.

Signature of participant	Date
Printed name of participant	
Signature of person obtaining consent	Date
Printed name of person obtaining consent	

APPENDIX E

DEMOGRAPHICS

Participant ID # ____

Staff Initials _____

Date of Baseline Data Collection_____

Date of Study Completion Data Collection_____

Date of Study Follow-Up Data Collection_____

For staff use only

Move Well Study

Baseline Demographic Questionnaire

PART I – PARTICIPANT COMPLETION

1. What is your date of birth and age? _____
2. What is your current weight? _____
3. What is the date of your last menstrual cycle (approximate)?

   _____
4. Have you lost weight in the past 30 days?

   ☐YES (1) ☐NO (0)

   If Yes, how much in pounds? _____
5. Have you gained weight in the past 30 days?

   ☐YES (1) ☐NO (0)

   If Yes, how much in pounds? _____
6. Have you had bariatric surgery in the past? ☐YES (1) ☐NO (0)

   If Yes, what type?

   ☐1 Gastric Banding

☐2 Gastric Bypass

☐3 Gastric Sleeve

☐4 Other _____

Date of surgery _____

7. Have you ever practiced any form of "meditative movement" regularly, such as yoga, tai chi, qigong?

☐YES (1) ☐NO (0)

If Yes, How long have you practiced? Years _____ Months _____

8. Have you ever practiced any form of meditation regularly, such as mantra meditation, mindfulness-based meditation, transcendental meditation, or other?

☐YES (1) ☐NO (0)

If Yes, How long have you practiced? Years _____ Months _____

Participant ID # ____

9. What is the highest level of education you have completed?

☐1 Less than High School Diploma

☐2 High School Diploma/GED

☐3 Associates Degree, Technical Training, or Some College

☐4 Four-Year College Degree or Beyond

☐5 Prefer not to Answer

10. Ethnicity	Hispanic or Latino? ☐1 No ☐2 Yes
11. Race (Please check all that apply)	☐1 American Indian or Alaska Native ☐2 Asian ☐3 Native Hawaiian or Other Pacific Islander ☐4 Black or African American ☐5 White

12. What medications and/or supplements are you currently taking? Please include hormone replacement therapy (HRT) if applicable. If none, please write NONE.

_____

_____

_____

_____

_____

_____

_____

APPENDIX F

BIOMETRICS, HRV, HRC

Body Composition Measures

Height:_____ Height:_____

Weight:_____ Weight:_____

Body Fat %:_____ Body Fat %:_____

BMI:_____ BMI:_____

HRV Data Collection Form

Circle One: Baseline (pre- intervention) Post-Intervention

Enter both 3 minute Vertical Bar sessions only (the first and third HRV assessments conducted per protocol).

FIRST: 3 minute session scores (normal, no instruction)

_____% low (red) _____% med (blue) _____% high (green) _____HR

SAVE SESSION

SECOND: 3 minute session scores-Vertical bars (Heart-focused breathing instruction):

_____% low (red) _____% med (blue) _____% high (green) _____HR

SAVE SESSION

APPENDIX G

MOVE WELL QUESTIONNAIRES

Participant ID_____

T1_____ T2_____

Instructions: The questions in this questionnaire will ask you about your current level of sleep quality, mood, stress, physical activity and mindfulness levels and eating patterns. Please answer all questions to the best of your ability. If you have any questions, please ask a research staff member and he or she will assist you. If there is a question that you are not comfortable answering, you are welcome to skip this question. We appreciate your careful review and thoughtful responses to each question as this information will help us learn more about ways to increase women's energy and well-being.

YOUR SLEEP HABITS

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

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

   _____ usual bed time?

2. During the past month, how long (in minutes) does it usually take you to fall asleep each

   night?

   _____ number of minutes?

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

_____ usual time to get up?

4. During the past month, how many hours of actual sleep did you get at night? (This may be

different than the number of hours you spend in bed).

_____ hours of sleep per night?

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

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

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

d. Cannot breathe comfortably	0	1	2	3
e. Cough or snore loudly	0	1	2	3
f. Feel too cold	0	1	2	3
g. Feel too hot	0	1	2	3
h. Have bad dreams	0	1	2	3
i. Have pain	0	1	2	3
j. Other reasons (please describe)	0	1	2	3

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

_____ 0 Very good

_____ 1 Fairly good

_____ 2 Fairly bad

_____ 3 Very bad

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	0	1	2	3
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	0	1	2	3

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

_____ 0 No problem at all

_____ 1 Only a very slight problem

_____ 2 Somewhat of a problem

_____ 3 A very big problem

10. Do you have a bed partner or roommate? Please check one.

_____ 0 No bed partner or roommate

_____ 1 Partner/roommate in other room

_____ 2 Partner in same room, but not same bed

_____ 3 Partner in same bed

11. If you have a roommate or bed partner, how often has this person complained that you have...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Loud snoring	0	1	2	3
b. Long pauses between breaths while asleep	0	1	2	3
c. Legs twitching or	0	1	2	3

jerking while you sleep				
d. Episodes of disorientation or confusion during sleep	0	1	2	3
e. Other restlessness while you sleep; please describe	0	1	2	3

YOUR MOOD

The next set of questions will ask you how you are feeling right now.

Directions: Describe HOW YOU FEEL RIGHT NOW by circling the best number under each of the words listed below:

Feeling	Not at all	A little	Moderately	Quite a bit	Extremely
Tense	1	2	3	4	5
Angry	1	2	3	4	5
Worn Out	1	2	3	4	5

Unhappy	1	2	3	4	5
Lively	1	2	3	4	5
Confused	1	2	3	4	5
Peeved	1	2	3	4	5
Sad	1	2	3	4	5
Active	1	2	3	4	5
On edge	1	2	3	4	5
Blue	1	2	3	4	5
Energetic	1	2	3	4	5
Hopeless	1	2	3	4	5
Uneasy	1	2	3	4	5
Restless	1	2	3	4	5
Unable to concentrate	1	2	3	4	5
Fatigued	1	2	3	4	5
Annoyed	1	2	3	4	5
Discouraged	1	2	3	4	5
Resentful	1	2	3	4	5
Nervous	1	2	3	4	5
Miserable	1	2	3	4	5
Cheerful	1	2	3	4	5
Bitter	1	2	3	4	5

Exhausted	1	2	3	4	5
Anxious	1	2	3	4	5
Grouchy	1	2	3	4	5
Helpless	1	2	3	4	5
Weary	1	2	3	4	5
Bewildered	1	2	3	4	5
Furious	1	2	3	4	5
Full of pep	1	2	3	4	5
Worthless	1	2	3	4	5
Forgetful	1	2	3	4	5
Vigorous	1	2	3	4	5
Uncertain about things	1	2	3	4	5
Bushed	1	2	3	4	5

The following questions ask about your feelings and thoughts during the past month. In each question, you will be asked HOW OFTEN you felt or thought a certain way. Although some of the questions are similar, there are small differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don't try to count up the exact number of times you felt a particular way, but tell me the answer that in general seems the best.

	Never	Almost Never	Sometimes	Fairly Often	Very Often
B.1. In the past month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
B.2. In the past month, how often have you felt unable to control the important things in your life?	0	1	2	3	4

B.3. In the past month, how often have you felt nervous or stressed?	0	1	2	3	4
B.4. In the past month, how often have you felt confident about your ability to handle personal problems?	0	1	2	3	4
B.5. In the past month, how often have you felt that things were	0	1	2	3	4

going your way?					
B.6. In the past month, how often have you found that you could not cope with all the things you had to do?	0	1	2	3	4
B.7. In the past month, how often have you been able to control irritations in your life?	0	1	2	3	4
B.8. In the past month,	0	1	2	3	4

how often have you felt that you were on top of things?					
B.9. In the past month, how often have you been angry because of things that happened that were outside of your control?	0	1	2	3	4
B.10. In the past month, how often have you felt that difficulties	0	1	2	3	4

were piling

up so high

that you could

not overcome

them?

YOUR PHYSICAL ACTIVITY

The next set of questions will ask you about your physical activity patterns in the last week. Please check the best response.

1. Think about walking you do outside the home. How often do you walk outside the home for more than 10 minutes without stopping? (Mark only one).

- □ Rarely or never
- □ 1-3 times each month
- □ 1 time each week
- □ 2-3 times each week
- □ 4-6 times each week
- □ 7 or more times each week

1.1 When you walk outside the home for more than 10 minutes without stopping, for how many minutes do you usually walk?

- □ Less than 20 minutes

□ 20-39 minutes

□ 40-59 minutes

□ 1 hour or more

1.2 What is your usual speed?

□ Casual strolling or walking (less than 2 miles an hour)

□ Average or normal (2-3 miles an hour)

□ Fairly fast (3-4 miles an hour)

□ Very fast (more than 4 miles an hour)

□ Don't know

Not including walking outside the home, how often each week (7 days) do you usually do the exercises below?

2. STRENUOUS OR VERY HARD EXERCISE (You work up a sweat and your heart beats fast.) For example, aerobic dancing, jogging, tennis, swimming laps.

□ None

□ 1 day per week

□ 2 days per week

□ 3 days per week

□ 4 days per week

□ 5 or more days per week

2.1 How long do you usually exercise like this at one time?

□ Less than 20 minutes

□ 20-39 minutes

□ 40-59 minutes

□ 1 hour or more

3. MODERATE EXERCISE (Not exhausting). For example, biking outdoors, using an exercise machine (like a stationary bike or treadmill), calisthenics, easy, swimming, popular or folk dancing.

□ None

□ 1 day per week

□ 2 days per week

□ 3 days per week

□ 4 days per week

□ 5 or more days per week

3.1 How long do you usually exercise like this at one time?

□ Less than 20 minutes

□ 20-39 minutes

□ 40-59 minutes

□ 1 hour or more

4. MILD EXERCISE. For example, slow dancing, bowling, golf.

□ None

□ 1 day per week

□ 2 days per week

□ 3 days per week

□ 4 days per week

□ 5 or more days per week

4.1 How long do you usually exercise like this at one time?

□ Less than 20 minutes

□ 20-39 minutes

□ 40-59 minutes

□ 1 hour or more

For each of the ages below, did you usually do strenuous or very hard exercises at least 3 times a week? This would include exercise that was long enough to work up a sweat and make your heart beat fast. (Be sure to mark "No" if you did not do very hard exercises at the ages listed below.)

5.1 18 years old

□ No

□ Yes

5.2 35 years old

□ No

□ Yes

5.3 50 years old

□ No

□ Yes

The next set of questions asks about some of your usual activities.

6. About how many hours each week do you usually spend doing heavy (strenuous) indoor household chores such as scrubbing floors, sweeping, or vacuuming?

□ Less than 1 hour

□ 1-3 hours

□ 4-6 hours

□ 7-9 hours

□ 10 or more hours

7. About how many months during the year do you usually do things in the yard, such as mowing, raking, gardening, or shoveling snow?

□ Less than 1 month

□ 1-3 months

□ 4-6 months

□ 7-9 months

□ 10 or more months

7.1 When you do these things in the yard, how many hours each week do you do them?

□ Less than 1 hour

□ 1-3 hours

□ 4-6 hours

□ 7-9 hours

□ 10 or more hours

8. During a usual day and night about how many hours do you spend sitting? Be sure to include the time you spend sitting at work, sitting at the table eating, driving or riding in a car or bus, and sitting up watching TV or talking.

□ Less than 4 hours

□ 4-5 hours

□ 6-7 hours

□ 8-9 hours

□ 10-11 hours

□ 12-13 hours

□ 14-15 hours

□ 16 or more hours

9. During a usual day and night about how many hours do you spend sleeping or lying down with your feet up? Be sure to include the time you spend sleeping or trying to sleep at night, resting or napping, and lying down watching TV.

- □ Less than 4 hours
- □ 4-5 hours
- □ 6-7 hours
- □ 8-9 hours
- □ 10-11 hours
- □ 12-13 hours
- □ 14-15 hours
- □ 16 or more hours

YOUR EATING PATTERNS

This next set of questions will ask also you about your eating patterns in the last week. Please circle the correct response.

1. When I smell a sizzling steak or juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

2. I deliberately take small helpings as a means of controlling my weight.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

3. When I feel anxious, I find myself eating.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

4. Sometimes when I start eating, I just can't seem to stop.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

5. Being with someone who is eating often makes me hungry enough to eat also.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

6. When I feel blue, I often overeat.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

7. When I see a real delicacy, I often get so hungry that I have to eat right away.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

8. I get so hungry that my stomach often seems like a bottomless pit.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

9. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

10. When I feel lonely, I console myself by eating.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

11. I consciously hold back at meals in order not to weight gain.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

12. I do not eat some foods because they make me fat.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

13. I am always hungry enough to eat at any time.

Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)

14. How often do you feel hungry?

Only at meal times(1)/ sometimes between meals (2)/ often between meals (3)/ almost always (4)

15. How frequently do you avoid “stocking up” on tempting foods?

Almost never (1)/ seldom (2)/ usually (3)/ almost always (4)

16. How likely are you to consciously eat less than you want?

Unlikely (1)/ slightly likely (2)/ moderately likely (3)/ very likely (4)

17. Do you go on eating binges though you are not hungry?

Never (1)/ rarely (2)/ sometimes (3)/ at least once a week (4)

18. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?

_____

1. Think about your eating habits over the past 12 months. About how often did you eat or drink each of the following foods? Remember breakfast, lunch, dinner, snacks, and eating out. Blacken in only one bubble for each food.

Type of Food	Never	Less Than Once Per Month	1-3 Times Per Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 or More Times Per Day
Cold cereal	□	□	□	□	□	□	□	□

Skim milk, on cereal or to drink	□	□	□	□	□	□	□	□
Eggs, fried or scrambled in margarine, butter, or oil	□	□	□	□	□	□	□	□
Sausage or bacon, regular-fat	□	□	□	□	□	□	□	□
Margarine or butter on bread, rolls, pancakes	□	□	□	□	□	□	□	□
Orange juice or grapefruit juice	□	□	□	□	□	□	□	□
Fruit (not juices)	□	□	□	□	□	□	□	□

Beef or pork hot dogs, regular-fat	□	□	□	□	□	□	□	□
Cheese or cheese spread, regular-fat	□	□	□	□	□	□	□	□
French fries, home fries, or hash brown potatoes	□	□	□	□	□	□	□	□
Margarine or butter on vegetables, including potatoes	□	□	□	□	□	□	□	□
Mayonnaise, regular-fat	□	□	□	□	□	□	□	□
Salad dressings, regular-fat	□	□	□	□	□	□	□	□

Rice	□	□	□	□	□	□	□	□
Margarine, butter, or oil on rice or pasta	□	□	□	□	□	□	□	□

2. Over the past 12 months, when you prepared foods with margarine or ate margarine, how often did you use a reduced-fat margarine?

□	□	□	□	□	□
Didn't use margarine	Almost never	About ¼ of the time	About ½ of the time	About ¾ of the time	Almost always or always

3. Overall, when you think about the foods you ate over the past 12 months, would you say your diet was high, medium, or low in fat?

□	□	□
High	Medium	Low

These next questions are going to ask you about your fruit and vegetable consumption over the past month. Think about what you usually ate in the last month. Think about all the fruits and vegetables that you ate last month. Include those that were: a) raw and cooked; b) eaten as snacks and at meals; c) eaten at home and away from home (restaurants, friends, take out); and d) eaten alone and mixed with other foods. Report

how many times per month, week or day you ate each food and, if you ate it, how much you usually had. If you mark "Never" for a question, follow the "Go to" instruction. Choose the best answer for each question. Mark only one response for each question.

1. Over the last month, how many times per month, week, or day did you drink 100% juice such as orange, apple, grape, or grapefruit juice? Do not count fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you drank at all mealtimes and between meals.

□	□	□	□	□	□	□	□	□	□
Never (Go to Question 2)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

1a. Each time you drank 100% juice, how much did you usually drink?

□	□	□	□
Less than ¾ Cup (less than 6 ounces)	¾ to 1 ¼ Cup (6 to 10 ounces)	1 ¼ to 2 Cups (10 to 16 ounces)	More than 2 Cups (more than 16 ounces)

2. Over the last month, how many times per month, week, or day did you eat fruit? Count any kind of fruit—fresh, canned, and frozen. Do not count juices. Include fruit you ate at all mealtimes and for snacks.

□	□	□	□	□	□	□	□	□	□
Never (Go to Question 3)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

2a. Each time you ate fruit, how much did you usually eat?

□	□	□	□
Less than 1 medium fruit	1 medium fruit	2 medium fruits	More than 2 medium fruits
□	□	□	□
Less than ½ cup	About ½ cup	About 1 cup	More than 1 cup

3. Over the last month, how often did you eat lettuce salad (with or without other vegetables)?

□	□	□	□	□	□	□	□	□	□
Never (Go to	1-3 Times	1-2 Times	3-4 Times	5-6 Times	1 Time	2 Times	3 Times	4 Times	5 or More

Question 4)	Last Month	Per Week	Per Week	Per Week	Per Day	Per Day	Per Day	Per Day	Times Per Day

3a. Each time you ate lettuce salad, how much did you usually eat?

□ About ½ cup □ About 1 cup □ About 2 cups □ More than 2 cups

4. Over the last month, how often did you eat French fries or fried potatoes?

□ Never (Go to Question 5)	□ 1-3 Times Last Month	□ 1-2 Times Per Week	□ 3-4 Times Per Week	□ 5-6 Times Per Week	□ 1 Time Per Day	□ 2 Times Per Day	□ 3 Times Per Day	□ 4 Times Per Day	□ 5 or More Times Per Day

4a. Each time you ate French fries or fried potatoes, how much did you usually eat?

5. Over the last month, how often did you eat other white potatoes? Count baked, boiled, and mashed potatoes, potato salad, and white potatoes that were not fried.

□ □ □ □ □ □ □ □ □ □

Never (Go to Question 6)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

5a. Each time you ate these potatoes, how much did you usually eat?

□	□	□	□
1 small potato or less (1/2 cup or less)	1 medium potato (½ to 1 cup)	1 large potato (1 to 1 ½ cups)	2 medium potatoes or more (1 ½ cups or more)

6. Over the last month, how often did you eat cooked dried beans? Count baked beans, bean soup, refried beans, pork and beans and other bean dishes.

□	□	□	□	□	□	□	□	□	□
Never (Go to Question 7)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

6a. Each time you ate these beans, how much did you usually eat?

□	□	□	□
Less than ½ cup	½ to 1 cup	1 to 1 ½ cups	More than 1 ½ cups

7. Over the last month, how often did you eat other vegetables?

□	□	□	□	□	□	□	□	□	□
Never (Go to Question 8)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

7a. Each of these times that you ate other vegetables, how much did you usually eat?

□	□	□	□
Less than ½ cup	½ to 1 cup	1 to 2 cups	More than 2 cups

8. Over the last month, how often did you eat tomato sauce? Include tomato sauce on pasta or macaroni, rice, pizza, and other dishes?

□	□	□	□	□	□	□	□	□	□
Never (Go to Question 9)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times

Per Day

8a. Each time you ate tomato sauce, how much did you usually eat?

□	□	□	□
About ¼ cup	About ½ cup	About 1 cup	More than 1 cup

9. Over the last month, how often did you eat vegetable soups? Include tomato soup, gazpacho, beef with vegetable soup, minestrone soup, and other soups made with vegetables.

□	□	□	□	□	□	□	□	□	□
Never (Go to Question 10)	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

9a. Each time you ate vegetable soup, how much did you usually eat?

□	□	□	□
Less than 1 cup	1 to 2 cups	2 to 3 cups	More than 3 cups

10. Over the last month, how often did you eat mixtures that included vegetables? Count such foods as sandwiches, casseroles, stews, stir-fry, omelets, and tacos.

□	□	□	□	□	□	□	□	□	□
Never	1-3 Times Last Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 Times Per Day	3 Times Per Day	4 Times Per Day	5 or More Times Per Day

YOUR MINDFULNESS

These next questions are meant to measure your mindfulness levels right now. Please circle the most appropriate response.

1 = Rarely/Not at All

2 = Sometimes

3 = Often

4 = Almost Always

It is easy for me to concentrate on what I am doing.	1	2	3	4
I can tolerate emotional pain.	1	2	3	4

I can accept things I cannot change.	1	2	3	4
I can usually describe how I feel at the moment in considerable detail.	1	2	3	4
I am easily distracted. (R)	4	3	2	1
It's easy for me to keep track of my thoughts and feelings.	1	2	3	4
I try to notice my thoughts without judging them.	1	2	3	4
I am able to accept the	1	2	3	4

thoughts and feelings I have.				
I am able to focus on the present moment.	1	2	3	4
I am able to pay close attention to one thing for a long period of time.	1	2	3	4

Listed below are a number of statements regarding your sensitivity to normal, non-emotive body processes. For each statement, select a number from 1 to 7 that best describes how the statement describes you feel right now and place the number in the space to the right of the statement.

Not at all true of me						Very true of me
1	2	3	4	5	6	7

1. I notice differences in the way my body reacts to various foods.

2. I can always tell when I bump myself whether or not it will become a bruise.

3. I always know when I've exerted myself to the point where I'll be sore the next day.

4. I am always aware of changes in my energy level when I eat certain foods.

5. I know in advance when I'm getting the flu.

6. I know I'm running a fever without taking my temperature.

7. I can distinguish between tiredness because of hunger and tiredness because of lack of sleep.

8. I can accurately predict what time of day lack of sleep will catch up with me.

9. I am aware of a cycle in my activity level throughout the day.

10.* I don't notice seasonal rhythms and cycles in the way my body functions.

11. As soon as I wake up in the morning, I know how much energy I'll have during the day.

12. I can tell when I go to bed how well I will sleep that night.

13. I notice distinct body reactions when I am fatigued.

14. I notice specific body responses to changes in the weather.

15. I can predict how much sleep I will need at night in order to wake up refreshed.

16. When my exercise habits change, I can predict very accurately how that will affect my energy level.

17. There seems to be a “best” time for me to go to sleep at night.

18. I notice specific bodily reactions to being over-hungry.

These next questions are designed to measure your feelings of well-being. Please answer by placing an “X” closest to the statement that matches how you feel.

1. Taking into account your physical, mental, emotional, social, and spiritual condition, please rate how well you have felt over the last month, using the following scale:

Worst you have_____ Best you have

Ever been Ever been

2. Taking into account your physical, mental, emotional, social, and spiritual condition, please rate how well you have felt over the last 24 hours, using the following scale:

Worst you have_____ Best you have

Ever been Ever been

Please read each statement carefully before answering. To the left of each item, indicate how often you behave in the stated manner, using the following scale:

Almost Never				Almost Always
1	2	3	4	5

1. I'm disapproving and judgmental about my own flaws and inadequacies.
2. When I'm feeling down I tend to obsess and fixate on everything that's wrong.
3. When things are going badly for me, I see the difficulties as part of life that everyone goes through.
4. When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world.
5. I try to be loving towards myself when I'm feeling emotional pain.
6. When I fail at something important to me I become consumed by feelings of inadequacy.
7. When I'm down and out, I remind myself that there are lots of other people in the world feeling like I am.
8. When times are really difficult, I tend to be tough on myself.
9. When something upsets me I try to keep my emotions in balance.

10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.

11. I'm intolerant and impatient towards those aspects of my personality I don't like.

12. When I'm going through a very hard time, I give myself the caring and tenderness I need.

13. When I'm feeling down, I tend to feel like most other people are probably happier than I am.

14. When something painful happens I try to take a balanced view of the situation.

15. I try to see my failings as part of the human condition.

16. When I see aspects of myself that I don't like, I get down on myself.

17. When I fail at something important to me I try to keep things in perspective.

18. When I'm really struggling, I tend to feel like other people must be having an easier time of it.

19. I'm kind to myself when I'm experiencing suffering.

20. When something upsets me I get carried away with my feelings.

21. I can be a bit cold-hearted towards myself when I'm experiencing suffering.

22. When I'm feeling down I try to approach my feelings with curiosity and openness.

23. I’m tolerant of my own flaws and inadequacies.

24. When something painful happens I tend to blow the incident out of proportion.

25. When I fail at something that is important to me, I tend to feel alone in my failure.

26. I try to be understanding and patient towards those aspects of my personality I don’t like.

APPENDIX H

HEARTMATH PROTOCOLS FOR HRV

3 Minute Bus (Baseline)

This is the vertical bar session that results in data on low/medium/high coherence %, and heart rate. This is the same session used for the third session (heart focused breathing vertical bars).

"In accordance with HeartMath's standard procedure (R. McCraty, personal communication, March 9, 2009), for the purposes of collecting data of the participants' HRV at pre- and post- intervention testing, the following script was read to the participants: For 10 minutes, I would like you to sit quietly with your eyes open, kind of like you are waiting at a bus stop for the bus. Please avoid using any relaxation techniques such as meditation. Also avoid any intense mental activity. I will let you know when the 10 minutes are up." (Kim, Rath, McCraty, Zemon, Cavalo, & Foley, 2015).

3 Minute Heart Focus

Session originally used in MW before switching to vertical bar heart focused session

Reference: emWavePro > HeartMath Library Content and Information > emWave Pro Plus Tour

The HRV Assessment calculates the most common HRV measures from two-minute or longer Interbeat-interval (IBI) recordings.

HRV recorded in resting conditions is a common approach to assessing HRV. The most common recording lengths used are five and 10 minutes. However, assessment can be done over any time period, depending on the research question and the assessment protocol.

Review the Assessment Considerations section below.

Measures: The minimum recording length is two minutes. The recording lengths can be set by the user and extended up to 99 minutes.

Time domain measures: Time domain indices quantify the amount of variance in the interbeat intervals (IBI) using statistical measures. Although they are the easiest to calculate, they do not provide a means of fully quantifying autonomic dynamics or determining the rhythmic activity generated by the different physiological control systems. Because they are always calculated the same way, however, data collected by different researchers are comparable, but only if the recordings are exactly the same length of time and the data are collected under the same conditions.

Duration: Length of the recording in minutes.

Number of RR intervals: Number of all interbeat intervals used in the analysis.

Mean Heart Rate: The mean of all normal interbeat intervals after converting to BPM. It is important to note the natural relationship between heart rate (HR) and amount of HRV. As HR increases there is less time between heartbeats for variability to occur, thus HRV decreases. At lower heart rates, there is more time between heartbeats and variability naturally increases. This is called cycle length dependence and it persists in the healthy elderly to a variable degree, even at a very advanced age. Even in healthy subjects, the effects of cycle length dependence should be taken into account when assessing HRV. HR values should always be reported, especially when they are influenced by factors such as stress reactions, medications and physical activity.

Mean Interbeat Interval: Mean of all normal interbeat intervals, in milliseconds.

SDNN: The standard deviation of all normal interbeat intervals in the recording, in milliseconds. This measure reflects the ebb and flow of all factors that contribute to HRV. In short-term resting recordings, the primary source of the variation is parasympathetic mediation, especially with slow, deep breathing protocols. However, in ambulatory and longer-term recordings, the SDNN values are highly correlated with lower frequency rhythms. Low age-adjusted values are more predictive of morbidity and mortality than vagally mediated measures.

RMSSD: Root mean square of successive difference, the square root of the mean squared differences of successive (adjacent) normal interbeat intervals over the entire recording period, in milliseconds. The RMSSD reflects the beat-to-beat variance in heart rate and is the primary time domain measure used to estimate the vagally mediated changes reflected in HRV. The RMSSD is correlated with high frequency (HF) power.

The vagally mediated (parasympathetic) HRV is most relevant to mental health-care professionals because it is most strongly correlated with self-regulatory capacity and cognitive functioning. This is sometimes called a measure of "vagal tone," though HeartMath and a growing number of researchers believe the term, vagal activity, is more appropriate.

Frequency domain measures: Analogous to brainwaves, power spectral analysis is used to separate HRV into its component rhythms that operate within different frequency ranges. The main advantages of frequency domain analysis over the time domain measures is that it supplies both frequency and amplitude information on the specific

rhythms that exist in the HRV waveform, providing a means of quantifying the various oscillations.

The values are expressed as the power spectral density (PSD), which is the area under the curve in a given bandwidth of the spectrum. The power, or height of the peak at any given frequency indicates the amplitude and stability of the rhythm at that frequency. The frequency reflects the period of time over which the rhythm cycles. For example, a 0.1 hertz frequency (heart coherence) has a cycle period of 10 seconds.

The European Society of Cardiology and the North American Society of Pacing and Electrophysiology Task Force Report on HRV (see paper titled Heart Rate Variability: Standards of Measurement, Physiological Interpretation, and Clinical Use in the Reference section) divided heart-rhythm oscillations into four primary frequency bands: high frequency (HF), low frequency (LF), very low-frequency (VLF) and ultralow frequency (ULF).

Most HRV analysis is done on five-minute segments, although other recording periods often are used. When other recording lengths are analyzed, the length of the recording should be reported because this has a big influence on HRV frequency and time domain values. The various rhythms all have specific underlying physiological sources and are associated with various, physical and mental health issues as well as the effects of stress.

Total Power (ms2/hertz): Sum of the PSD in the range > 0 to < 0.4 hertz. Total power is correlated with SDNN. It reflects the ebb and flow of all factors that contribute to HRV.

Very Low Frequency (ms2/hertz)†: Sum of the PSD in the range >= 0 .0033 to < 0.04 hertz, which equates to rhythms or modulations with periods that occur between 25 and 300 seconds.

Experimental evidence suggests VLF rhythm is intrinsically generated by the heart and that the amplitude and frequency of these oscillations are modulated by efferent sympathetic activity resulting from physical activity and stressful emotions. Normal VLF power appears to indicate healthy function, and increases in resting VLF power and/or shifting of their frequency can reflect efferent sympathetic activity, especially in ambulatory recordings.

†VLF is not analyzed and reported if the recording length is less than five minutes.

Low Frequency (ms2/hertz): Sum of the PSD in the range >= 0.04 to < 0.15 hertz, which equates to rhythms or modulations with periods that occur between 7 and 25 seconds.

This region primarily reflects baroreceptor activity while at rest. The vagus nerves are a major conduit though which both efferent and afferent neurological signals travel between the heart and brain, including baroreflex signals. The cardiovascular system resonance frequency is a distinctive high-amplitude peak in the HRV power spectrum around 0.1 hertz. It has long been established that it is caused by a delay in the feedback loops within the baroreflex system between the heart and brain. In humans and many other mammals, the resonance frequency of the system is approximately 0.1 hertz, which also is characteristic of the coherent state.

The sympathetic nervous system does not appear to have much influence in rhythms above 0.1 hertz, while the parasympathetic system can be observed to affect heart rhythms down to 0.05 hertz (20-second rhythm). Therefore, during periods of slow respiration rates, vagal activity can easily generate oscillations in the heart rhythms that cross over into the LF band. Thus, respiratory-related efferent vagally mediated influences are particularly present in the LF band when respiration rates are below 8.5 breaths per minute (approximately one breath every 7 seconds) or when an individual sighs or takes a deep breath.

In ambulatory 24-hour HRV recordings, it has been suggested that the LF band reflects sympathetic activity. A number of researchers have challenged this perspective and have argued persuasively that in resting conditions, the LF band reflects baroreflex activity and not cardiac sympathetic innervation. (In References below, you can click on PDF to read the article,Heart Rate Variability: New Perspectives on Physiological Mechanisms, Assessment of Self-Regulatory Capacity, and Health Risk.)

During periods of increased cardiac coherence or resonance, there typically is an increased range of variability in both blood pressure and heart rate, which is detected as increases in the rate of change by the sensory neurons, resulting in increased firing rates, which increase vagal afferent traffic. There also is a more ordered pattern of activity. Regular practice of HRV biofeedback results in lasting improvements in baroreflex gain independent of cardiovascular and respiratory effects, indicating neuroplasticity within the baroreflex system, likely within the intrinsic cardiac nervous system.

High Frequency (ms2/hertz): Sum of the PSD in the range >= 0.15 to < .4 hertz, which equates to rhythms with periods that occur between 2.5 and 7 seconds. This band primarily reflects parasympathetic or vagal activity and is frequently called the respiratory band because it corresponds to the HR variations related to the respiratory cycle known as respiratory sinus arrhythmia. The mechanisms linking the variability of HR to respiration are complex and involve both central and reflex interactions. The RMSSD time domain measure is highly correlated with HF power.

Low Frequency/High Frequency ratio: The ratio of LF power to HF power. The LF/HF ratio should be interpreted with caution and the mean values of HF and LF power taken into consideration. For example: A high LF/HF ratio may indicate higher sympathetic activity relative to parasympathetic activity, as can be observed when people engage in meeting a challenge that requires effort and increased sympathetic activation such as physical activity or stress. It also can indicate increased parasympathetic activity such as that which occurs during slow breathing and during the coherent state, when the respiratory rate moves down in frequency and moves into the LF band.

Normalized Coherence: The coherence score is a measure of the degree of coherence in the heart rhythm pattern. A coherent heart rhythm is a stable regular repeating rhythm resembling a sine wave at a single frequency between 0.032 - 0.26 Hz (2 -15 cycles per minute). The more stable and regular the heart rhythm frequency, the higher the coherence score. The normalized coherence level is determined by measuring the power spectral density (PSD) around the largest peak in the coherence range and dividing it by the PSD total power. Normalized coherence ranges from 0 - 100.

Assessment analysis option: The recording length can be adjusted to any desired number of minutes.

"While HeartMath techniques incorporate a breathing element, paced breathing is not their primary focus and they should therefore not be thought of simply as breathing exercises. The main difference between the HeartMath tools and most commonly practiced breathing techniques is the HeartMath tools' focus on the intentional generation of a heartfelt positive emotional state. This emotional shift is a key element of the techniques' effectiveness. Positive emotions appear to excite the system at its natural resonant frequency and thus enable coherence to emerge and to be maintained naturally, without conscious mental focus on one's breathing rhythm. . . Additionally, the positive emotional focus of the HeartMath techniques confers a much wider array of benefits than those typically achieved through breathing alone. These include deeper perceptual and emotional changes, increased access to intuition and creativity, cognitive and performance improvements, and favorable changes in hormonal balance. (McCraty, 2015).

"It is important to note that the heart's rhythmic patterns and the patterns of afferent neurological signals change to a more ordered and stable pattern when one uses HeartMath's heart-focused self-regulation techniques. Regular practice of these techniques, which include a shift of attentional focus to the center of the chest (heart area) accompanied by the conscious self-induction of a calm or positive emotional state, reinforces the association (pattern match) between a more coherent rhythm and a calm or

positive emotion. Positive feelings then more automatically initiate an increase in cardiac coherence. Increased coherence initiated through heart-focused breathing tends to facilitate the felt experience of a positive emotion. Thus, practice affects the repatterning process. This is important in situations where there has been a sustained exposure to truly high-risk environments or trauma in the past, but which no longer are in effect and the patterns that developed in response to them no longer serve the individual in present safe environments." (McCraty, 2015).

APPENDIX I

PRACTICE LOGS

Move Well Practice Log
(Please bring back each week)

Instructions: Please use this log to keep track of the number of minutes you practice TCE at home in between the weekly TCE classes and total them up for the week. Please be sure to record all practice sessions no matter how long or short.

Add any comments about matter that may have impacted your practice at home, e.g., sick or on vacation. You may also add notes as to how you were feeling before/after the practice session. Everything in the log will remain confidential as to your identity; you will be identified only by your participant ID number.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
Total minutes of TCE practiced at home?								
Comments about practice?								

APPENDIX J

ATTENDANCE SHEET

MOVE WELL
Attendance Sheet

Date:

Instructions:

1. Provide your study ID number and signature below for attendance to today's class.
2. Please turn in your practice log to staff if you brought it.

APPENDIX K

LETTER OF PERMISSION

Arizona State University, Graduate College:

I have secured permission from all prospective coauthors, who are members of my dissertation committee, to be included in publishable works related to the submitted dissertation: Linda K. Larkey (Chair), Bronwynne Evans, Ann Sebren, and Kimberley Goldsmith.

Sincerely,
Darith James

APPENDIX L

IRB APPROVED PROTOCOL DOCUMENT

Instructions and Notes:

- Depending on the nature of what you are doing, some sections may not be applicable to your research. If so, mark as "NA".
- When you write a protocol, keep an electronic copy. You will need a copy if it is necessary to make changes.

1 Protocol Title

Effects of Meditative Movement on Body Composition in Midlife Women (Lay Title: Move Well)

2 **Background and Objectives**

Provide the scientific or scholarly background for, rationale for, and significance of the research based on the existing literature and how will it add to existing knowledge.

- Describe the purpose of the study.
- Describe any relevant preliminary data or case studies.
- Describe any past studies that are in conjunction to this study.

A growing body of published evidence indicates that meditative movement (MM) practices may be helpful for body composition improvement. Less strenuous forms of exercise that include a focus on the breath and meditative state (i.e., "meditative movement" such as Yoga, Qigong, or Tai Chi) may be easier to adopt for unfit, sedentary, overweight or obese women, which characterizes a large percentage of the general population. Despite this preliminary evidence, no studies have proposed a model for how or why weight loss might occur in MM interventions where the goals are not designated as weight loss, nutritional counseling is not included, and energy expenditure is not at the level assumed to be required to achieve weight loss. The proposed intervention is designed to refine and gather preliminary evidence for a novel "mindful-body-wisdom" model of intervening on improving body composition and to examine the contribution of model factors (psychological and behavioral) of how such a non-diet/non-vigorous exercise intervention might work, in 60 midlife women.

A.1. Specific Aim 1: To test whether Meditative Movement (MM, based on a standardized and tested QG/TCE protocol) will improve body composition and associated "wellness" factors.

A.1.a Primary Hypothesis: MM will reduce body mass index (BMI) by 5%.

A.1.b. Secondary Hypothesis: The degree of BMI reduction will be correlated with levels of adherence and measures of practice fidelity (as measured by participant practice logs and the Meditative Movement Inventory).

A.1.c. Tertiary Hypothesis: MM will improve factors associated with body composition-- sleep quality, anxiety, depression, stress, mindfulness, dietary quality, emotional eating, body awareness and physical activity levels

Preliminary studies: A number of recent studies indicate that weight, or more specifically BMI, may be reduced in response to MM practices (Larkey et al., 2012; Janelsins, Davis, Wideman et al, 2011), particularly for those who are overweight or obese (Chen et al., 2010), even when compared to non-MM exercise controls (Chen et al., 2010; Cheung et al., 2005; Dechamps et al., 2009).
There are a number of dynamics inherent in MM practice that may account for the positive body composition changes reported in the literature (See Figure 1).

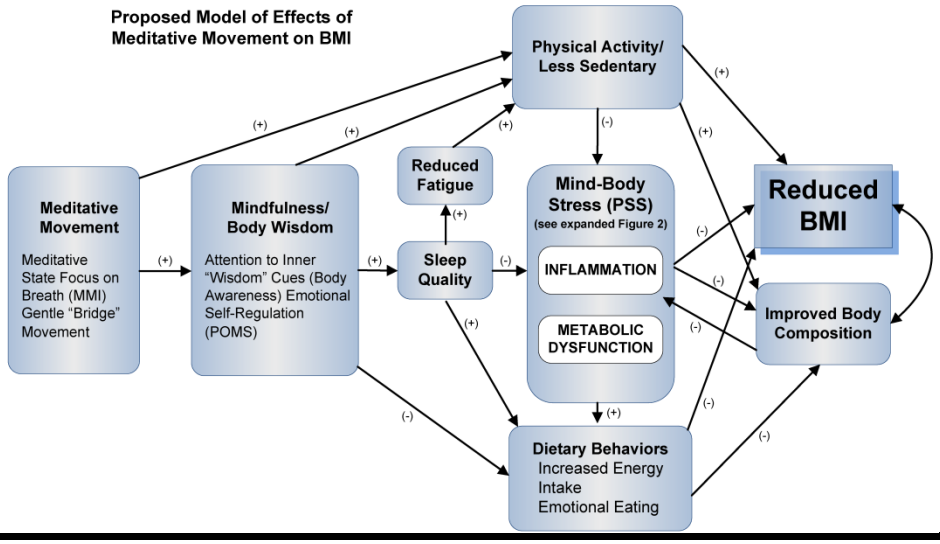

Figure 1.

3 Data Use

Describe how the data will be used.
Examples include:

- Dissertation, Thesis, Undergraduate honors project
- Publication/journal article, conferences/presentations
- Results released to agency or organization
- Results released to participants/parents
- Results released to employer or school
- Other (describe)

Data will be used for publications, and conferences/presentations.

4 Inclusion and Exclusion Criteria

Describe the criteria that define who will be included or excluded in your final study sample. If you are conducting data analysis only describe what is included in the dataset you propose to use.
Indicate specifically whether you will target/exclude the following populations:

- Minors (individuals who are under the age of 18)
- Adults who are unable to consent
- Pregnant women
- Prisoners
- Native Americans
- Undocumented individuals

Inclusion Criteria: Females, 45-75 years of age, with the ability to participate in low intensity activity.
Exclusion criteria: Women who are unable to stand for 10-minute segments (e.g., wheelchair or walker bound and too weak), and/or unable to walk, will be excluded. Accommodations will be made for those with minor balance impairments to assure safety.
Minors, adults unable to consent, pregnant women, prisoners, Native Americans and undocumented individuals will not be specifically targeted.

5 **Number of Participants**

Indicate the total number of participants to be recruited and enrolled*:*
We will recruit and enroll 69 participants. Based on the attrition rate in previous research (15%) we expect that 60 participants will have complete data through the follow-up at 16 weeks (8 weeks post-intervention).

6 **Recruitment Methods**

- Describe who will be doing the recruitment of participants.
- Describe when, where, and how potential participants will be identified and recruited.
- Describe and attach materials that will be used to recruit participants (attach documents or recruitment script with the application).

NUMBER OF PARTICIPANTS: We will recruit and enroll 69 participants. Based on the attrition rate in previous research (15%) we expect that 60 participants will have complete data through the follow-up at 16 weeks (8 weeks post-intervention).
RECRUITMENT METHODS: Patients will be recruited from the Arizona State University (ASU) Downtown campus through a variety of methods. Electronic study announcements will be posted in the Announcement section of MyASU home pages for the various colleges and emails containing study information will be sent using ListServs. Recruitment will be on-going until the total number of participants has been enrolled.

7 Procedures Involved

Describe all research procedures being performed, who will facilitate the procedures, and when they will be performed. Describe procedures including:

- The duration of time participants will spend in each research activity.
- The period or span of time for the collection of data, and any long term follow up.
- Surveys or questionnaires that will be administered (Attach all surveys, interview questions, scripts, data collection forms, and instructions for participants to the online application).
- Interventions and sessions (Attach supplemental materials to the online application).
- Lab procedures and tests and related instructions to participants.
- Video or audio recordings of participants.
- Previously collected data sets that that will be analyzed and identify the data source (Attach data use agreement(s) to the online application)

Meditative Movement: The weekly Meditative Movement classes will be taught by certified Tai Chi Easy (TCE) Group Practice Leaders at the Lincoln Family Downtown YMCA near the Arizona State University Downtown campus. Participants will be mainly recruited from ASU employees and as such, we do not anticipate parking being an issue in terms of extra costs to study subjects. All practice leaders have completed at least 25 hours of training that consists of studying the TCE Practice Leader Training Manual, in-person group classes, and practicing the methods guided by a training DVD (as was the researcher).

TCE is a simple TC/QG form that was developed by Dr. Roger Jahnke and developed into a standardized research intervention protocol by a team of researchers. It has been used in several prior projects and one recently completed NIH/NCCAM-funded randomized controlled trial (RCT) with breast cancer survivors showing reduction in fatigue and depression, and improved sleep and physical function.

The TCE movements (as described below) will be repeated in differing sequences and timeframes during the course of the study. The variety and combination of the exercises will begin easy and progress to more advanced movements and/or intensities as the study progresses and participants become more experienced and comfortable with the routine.

Twisting at the Waist. With feet shoulder width apart, gently twist at the waist from right to left, left to right, and repeat allowing the arms to swing freely. A gentle patting of the back and abdomen are encouraged, as the arms are gently rotate from side to side. Slowing down the movement until the body is no longer twisting and is back to the center position concluded this exercise.

Right and Left Bending of the Spine. Right and left bending of the spine entails gently bending the upper body to the right side while exhaling and allowing the right arm to dangle in front of the body while slow deep breathing continues. This is then repeated to the left side. For participants who feel they need more challenge, the opposite arm can be stretched over the head. This can be performed in the standing opening position or in a seated position.

Flowing motion. Flowing motion encourages slow inhalation and deep breathing while turning the palms into a forward position. A gentle forward rocking motion while lifting the body weight onto toes and swinging arms forward and upward, to the maximum height of the shoulders or lower, dependent upon participant comfort with elbows slightly bent is the main motion. Participants are reminded to do this gently and to feel as though they are sinking their body weight down toward the ground.

Front and Back Bending Spine (Crushing Rocks). This movement may be done from the standing opening position or a seated position. Inhalation while raising the hands up with palms up and arms bent at about 90-degree angle. At chest height, palms are at face level and then upward as arms reach up. When arms are above shoulder height the head is tilted upward. During exhalation, the arms move forward and down, palms toward the face. Hands are placed near each other into fists and the whole body is contracted. The head is bent forward as the shoulders are rounded and full exhalation occurs. During this exercise the participant is encouraged to clear and calm their mind, body and spirit and during exhalation everything is contracted.

Gathering Heaven and Earth. With arms in front of the chest open arms to a 45-degree angle, palms facing each other. Bend the knees and lower the arms so that the palms are facing up. Sink down by gradually bending at the knees while making a scooping motion with both hands "gathering Earth" below. Slowly stand up while moving arms up to the sky (Heaven) while looking up. "Gather Heaven" and move the arms downward until palms are facing each other and repeat.

Reaching Upward and Stretching Outward. During inhalation, the fingers are laced together, palms toward body as they are passed in front of the body and face. Palms are rotated downward, then upward and toward the sky as arms are extended up and the participant is encouraged to rise on their toes if able.

Eligibility Screening, Consent and Data Collection: Data for eligibility screening will be collected on the Eligibility Screening form. Interested patients will call into the recruitment office and receive initial phone eligibility pre-screen at that time to assess age, ability to participate in low intensity PA and availability for MM classes.

If initial criteria are met, an in-person visit will be scheduled at the University, where private rooms are available to complete evaluation of eligibility, including evaluating BMI with bioelectrical impedance analysis (BIA). If eligible, participants will be provided full, informed consent. Baseline measures will be taken after consent and participants will be provided a schedule of classes and logbook explanation.

The intervention will consist of weekly, hour-long classes over the 8-week period. Participants will be encouraged to practice 30 or more minutes most days per week at home and asked to complete a log of their time spent doing MM outside of class time (Participant Logbooks). Subjects will also be asked to rate their perceived exertion (RPE) on the Borg scale after each at-home practice session. At the start of the intervention, participants may receive manuals and a DVD that they can keep that will facilitate continued practice of the movements learned. All participants will receive reminder phone calls or text messages to remind them of upcoming classes.

The following measures will be taken at baseline, and immediately post intervention and will take approximately 60 minutes to complete. Additional measures will be taken at 16 weeks (30 minutes) on most outcome variables (See table of measures).

Sources of Biological Materials

Diurnal Salivary cortisol: Salivary samples will be collected at baseline, post intervention and week 8 (post intervention) to measure diurnal cortisol. Participants will take home kits provided during baseline and post-intervention interviews, with both verbal and written instructions for using salivettes to collect saliva and how to store, refrigerated, in vials until returned at the beginning of first class (or other delivery method arranged at post-intervention).

Dated/ID marked vials will be included in each kit for each participant at pre- and post-intervention. Instructions will include a description of how to collect the first sample upon awakening, a second within an hour, and one final one near the end of the day, collected each day over two days (validated for slope assessment). Cortisol levels will be assessed by enzyme immunoassay (Salimetrics, State College, PA). All samples from a participant will be analyzed in the same assay to minimize variability.

The following measures will be taken at baseline, and immediately post intervention and will take approximately 45 minutes to complete. Additional measures will be taken at 24 weeks (30 minutes) on most outcome variables (See table of measures).

Sources of Biological Materials

Diurnal Salivary cortisol: A small subsample of participants (approximately 30%) will be randomly selected to provide saliva samples. Salivary samples will be collected at baseline, post intervention and week 12 (post intervention) to measure diurnal cortisol. Participants will take home kits provided during baseline and post-intervention interviews, with both verbal and written instructions for using salivettes to collect saliva and how to store, refrigerated, in vials until returned at the beginning of first class (or other delivery method arranged at post-intervention).
Dated/ID marked vials will be included in each kit for each participant at pre- and post-intervention. Instructions will include a description of how to collect the first sample upon awakening, a second within an hour, and one final one near the end of the day, collected each day over two days (validated for slope assessment). Cortisol levels will be assessed by enzyme immunoassay (Salimetrics, State College, PA). All samples from a participant will be analyzed in the same assay to minimize variability.

Heart rhythm coherence (HRC) will be measured one time during the weekly TCE classes. Participant HRC measurement will be captured with the use of the emWave2 while actively moving in the TCE class. Participants will be instructed to place the ear clip sensor to their earlobe (without earrings) and to initiate the emWave2 device by pressing the Sensor Button. Participants will be instructed to check that the Pulse Indicator is blinking blue, if blue light does not appear, it will be suggested that they remove and reposition the ear clip sensor. Once the Pulse Indicator has calibrated, the session will begin during which the Breath Pacer lights will move up and down on the Heart Action Strip (on the side of device). Participants will be instructed to match their breath to the Breath Pacer lights throughout the measurement. HRC will be visual to participants based on the color of the Coherence Level Indicator (low coherence = red; medium coherence = blue; high coherence = green). Post measurement period, device data will be collected by researchers and stored on emWave2 software. Computer interface will provide visual and numerical data for further understanding of participant heart rhythm coherence. Subjects will be notified via email about the changes.

Table of Study Measures	Pre-Eligibility	Baseline	Weeks 2-8 (Weekly)	Post Intervention	Week 16
Eligibility					
Age (45-75)	x				
Ability to do mild seated physical activity	x				
Miscellaneous Measures					
Informed Consent		x			
Demographics		x			
Physical Activity Measures					
WHI B-PAQ		x		x	x
Borg rating of perceived exertion (RPE)			x		
Body Composition Measures					
Bioelectrical Impedence Analysis (BIA) via Tanita		x		x	x
Eating Behavior Measures					
Three Factor Eating Questionnaire (TFEQ-R18V2)		x		x	x
NCI Fruit and Vegetable Screener		x		x	x
NCI Percentage Energy From Fat Screener		x		x	x
Mindfulness Measures					
Cognitive and Affective Mindfulness Scale-Revised (CAMS-R)		x		x	x
Body Awareness Questionnaire (BAQ)		x		x	x
Meditative Movement Inventory (MMI)				x	
Heart Rate Coherence (HRC)			X		
Psychosocial Measures					
Profile of Mood States (POMS) Depression and Anxiety subscales		x		x	x
Perceived Stress Scale (PSS)		x		x	x
Pittsburgh Sleep Quality Index (PSQI)		x		x	x
Arizona Integrated Outcomes Scale (AIOS)		x		x	x
Biomarkers					
Diurnal Cortisol		x		x	x
Ongoing Process Control and Intervention Fidelity					

MM Practice Log			x		
Perception of weight loss goals of study				x	

8 Compensation or Credit

- **Describe the amount and timing of any compensation or credit to participants.**
- **Identify the source of the funds to compensate participants**
- **Justify that the amount given to participants is reasonable.**
- **If participants are receiving course credit for participating in research, alternative assignments need to be put in place to avoid coercion.**

There will no compensation given to participants in this study.

9 Risk to Participants

List the reasonably foreseeable risks, discomforts, or inconveniences related to participation in the research. Consider physical, psychological, social, legal, and economic risks.

Risks of the gentle movement program are minimal. The protocol of exercises in the TCE intervention is very gentle and restful and is unlikely to pose extensive risk to patients. These "exercises" are very slow, gentle movements that we have shown to be at extremely low exertion level in previous research of this standardized protocol. Our research team's previous reviews of literature of a broad range of forms of Tai Chi and Qigong have indicated that these movements/breathing exercises are very safe, with over a hundred randomized controlled trials of these practices showing no adverse events.

Even so, as with any form of exercise, a number of safety standards are recommended to avoid adverse events, including accidental injury. We have worked with the TCE protocol using chairs for participants to hold if needed (with one arm while practicing), and for immediate balance correction if needed (to hold or to sit).

10 Potential Benefits to Participants

Realistically describe the potential benefits that individual participants may experience from taking part in the research. Indicate if there is no direct benefit. Do **not** include benefits to society or others.

Physical activity levels will increase as a result of participating in this study and as such, participants may experience decreases in cardiometabolic risk factors.

11 Privacy and Confidentiality

Describe the steps that will be taken to protect subjects' privacy interests. "Privacy interest" refers to a person's desire to place limits on with whom they interact or to whom they provide personal information. Click here for additional guidance on ASU Data Storage Guidelines.

Describe the following measures to ensure the confidentiality of data:

- Who will have access to the data?
- Where and how data will be stored (e.g. ASU secure server, ASU cloud storage, filing cabinets, etc.)?
- How long the data will be stored?
- Describe the steps that will be taken to secure the data during storage, use, and transmission. (e.g., training, authorization of access, password protection, encryption, physical controls, certificates of confidentiality, and separation of identifiers and data, etc.).
- If applicable, how will audio or video recordings will be managed and secured. Add the duration of time these recordings will be kept.
- If applicable, how will the consent, assent, and/or parental permission forms be secured. These forms should separate from the rest of the study data. Add the duration of time these forms will be kept.
- If applicable, describe how data will be linked or tracked (e.g. masterlist, contact list, reproducible participant ID, randomized ID, etc.).

If your study has previously collected data sets, describe who will be responsible for data security and monitoring.

Identifying data listed with participant IDs will be stored in locked file cabinets in a locked room in a secure building and in password protected and encrypted electronic files. All saliva samples will be stored in de-identified vials in a locked freezer. Self-report, clinical and biomarker data will be entered directly into database (using RedCap) and stored on a secure server at ASU. The database will be maintained on a dedicated computer not linked to public-access servers. Access will be restricted, password protected and maintained behind Enterprise-level firewalls. Accuracy of data entry will be independently verified. Computer files will be backed up following each use.

We will protect the confidentiality of the participants by publishing only aggregate data.

All data will be identified by a unique, anonymous study ID, except for the master file, linking IDs to participant names, which will be stored separately (flashdrives rotated every other day) from the data files. All data files will be kept under password-protected computer storage in a locked office. The master file will be destroyed within five years of the end of the study, to protect participant confidentiality. Source data files, data management programs, analysis datasets, and statistical programs will all be stored in a locked file, in password protected computers, and in encrypted data files. Only the study investigators will have access to the data. A detailed operations manual will be written for data entry, accuracy, safety, and protection and placed at the data collection site.

12 Consent Process

Describe the process and procedures process you will use to obtain consent. Include a description of:

- Who will be responsible for consenting participants?
- Where will the consent process take place?
- How will consent be obtained?
- If participants who do not speak English will be enrolled, describe the process to ensure that the oral and/or written information provided to those participants will be in that language. Indicate the language that will be used by those obtaining consent. Translated consent forms should be submitted after the English is approved.

If initial criteria are met in the telephone pre-screening for eligibility, an in-person visit will be scheduled either in our University office or at one of the two hospital recruitment sites where private rooms are arranged. Once eligibility is established, the Informed Consent Form will be thoroughly reviewed with the potential participant by trained staff (Graduate Research Assistant or Research Techs) and, if consenting, participants will sign.

13 Training

Provide the date(s) the members of the research team have completed the CITI training for human participants. This training must be taken within the last 4 years. Additional information can be found at: Training.

Dr. Lisa Smith (Co-investigator)-6/15/13

Dr. Linda Larkey (Co-Investigator)-7/13/13