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The Effect of Mindfulness Meditation on Perceived Stress and Total Health Care Cost

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Abstract

Background: Chronic stress can lead to hypertension, tachycardia, and increased inflammatory markers, which put individuals at risk for chronic diseases. Mindful meditation not only decreases perceived stress but also has the potential to decrease the risk of chronic diseases and health care cost. **Purpose:** The purpose of this mindfulness meditation project is to reaffirm that mindfulness meditation decreases perceived stress scores and to determine whether mindfulness meditation decreases health care cost. **Theoretical Model:** The relation of mindfulness meditation, lowered stress levels, and chronic diseases can be explained by the social cognitive theory (SCT). Applying SCT, meditation's goal is to alter one's environment and personal cognitive and affective factors in order to decrease stress and to influence one's persona to respond appropriately to emotional and maladaptive behavior. **Project Design:** The quasi-experimental mindfulness meditation project analyzed the pre- versus post- perceived stress scores and claims data. Data collection was accomplished through perceived stress score surveys and claims data retrieval for demographic data, chronic diseases, and cost of health care. **Results:** 36 participants in three mindfulness meditation groups completed the program. Of these, 22 participated in private sessions, 7 participated in group sessions, and 7 participated in both private and group sessions. A total of 13 participants within the sample population had complete claims data 6 months pre-program and 6 months post-program. Participants reported significant decreases in perceived stress after participating in the mindfulness meditation program ($t = 7.346$, $p < .05$) with a large effect size ($r=0.779$). Participant's total health care cost retrieved from claims data did not show a significant difference in cost after participating in the mindfulness meditation program ($p>.05$). **Discussion:** The study reaffirmed participation in a mindfulness meditation program as an effective strategy to decrease perceived stress. This

finding is consistent with the literature that mindfulness training should increase one's ability to respond mindfully to daily life experiences, which in turn should lead to improvements in the person's ability to adapt to stress. No significant change in health care cost occurred within 6 months of program completion. Future studies could analyze the effect of mindfulness meditation on participant health care cost over a longer period of time.

Keywords: mindfulness meditation, perceived stress, cost

The Effect of Mindfulness Meditation on Perceived Stress and Total Health Care Cost

Introduction

Although stress, a normal component of daily life, has several physiologic protective factors, chronic stress can result in detrimental consequences to the human body. For example, acute stress can be beneficial for the body in a fight or flight situation; however, chronic stress can lead to sustained hypertension, tachycardia, and unhealthy behaviors. According to the American Psychological Association (APA) (2014), 75% of Americans report at least one symptom of stress monthly. Stress symptoms include but are not limited to fatigue, inability to concentrate, and stomach upset. The negative effects of chronic stress put individuals at an increased risk for developing chronic diseases.

The disorders linked to stress are depression/anxiety, heart attack, stroke, hypertension, and immune system disturbances including autoimmune diseases (American Institute of Stress, 2016). The link between stress and chronic diseases originates from the stress response, which is triggered by a perceived threat. The sympathetic nervous system signals the adrenal glands to release adrenaline and cortisol which increase the heart rate, blood pressure, and glucose levels. Recent studies have discovered chronic stress increases inflammatory markers, decreases heart rate variability, and leads to an increase in mortality (Keller, Meyer, Wohlbier, Overath, & Kropp, 2016; Miller, Chen, & Parker, 2011; Rosenkranz, et al., 2016; Rutters, et al, 2014; Shearer, Hunt, Chowdhury, Nicol, 2016; Wolever, et al., 2012). Therefore, repeated episodes of stress can lead to inflammation in the coronary arteries and increase one's risk for a myocardial infarction and death (American Institute of Stress, 2016).

Along with the increased risk of chronic disease development and mortality, the prevalence of chronic diseases and the cost of health care continue to rise. Half of all adults in

the United States have one or more chronic health conditions (Centers for Disease Control and Prevention, 2016a). The most common, costly, and preventable chronic conditions are heart disease, stroke, cancer, type 2 diabetes, obesity, and arthritis, all of which may be worsened by chronic stress (CDC, 2016a). Each year in the United States, cardiovascular diseases account for $108.9 billion and 610,000 deaths (CDC, 2015b). Health care for hypertension alone costs the nation approximately 46 billion dollars per year (CDC, 2015c). Overall, 86% of all health care spending is contributed to chronic diseases (CDC, 2016b). The prevalence of chronic disease processes and cost of health care are on the rise, therefore, it is crucial to minimize the risk of chronic disease development and improve chronic disease management. One way to minimize that risk is to practice stress management through mindfulness meditation. In several studies, mindfulness meditation decreased stress, improved sleep quality, and improved overall health and well-being in various settings (Baer, Carmody, & Hunsinger, 2012; Cash, et al., 2015; Geary & Rosenthal, 2011; Shearer, Hunt, Chowdhury, & Nicole, 2016; Wolever, et al., 2012).

Problem Statement

Approximately 75% of people experience stress monthly or more often (APA, 2014). Chronic stress puts individuals at risk for costly, chronic diseases which occur in one out of two individuals in the United States (CDC, 2016a). In 2015, the Health Care Cost Institute disclosed the cost of health care rose 4.6 percent and the CDC (2013) attributed ~75% of total health expenditures to chronic diseases. In addition, the cost of health care continues to rise. In 2013, the United States spent $2 trillion on medical care and by 2014 had increased its medical expenditures to $3 trillion (CDC, 2013; CDC, 2016b). With the rising cost of healthcare, prevention of chronic diseases is necessary. Some chronic diseases can be prevented, minimized, or managed with stress reduction. Mindfulness meditation is a possible solution for

stress reduction, prevention and improved control of chronic diseases, and health care cost reduction. The research supporting mindfulness meditation as an effective stress management tool is lacking evidence linking this practice with decreased health care costs.

Purpose

The purposes of this project were to reaffirm that mindfulness meditation decreases perceived stress and to determine whether mindfulness meditation affects health care cost among 36 MissionPoint members. The objectives of the project included determining the pre- and post-perceived stress scores, whether there is a positive effect on health care cost, and were there any specific disease populations who had a greater effect from the mindfulness meditation program. A validated tool was used to assess perceived stress scores. The research question was "In 36 MissionPoint members, what effect does mindfulness meditation have on perceived stress scores and total health care claims?"

Review of Evidence

Mindfulness meditation is a therapeutic tool for mental and physical health that affects one's body through sound, breath, positioning, open thoughts, and attention (Fjorback, Arendt, Ornbol, Fink, & Walach, 2011; Geary & Rosenthal, 2011; Weymouth, 2007). Meditation alters the individual and his/her environment to modify one's behavior to focus on the present rather than the past or future. The literature conclusively reports mindfulness meditation reduces perceived stress scores (Baer, Carmody, & Hunsinger, 2012; Cash, et al., 2015; Geary & Rosenthal, 2011; Wolever, et al., 2012).

Mindfulness Meditation

The Buddhist community has practiced meditation for thousands of years. According to various methodologies, meditation can be practiced in several ways; even so, the common goal

of meditation is to quiet one's mind and focus on the present (Holzel, et al., 2011; Vago & Silbersweig, 2012). During the process of quieting one's mind, one can gain mindfulness by addressing two components: regulating one's attention and approaching experiences with curiosity, openness, and acceptance (Holzel, et al., 2011; Vago & Silbersweig, 2012). The concept of mindfulness focuses on gaining a state of mind with nonjudgmental attention to present experiences and allows one to expand his/her awareness to pay attention to experienced sensations, thoughts, emotions, and memories (Matchim, Armer, & Stewart, 2011).

Effect of Mindfulness Meditation on Stress

In the past, mindfulness meditation was a Buddhist practice to gain enduring happiness (Holzel, et al., 2011). The incidental outcome of this religious practice is relaxation. Because of the relaxation effect of meditation, it is now commonly used as a coping mechanism for stress (Baer, Carmody, & Hunsinger, 2012). Several studies have found mindfulness meditation to decrease perceived stress, increase attention control, and increase one's perception of health and well-being (Baer, Carmody, & Hunsinger, 2012; Bruin, van der Zwan, & Bogels, 2016; Cash et al., 2015; Creswell et al., 2016; Geary & Rosenthal, 2011; Keller et al., 2016; Rosenkranz et al., 2016; Wolever et al., 2012). Not only does mindfulness meditation lower perceived stress scores but it also can happen quickly. Baer, Carmody & Hunsinger (2012) discovered individuals who practice mindfulness meditation have a measurable increase in mindfulness by week two; however, perceived stress scores do not improve until week four.

Meditation's Physiologic Effects on Stress

Mindfulness meditation is a non-invasive, effective therapy for stress management and positively affects one's physical and mental health (Baer, Carmody, & Hunsinger, 2012). The health benefits of mindfulness meditation include decreased blood pressure and cortisol levels,

improved immune function and sleep quality, increased telomerase activity, decreased perceived stress, and minimized heart rate variability (Baime, 2012). Wolever, et al. (2012) evaluated a mind-body workplace stress reduction program including yoga and mindfulness meditation. The study consisted of 239 employees via convenience sampling divided into a yoga-based program group, a mindfulness via online program group, a mindfulness via in-person program, and a control group. Compared to the control group, all intervention groups documented significant improvements in perceived stress, sleep quality, and heart rate variability; the online vs. in-person programs were equivalent (Wolever, et al., 2012). An improvement in heart rate variability improves the body's efficacy and ability to self-regulate by stimulating the vagal nerve to gain a restful state (Shearer, Hunt, Chowdhury, & Nicol, 2016). Studies performed by Shearer, Hunt, Chowdhury and Nicol (2016) and Azam et al. (2015) found an improvement in heart rate variability after participation in mindfulness meditation programs. This improvement shows the population is more adaptive to stress after mindfulness meditation. Previous research on mindfulness-based programs in the workplace improve mood, well-being, psychological distress, systolic blood pressure, and sympathetic activation (Hartfiel Havenhand, Khalsa, Clarke, & Krayer, 2011; Limm et al., 2011; McCraty, Atkinson, & Tomasino, 2003; Mino, Babazono, Tsuda, & Yasuda, 2006).

Mindfulness meditation can lower blood pressure in multiple populations (Carlson, Speca, Faris, & Patel, 2007; Matchim, Armer, & Stewart, 2011; Palta et al., 2012; Rosenzweig, et al., 2007). Blood pressure was evaluated in African-Americans after an 8-week mindfulness based program showing statistical significance in the mean systolic and diastolic blood pressures; the mean systolic blood pressure decreased by 21.92mmHg and the mean diastolic blood pressure decreased by 16.70mmHg (Palta et al., 2012). Matchim, Armer, and Stewart (2011) discovered a

decrease in blood pressure after a mindfulness-based stress reduction program among breast cancer survivors. Rosenzweig et al. (2007) found the mean arterial pressure statistically decreased by 6mmHg after a mindfulness-based stress reduction program among Type II diabetics. Lastly, Carlson, Speca, Faris, and Patel (2007) found the systolic blood pressure decreased significantly after a mindfulness-based stress reduction program in breast and prostate cancer patients.

Mindfulness-based stress reduction programs decreased the amount of cortisol released, increased the cortisol reactivity, and decreased the inflammatory response (Creswell, Pacilio, Lindsay, & Brown, 2014; Keller et al., 2016; Rosenkranz et al., 2016). A decrease in cortisol allows the body to respond to stressful events with less hormonal intervention and an increase in cortisol reactivity correlates to the body's ability to respond to stressors quickly. In other words, stressful events are not as taxing on the body as they once were and the body is able to respond quicker due to the increase in cortisol reactivity.

Overall, the literature shows mindfulness meditation and mindfulness-based stress reduction programs aid in mental and physical health. An increase in heart rate variability enables individuals to adapt to stressful situations more efficiently. In addition, a decrease in cortisol and an increase in cortisol reactivity allow individuals to respond to stressful situations more effectively. A decrease in the inflammatory response could aid those with chronic inflammatory conditions (Rosenkranz et al., 2016). A measurable, physiologic outcome of mindfulness meditation is blood pressure; the literature shows mindfulness meditation decreases blood pressure in multiple populations. The literature has not reported any negative physiologic outcomes associated with mindfulness meditation.

Effects of Physiologic Stress

In a state of stress, an individual's heart rate, stress hormones, and blood pressure all increase. Due to this mechanism of action, comorbidities including conditions of the heart and blood vessels may arise from chronic stress (APA, 2016). Chronic stress can be identified as repetitive or long-term which can lead to sustained elevated heart rate and blood pressure; both of which put an individual at risk for hypertension, heart attack, and/or stroke (APA, 2016). These disorders can further lead to chronic heart failure and/or chronic kidney disease (CDC, 2015c).

Rutters, et al. (2014) found individuals with three or more stressful life events exhibited unhealthy behaviors such as smoking and possessed comorbidities including cardiovascular disease and diabetes which all put the individual at an increased risk of mortality. Miller, Chen, and Parker (2011) demonstrated a direct correlation of chronic stress with elevated inflammatory markers. Creswell, Pacilio, Lindsay, and Brown (2014) found mindfulness meditation to improve interleukin-6 at a four-month follow-up. An increase in inflammatory markers was associated with the development of metabolic syndrome (hypertension, hyperlipidemia, obesity, elevated fasting blood glucose), atherosclerosis, autoimmune conditions, the growth and spread of tumors, as well as frailty syndrome which is comprised of softening bone, loss of muscle mass, strength, and function, and decline in cognitive function (Miller, Chen, & Parker, 2011). Therefore, an improvement in interleukin-6 can decrease the risk of inflammatory diseases. As exhibited by the evidence, chronic stress can lead to detrimental changes to one's body and further lead to chronic diseases.

Meditation's Potential Cost Savings

With significant stress reduction, mindfulness meditation has the potential to decrease the risk of chronic diseases leading to a decrease in one's health care cost. Mindfulness meditation may be the link to decreasing stress, chronic diseases, and cost. Morledge, et al. (2013), Redstone (2015), and Shonin, van Gordon, & Griffiths (2013) project mindfulness meditation as a cost-effective therapy for stress reduction and the management of one's health. Morledge et al. (2013) suggests mindfulness meditation delivered via an online tool for a more cost-effective method. Redstone's (2015) pilot study of mindfulness meditation in an inpatient psychiatric unit resulted in decreased stress and anxiety among participants and suggests this program as a cost-effective therapy. Shonin, van Gordon, and Griffiths (2013) also reported mindfulness-based interventions to be cost-effective treatment for psychological and somatic illnesses. Zeng, Stason, Fournier, et al. (2013) found lifestyle programs including stress reduction to not only be beneficial to one's cardiovascular health but also to be a cost-effective management of coronary heart disease. Baime (2012) found mindfulness programs decreased perceived stress scores and theorized a decrease in health risks, cost, and increase in productivity. Despite this finding, research specifically analyzing the relationship between stress reduction and health care cost is needed.

Theoretical Model

The relation of mindfulness meditation, lowered stress levels, and chronic diseases can be explained by a theory grounded in psychology, the social cognitive theory (SCT). This theoretical framework lays the foundation for understanding the behavioral connection of mindfulness to stress reduction and was used as the theoretical model for the mindfulness meditation project.

SCT has been developed over many decades. Miller and Dollard (1941) proposed a social learning theory including the *person, environment,* and *behavior*. These 3 major constructs provide an explanation of psychosocial functioning and are connected in a triadic reciprocal causation (Bandura, 1986) (see Figure 1). The first construct, the *person*, has cognitive, affective, and biological factors contributing to the theoretical framework (Bandura, 1999). The *environment* or second construct considered in this framework includes the social and the physical environment (Miller & Dollard, 1941). The final construct, *behavior*, is molded by knowledge from exploratory activities, verbal instruction, and innovative cognitive syntheses of acquired knowledge (Bandura, 1999). The exploratory activities, verbal, and cognitive syntheses can arise from the *environment* and the *person*. In turn, one's *behavior* can influence one's environment and personal factors.

The aim of SCT in the mindfulness meditation project was to provide a theoretical framework of stress reduction through meditation. Bandura's framework was applied to the mindfulness meditation project by incorporating mindfulness meditation and how this intervention affects the *person, environment,* and *behavior* (see Figure 2). The model explains the bidirectional connections of stress *behaviors*, the adult participant's *personal factors*, and the *environment* of meditation.

The *personal factors* of the adult participant include cognitive, affective, and biological factors. The cognitive factor related to stress is the participant's existing coping skills whether positive or negative. Common reactions to a stressful event include anger, helplessness, and disbelief; however, some individuals have positive coping skills established such as taking a break or talking to others (CDC, 2015a). The affective factor is the participant's mood and SCT says optimists have a greater impact in shaping one's own destiny (Bandura, 1999). The

biological factor is the participant's physiologic stress response. The physiologic stress response is triggered by a stressor and the body then attempts to achieve homeostasis via the sympathomedullary pathway for short-term stress and via the Hypothalamic Pituitary-Adrenal system for long-term stress (McLeod, 2010). When chronic, the physiologic stress response puts individuals at an increased risk of mortality and chronic disease development as a result of increased inflammatory markers produced by the stress response (Miller, Chen, & Parker, 2011; Rutters, et al., 2014). All of these *personal factors* can affect and/or influence one's stress *behaviors* and/or *environment*.

The *environmental factors* include the setting and frequency of meditation sessions as well as the presence or absence of chronic diseases. The social *environment* of each participant's meditation is either a private or group session. Within the social *environment*, observational learning occurs in two different ways during the meditation project. One group of participants received the meditation program privately with a meditation leader whereas the other group of participants received the meditation program within a group of participants along with the meditation leader. The physical *environment* includes the meditation location, sounds, and props. The meditation sessions occurred in a quiet room with participants sitting in a chair or on a floor cushion with the meditation leader using a bell or singing bowl to redirect participant's attention. In addition to the physical and social *environment*, vicarious reinforcement occurred in the meditation program by requiring meditation sessions weekly. There was no reward or punishment for attending or not attending meditation sessions; even so, unintended consequences of absences may result in negative outcomes. The attendance rate and duration of program may affect one's stress reduction outcome (Baer, Carmody, & Hunsinger, 2012; Creswell, et al., 2014).

The *behavioral* component of the mindfulness meditation theoretical framework is stress. Stress is a condition characterized by physical or emotional tension (CDC, 2015a). The factors of stress addressed during mindfulness meditation include learned and innate coping mechanisms, one's feelings towards stress, and stress inducing or reducing *behaviors*. The intended, learned coping mechanism is mindfulness meditation. The mindfulness meditation sessions work to focus one's attention on feelings and sensations within the body, awareness of one's situation, and accepting the situation with a positive outlook. Once the participant has learned this coping mechanism, then the participant applies a positive affect towards stressful situations and engages in stress-reducing behaviors. Overall, mindfulness meditation encompasses all components of the social cognitive theory; mindfulness meditation embodies the participant, alters the environment, and teaches coping mechanisms and new affects towards stressful situations.

There are two major assumptions of SCT 1) the *person* is motivated and intends to change one's *behaviors* and 2) changes in the *environment* will lead to changes in *behavior* (Boston University School of Public Health, 2016). The mindfulness meditation program heavily relies on these two assumptions. The participants of the meditation program must be willing and eager to participate in order to gain mindfulness (Vago, 2012; Matchim, Armer, & Stewart, 2011). The goal of the mindfulness meditation program is to alter one's *persona* and *environment* in order to change one's stress *behaviors*.

Even though the meditation program relies on these assumptions, the social cognitive theory has been supported in the literature (McEwen & Wills, 2014). The social cognitive theory has been successfully used in a study associated with yoga and decreased feelings of anxiety and depression (Mehta & Sharma, 2011). In addition, Sharma (2015) discussed the use of social

cognitive theory in regulating meditation practices to reduce anxiety, manage arthritic pain, and smoking cessation. The social cognitive theoretical framework is projected to be successful in correlating meditation with decreased perceived stress scores.

Project Design

The mindfulness meditation project design was quasi-experimental due to the lack of random assignment. The sample was chosen via purposive sampling. Three groups were designated; participants who received private meditation sessions, participants who received meditation in a group session, and participants who received meditation in both private and group sessions. The purpose of this project was to reaffirm that mindfulness meditation decreases perceived stress and to determine whether mindfulness meditation affected health care cost. The independent variable was the mindfulness meditation program. The dependent variables were the perceived stress score and total health care cost. The perceived stress score was an interval variable whereas the cost was a ratio variable. The perceived stress score and cost depended on the mindfulness meditation intervention. Within this quasi-experimental design, the perceived stress scores and total cost of health care obtained followed a within-group pre-test post-test design.

A MissionPoint employee, using the concept of mindfulness, designed the mindfulness meditation program. The private meditation group received sixty-minute sessions weekly for four weeks with a meditation leader. The group sessions included the instructor with multiple participants for a single two and a half hour workshop. Some participants were grouped together for receiving both group and private sessions. The first meditation session identified and incorporated skillful means to assess the participant's intention of meditation. The remaining private and group meditation sessions focused on quieting one's mind, then approaching areas of

openness and curiosity. During each session, the participant had the option of sitting on the floor with cushions or sitting in a chair. The only prop used during the meditation session was a bell or singing bowl for centering and attention direction.

Clinical Setting

The mindfulness meditation project took place at MissionPoint Health Partners in Nashville, TN. MissionPoint is a privately owned for-profit population health management organization. MissionPoint's mission is "to make healthcare more affordable, accessible and improve the quality of care for our members" (MissionPoint, 2016). Overall, MissionPoint works with employers to improve the health of employees. MissionPoint serves approximately 250,000 members in six different states. The MissionPoint members who participated in the mindfulness meditation project were from the Tennessee district.

Project Population

Study participants were enrolled in a mindfulness meditation program at MissionPoint Health Partners. MissionPoint's healthcare providers purposely selected the MissionPoint members who exhibited a need for stress management. Providers identified the stress management need by identifying one's coping skills, sources of stress, self-awareness, and reactivity to stress. Those excluded from the referral process included members in an acute psychiatric crisis such as those exhibiting suicidal/homicidal ideation or those with a significant psychiatric history such as bipolar disorder or schizophrenia. The exclusion criterion was established for liability purposes due to the instability of patients with significant mental health conditions.

A total of 36 participants were included in the project. Of the 36 participants who received the intervention, 22 received private mindfulness meditation, 7 received group

mindfulness meditation, and 7 received both private and group mindfulness meditation. When it came to cost, only 13 participants of the 36 participants had complete claims data for cost data retrieval.

Belmont University's Institutional Review Board (IRB) verified the mindfulness meditation project as exempt because the project was an analysis of retrospective, de-identified data, and it presented no harm to human subjects. The verified exemption allowed the project to continue without obtaining an informed consent.

Sources of Data/Data Collection Instruments

The 4-item version of the perceived stress scale (PSS) also known as the PSS4 was used to collect pre-meditation and post-meditation perceived stress scores. This scale was delivered by paper survey prior to beginning the mindfulness meditation program as well as at the conclusion of the program. The PSS is a validated scale for measuring one's stress level. Cronbach alpha scores for the PSS range from 0.75 to 0.85 (Cohen, Karmarck, & Mermelstern, 1983). The PSS was created to allow one to measure one's stress over the past month through assessing one's unpredictable, uncontrollable, and overwhelming situations (Baer, Carmody, & Hunsinger, 2012). The PSS4 consists of four questions with each question scored from zero to four (0=Never; 1=Almost Never, 2=Sometimes, 3=Fairly Often, 4=Very Often). The scale is assumed to be a ratio with equal distances between values. The perceived stress scale total was scored from zero to sixteen. A higher score indicated a higher degree of perceived stress whereas a lower score indicated a lesser degree of perceived stress. Cohen, Kamarck, and Mermelstern (1983) reported the PSS has good internal consistency and expected correlations. As for the other dependent variable, the total cost of health care, was obtained from MissionPoint's claims data and measured in monetary units (US dollars).

Data Collection Process/Procedures

The pre-program perceived stress scale was administered to each participant and completed prior to beginning the mindfulness meditation program. These pre-program PSS4 scores assigned a perceived stress score according to the participants' responses. Post-program PSS4 were completed during the final mindfulness meditation session. Participants' PSS4 surveys were collected by the meditation leader.

Once the pre-program stress scores were obtained, the private mindfulness meditation sessions were completed weekly for four weeks whereas the group mindfulness meditation sessions consisted of a single two and a half hour session. A four-week period was validated in the literature as an adequate time period for changes in perceived stress to occur (Baer, Carmody, and Hunsinger, 2012). MissionPoint's Brian Woolworth, RN, led the mindfulness meditation sessions. Woolworth has focused his MissionPoint career on mindfulness meditation and its effect on one's psychological and physical well-being. Once the private participants completed the four-week program and the group participants completed the session, each participant completed a post-test of his/her perceived stress score. MissionPoint collected claims data on the study population.

The method of data collection was through surveys for the perceived stress scores and claims data for demographic data, health care data, and costs of health care. Any participants who had missing values of perceived stress scores were discarded from the population sample. The claims and demographic data were pre-collected by MissionPoint. The demographic data included gender and age. The claims data obtained included chronic diseases and the total cost of health care for each individual. The data obtained was from six months prior to the meditation program and from six months after the meditation program. The six month pre- and post-

claims data range was consistent with the literature (Jonk, et al., 2015). The pre- and post-claims data range enables the project to capture cost savings after behavior changes are performed.

A data analysis was performed among these variables. Descriptive statistics were performed on categorical demographic variables (age, gender, insurance provider) as well as chronic diseases. A Shapiro-Wilks test was performed to assess normality of the sample. A paired t-test was performed on pre- and post-meditation stress scores. The analyses within-groups (private, group, and private/group) and between-groups were not performed due to the small sample sizes of each group. A Related-Samples Wilcoxon Signed Rank Test was performed on the pre- and post-meditation cost.

Results

Demographics of Study Population

A total of 36 participants in three mindfulness meditation groups completed the program. See Table 1. Of these, 22 participated in private sessions, 7 participated in group sessions, and 7 participated in private and group sessions. Pre-post analyses were based on 36 participants with complete pre-post data. Of these, 18 (50%) self-reported attending three or fewer of the 4 weekly sessions, 14 (39%) self-reported attending five or more sessions, and 4 (11.1%) did not respond. A total of 13 participants within the sample population had complete claims data 6 months pre-program and 6 months post-program. Of these, 4 participated in private sessions, 3 participated in group sessions, and 6 participated in private and group sessions.

Participants' mean age was 55.19 years (standard deviation = 14.892, range 28-78) and 80.6% were female. See Table 1. The population sample received healthcare insurance from the following: 10 (27.8%) were covered by Medicare, 8 (22.2%) were covered by SmartHealth, 14

(38.9%) were covered by Blue Cross Blue Shield of Tennessee, 1 (2.8%) was covered by Amerigroup, and 1 (2.8%) was covered by Provider Chronic Care. Of 36 participants, 11 (30.6%) had no comorbidities, 13 (36.1%) had hypertension, hyperlipidemia, coronary artery disease, and/or type 2 diabetes mellitus, 13 (36.1%) had chronic pain, and 10 (27.8%) had anxiety and/or depression.

Pre-Post Changes in Perceived Stress

The first hypothesis of this project was that mindfulness meditation would decrease perceived stress scores. The Shapiro-Wilks test assumed sample to be approximately normal. The hypothesis was tested using a paired-sample t-test (n=36). As shown in Table 2 and Table 3, the overall stress scores as a result of mindfulness meditation were significantly reduced (t_{35}= 7.346, p < .001). Pre-post effect size was calculated. Effect size for the sample was large (r=0.779). We further examined the stress scores by delivery methods. The difference in perceived stress within private sessions (t_{21} = 5.488, p <.001), group sessions (t_6 = 3.361, p <.05), and private/group sessions (t_6 = 5.123, p <.01) all decreased (see Table 2).

The difference in perceived stress within and between each chronic disease group (HTN/HLD/CAD/DM, Chronic Pain, Anxiety/Depression) was undetermined due to small group sizes. The nonparametric Kruskal-Wallis test was performed to test the pre-perceived stress scores and post-perceived stress scores between chronic disease groups and was not significant.

Pre-Post Changes in Total Health Care Cost

The second hypothesis was total health care cost will decrease within 6 months after participating in a mindfulness meditation program. Cost data was limited; therefore, the sample was reduced from 36 to 13. Due to a small sample size (n=13), the hypothesis was tested using a nonparametric Related-Samples Wilcoxon Signed Rank Test. The Wilcoxon test suggested the

median of differences between pre-cost and post-cost were not significantly different from zero (n=13, p=.972). As shown in Table 4, participant's total health care cost retrieved from claims data did not show a significant difference in cost after participating in the mindfulness meditation program. Further analysis of the delivery method groups revealed non-significant findings.

Discussion

The primary purpose of this study was to reaffirm that mindfulness meditation decreases perceived stress scores and to determine whether mindfulness meditation decreases health care cost. The first hypothesis was that, consistent with previous studies, participation in a mindfulness meditation program would be associated with significant decreases in perceived stress. This hypothesis was supported. The participants' stress scores changed significantly in the expected direction and were consistent with the literature regarding perceived stress scores changing within four weeks. This finding is not only supported in previous studies but it is also supported by the social cognitive theory (Bandura, 1986; Creswell, et al., 2014; Morledge, et al., 2013; Redstone, 2015; Rosenkranz, et al., 2016; Van Dam, Hobkirk, Sheppard, Aviles-Andrews, & Earleywine, 2014). By altering one's environment through mindfulness meditation, the participant learns to positively adapt to stress that then allow stress behaviors and perceived stress to improve. This finding is consistent with the belief that mindfulness training should increase one's ability to respond mindfully to daily life experiences, which in turn should lead to improvements in the person's ability to adapt to stress (Holzel, et al., 2011; Shonin, Van Gordon, & Griffiths, 2013; Vago & Silversweig, 2012). With improved stress adaptability, mindfulness meditation has the potential to impact health outcomes. When moderating the stress response, the inflammatory response frequency decreases; therefore, the risk associated with stress-related diseases diminishes. Because the inflammatory response plays a role in the majority of chronic

diseases, effective interventions to modulate the stress response is important for disease prevention and management.

Examination of perceived stress at the subscale level showed that the private, group, and private/group participants all resulted in decreased perceived stress; however, statistical significance was not determined due to the small sample sizes of each group. This finding suggests that mindfulness meditation has positive results regardless of the delivery method, although the finding does not differentiate the various delivery methods of mindfulness meditation effectiveness. Future research could aim at which delivery method is the most effective. Likewise, the examination of perceived stress between those with hypertension, hyperlipidemia, coronary artery disease, and/or type II diabetes compared to those with chronic pain and/or anxiety and depression all resulted in decreased perceived stress but did not differentiate which co-morbidity group benefited the most due to the small sample sizes within groups. Patient populations who have seen perceived stress and disease improvement include hypertensive and migraine patients as well as breast cancer survivors. Stress compared among each co-morbidity group has not been established in the literature. Further research is needed to determine which co-morbidities are most impacted by perceived stress.

The second hypothesis predicted total health care cost would decrease within 6 months after participating in a mindfulness meditation program. This hypothesis was not supported. No significant change in health care cost occurred within 6 months. In previous studies, cost was not affected by a short-term mindfulness meditation program but was predicted to be effective in a long-term program lasting at least three years (Redstone, 2015; Shonin, Van Gordon, & Griffiths, 2013; Zeng, et al., 2013). Due to the stress response's negative impact on chronic diseases, the incidence of chronic conditions increases and disease processes progress causing a

greater burden on the health care system. Long-term studies are needed to determine the cost-effectiveness of mindfulness meditation programs on chronic conditions.

Strengths and Limitations of the Study

Several limitations to this study merit mention. The preliminary limitation was the lack of a control group which then prevented the conduction of comparison analyses. The greatest limitation was the small sample size of the subscales and the population with cost data. Future research should obtain an adequately powered sample as well as a control group in order to examine the impact of mindfulness meditation on health care cost. Despite the use of nonparametric tests due to small sample sizes, significant findings in the total health care cost between intervention groups is not conclusive. In addition, the study population mostly consisted of females and those who possessed the designated chronic diseases; therefore, the findings may not generalize to populations with other characteristics. Furthermore, the study participants' attendance varied which could have led to inconsistent results. Due to this inconsistency, encouraging attendance to all designated sessions would enhance the validity of future studies.

Despite these limitations, the current study brings value to the mindfulness literature by reproducing similar results related to perceived stress after participating in mindfulness sessions. A strength present in this study was the meditation leader implementing the private, group, and private/group sessions. Having had the same meditation leader for each group brought consistency to the mindfulness implementation phase. In addition, the meditation leader, Brian Woolworth, was a strength in this study due to his vast experience with mindfulness meditation. Lastly, the project results confirm previously published literature regarding the positive impact of mindfulness meditation on stress perception.

Conclusion

In summary, mindfulness meditation appears to have a positive impact on reducing perceived stress. These findings are likely due to the role that mindfulness meditation plays in altering an individual's environment and persona leading to positive changes in stress behaviors. Mindfulness meditation is an evidenced-based secondary prevention method with a positive effect on developing chronic diseases, as well as a tertiary prevention method for managing existing chronic diseases. The effect of mindfulness meditation on health care cost was undetermined in this study; however, future prospective studies should enroll a larger sample and analyze the longer-term effect of mindfulness meditation on health care cost.

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Appendix

Figure 1. Social Cognitive Theory (Boston University School of Public Health, 2016).

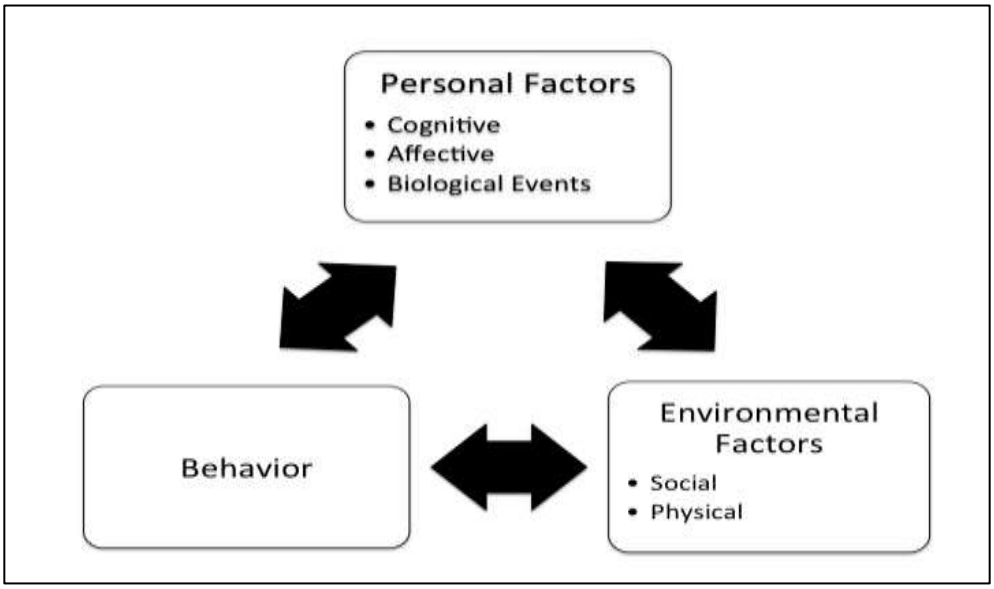

Figure 2. Mindfulness Meditation within the Social Cognitive Theoretical Framework

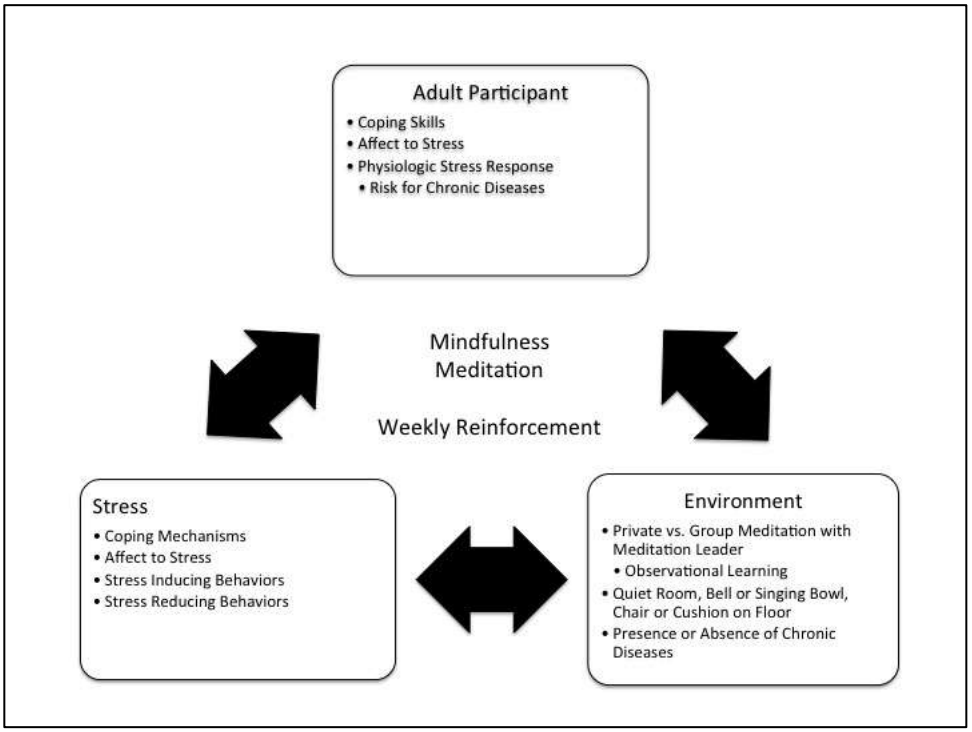

Table 1. Demographic and Health Status Characteristics of Participants

	Private Sessions	Group Sessions	Private & Group Sessions	Sample Population
Perceived Stress Sample				
	N=22	N=7	N=7	N=36
Cost Sample				
	N=4	N=3	N=6	N=13
Gender				
Male	5 (22.7%)	1 (14.3%)	1 (14.3%)	7 (19.4%)
Female	17 (77.3%)	6 (85.7%)	6 (85.7%)	29 (80.6%)
Age				
28-50y	5 (22.7%)	4 (57.1%)	3 (42.9%)	12 (33.3%)
50-65y	7 (31.8%)	3 (42.9%)	4 (57.1%)	14 (38.9%)
65y and older	10 (45.5%)	0 (0%)	0 (0%)	10 (27.8%)
Insurance Population				
Medicare	10 (45.5%)	0 (0%)	0 (0%)	10 (27.8%)
SmartHealth	4 (18.2%)	3 (40%)	2 (28.6%)	8 (22.2%)
Blue Cross Blue Shield of Tennessee	6 (27.3%)	4 (60%)	5 (71.4%)	14 (38.9%)
Amerigroup	1 (4.5%)	0 (0%)	0 (0%)	1 (2.8%)
Provider Chronic Care	1 (4.5%)	0 (0%)	0 (0%)	1 (2.8%)
Chronic Disease				
No Chronic Diseases	5 (22.7%)	4 (57.1%)	2 (28.6%)	11 (30.6%)
Hypertension, Hyperlipidemia, Diabetes, and/or Coronary Artery Disease	9 (40.9%)	2 (28.6%)	2 (28.6%)	13 (36.1%)
Chronic Pain	18 (81.8%)	2 (28.6%)	2 (28.6%)	13 (36.1%)
Anxiety and/or Depression	9 (40.9%)	0 (0%)	1 (14.3%)	10 (27.8%)
Session Frequency				
3 or Less	11 (50%)	4 (57.1%)	3 (42.9%)	18 (50%)
4 or More	9 (40.9%)	1 (14.3%)	4 (57.1%)	14 (38.9%)
Did Not Respond	2 (9.1%)	2 (28.6%)	0 (0%)	4 (11.1%)

Table 2. Perceived Stress at Pre-Meditation and Post-Meditation, Paired t-Tests, and Significance of Population Groups.

	N	Mean (SD)	t_{df}	p-value
Private Sessions	22			
Pre-PSS4		9.55 (3.447)	5.488_{21}	
Post-PSS4		4.95 (2.663)		.000***
Group Sessions	7			
Pre-PSS4		7.29 (2.690)	3.361_{6}	
Post-PSS4		5.00 (1.000)		.015*
Private & Group Sessions	7			
Pre-PSS4		9.57 (2.992)	5.123_{6}	
Post-PSS4		4.57 (1.512)		.002**
Total	36	4.222 (3.448)		
Pre-PSS4		9.11 (3.276)	7.346_{35}	
Post-PSS4		4.89 (2.201)		.000***

*Significant at p < .05
**Significant at p < .01
***Significant at p < .001

Table 3. Perceived Stress at Pre-Meditation and Post-Meditation, Paired t-Tests, and Significance of Sample Population.

Paired Samples Test Pre-PSS4 – Post-PSS4		
Mean		4.222
Std. Deviation		3.448
Std. Error Mean		.575
95% Confidence Interval of the Difference	Upper	5.389
	Lower	3.055
t		7.346
df		35
Sig. (2-tailed)		.000***

*Significant at p < .05
**Significant at p < .01
***Significant at p < .001

Table 4. Difference in Health Care Cost for Participants in the pre-participation and post-participation time periods.

	N	Mean (SD)	Sums
Private Sessions	4		
Pre-PSS4		$13,147.23 (21,248.47)	$52,589.27
Post-PSS4		$26,474.88 (44,246.64)	$105,899.50
Group Sessions	3		
Pre-PSS4		$29,880.73 (36,384.51)	$89,642.19
Post-PSS4		$49,124.85 (81,342.76)	$147,374.56
Private & Group Sessions	6		
Pre-PSS4		$5,953.02 (9,319.89)	$35,718.13
Post-PSS4		$2,113.6 (2,549.16)	$12,681.65
Total	13		
Pre-PSS4		$13,688.43 (21,570.08)	$177,949.59
Post-PSS4		$20,458.13 (44,505.01)	$265,955.71

Table 5. Mean Ranks of Health Care Cost for Participants in the pre-participation and post-participation time periods.

	N	Mean Rank	Significance
Private Sessions	4		
Pre-Cost		1.5	
Post-Cost		3.5	0.465
Group Sessions	3		
Pre-Cost		1.5	
Post-Cost		3.0	NS*
Private & Group Sessions	6		
Pre-Cost		3.5	
Post-Cost		3.5	0.463
Total	13		
Pre-Cost		5.75	
Post-Cost		9.00	0.972

*Not Significant

**Significant at $p < .05$