EXAMINGING MEDIATORS OF THE EFFECTS OF YOGA ON SLEEP IN BREAST CANCER PATIENTS UNDERGOING CHEMOTHERAPY

_____

A Thesis

Presented to

The Faculty of the Department of Philosophy and Psychology

Sam Houston State University

_____

In Partial Fulfillment

of the Requirements for the Degree of

Master of Arts

_____

by

Melissa Sartain

August, 2020

EXAMINGING MEDIATORS OF THE EFFECTS OF YOGA ON SLEEP IN BREAST CANCER PATIENTS UNDERGOING CHEMOTHERAPY

by

Melissa Sartain

_____

APPROVED:

Chelsea Ratcliff, PhD
Thesis Director

David Nelson, PhD
Committee Member

Craig Henderson, PhD
Committee Member

Abbey Zink, PhD
Dean, College of Humanities and Social Sciences

ABSTRACT

Sartain, Melissa , *Examinging mediators of the effects of yoga on sleep in breast cancer patients undergoing chemotherapy*. Master of Arts (Clinical Psychology), August, 2020, Sam Houston State University, Huntsville, Texas.

Yoga has been increasingly utilized as a complementary therapy by cancer patients. Literature supports the use of yoga therapy as a prophylactic intervention that can improve sleep and preserve the long-term QOL outcomes for patients. Investigation of the mechanisms by which yoga impacts mental and physical health-related outcomes, including sleep, in breast cancer patients is essential to inform potential interventions to potentially address poorer cancer-related outcomes. Previous research suggests that yoga may impact the way in which a traumatic experience, such as cancer diagnosis and treatment, is processed. The effect of yoga on posttraumatic stress and growth may account for the positive effect of yoga on physical and mental health outcomes in cancer patients, but this relationship has been insufficiently explored. The current study is a secondary analysis of a randomized controlled trial of a Tibetan yoga program compared to active and waitlist control groups. The present study aimed to assess if the effect of group (i.e. yoga, stretching, and usual care) on perceived sleep daily disturbances (measured by Pittsburg Sleep Quality Index (PSQI) daily disturbance component (PSQI-DD), objective sleep (i.e. sleep efficiency (SE) and wakefulness after sleep onset (WASO), measured by wrist actigraphy) and in breast cancer patients undergoing chemotherapy is mediated by changes in posttraumatic stress (PTSS, measured by Impact of Event Scales, IES-intrusion, IES-avoidance, IES-total) and posttraumatic growth (PTG, measured by Posttraumatic Growth Inventory (PTGI)). No significant relative indirect effect using the conditional indirect mediation model (Model 4), a 1000-sample

bootstrap procedure to estimate bias-corrected 95% confidence intervals (CIs) was found. Further exploratory analysis on if the effect of group on 3-month health related Quality of Life (QOL, measured by SF-36 mental health and physical health component score (MCS and PCS)) is mediated by 1-week PTSS and PTG also found no significant indirect mediation. The understanding of how a yoga intervention impacts breast cancer patients' sleep and QOL, through mediators such as PTG and PTSS, will further support the utility of such complimentary therapies.

KEY WORDS: Yoga, Posttraumatic growth, Posttraumatic stress, Breast Cancer, Sleep, Quality of Life

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Figure **Page**

CHAPTER I

Examining Mediators of the Effects of Yoga on Sleep in Breast Cancer Patients Undergoing Chemotherapy

Cancer is a disease in which cells in the body grow out of control. Cancer is the second leading cause of death globally and is estimated to account for 9.6 million deaths in 2018 (World Health Organization, 2019). Breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death among females, accounting for 23 percent of the total cancer cases and 14 percent of the cancer deaths among women (Jemal et al., 2011). Approximately 1 in 8 women will develop breast cancer in her lifetime and there are currently more than 3.1 million breast cancer survivors in the United States. Death rates from female breast cancer dropped 40% from 1989 to 2016 (American Cancer Society, 2019). The decline in breast cancer mortality has been attributed to both improvements in treatment and early detection (Berry et al., 2006). Treatment for breast cancer can significantly impact women's physical, psychosocial, and emotional health and well-being (Dunne & Keenan, 2016). Seeking to live as normal a life as possible, including the ability to fulfill roles and maintain relationships, is a goal for many that is negatively affected by advanced breast cancer and decreasing physical function (Luoma & Hakamies-Blomqvist, 2004). Therefore, in light of the increasing number of breast cancer survivors experiencing the burdensome sequela of cancer treatment, there is a need for effective approaches to manage physical and psychological symptoms to improve quality of life (QOL) of breast cancer patients during and after treatment.

Physical and Psychological Cancer Related Symptoms

It is clear through the literature that cancer and its treatment elicit a wide range of physical and psychological morbidities. Many of these adverse effects emerge or amplify during cancer treatment and persist in a chronic, long-term manner after treatment terminates (Wu & Harden, 2015). Psychosocial and biomedical sequelae of cancer and its treatment include sleep disturbance, fatigue, psychological distress (e.g. depression, anxiety, fear of recurrence), as well as pain, nausea/vomiting, cognitive difficulties, immunosuppression, and cardiotoxicity (Curigliano et al., 2016; Dong et al., 2016; Kroemeke, Bargiel-Matusiewicz, & Kalamarz, 2017; National Institutes of Health, 2017; Wu & Harden, 2015). This symptom burden is associated with decreased functioning, increased disability, and poorer quality of life (QOL) (Jones et al., 2016; Wu & Harden, 2015).

Two of the most commonly reported cancer-related symptoms are sleep disturbance and compromised health-related QOL (Anderson et al., 2003; Broeckel, Jacobsen, Horton, Balducci, & Lyman, 1998). Sleep disturbance has been presented as one of the top five concerns reported by cancer survivors across various malignancies (Wu & Harden, 2015). Sleep disruption is prevalent in patients and survivors of breast cancer (Broeckel et al., 1998; Schmidt et al., 2012; Von Ah et al., 2012). Most patients undergoing chemotherapy will experience transient sleep disruption. For example, an estimated 30–60% of newly diagnosed or recently treated cancer patients experience symptoms of insomnia, much higher than the 9-15% reported by the general population (Ancoli-Israel et al., 2006; Colagiuri et al., 2011). Furthermore, nearly 60% will have chronic sleep problems (Palesh et al., 2013). Many cancer survivors also experience comprised health-related quality of life, including poorer physical functioning and greater

mental health-related burden, during treatment as well as the months following treatment (Wu & Harden, 2015).

Previous research suggests that several psychosocial interventions, including yoga, may be effective at reducing the common cancer-related symptoms of sleep disturbance and quality of life (El-Hashimi & Gorey, 2019). However, determining the mechanisms by which these interventions, such as yoga, take effect on sleep or QOL may give insight to ways in which future interventions may be optimized to reduce cancer symptom comorbidities.

Yoga's Effect on Sleep and QOL

Yoga has been increasingly relevant in today's western society. As a traditional discipline derived from Indian culture, yoga includes aspects of physical postures (asana), breathing techniques (pranayama), and meditation (Dhyana), chants (mantras) and wisdom teachings (sutras) to encourage health and relaxation (Satchidananda, 2012), with the goal of uniting the mind, body, and spirit for health and self-awareness (Smith & Pukall, 2009). The National Institutes of Health (US; 2012) describes yoga as a safe and effective intervention to increase strength, flexibility and balance, and treatment for high blood pressure, heart disease, aches and pains, depression, stress, and potentially asthma. Yoga is also increasingly recognized as a complementary approach to diminishing the onset and/or treating the severity of cancer-related physical and psychological symptoms (Lin et al., 2018)(McCall, Thorne, Ward, & Heneghan, 2015). Cancer survivors turn to complementary therapies like yoga to enhance recovery and wellness and are particularly likely to approach yoga as a complementary option based on recommendations from health care providers (Mao, Palmer, Healy, Desai, & Amsterdam, 2011).

More specifically, in a review of 18 randomized control trials (RCTs) of yoga interventions for women with breast cancer, seven studies reported beneficial effects of the yoga intervention on QOL outcomes (Harder, Parlour, & Jenkins, 2012). Specifically, a group-by-time effects were predominately observed for overall or global QOL, and emotional well-being. In a following review of 12 RCTs examining the effect of yoga interventions on QOL and psychological health, Cramer et al (2012) showed that yoga interventions provided reductions anxiety, perceived stress, and psychological distress in patients with breast cancer close to the end of the yoga intervention (Cramer, Lange, Klose, Paul, & Dobos, 2012). In accordance to previous reviews, Sharma and colleague' (2016) review of yoga interventions for cancer survivors reported that one RCT demonstrated improved sleep quality, sleep latency, sleep duration, sleep efficiency (Mustian et al., 2013), five RCTs showed improved overall QOL (Andysz et al., 2014; McCall et al., 2015; Rahmani & Talepasand, 2015; Siedentopf et al., 2013; Yagli & Ulger, 2015), and three RCTs found reduced fatigue and related symptoms (Chakrabarty et al., 2015; Kiecolt-Glaser et al., 2014; Taso et al., 2014). A more recent meta-analysis of yoga interventions' effects on cancer symptom burden found that five out of six RCTs demonstrated favorable effects of yoga on global and domain-specific QOL measures (i.e. physical, emotional, social, and cognitive); seven out of 10 studies reported improved fatigue; five out of seven studies demonstrated sleep improvement; two out of three studies reported significant effects on depression; four out of seven studies reported significant finding psychosocial outcomes (i.e. benefit-finding, intrusive/avoidant thoughts, life satisfaction, mindfulness, spirituality, and affect) (Danhauer et al., 2019).

Overall, studies suggest that yoga is effective in improving symptoms that arise from cancer treatment, including sleep disturbance and QOL.

Moreover, yoga intervention effectiveness may depend on treatment adherence. In a systematic review of the physical and psychosocial benefits of yoga in cancer patients, Buffart et al. (2012) found mixed results on the effect of adherence to a yoga intervention on cancer symptoms and QOL. Some studies reported that there was no effect of the level of adherence to a yoga intervention on QOL outcomes (Vadiraja et al., 2009), while others reported that better intervention adherence was associated with higher self-reported physical function and QOL (Danhauer et al., 2009). Another study found a positive association between yoga intervention attendance and improved mood among breast cancer survivors (Moadel et al., 2007). One study concluded that greater yoga practice time was associated with less fatigue, less symptom bother, and more acceptance at post-treatment among breast cancer survivors, and tended to be associated with less sleep disturbances (Mcdonough, Sabiston, & Wrosch, 2014). Chaoul et al. (2018) found breast cancer patients in a yoga intervention who practiced yoga at home at least two times a week reported fewer daily sleep disturbances at three and six months after treatment compared to those that didn't and those in the control group. Overall, some studies show the importance of adherence to the yoga intervention on cancer symptomology outcomes, while others show no effect. Further research is necessary to inform the underlying processes of a yoga intervention on associated outcomes.

Mediators of Yoga on Sleep and QOL Outcomes

To date, there have been only two studies that have investigated some of the potential processes that underly the effects of a yoga intervention on cancer symptomology and

QOL. One study found that a four-week yoga intervention for cancer survivors improved global sleep quality, and that changes in sleep quality significantly mediated yoga intervention's effect on reduction of perceived memory difficulty (Janelsins et al., 2016). This study suggests that interventions targeting improvement in global sleep quality may in turn improve other cognitive functions and associated symptoms. The second study found that part of the effect of yoga on physical health-related QOL at the long-term follow-up can be attributed to the increased benefit finding experienced by yoga participants midway through the follow-up period (Ratcliff et al., 2016), further supporting investigating potential processes that underly these effects. Breast cancer is highly stressful eliciting adverse effects on physical integrity and mental health.

The ways in which cancer diagnosis and treatment is processed may impact the adverse physical and psychological effects associated with cancer treatment. In the wake of cancer diagnosis and treatment, individuals may experience posttraumatic symptoms, such as intrusive thoughts and/or avoidance, as well as posttraumatic growth, both of which are associated with treatment-related symptoms (van de Wiel, Geerts, & Hoekstra-Weebers, 2008). Yoga intervention, which often includes elements of acceptance and mindfulness (Carson, Carson, Olsen, Sanders, & Porter, 2017), may stimulate changes in the way a cancer experience is processed (i.e., curbing posttraumatic symptoms and/or stimulating posttraumatic growth), which may in turn lead to downstream effects on cancer-related symptoms, such as fatigue, sleep disturbance, and QOL However, further research is needed to establish these underlying processes. Characterizing the mediators of the effect of yoga interventions on cancer symptomology and related outcomes can help to inform and adapt yoga interventions to promote the even greater benefits.

Posttraumatic Stress Symptoms. Events that unfold during a cancer diagnosis and subsequent treatment may produce Posttraumatic stress disorder (PTSD) and symptoms of PTSD (PTSS) (Green et al., 1998; Kangas, Henry, & Bryant, 2002). PTSS related to a cancer diagnosis, can include intrusive, unwanted negative thoughts which may be accompanied and/or alternated by efforts to avoid these thoughts (van de Wiel et al., 2008). Intrusion can be characterized by intense feelings of helplessness, powerlessness, sadness, anger, and fear (van de Wiel et al., 2008). Avoidance can be characterized by avoidance of feelings/thoughts and numbness to responsiveness (e.g. related to cancer experience) (Oliveri et al., 2019). PTSS have been reported in up to 50% of cancer patients (Gurevich, Devins, & Rodin, 2002) and may be a precursor to PTSD (Kangas et al., 2002). The prevalence of PTSD in breast cancer patients is considerably lower than that of PTSS, with estimates varying from 0% to 32.3% depending on the disease phase, the stage of disease, and the instruments adopted to detect prevalence (Arnaboldi, Riva, Crico, & Pravettoni, 2017). PTSS and PTSD are associated with a variety of negative health outcomes among cancer survivors. For example, one study of long-term survivors of breast cancer found that survivors with PTSD reported significantly poorer QOL in all dimensions (i.e. physical health, psychological health, social relations, and environment) compared to the non-PTSD survivor group (Amir & Ramati, 2002). PTSD and sub-syndromal PTSS are associated with higher rates of depression and lower QOL among cancer patients and survivors (Cordova & Andrykowski, 2003). Van de Waal et al. (2008) reported an association in the way cancer is processed (i.e., intrusive thoughts/avoidance cs. Acceptance) and QOL. Specifically, general health-related QOL and mental health-QOL were negatively

associated with intrusive thoughts rather than avoidance. In addition, women with breast cancer with initial high vs. low levels of avoidance reported a poorer course in physical functioning, social functioning, and general health overtime (van de Wiel et al., 2008). Implementation of interventions that may mitigate PTSS may, in turn, improve overall QOL. This further supports the necessity of understanding how yoga may influence the ways in which cancer diagnosis is processed.

Posttraumatic Growth. Counter to PTSD, Posttraumatic growth (PTG) refers to a better appreciation of life, a sense of personal strength, better relationships with others, a deeper spirituality, recognition of new possibilities (Tedeschi & Calhoun, 1996) and positive change in health behavior after a traumatic event. Breast cancer, as previously discussed, is a potential traumatic stressor, that can challenge the core assumptions the patient has about the world (Koutrouli, Anagnostopoulos, & Potamianos, 2012). It is possible to experience cancer-related stress and growth simultaneously because people often view the experience as both a trauma and a transition to a new phase in their lives. Koutrouli et al. (2012) conducted a review on PTG in breast cancer patients, and found that the majority of patients with breast cancer experienced PTG after their diagnosis, with 83% of patients reporting a positive change after their disease in one study (Sears, Stanton, & Danoff-Burg, 2003) and 98% reporting PTG in another (Weiss, 2002). Among cancer survivors, PTG is associated with a variety of positive outcomes. For example, women endorsing PTG (i.e., greater appreciation for life and their health) following breast cancer treatment exhibited positive changes in their health behavior (Casellas-Grau, Vives, Font, & Ochoa, 2016). One study found that breast cancer patients reporting high PTG displayed higher levels of physical and psychological

wellbeing compared to a stressed healthy control (Ruini, Vescovelli, & Albieri, 2013). In contrast, Loeffler et al. (2018) reported no significant correlation between wellbeing and PTG (Loeffler, Poehlmann, & Hornemann, 2018). The mixed results of how PTG affects overall-QOL may be due to the way the study characterized the relationship between the two. Further clarification on how PTG impacts cancer-related outcomes, such as QOL, and experiences that may increase PTG is needed. Several studies suggest that yoga interventions may impact the way in which patients process their cancer diagnosis and treatment. An RCT of a yoga program during and after radiotherapy found that women in the yoga intervention experienced enhanced benefit finding three months after treatment compared to those in a waitlist control group (Chandwani et al., 2010). Interestingly, aspects of PTSS and PTG may be intertwined. One study of ovarian cancer survivors found that characteristics of PTSS, such as intrusive rumination or deliberate rumination, may be predictive of the development of PTG (Hill & Watkins, 2017). Specifically, deliberate rumination was positively predictive of PTG and intrusive rumination was negatively predictive of PTG (Hill & Watkins, 2017). In a review of psychosocial factors related to PTG, three studies showed a positive association between cognitive and emotional processing (e.g. positive cancer-related rumination, seeking a reason for the traumatic event, and to understand the feelings evoked by the trauma) and PTG (Kolokotroni, Anagnostopoulos, & Tsikkinis, 2014). However, two studies did not find a significant association between intrusive thoughts and PTG (Kolokotroni et al, 2014). These results may be indicative of the varying cognitive processes of automatic thoughts in comparison to deliberate rumination. These studies showed that positive cancer-related rumination, cognitive, and emotional processing understanding how PTSS and PTG

affect cancer symptomology outcomes, such as sleep, fatigue, and QOL, can inform which aspects of yoga interventions are most efficacious. To date, there are no studies looking at the relationship of PTG and sleep in breast cancer patients. Furthermore, there is limited research on addressing the relationship of yoga on cancer symptomology of sleep and QOL and the potential mediating effects of PTG. One study found that the effect of yoga on physical health-related QOL after radiation was mediated by benefit finding (Ratcliff et al., 2016). Indeed, more research is needed to understand the potential mechanisms (i.e., posttraumatic stress and growth) by which yoga effects cancer-related outcomes.

CHAPTER II

The Present Study

The current study is a secondary analysis of a previously completed RCT examining the effects of a Tibetan yoga program compared to an active control group (stretching) and usual care on fatigue and sleep in women with breast cancer actively receiving chemotherapy (Chaoul et al., 2018). The original trial was a repeated-measures 3 (group: TYP, STP, UC) x 5 (time: baseline, 1-week and 3, 6, 12 months after chemotherapy) mixed factor design. The present study found that women in TYP reported fewer PSQI-assessed daily disturbances at 1-week post-intervention compared to those in STP ($p = .002$) and, when considering only those who practiced at home at least 2 times per week, at 6 months post-intervention compared to UC ($p = .017$). Additionally, at 1-week post-intervention, TYP was associated with less actigraphy-assessed wake time after sleep onset (WASO, $p = .0003$) and greater actigraphy-assessed sleep efficiency (SE; $p = .02$). When considering only those who practiced at home at least 2 times per week, TYP was associated with greater actigraphy-assessed SE compared to UC at 6 months. Thus, compared to STP, TYP improved PSQI-assessed daily disturbances and actigraphy-assessed WASO and SE at 1 week. Additionally, women who practiced TYP at home at least 2 times per week experienced reduced PSQI-assessed daily disturbances at 3-months and improved actigraphy-assessed SE at 6-months compared to UC.

The present study aimed to assess if 1) the effect of group (i.e. yoga, stretching, and usual care) on 3-month PSQI-assessed daily disturbances is mediated by 1-week posttraumatic stress and posttraumatic growth, and 2) the effect of group on 6-month actigraphy-assessed SE is mediated by 1-week posttraumatic stress and posttraumatic

growth; and 3) the effect of group on 1-week PSQI-assessed daily disturbances, actigraphy-assessed WASO and SE is mediated by 1-week posttraumatic stress and posttraumatic growth. The primary paper did not examine the effect of group on health related QOL. Thus, the mediating effect of 1-week posttraumatic stress and posttraumatic growth on 3-month health-related QOL will also be examined as an exploratory outcome.

CHAPTER III

Methods

Participants

The study includes a sample of women with stage (American Joint Committee on Cancer (AJCC) TNM) I to III breast cancer who were undergoing chemotherapy and were aged ≥18 years; were able to read, write, and speak English; and were scheduled to undergo neoadjuvant or adjuvant chemotherapy (weekly or every 21 days) at the University of Texas MD Anderson Cancer Center. Patients with lymphedema, deep vein thrombosis, a documented diagnosis of a formal thought disorder (e.g., schizophrenia), a score of ≤ 23 on the Mini-Mental State Examination, extreme mobility problems limiting their ability to engage in the practice (self-defined), or those who had regularly (self-defined) practiced yoga in the year before diagnosis were excluded. The protocol was approved by the University of Texas MD Anderson Cancer Center Institutional Review Board and patients were recruited between 2007 and 2012. Women were approached either before starting or within the first 2 cycles of chemotherapy. Women completed self-report questionnaire measures, collected at baseline (i.e. either before starting or within the first 2 cycles of chemotherapy), 1 week after treatment, and at 3-, 6-, and 12-months (Chaoul et al., 2018).

Procedures

Study participants completed a baseline assessment and were randomized into 1 of 3 groups, Tibetan yoga program (TYP), stretching (STP), or waitlist group (UC) using a form of adaptive randomization, minimization, with age, stage of disease, time since diagnosis, baseline fatigue scores, menopausal status, type of surgical procedure, and

chemotherapy treatment and regimen as randomization factor. TYP and STP interventions participated in 4, 75-90-minute classes during their chemotherapy treatment and 3 booster sessions during follow-up (Chaoul, et al. 2018).

Sample Size

Sample size was determined by the original TYP study (Chaoul, et al. 2018). This study will exclude patients that have not completed assessments at associated timepoints. At 1-week post-chemotherapy 202 women completed all questionnaires. At 3-month time point, 188 women completed all questionnaires. At 6-month time point, 160 women completed all questionnaires.

Measures

Patients reported demographic information, clinical information, and medical history at baseline. Specifically, age, stage, surgery, education will be included as covariates based on previous research that has found associations with these variables and the present study's outcome of interest and/or mediator variables (Kolokotroni et al., 2014).

Outcome Variables.

Perceived Sleep. Perceived sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI). The PSQI is an 18-item self-rated questionnaire that assesses quality of sleep and sleep disturbances over a 1-month period. The scale includes 3 component subscales of sleep efficiency, perceived sleep quality, and daily disturbances, and a total score, with scores of ≥ 5 indicating clinically significant sleep disturbances (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Considering the results of the primary paper, daily disturbance at 1-week and 3-months will be included as outcome measures.

Objective Sleep. Objective sleep was assessed using wrist actigraphy (Actiwatch, Minimitter Philips Inc., Bend, Oregon). Participants were instructed to wear the Actiwatch on their non-dominant arm 24 hours a day for 7 consecutive days. The Actiwatch (Actiwatch 2 model) contains a uniaxial accelerometer that records movement. Each device was set to an epoch length of 30 seconds and medium level of sensitivity. The Actiwatch data were then analyzed using the manufacturer's software (Actiwatch Activity and Sleep Analysis 5, version 5.32, Cambridge Neurotechnology). Actigraphy-assessed outcomes included wakefulness after sleep onset (WASO), as measured by total minutes of wakefulness between nocturnal sleep onset and the end of the sleep period and sleep efficiency (SE), as measured by the percent sleep obtained during the nocturnal sleep period (TST/time in bed x 100). The cutoff for number of nights and days for WASO was 6 days and for SE was 3 days. Each outcome was measured as a continuous variable, with lower SE indicating poorer sleep efficiency and. higher WASO indicating greater minutes awake after sleep onset. Considering the results of the primary paper, WASO at 1-week and SE at 1-week and 6-months will be included as outcome measures.

Overall Quality of Life. Overall Quality of Life (QOL) was assessed using Medical Outcome Study, 36-item Short Form Survey (SF-36). SF-36 is a 36-item questionnaire assessing the patient's views about their health. SF-36 measures 8 scales, including physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health, and includes an overall physical and mental component scale (PCS and MCS). To reduce the number of analyses, the present study will only examine the PCS and MCS. All questions are scored on a scale from 0 to 100, with 100 representing the highest level of functioning possible. As the primary paper

did not examine the effect of group on QOL, SF-36 PCS and MCS at 3 months will be included as an exploratory outcome measure.

Mediator Variables.

Posttraumatic Growth. Posttraumatic Growth was assessed using the Post Traumatic Growth Inventory (PTGI). PTGI is a 21-item questionnaire assessing if a change occurred in their life due to a crisis/disaster (i.e. diagnosis of breast cancer). Patients rate their change with 0 indicating "I did not experience this change as a result of my crisis" and 5 indicating "I experienced this change to a very great degree as a result of my crisis". PTGI total score is scored by adding all the responses. Individual factors are scored by adding responses to items on each factor. The 5 factors are: Relating to Others, New Possibilities, Personal Strength, Spiritual Change, and Appreciation of Life (Taku, et al. 2008). To reduce the number of analyses, the present study will examine only the PTGI total score. Given that the primary paper found the majority of group effects 1 week after the intervention, 1-week PTGI will be examined as a mediator (Kraemer, Kiernan, Essex, & Kupfer, 2008).

Posttraumatic Stress. Posttraumatic Stress symptoms (PTSS) were assessed using Impact of Event Scale-Revised (IES-R). IES-R is a 22-item questionnaire assessing difficulties people sometimes have after a stressful life event (i.e. breast cancer diagnosis). Patients rate their degree of difficulty on each item with 0 indicating "not at all" to 4 indicating "extremely." Scores are totaled with a possibility of 0-88 points, with ≥ 24 indicating PTSD is a clinical concern, ≥ 33 indicating diagnosis of PTSD, and ≥ 37 indicating high enough to suppress your immune system's functioning. The scores include subscales of IES-intrusion (IES-int) and IES-avoidance (IES-avo) and IES-total

(Weiss, D.S. 2007). Given that the primary paper found the majority of group effects 1 week after the intervention, 1-week IES-int and IES-avo scores will be examined as a mediator (Kraemer et al., 2008).

Hypotheses

I will examine 15 models of moderated mediation models:

H1a: 1-week post-chemotherapy PTG will partially mediate the effect of group (i.e. TYP, STP, UC) on 3-month PSQI-DD.

H1b: 1-week post-chemotherapy PTSS (measured by the Impact of Event Scale's intrusive (IES-int) and avoidance (IES-avo) will partially mediate the effect of group on 3-month PSQI-DD.

H2a: 1-week post-chemotherapy PTG will partially mediate the effect of group on 6-month actigraphy sleep efficiency (SE).

H2b: 1-week post-chemotherapy PTSS (IES-int, IES-avo) will partially mediate the effect of group on 6-month actigraphy sleep efficiency (SE).

H3a: 1-week post-chemotherapy PTG will partially mediate the effect of group on 1-week PSQI-DD. This effect will be moderated by home practice adherence.

H3b: 1-week post-chemotherapy PTSS (IES-int, IES-avo) will partially mediate the effect of group on 1-week PSQI-DD.

H4a: 1-week post-chemotherapy PTG will partially mediate the effect of group on 1-week actigraphy-SE.

H4b: 1-week post-chemotherapy PTSS (IES-int, IES-avo) will partially mediate the effect of group on 1-week actigraphy- SE.

H5a: 1-week post-chemotherapy PTG will partially mediate the effect of group on 1-week actigraphy wake time after sleep onset (WASO).

H5b: 1-week post-chemotherapy PTSS (IES-int, IES-avo, IES-tot) will partially mediate the effect of group on 1-week WASO.

Exploratory Hypotheses

H6a: 1-week post-chemotherapy PTG will partially mediate the effect of group on 3-month health-related QOL (i.e. SF-36 MCS and PCS). This effect will be moderated by home practice adherence. H6b: 1-week post-chemotherapy PTSS (IES-int, IES-avo, IES-tot) will partially mediate the effect of group on 3-month health-related QOL (i.e. SF-36 MCS and PCS).

Statistical Analysis

For all hypotheses, given 1 IV (group assignment), 3 mediators (1-week IES-int, IES-avo, PTG), 5 DVs (i.e. 1-week and 3-month PSQI-DD, 1-week and 6-month actigraphy-SE, 1-week WASO), and 1 moderator (practice adherence), we conducted 15 tests of moderated mediation using SPSS PROCESS macro (Hayes, 2013). Using the conditional indirect mediation model (Model 7), a 1000-sample bootstrap procedure was used to estimate bias-corrected 95% confidence intervals (CIs) to test the significance of indirect effects of the IV (group assignment) on the each of the 5 DVs via each of the 3 mediators (1-week PTG, IES-int, IES-avo). If CIs do not contain 0, indirect relationships are significant, indicating significant mediating effect (Hayes, 2013). These models included 4 clinical covariates (age, stage, surgery, education).

CHAPTER IV

Results

Baseline Characteristics of Sample

352 participants completed baseline measures and were randomized into TYP, STP, or UC. Of the patients randomized, 49 had already completed chemotherapy at baseline, and 74 did not provide follow-up data, resulting in an evaluable sample of 229 participants. Chi-square and t-tests comparing baseline demographic and medical characteristics and outcome measures between groups demonstrated no significant differences (Table 1).

Table 1

Participant Demographic and Clinical Characteristics at Baseline

	TYP N = 78	STP N = 67	UC N = 84	P
Mean, age (SD), y	49.51 (10.0)	50.37 (10.2)	49.51 (10.0)	0.644
Race (n=224)				0.627
White	45 (57.7)	45 (67.2)	52 (61.9)	
Hispanic	13 (16.7)	6 (9.0)	12 (14.3)	
Black	10 (14.1)	10 (14.9)	12 (14.3)	
Asian	6 (7.7)	4 (6.0)	2 (2.4)	
Other/unknown	4 (5.1)	1 (1.5)	2 (2.4)	
Religion (n=223)				0.458
Catholic	22 (28.2)	14 (20.9)	16 (19.0)	
Jewish	0 (0)	1 (1.5)	0 (0)	
Protestant	24 (30.8)	29 (43.3)	37 (44.0)	
Other	27 (34.6)	20 (29.9)	23 (27.4)	
Non-religious	3 (3.8)	2 (3.0)	5 (6.0)	
Employment Status (n=222)				.677

	TYP N = 78	STP N = 67	UC N = 84	P
Employed full-time	41 (52.6)	31 (46.3)	41 (48.8)	
Employed part-time	8 (10.3)	13 (19.4)	14 (16.7)	
Not employed, looking	12 (15.4)	6 (9.0)	9 (10.7)	
Retired	15 (19.2)	15 (22.4)	17 (20.2)	
Education (n=223)				0.835
High school or technical school	15 (19.2)	12 (17.9)	16 (19.0)	
Some college	12 15.4)	15 (22.4)	18 (21.4)	
Higher education	49 (62.8)	38 (56.7)	48 (57.1)	
Mean time since diagnosis (SD), days	19.3 (29.3)	15.0 (11.1)	15.14 (8.8)	0.287
Stage of disease (American Joint Committee on Cancer (AJCC) TNM) (n = 229)				0.553
I	19 (24.4)	16 (23.9)	16 (19.0)	
II	41 (52.6)	41 (61.2)	47 (56.0)	
III	18 (23.1)	10 (14.9)	21 (25.0)	
Surgery				0.393
Chemotherapy regimen (n=228)				0.119
Weekly	58 (74.4)	47 (70.1)	71 (84.5)	
Every 3 weeks	20 (25.6)	19 (28.4)	13 (15.5)	
Timing of chemotherapy (n=229)				0.502
Neoadjuvant	35 (44.9)	35 (52.3)	45 (53.6)	
Adjuvant	43 (55.1)	32 (47.8)	39 (46.4)	
Menopausal status				.855
Premenopausal	36 (46.2)	34 (50.7)	40 (47.6)	
Menopausal	42 (53.8)	33 (49.3)	44 (52.4)	

Note. Abbreviations: SD, standard deviation; STP, stretching program; TYP, Tibetan yoga program; UC, usual care

Intervention Effects

Sleep Disturbances. The aim of this study was to determine whether the effect of group on sleep was explained by 1-week posttraumatic growth (PTGI) and 1-week posttraumatic stress symptoms (IES-int and IES-avo). Before formally testing for mediation, detection-tolerance, and the variance inflation factor (VIF) were used to assess multicollinearity. Because multicollinearity was not a problem, with tolerance greater than .2 and a VIF less than 4 in all cases, centering the predictor variables was not necessary ((Aiken & Stephen, 1987; Williams, Holmbeck, & Greenley, 2002). Although the main paper found that the women in the TYP group reported significantly fewer daily disturbances than woman in the STP and UC groups at 1 week post treatment (F= 4.67 [p = .03; Cohen D -0.41] and F=5.05 [p=.025; Cohen D = -0.39] there were no significant relative indirect mediation effects. When 1-week posttraumatic growth (PTGI_1) was used as the mediator, group assignment (TYP vs. UC; STP vs. UC) served as the independent variable, and 3 month PSQI daily disturbances (PSQIDD2) served as the outcome variable, the test of relative indirect effect did not indicate the presence of a significant mediational model, with the mean of relative indirect effect across all bootstrap samples estimated at .0256 (CI -0.024 to 0.113) and .0164 (CI = -0.023 to .0954; Hayes 2019) respectively. When the 1-week IES-intrusion (IES-int) was used as the mediator, the test of relative indirect effect did not indicate the presence of a significant mediational model, with the mean of relative indirect effect across all bootstrap samples estimated at -0.016 (CI -0.097 to 0.029; Hayes 2019) and at -0.003 (CI -0.061 to 0.043; Hayes 2019) respectively. When the 1-week IES-avoidance (IES-avo) was used as the mediator, the test of relative indirect effect did not indicate the presence

of a significant mediational model, with the mean of relative indirect effect across all bootstrap samples estimated at -0.003 (CI -0.0.044 to 0.0.051; Hayes 2019) and at -0.003 (CI -0.42 to 0.057; Hayes 2019) respectively. There is also no significant indirect mediation effect on the effect of group on 1-week daily sleep disturbance (1-week PSQIDD). Unstandardized path coefficients for the significant mediational model is presented in Figure 1 and Table 2-4.

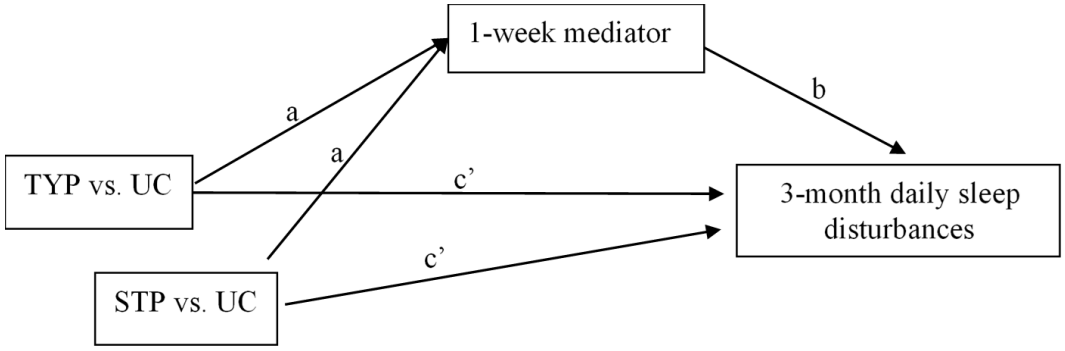

Figure 1. Mediation model exploring the effect of group on 3-month daily sleep disturbances through the proposed mediator of 1-week mediator (PTG, IES-int, IES-avo).

Table 2

Mediational model of the effect of group on PSQI daily disturbances at 3 months through 1-week posttraumatic growth (PTG).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (PTGI_1)	7.46	4.79	.122
A. IV (Group- STP vs. UC) to Mediator (PTGI_1)	4.77	5.11	.353
B. Mediator (PTGI_1) to DV (PSQI_DD_2)	.004	.004	.288
C. Total Effect: Group (TYP vs. UC) to PSQI_DD_2	-.142	.214	.509
C. Total Effect: Group (STP vs. UC) to PSQI_DD_2	.435	.227	.057

Path	Coefficient	SE	P
C'. Direct Effect: Group (TYP vs. UC) to PSQI_DD_2	-.111	.223	.601
C'. Direct Effect: Group (STP vs. UC) to PSQI_DD_2	.455	.226	.047

Table 3

Mediational model of the effect of group on PSQI daily disturbances at 3 months through 1-week IES-intrusion (IES-int).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (IES-int)	-1.67	1.31	.202
A. IV (Group- STP vs. UC) to Mediator (IES-int)	-.275	1.36	.840
B. Mediator (IES-int) to DV (PSQI_DD_2)	.011	.014	.416
C. Total Effect: Group (TYP vs. UC) to PSQI_DD_2	-.309	.209	.141
C. Total Effect: Group (STP vs. UC) to PSQI_DD_2	.368	.217	.093
C'. Direct Effect: Group (TYP vs. UC) to PSQI_DD_2	-.290	.210	.170
C'. Direct Effect: Group (STP vs. UC) to PSQI_DD_2	.371	.218	.091

Table 4

Mediational model of the effect of group on PSQI daily disturbances at 3 months through IES-avoidance (IES-avo).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (IES-avo)	1.03	1.48	.486
A. IV (Group- STP vs. UC) to Mediator (IES-avo)	1.03	1.56	.510

Path	Coefficient	SE	P
B. Mediator (IES-avo) to DV (PSQI_DD_2)	.004	.013	.780
C. Total Effect: Group (TYP vs. UC) to PSQI_DD_2	-.233	.218	.286
C. Total Effect: Group (STP vs. UC) to PSQI_DD_2	.349	.230	.131
C'. Direct Effect: Group (TYP vs. UC) to PSQI_DD_2	-.237	.219	.281
C'. Direct Effect: Group (STP vs. UC) to PSQI_DD_2	.346	.231	.137

Actigraphy. The main paper found that the women in the TYP group reported that at 1-week post treatment, a greater association with less wake time after sleep onset (WASO) and greater association with sleep efficiency (SE). However, there were no significant relative indirect mediation effects. Specifically, when the 1-week posttraumatic growth (PTGI_1) was used as the mediator, group assignment (TYP vs. UC; STP vs. UC) served as the independent variable, and 6 month sleep efficiency (SE) served as the outcome variable, the test of relative indirect effect did not indicate the presence of a significant mediational model, with the mean of relative indirect effect across all bootstrap samples estimated at -0.332 (CI -2.00 to 0.863). No significant indirect mediation effects of group on SE at any timepoint when posttraumatic growth (PTG), IES-intrusion (IES-int) and IES-avoidance (IES-avo) were used as the mediator. Unstandardized path coefficients for the significant mediational model is presented in Table 5-7 and Figure 2. Additionally, there were no significant relative indirect mediation effects of group on 1-week WASO. Unstandardized path coefficients for the significant mediational model is presented in Table 8-10 and Figure 3.

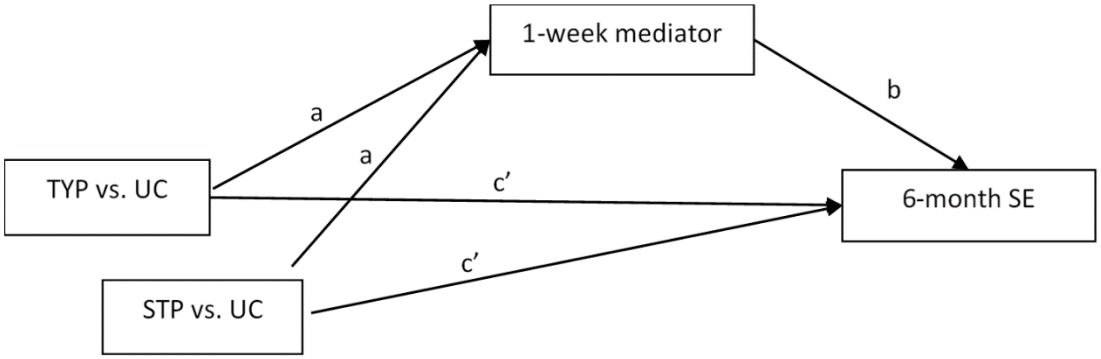

Figure 2. Mediation model exploring the effect of group on 6-month SE through the proposed mediator of 1-week mediator (PTG, IES-int, IES-avo).

Table 5

Mediational model of the effect of group on Sleep Efficiency at 6 months through 1-week posttraumatic growth (PTG).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (PTG_1)	1.57	13.80	.911
A. IV (Group- STP vs. UC) to Mediator (PTG_1)	28.83	14.72	.072
B. Mediator (PTG_1) to DV (SE_3)	-0.06	.051	.281
C. Total Effect: Group (TYP vs. UC) to SE_3	-1.53	2.57	.564
C. Total Effect: Group (STP vs. UC) to SE_3	4.46	2.74	.128
C'. Direct Effect: Group (TYP vs. UC) to SE_3	-1.43	2.55	.584
C'. Direct Effect: Group (STP vs. UC) to SE_3	6.12	3.09	.071

Table 6

Mediational model of the effect of group on Sleep Efficiency at 6 months through 1-week IES-intrusion (IES-int).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (IES-avo)	.713	2.36	.767
A. IV (Group- STP vs. UC) to Mediator (IES-avo)	-2.57	2.10	.240
B. Mediator (IES-avo) to DV (PSQI_DD_2)	.480	.332	.172
C. Total Effect: Group (TYP vs. UC) to PSQI_DD_2	2.41	3.05	.443
C. Total Effect: Group (STP vs. UC) to PSQI_DD_2	4.38	2.71	.128
C'. Direct Effect: Group (TYP vs. UC) to PSQI_DD_2	2.07	2.95	.500
C'. Direct Effect: Group (STP vs. UC) to PSQI_DD_2	5.62	2.74	.061

Table 7

Mediational model of the effect of group on Sleep Efficiency at 6 months through 1-week IES-avoidance (IES-avo).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (IES-avo)	3.09	5.61	.591
A. IV (Group- STP vs. UC) to Mediator (IES-avo)	5.42	4.88	.290
B. Mediator (IES-avo) to DV (PSQI_DD_2)	.016	.188	.932
C. Total Effect: Group (TYP vs. UC) to PSQI_DD_2	2.68	3.64	.476
C. Total Effect: Group (STP vs. UC) to PSQI_DD_2	4.37	3.17	.191
C'. Direct Effect: Group (TYP vs. UC) to PSQI_DD_2	2.63	3.84	.507
C'. Direct Effect: Group (STP vs. UC) to PSQI_DD_2	4.28	3.45	.239

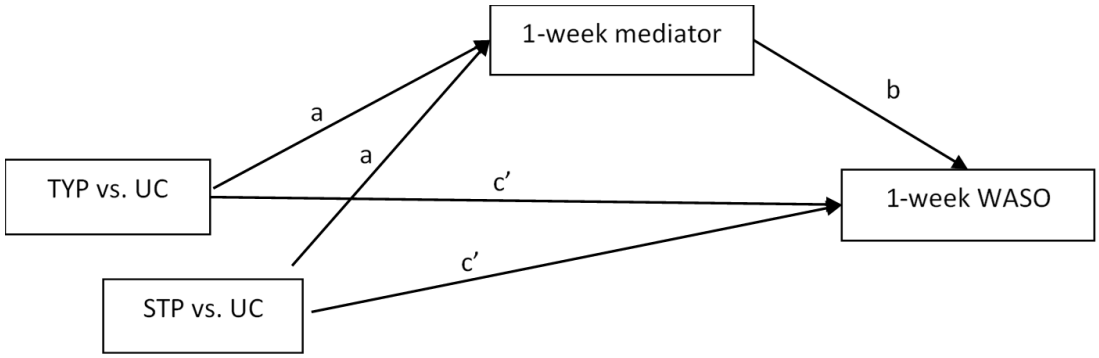

Figure 3. Mediation model exploring the effect of group on 1-week WASO through the proposed mediator of 1-week mediator (PTG, IES-int, IES-avo).

Table 8

Mediational model of the effect of group on WASO at 1-week through 1-week posttraumatic growth (PTG).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (PTG_1)	-5.79	10.92	.600
A. IV (Group- STP vs. UC) to Mediator (PTG_1)	1.04	9.84	.916
B. Mediator (PTG_1) to DV (WASO_1)	.066	.11.	.565
C. Total Effect: Group (TYP vs. UC) to WASO_1	-7.23	6.78	.295
C. Total Effect: Group (STP vs. UC) to WASO_1	10.24	6.11	.104
C'. Direct Effect: Group (TYP vs. UC) to WASO_1	-6.85	6.88	.328
C'. Direct Effect: Group (STP vs. UC) to WASO_1	10.17	6.18	.110

Table 9

Mediational model of the effect of group on WASO at 1-week through 1-week IES-intrusion (IES-int).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (IES-int)	-0.661	1.82	.720
A. IV (Group- STP vs. UC) to Mediator (IES-int)	-1.99	1.61	.224
B. Mediator (PTG_1) to DV (WASO_1)	.740	.648	.262
C. Total Effect: Group (TYP vs. UC) to WASO_1	-8.89	6.72	.200
C. Total Effect: Group (STP vs. UC) to WASO_1	8.25	5.92	.173
C'. Direct Effect: Group (TYP vs. UC) to WASO_1	-8.40	6.70	.219
C'. Direct Effect: Group (STP vs. UC) to WASO_1	9.72	6.03	.117

Table 10

Mediational model of the effect of group on WASO at 1-week through 1-week IES-avoidance (IES-avo).

Path	Coefficient	SE	P
A. IV (Group- TYP vs. UC) to Mediator (IES-avo)	6.70	3.63	.075
A. IV (Group- STP vs. UC) to Mediator (IES-avo)	2.96	3.06	.341
B. Mediator (PTG_1) to DV (WASO_1)	-0.419	3.69	2.66
C. Total Effect: Group (TYP vs. UC) to WASO_1	-5.87	7.50	.440
C. Total Effect: Group (STP vs. UC) to WASO_1	9.12	6.31	.159
C'. Direct Effect: Group (TYP vs. UC) to WASO_1	-3.07	7.86	.699
C'. Direct Effect: Group (STP vs. UC) to WASO_1	10.36	6.38	.115

Exploratory. To explore the effect of 1-week posttraumatic growth (PTG) and 1-week posttraumatic stress symptoms (IES-int and IES-avo) on group on 3-month QOL, SF-36 PCS and MCS was analyzed using mediation using SPSS PROCESS macro (Hayes, 2013). There was no significant indirect effect of group (TYP vs. UC and STP vs. UC) on 3-month PCS and MCS, using 1-week PTG, 1-week IES-int, and 1-week IES-avo as the mediator.

CHAPTER V

Discussion

We examined factors mediating the effect of a Tibetan yoga program on sleep disturbance in women undergoing chemotherapy for breast cancer. No measures of posttraumatic growth or posttraumatic stress had a significant relative indirect mediation on the effect of group on sleep. Group differences were observed in the original article, specifically, the TYP group displayed fewer daily disturbances in sleep than the STP at each follow up time and fewer daily disturbances than UC 1 week after the intervention. The STP group also displayed more minutes awake after sleep onset (WASO) than both TYP and UC participants one week after the intervention ended. However, contrary to hypotheses, these group differences were not mediated by posttraumatic growth or posttraumatic stress symptoms, specifically intrusion and avoidance on the impact of events scale.

A reason for modest effects of the TYP on the original study and moreover the lack of significant effect of mediation may be due to the clinical characteristics of the patient population. This patient population varied in terms of type of surgery and at what point they had surgery throughout their treatment. The physical recovery from breast cancer surgery (i.e. mastectomy, lumpectomy, etc.) is complex (Kroenke, Johns, Theobald, Wu, & Tu, 2013). The timeline of their surgery recovery and the physical demands required on a patient may play a role yoga intervention and eventual outcomes.

Although we hypothesized that the weekly practice of yoga during chemotherapy treatment would support processing of a traumatic event, such as breast cancer diagnosis and treatment, and in turn facilitate posttraumatic growth and augment posttraumatic

stress symptoms, we were not able to evaluate this hypothesis due to missing practice data for individuals in the STP group.

It remains unclear if the mediating factors would play a mediating role if the population were screened for perceived stress. A meta-analysis (Schneider et al., 2010) examining psychosocial interventions on psychological distress found intervention effects are pronounced in patients that were high on distress pre-intervention and therefore psychosocial interventions may be most beneficial to cancer patients high in distress. Danhauer et al. (2019) found that women with higher negative affect and lower emotional well-being at baseline had a greater benefit from the yoga intervention. Another study found that women with higher depressive symptoms and greater sleep disturbances at baseline derived the greatest mental health related-QOL benefit from a yoga intervention delivered during radiotherapy (Ratcliff et al., 2016). This suggests that a yoga intervention's effect on sleep, and related mediating factors, will be may be most effective if patients with sleep related issues were selected.

There are several limitations stated by the original study. Recruiting patients undergoing chemotherapy was challenging, resulting in 56% participation rate, homogeneous population, patient-instructor encounter time, and the 1-on-1 format (Chaoul et al., 2018). However, there were no significant group differences noted between the patients that dropped out and those that participated. The study population is relatively homogeneous, with most white women, age 40-60, with higher education and socioeconomic status. All of these may be contributing factors of the sample population support system (i.e. social, financial, etc.) in comparison to someone with less financial means. At the time of this study, this study model of mind-body research was a novel

approach. Yoga interventions vary in style and approach, with the core concept of mind-body connection. Focusing on a yoga style that can be tailored to and is most conducive for a target population, including cultural implications, could further mind-body research. Further research into online and at-home yoga practice could continue to bridge treatment opportunities outside of a clinical setting. Future studies should target the immediate psychosocial and biological changes that occur within a short period of a cancer diagnosis. Continued research on the critical timing of a psychosocial intervention after diagnosis may lend insight to the overall trajectory of that woman's experience. Future studies should inquire about past life-time yoga practice, the perceived benefits of the intervention at baseline, methodology of the yoga intervention, other biological markers, and within marginalized populations.

Future research is needed to progress targeted psychosocial interventions. Women facing a breast cancer diagnosis and treatment, and those presenting with signs of depression, anxiety, distress, and sleep related issues would benefit from targeted psychosocial interventions, such as yoga.

REFERENCES

Aiken, L. S., & Stephen, G. (1987). *West. 1991. Multiple regression: Testing and interpreting interactions. Multiple Regression Testing and interpreting interactions*. https://doi.org/10.1074/jbc.271.11.6509

American Cancer Society. (2019). *Facts & Figures 2019. American Cancer Society*.

Amir, M., & Ramati, A. (2002). Post-traumatic symptoms, emotional distress and quality of life in long-term survivors of breast cancer: A preliminary research. *Journal of Anxiety Disorders*. https://doi.org/10.1016/S0887-6185(02)00095-6

Ancoli-Israel, S., Liu, L., Marler, M. R., Parker, B. A., Jones, V., Sadler, G. R., … Fiorentino, L. (2006). Fatigue, sleep, and circadian rhythms prior to chemotherapy for breast cancer. *Supportive Care in Cancer*. https://doi.org/10.1007/s00520-005-0861-0

Anderson, K. O., Getto, C. J., Mendoza, T. R., Palmer, S. N., Wang, X. S., Reyes-Gibby, C. C., & Cleeland, C. S. (2003). Fatigue and sleep disturbance in patients with cancer, patients with clinical depression, and community-dwelling adults. *Journal of Pain and Symptom Management*. https://doi.org/10.1016/S0885-3924(02)00682-6

Andysz, A., Merecz, D., Wójcik, A., ̄wiątkowska, B., Sierocka, K., & Najder, A. (2014). Effect of a 10-week yoga programme on the quality of life of women after breast cancer surgery. *Przeglad Menopauzalny*. https://doi.org/10.5114/pm.2014.43823

Arnaboldi, P., Riva, S., Crico, C., & Pravettoni, G. (2017). A systematic literature review exploring the prevalence of post-traumatic stress disorder and the role played by stress and traumatic stress in breast cancer diagnosis and trajectory. *Breast Cancer: Targets and Therapy*. https://doi.org/10.2147/BCTT.S111101

Berry, Donald A., P. D., Cronin, Kathleen A., P. D., Plevritis, Sylvia K., P. D., Fryback, Dennis G., P. D., Clarke, Lauren, M. S., Zelen, Marvin, P. D., … Feuer, Eric J., P. D. (2006). Effect of screening and adjuvant therapy on mortality from breast cancer: Commentary. *Obstetrical and Gynecological Survey*. https://doi.org/10.1097/01.ogx.0000201966.23445.91

Broeckel, J. A., Jacobsen, P. B., Horton, J., Balducci, L., & Lyman, G. H. (1998). Characteristics and correlates of fatigue after adjuvant chemotherapy for breast cancer. *Journal of Clinical Oncology*. https://doi.org/10.1200/JCO.1998.16.5.1689

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Carson, J. W., Carson, K. M., Olsen, M. K., Sanders, L., & Porter, L. S. (2017). Mindful Yoga for women with metastatic breast cancer: Design of a randomized controlled trial. *BMC Complementary and Alternative Medicine*, *17*(1). https://doi.org/10.1186/s12906-017-1672-9

Casellas-Grau, A., Vives, J., Font, A., & Ochoa, C. (2016). Positive psychological functioning in breast cancer: An integrative review. *Breast*. https://doi.org/10.1016/j.breast.2016.04.001

Chakrabarty, J., Fernandes, D., Joisa, G., Varghese, P., Mayya, S., & Vidyasagar, M. (2015). Effectiveness of pranayama on cancer-related fatigue in breast cancer patients undergoing radiation therapy: A randomized controlled trial. *International Journal of Yoga*. https://doi.org/10.4103/0973-6131.146062

Chandwani, K. D., Thornton, B., Perkins, G. H., Arun, B., Raghuram, N. V., Nagendra, H. R., … Cohen, L. (2010). Yoga improves quality of life and benefit finding in women undergoing radiotherapy for breast cancer. *Journal of the Society for Integrative Oncology*. https://doi.org/10.2310/7200.2010.0002

Chaoul, A., Milbury, K., Spelman, A., Basen-Engquist, K., Hall, M. H., Wei, Q., … Cohen, L. (2018). Randomized trial of Tibetan yoga in patients with breast cancer undergoing chemotherapy. *Cancer*. https://doi.org/10.1002/cncr.30938

Colagiuri, B., Christensen, S., Jensen, A. B., Price, M. A., Butow, P. N., & Zachariae, R. (2011). Prevalence and predictors of sleep difficulty in a national cohort of women with primary breast cancer three to four months postsurgery. *Journal of Pain and Symptom Management*. https://doi.org/10.1016/j.jpainsymman.2011.02.012

Cordova, M. J., & Andrykowski, M. A. (2003). Responses to cancer diagnosis and treatment: posttraumatic stress and posttraumatic growth. *Semin Clin Neuropsychiatry*. https://doi.org/S1084361203000546 [pii]

Cramer, H., Lange, S., Klose, P., Paul, A., & Dobos, G. (2012). Yoga for breast cancer patients and survivors: A systematic review and meta-analysis. *BMC Cancer*. https://doi.org/10.1186/1471-2407-12-412

Curigliano, G., Cardinale, D., Dent, S., Criscitiello, C., Aseyev, O., Lenihan, D., & Cipolla, C. M. (2016). Cardiotoxicity of anticancer treatments: Epidemiology, detection, and management. *CA: A Cancer Journal for Clinicians*. https://doi.org/10.3322/caac.21341

Danhauer, S. C., Addington, E. L., Cohen, L., Sohl, S. J., Van Puymbroeck, M., Albinati, N. K., & Culos-Reed, S. N. (2019). Yoga for symptom management in oncology: A

review of the evidence base and future directions for research. *Cancer*. https://doi.org/10.1002/cncr.31979

Danhauer, S. C., Mihalko, S. L., Russell, G. B., Campbell, C. R., Felder, L., Daley, K., & Levine, E. A. (2009). Restorative yoga for women with breast cancer: Finding from a randomized pilot study. *Psycho-Oncology*. https://doi.org/10.1002/pon.1503

Dong, S. T., Costa, D. S. J., Butow, P. N., Lovell, M. R., Agar, M., Velikova, G., … Fayers, P. M. (2016). Symptom Clusters in Advanced Cancer Patients: An Empirical Comparison of Statistical Methods and the Impact on Quality of Life. *Journal of Pain and Symptom Management*. https://doi.org/10.1016/j.jpainsymman.2015.07.013

Dunne, M., & Keenan, K. (2016). CE: Late and long-term sequelae of breast cancer treatment. *American Journal of Nursing*. https://doi.org/10.1097/01.NAJ.0000484223.07306.45

El-Hashimi, D., & Gorey, K. M. (2019). Yoga-Specific Enhancement of Quality of Life Among Women With Breast Cancer: Systematic Review and Exploratory Meta-Analysis of Randomized Controlled Trials. *Journal of Evidence-Based Integrative Medicine*. https://doi.org/10.1177/2515690X19828325

Green, B. L., Rowland, J. H., Krupnick, J. L., Epstein, S. A., Stockton, P., Stern, N. M., … Steakley, C. (1998). Prevalence of posttraumatic stress disorder in women with breast cancer. *Psychosomatics*. https://doi.org/10.1016/S0033-3182(98)71356-8

Gurevich, M., Devins, G. M., & Rodin, G. M. (2002). Stress Response Syndromes and Cancer: Conceptual and Assessment Issues. *Psychosomatics*. https://doi.org/10.1176/appi.psy.43.4.259

Harder, H., Parlour, L., & Jenkins, V. (2012). Randomised controlled trials of yoga interventions for women with breast cancer: A systematic literature review. *Supportive Care in Cancer*. https://doi.org/10.1007/s00520-012-1611-8

Hill, E. M., & Watkins, K. (2017). Women with Ovarian Cancer: Examining the Role of Social Support and Rumination in Posttraumatic Growth, Psychological Distress, and Psychological Well-being. *Journal of Clinical Psychology in Medical Settings, 24*(1). https://doi.org/10.1007/s10880-016-9482-7

Janelsins, M. C., Peppone, L. J., Heckler, C. E., Kesler, S. R., Sprod, L. K., Atkins, J., … Mustian, K. M. (2016). YOCAS©® Yoga Reduces Self-reported Memory Difficulty in Cancer Survivors in a Nationwide Randomized Clinical Trial: Investigating Relationships between Memory and Sleep. *Integrative Cancer Therapies.* https://doi.org/10.1177/1534735415617021

Jemal, A., Bray, F., Center, M. M., Ferlay, J., Ward, E., & Forman, D. (2011). Global cancer statistics. *CA: A Cancer Journal for Clinicians*. https://doi.org/10.3322/caac.20107

Jones, J. M., Olson, K., Catton, P., Catton, C. N., Fleshner, N. E., Krzyzanowska, M. K., … Howell, D. (2016). Cancer-related fatigue and associated disability in post-treatment cancer survivors. *Journal of Cancer Survivorship*. https://doi.org/10.1007/s11764-015-0450-2

Kangas, M., Henry, J. L., & Bryant, R. A. (2002). Posttraumatic stress disorder following cancer: A conceptual and empirical review. *Clinical Psychology Review*. https://doi.org/10.1016/S0272-7358(01)00118-0

Kiecolt-Glaser, J. K., Bennett, J. M., Andridge, R., Peng, J., Shapiro, C. L., Malarkey, W.

B., … Glaser, R. (2014). Yoga's impact on inflammation, mood, and fatigue in breast cancer survivors: A randomized controlled trial. *Journal of Clinical Oncology*. https://doi.org/10.1200/JCO.2013.51.8860

Kolokotroni, P., Anagnostopoulos, F., & Tsikkinis, A. (2014). Psychosocial Factors Related to Posttraumatic Growth in Breast Cancer Survivors: A Review. *Women and Health*. https://doi.org/10.1080/03630242.2014.899543

Koutrouli, N., Anagnostopoulos, F., & Potamianos, G. (2012). Posttraumatic stress disorder and posttraumatic growth in breast cancer patients: A systematic review. *Women & Health, 52*(5), 503–516. https://doi.org/10.1080/03630242.2012.679337

Kraemer, H. C., Kiernan, M., Essex, M., & Kupfer, D. J. (2008). How and Why Criteria Defining Moderators and Mediators Differ Between the Baron & Kenny and MacArthur Approaches. *Health Psychology*. https://doi.org/10.1037/0278-6133.27.2(Suppl.).S101

Kroemeke, A., Bargiel-Matusiewicz, K., & Kalamarz, M. (2017). Mixed Psychological Changes Following Mastectomy: Unique Predictors and Heterogeneity of Post-traumatic Growth and Post-traumatic Depreciation. *Frontiers in Psychology, 8*, 1245. https://doi.org/10.3389/fpsyg.2017.01245

Kroenke, K., Johns, S. A., Theobald, D., Wu, J., & Tu, W. (2013). Somatic symptoms in cancer patients trajectory over 12 months and impact on functional status and disability. *Supportive Care in Cancer*. https://doi.org/10.1007/s00520-012-1578-5

Lin, P. J., Peppone, L. J., Janelsins, M. C., Mohile, S. G., Kamen, C. S., Kleckner, I. R., … Mustian, K. M. (2018). Yoga for the Management of Cancer Treatment-Related Toxicities. *Current Oncology Reports*. https://doi.org/10.1007/s11912-018-0657-2

Loeffler, S., Poehlmann, K., & Hornemann, B. (2018). Finding meaning in suffering?-Meaning making and psychological adjustment over the course of a breast cancer disease. *European Journal of Cancer Care, 27*(3), e12841. https://doi.org/10.1111/ecc.12841

Luoma, M. L., & Hakamies-Blomqvist, L. (2004). The meaning of quality of life in patients being treated for advanced breast cancer: A qualitative study. *Psycho-Oncology*. https://doi.org/10.1002/pon.788

Mao, J. J., Palmer, C. S., Healy, K. E., Desai, K., & Amsterdam, J. (2011). Complementary and alternative medicine use among cancer survivors: A population-based study. *Journal of Cancer Survivorship*. https://doi.org/10.1007/s11764-010-0153-7

McCall, M., Thorne, S., Ward, A., & Heneghan, C. (2015). Yoga in adult cancer: An exploratory, qualitative analysis of the patient experience. *BMC Complementary and Alternative Medicine*. https://doi.org/10.1186/s12906-015-0738-9

Mcdonough, M. H., Sabiston, C. M., & Wrosch, C. (2014). Predicting changes in posttraumatic growth and subjective well-being among breast cancer survivors: The role of social support and stress. *Psycho-Oncology*. https://doi.org/10.1002/pon.3380

Moadel, A. B., Shah, C., Wylie-Rosett, J., Harris, M. S., Patel, S. R., Hall, C. B., & Sparano, J. A. (2007). Randomized controlled trial of yoga among a multiethnic sample of breast cancer patients: Effects on quality of life. *Journal of Clinical Oncology*. https://doi.org/10.1200/JCO.2006.06.6027

Mustian, K. M., Sprod, L. K., Janelsins, M., Peppone, L. J., Palesh, O. G., Chandwani, K., … Morrow, G. R. (2013). Multicenter, randomized controlled trial of yoga for

sleep quality among cancer survivors. *Journal of Clinical Oncology*. https://doi.org/10.1200/JCO.2012.43.7707

National Institutes of Health. (2017). *Cancer Statistics - National Cancer Institute*. *NIH.Gov*. https://doi.org/10.1111/j.1745-4514.2006.00069.x

Oliveri, S., Arnaboldi, P., Pizzoli, S. F. M., Faccio, F., Giudice, A. V., Sangalli, C., … Pravettoni, G. (2019). PTSD symptom clusters associated with short- And long-term adjustment in early diagnosed breast cancer patients. *Ecancermedicalscience*. https://doi.org/10.3332/ecancer.2019.917

Palesh, O., Aldridge-Gerry, A., Ulusakarya, A., Ortiz-Tudela, E., Capuron, L., & Innominato, P. F. (2013). Sleep disruption in breast cancer patients and survivors. *JNCCN Journal of the National Comprehensive Cancer Network*. https://doi.org/10.6004/jnccn.2013.0179

Rahmani, S., & Talepasand, S. (2015). The effect of group mindfulness - based stress reduction program and conscious yoga on the fatigue severity and global and specific life quality in women with breast cancer. *Medical Journal of the Islamic Republic of Iran*.

Ratcliff, C. G., Milbury, K., Chandwani, K. D., Chaoul, A., Perkins, G., Nagarathna, R., … Cohen, L. (2016). Examining Mediators and Moderators of Yoga for Women With Breast Cancer Undergoing Radiotherapy. *Integrative Cancer Therapies*, *15*(3), 250–262. https://doi.org/10.1177/1534735415624141

Ruini, C., Vescovelli, F., & Albieri, E. (2013). Post-traumatic growth in breast cancer survivors: New insights into its relationships with well-being and distress. *Journal of Clinical Psychology in Medical Settings*. https://doi.org/10.1007/s10880-012-9340-1

Satchidananda, S. S. (2012). The Yoga Sutras of Patanjali. *Integral Yoga Publications*. https://doi.org/10.1002/sim.3775

Schmidt, M. E., Chang-Claude, J., Vrieling, A., Heinz, J., Flesch-Janys, D., & Steindorf, K. (2012). Fatigue and quality of life in breast cancer survivors: Temporal courses and long-term pattern. *Journal of Cancer Survivorship*. https://doi.org/10.1007/s11764-011-0197-3

Schneider, S., Moyer, A., Knapp-Oliver, S., Sohl, S., Cannella, D., & Targhetta, V. (2010). Pre-intervention distress moderates the efficacy of psychosocial treatment for cancer patients: A meta-analysis. *Journal of Behavioral Medicine*. https://doi.org/10.1007/s10865-009-9227-2

Sears, S. R., Stanton, A. L., & Danoff-Burg, S. (2003). The yellow brick road and the Emerald City: Benefit finding, positive reappraisal coping, and posttraumatic growth in women with early-stage breast cancer. *Health Psychology*. https://doi.org/10.1037/0278-6133.22.5.487

Siedentopf, F., Utz-Billing, I., Gairing, S., Schoenegg, W., Kentenich, H., & Kollak, I. (2013). Yoga for patients with early breast cancer and its impact on quality of life - A randomized controlled trial. *Geburtshilfe Und Frauenheilkunde*. https://doi.org/10.1055/s-0032-1328438

Smith, K. B., & Pukall, C. F. (2009). An evidence-based review of yoga as a complementary intervention for patients with cancer. *Psycho-Oncology*. https://doi.org/10.1002/pon.1411

Taso, C. J., Lin, H. S., Lin, W. L., Chen, S. M., Huang, W. T., & Chen, S. W. (2014). The effect of yoga exercise on improving depression, anxiety, and fatigue in women with

breast cancer: A randomized controlled trial. *Journal of Nursing Research*. https://doi.org/10.1097/jnr.0000000000000044

Tedeschi, R. G., & Calhoun, L. G. (1996). The posttraumatic growth inventory: Measuring the positive legacy of trauma. *Journal of Traumatic Stress*. https://doi.org/10.1002/jts.2490090305

Vadiraja, H. S., Rao, M. R., Nagarathna, R., Nagendra, H. R., Rekha, M., Vanitha, N., … Rao, N. (2009). Effects of yoga program on quality of life and affect in early breast cancer patients undergoing adjuvant radiotherapy: A randomized controlled trial. *Complementary Therapies in Medicine*. https://doi.org/10.1016/j.ctim.2009.06.004

van de Wiel, H., Geerts, E., & Hoekstra-Weebers, J. (2008). Explaining inconsistent results in cancer quality of life studies: The role of the stress-response system. *Psycho-Oncology*. https://doi.org/10.1002/pon.1214

Von Ah, D. M., Russell, K. M., Carpenter, J., Monahan, P. O., Qianqian, Z., Tallman, E., … Champion, V. L. (2012). Health-related quality of life of African American breast cancer survivors compared with healthy African American women. *Cancer Nursing*. https://doi.org/10.1097/NCC.0b013e3182393de3

Weiss, T. (2002). Posttraumatic growth in women with breast cancer and their husbands: An intersubjective validation study. *Journal of Psychosocial Oncology*. https://doi.org/10.1300/J077v20n02_04

Williams, P. G., Holmbeck, G. N., & Greenley, R. N. (2002). Adolescent health psychology. *Journal of Consulting and Clinical Psychology*. https://doi.org/10.1037//0022-006x.70.3.828

World Health Organization. (2019). *WHO | Breast cancer*. *WHO*.

Wu, H. S., & Harden, J. K. (2015). Symptom Burden and quality of life in survivorship: A review of the literature. *Cancer Nursing*. https://doi.org/10.1097/NCC.0000000000000135

Yagli, N. V., & Ulger, O. (2015). The effects of yoga on the quality of life and depression in elderly breast cancer patients. *Complementary Therapies in Clinical Practice*, *21*(1). https://doi.org/10.1016/j.ctcp.2015.01.002

VITA

MELISSA SARTAIN, B.S.

Education

M.A.	Sam Houston State University, Huntsville, TX
Summer 2020	Clinical Psychology
	Thesis: *Examining Mediators of the Effect of Yoga on Quality of Life and Sleep in Breast Cancer Patients Undergoing Chemotherapy (Defended June 2020)*
	Chair: Chelsea Ratcliff, Ph.D.
	GPA: 3.92
B.S.	Michigan State University, East Lansing, MI
May 2011	Genomics and Molecular Genetics
	GPA: 3.1975

Academic Employment

August 2019 –	**Teaching Assistant**
May 2020	Department of Psychology and Philosophy
	Sam Houston State University, Huntsville, Texas
	Psychology 3331: *Abnormal Psychology*
	Responsibilities:
	Graded written assignments, proctored exams, entered grades into the Blackboard system, and was a resource for students with questions about lecture.

Manuscripts in Preparation

1. **Sartain, M.**, Ratcliff, C., Chaoul, A., Cohen, L. (In Preparation). Examining mediators of the effect of yoga on sleep in breast cancer patients undergoing chemotherapy.

Conference Presentations

1. **Sartain, M.**, Ratcliff, C., Chaoul, A., Cohen, L., (2019). *Examining mediators of the effect of coping strategies on quality of life for women undergoing chemotherapy for breast cancer.* Selected for oral presentation at the annual conference of the American Psychosomatic Society, Vancouver, BC

2. **Sartain, M.**, Friderici, K., (2011) *Characterization of mutant actins with known actin binding proteins using a yeast 2 hybrid approach*. Poster presentation at the annual University Undergraduate Research and Arts Forum, Michigan State University, East Lansing, MI

Research Experience

August 2018 – May 2020 **Graduate Research Assistant**
Integrative Health Lab
Department of Psychology and Philosophy, Sam Houston State University
Supervisor: Chelsea Ratcliff, Ph.D.
Projects/Duties: Worked on two ongoing studies, Couples-Based Mindfulness Intervention Study and Politics & Psychology: How Today's News Affects our Bodies and Minds. Contributed to manuscript development for 2 sets of secondary analyses using existing data, noted in the "In preparation" section above.

2010 – 2011 **Research Assistant**
Human Genetics Lab
Department of Microbiology and Molecular Genetics
Michigan State University, East Lansing, MI
Supervisor: Karen Friderici, Ph.D.
Projects/Duties: Assisted in data collection through various research techniques such as polymerase chain rection (PCR), cloning techniques, DNA/RNA preparation, extraction, digestion, ligation, and purification assays, sequence analysis, mouse dissection and genotyping, and transformation assay. I predominately worked on characterizing mutant-actin genes within the hearing-impaired population.

Ad Hoc Review Experience

April 2019 *Mindfulness* (Co-Reviewer)

October 2019 *Mindfulness* (Co-Reviewer)

Clinical/Practicum Experience

Spring 2020 **Master's Practicum Student**

Total Wellness Assessments & Counseling Center Humble, TX
Setting: Community Mental Health Center
Population: Ethnically diverse adolescent and adult patients with various mental health concerns
Responsibilities:

- Provide care through assessment, development, and implementation of evidence-based treatment plans
- Provide routine counseling to clients with mental health issues including anxiety, depression, trauma, stress management, adolescent issues
  Supervisor: Dr. Gina Hudnall, Ph.D.

Professional Society Affiliations

2019-present	American Psychosomatic Society *Associate Member*
2019-present	American Psychological Association *Graduate Student Affiliate*
2018-present	Association for Psychological Science *Graduate Student Affiliate*
2018-present	Graduate Student Psychology Organization, Sam Houston State University *Member*

Professional Development and Training

September 2019	*Cultural Diversity Training* Tri-County Behavioral Healthcare, Conroe, TX
September 2019	*Satori Alternatives to Managing Aggression (SAMA) Training* Tri-County Behavioral Healthcare, Conroe, TX *Presenter:* Christopher Carni, LPC
August 2019	*Protocol Therapist Training for Mindfulness Based Dyadic Therapy* MD Anderson Cancer Center, Houston, Texas *Presenter:* Kathrin Milbury, Ph.D.
July 2019	*Rigor and Reproducibility Scientific Data Integrity Workshop* Gulf Coast Consortia for Quantitative Biomedical Sciences, Houston, TX *Presenter*: Melissa Eitzen, MT(ASCCP), MS, RQAP-GLP
November 2018	C*ortisol Assay Training* Biological Sciences Department, Sam Houston State University *Presenter:* Jim Harper, Ph.D.