ASSOCIATIONS BETWEEN MIND-BODY INTERVENTION ATTENDANCE, PSYCHOSOCIAL OUTCOMES, PHYSICAL ACTIVITY AND SITTING TIME AMONG RACIAL/ETHNIC MINORITY AND RURAL APPALACHIAN ADULTS

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ABSTRACT

Compared to the general U.S. population, racial/ethnic minorities and rural Appalachian residents face lower rates of physical activity (PA), higher prevalence of physical inactivity, and increased rates of morbidity and mortality, contributing to rural racial/ethnic health disparities. Culturally-tailored mind-body interventions may address these disparities, however, little is known regarding the optimal level of intervention adherence for benefits among these hard-to-reach populations. **Purpose:** This study aimed to (1) determine the associations between mind-body intervention attendance and changes in psychosocial outcomes (i.e., stress, depression, anxiety, positive and negative affect, and spirituality), PA, and sitting time (ST), explore differences in changes in outcomes between low attenders and high attenders and assess whether a dose-response relationship exists, and, (2) determine the associations between changes in psychosocial outcomes and changes in PA and ST over time. **Methods:** African American adults in Houston, TX (n=26) and non-metro residents in State College, PA (n=46) participated in a culturally-adapted mind-body intervention to increase PA and reduce stress. Participants (N=72) completed PA and psychosocial questionnaires and accelerometer protocols at baseline (T1) and post-intervention (T2) and attended 16 mind-body sessions over eight weeks. Attendance was collected at intervention sessions via sign-in sheets. **Results:** Linear regression analyses indicate that increased session attendance was significantly associated with increased spirituality ($\beta=.168$, $p=.013$). Repeated measures ANOVA demonstrated significant: 1) differences in changes in depressive symptoms over time between low and high attenders ($F(1,55)=4.746$, $p=0.034$), with low attenders experiencing greater decreases in depressive symptoms, 2) differences in changes in positive affect between attendance group and study site ($F(1,53)= 7.839$, $p=.007$), 3) differences in changes in spirituality by number of sessions attended ($F(12,31)= 2.393$, $p=0.025$), and, 4) differences in changes in perceived stress ($F(10,33)= 3.679$, $p=0.002$) and spirituality.
Regression analyses also found that increased self-reported walking was associated with increased perceived stress ($\beta=.298$, $p=.030$). **Conclusions:** Findings suggest that participants attending more sessions experienced greater increases in spirituality, thus, improving intervention attendance rates may increase the potency of mind-body interventions for increasing spirituality. Although an optimal number of mind-body sessions for improving psychosocial outcomes, increasing physical activity and decreasing sitting time was not determined, findings provided direction for future research which can be used to inform the broader implementation efforts of culturally-tailored mind-body interventions among racial/ethnic minorities and rural Appalachian residents.
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Chapter 1: Introduction and literature review

Rural racial/ethnic minorities are a critically underserved, high-risk population. Obesity, heart disease and cancer mortality rates are higher among Appalachian residents compared to their non-Appalachian counterparts (Appalachian Regional Commission, 2017). Within rural Appalachia, racial/ethnic minorities are more physically inactive, at greater risk of developing chronic conditions (James et al., 2017; Mensah & Brown, 2007), and report worse health outcomes and less access to health care compared with non-Hispanic whites, contributing to rural racial/ethnic health disparities and highlighting the need for intervention efforts to improve the health of this population (August & Sorkin, 2011). Given that this is a traditionally hard-to-reach population, it is important to understand whether there is an optimal intervention dose, or a minimum number of intervention sessions at which health benefits can be seen, but that also reduces participant burden. Thus, the present study aimed to increase our understanding of an optimal level of adherence to a culturally-tailored mind-body intervention which aimed to increase physical activity in racial/ethnic minorities and diverse Appalachian adults.

Physical activity and disease risk

The protective effects of physical activity on various chronic diseases is well documented and supported in the literature. Physical activity is associated with reductions in the risk of early death, coronary heart disease, stroke, high blood pressure, type 2 diabetes, and several cancers (Kyu et al., 2016; Moore et al., 2016; Moore et al., 2009). Furthermore, a dose-response relationship exists between physical activity and several
diseases, including certain cancers, diabetes, ischemic heart disease, and ischemic stroke events, such that individuals engaging in physical activity levels several times higher than the current recommended minimum guidelines experiencing significant reductions in disease risk (Kyu et al., 2016). Conversely, physical inactivity is strongly linked to an increased risk of major non-communicable diseases including coronary heart disease, type 2 diabetes, and breast and colon cancers, and shortened life expectancy (Lee et al., 2012).

Health disparities

Despite the numerous health benefits of physical activity, and the health risks associated with physical inactivity, over a fifth of the adult population in the United States (U.S.) remains physically inactive (An, Xiang, Yang, & Yan, 2016). More concerning are the even lower rates of physical activity (Benjamin et al., 2017), higher prevalence of physical inactivity (Wilson-Frederick et al., 2014), and increased rates of morbidity and mortality (Appalachian Regional Commission, 2017) faced by certain underserved and disadvantaged populations in the U.S. when compared to the general population.

Racial/ethnic minorities are one underserved and disadvantaged population in the U.S. Racial/ethnic health disparities have been well-documented (Carlo, Crockett, Carranza, & Martinez, 2011; Olden & White, 2005; Payne-Sturges & Gee, 2006), with racial/ethnic minorities being at greater risk of developing chronic conditions involving lifestyle factors, such as heart disease and diabetes, and engaging in less physical activity compared to non-Hispanic whites across the lifespan (August & Sorkin, 2011; Mensah &
Brown, 2007). The prevalence of meeting physical activity guidelines is lower among non-Hispanic blacks (42.1%) and Hispanics (43.3%) than among non-Hispanic whites (53.1%), and Hispanic and non-Hispanic black adults are more likely to be inactive (38.8% and 39.0%, respectively) than non-Hispanic white adults (27.0%) (Benjamin et al., 2017). Among men, although the difference is not statistically significant, the prevalence of obesity is higher among non-Hispanic blacks (38.0%) and Hispanics (37.9%) than non-Hispanic whites (34.7%). Among women, the prevalence of obesity is significantly higher in non-Hispanic blacks (57.2%), and similar in Hispanics (46.9%), compared with non-Hispanic whites (38.2%) (Benjamin et al., 2017).

Using data from the National Health and Nutrition Examination Survey (NHANES), Pool, Ning, Lloyd-Jones, and Allen (2017) found enduring racial/ethnic differences in cardiovascular health for non-Hispanic blacks and Mexican-Americans as compared with non-Hispanic whites which persisted over a decade, and little evidence of narrowing disparities. The prevalence of diabetes is also higher in non-Hispanic blacks (15.4%) and Mexican Americans (11.6%) than in whites (8.6%) (Benjamin et al., 2017). In addition to these outcomes, more racial/ethnic minorities report worse health outcomes and less access to health care compared with non-Hispanic whites (August & Sorkin, 2011). Racial/ethnic minorities also face mental health disparities (McGuire & Miranda, 2008). Although the risk of having a psychiatric disorder is lower among in blacks and Hispanics compared to their whites counterparts, blacks and Hispanics who develop a psychiatric disorder tend to have more persistent disorders (Breslau et al., 2006). While African Americans are less likely to have major depression during their lifetimes than their non-Hispanic white counterparts, it is usually untreated and is more severe and
disabling compared with that in non-Hispanic whites (Williams et al., 2007). Additionally, further racial/ethnic health disparities exist within rural communities (James et al., 2017).

Residents of the Appalachian region in the U.S., which contains 420 counties in 13 states and is home to over 25 million residents, are another population facing physical inactivity and related health disparities (Appalachian Regional Commission, 2017). Appalachian residents are less physically active than the general U.S. population (28.4% vs 23.1% physically inactive), and Appalachian residents face a higher prevalence of obesity (31.0% vs 27.4% obese) (Appalachian Regional Commission, 2017). Appalachian residents also have a 17% higher heart disease mortality rate and 10% higher cancer mortality rate than the national rates (Appalachian Regional Commission, 2017). Furthermore, Appalachia consists of a largely rural population, as 42% of the population is rural compared with 20% of the U.S. population as whole, and residents of rural Appalachian counties are more physically inactive (31.8% vs 25.2%), are more likely to be obese (33.1 vs 29.5%), and face greater health disparities than their non-rural Appalachian counterparts (Appalachian Regional Commission, 2017). The heart disease mortality rate for rural Appalachian counties is 27% higher than metro Appalachian counties and 34% higher than the national rate, and the cancer mortality rate for rural Appalachian counties is 15% higher than metro Appalachian counties and 20% higher than the national rate (Appalachian Regional Commission, 2017). In addition to having higher morbidity and mortality, rural residents report less access to and lower quality of healthcare (Moy et al., 2017).
Given these disparities, the Healthy People 2020 initiative and the American Heart Association’s (AHA) Strategic Impact Goal have both highlighted addressing and eliminating health disparities as a key public health goal (Lloyd-Jones et al., 2010; Office of Disease & Health, 2000). To improve physical activity, and in turn reduce physical inactivity-related adverse health outcomes, physical activity interventions that target potential precursors to physical activity and that are tailored to populations facing these disparities are needed.

**Physical activity and psychosocial health**

Physical activity has also been shown to be associated with psychosocial outcomes such as stress (Stults-Kolehmainen & Sinha, 2014), depression and anxiety (Wipfli, Rethorst, & Landers, 2008), positive and negative affect (Liao, Shonkoff, & Dunton, 2015), and spirituality (Silfee, Haughton, Lemon, Lora, & Rosal, 2017).

Psychological stress has a detrimental effect on a wide range of physical and mental health outcomes (Cohen, Tyrrell, & Smith, 1991; Sandi, 2004). Individuals with high levels of stress have increased risk of acute myocardial infarction, are less likely to survive cardiac events, and have higher susceptibility to infections and (Cohen et al., 1991; Rosengren et al., 2004). Both acute and chronic stressors, including chronic work stress, can increase the risk for mortality (Matthews & Gump, 2002). Individuals employed in jobs described as high in work strain were found to be at elevated risk for all-cause and CVD mortality (Schnall, Landsbergis, & Baker, 1994; Theorell et al., 1998). The American Psychological Association’s Stress in America™ annual survey, which explores stress among U.S. adults, shed light on recently emergent additional sources of stress (American Psychological Association, 2017). The 2017 survey results
revealed that the two most common sources of stress were the future of the nation and the current political climate, whereas work and money had consistently been the top sources previous to the 2016 election season (American Psychological Association, 2017). The perception that stress impacts health, along with high amounts of stress, were also found to be associated with poor health, poor mental health, and an increased risk of premature death (Keller et al., 2012).

The relationship between stress and physical activity has been extensively researched (Shields et al., 2018; Stults-Kolehmainen & Sinha, 2014), with findings generally showing that exercise and physical activity result in lower perceived stress, that physical activity promotes positive changes in one’s ability to cope with stressful encounters, and that physical activity can mitigate the physiological impact of chronic and acute stress while improving aspects of stress resilience (Lutz, Lochbaum, Lanning, Stinson, & Brewer, 2007; Stults-Kolehmainen & Sinha, 2014). Research also shows that stress predicts less physical activity/intentional exercise and more sedentary behavior (Lutz et al., 2007), that the experience of stress impairs efforts to be physically active, and that combining stress management programming with exercise interventions can mitigate stress-related reductions in physical activity (Stults-Kolehmainen & Sinha, 2014). Additionally, research assessing a bi-directional stress-exercise association found that the relationship between stress and exercise can be uni-directional or bi-directional and varies from person to person (Burg et al., 2017).

Another mental health outcome associated with physical activity is depression (Azevedo Da Silva et al., 2012; Rethorst, Wipfli, & Landers, 2009). Major depression is a
mental disorder characterized by changes in mood and cognitive and physical symptoms over a 2-week period (American Psychiatric Association, 2013). The direct treatment of depression and indirect impact on other conditions substantially contributes to health care costs, with the economic burden of depression in the U.S. estimated to be $210 billion per year, including direct medical costs (45%), suicide-related mortality costs (5%), and workplace costs (50%) (Greenberg, Fournier, Sisitsky, Pike, & Kessler, 2015). Depression is associated with greater functional impairment than many other chronic diseases, including hypertension, diabetes, and arthritis, and between 2013-2016, 8.1% of American adults had depression in a given 2-week period (Brody, Hughes, & Pratt, 2018; Wells et al., 1989).

A multitude of reviews and meta-analyses examining the effects of exercise on depression have found beneficial effects of exercise in reducing depressive symptoms in both healthy and clinical populations, and have found that exercise has a possible protective effect against the development of depression (Brosse, Sheets, Lett, & Blumenthal, 2002; Kim, Shin, Nam, Choi, & Kim, 2008; Rethorst et al., 2009; Roshanaei-Moghaddam, Katon, & Russo, 2009). A study examining the dose-response relationship between exercise and depression found that aerobic exercise at a dose consistent with physical activity guidelines was an effective treatment for major depressive disorder of mild to moderate severity, and that a lower dose was comparable to placebo effect (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005).

Research shows that depression may be a significant risk factor for development of a sedentary lifestyle and decreased levels of physical exercise (Roshanaei-Moghaddam
et al., 2009), and that a bidirectional association exists between physical activity and depressive symptoms (Azevedo Da Silva et al., 2012). Thus, meeting the recommended levels of physical activity reduces the risk of developing depressive symptoms, while having depressive symptoms increases the likelihood of not meeting recommended physical activity levels (Azevedo Da Silva et al., 2012). A study assessing factors associated to adherence to a physical activity intervention among older Latin American adults found that depression was not only a barrier to physical activity among participants, but that it predicted less adherence to physical activity classes (Garmendia et al., 2013).

Depressive and anxiety disorders frequently occur together, and co-morbid anxiety and depression predicts a higher percentage of treatment resistance than either disorder occurring alone (Coplan, Aaronson, Panthangi, & Kim, 2015; Hirschfeld, 2001). Reviews of exercise interventions on anxiety outcomes have generally found a strong relationship between exercise and anxiety, showing that regular physical activity is associated with a reduction in anxiety symptoms (Conn, 2010; Herring, O'Connor, & Dishman, 2010). Research has shown plausibility of a dose-response relationship between physical activity and anxiety symptoms (Dunn, Trivedi, & O'Neal, 2001), although there is less research in this area compared to depression (Wipfli et al., 2008). There is also evidence to support the bidirectional association between physical activity at recommended levels and anxiety symptoms (Azevedo Da Silva et al., 2012). Thus, individuals who meet physical activity recommendations are likely to develop symptoms of anxiety, while individuals with symptoms of anxiety are more likely to not meet the
recommended levels of physical activity (Azevedo Da Silva et al., 2012). Although little research has addressed the role of anxiety symptoms on adherence or participation in physical activity interventions among minorities, one study found that African American girls who were less anxious were more likely to participate regularly in a structured physical activity program (Lemmon, Ludwig, Howe, Ferguson-Smith, & Barbeau, 2007).

Positive and negative affective states are another psychosocial construct that has been shown to be linked to health and health behavior (Schwerdtfeger, Eberhardt, Chmitorz, & Schaller, 2010; Steptoe, Wardle, & Marmot, 2005). Studies have found that negative affective are associated with premature mortality and increased risk of coronary heart disease, type 2 diabetes, and disability, while positive affective states can exert a protective effect and are associated with health-relevant biological processes (Ryff, Singer, & Dienberg Love, 2004; Steptoe et al., 2005). Research has found that aerobic exercise can significantly diminish negative affect, and moderate levels of physical activity can increase positive affect (Schwerdtfeger et al., 2010). A review examining the associations between affective states and subsequent physical activity found a positive association between positive affective valence and physical activity and inconclusive evidence of negative affective valence predicting physical activity (Liao et al., 2015).

Another study exploring the bi-directional relationship between positive affect and exercise found that participants a) exercised more on days on which positive affective valence was high, and b) had higher evening positive affective valence the more they had exercised in the day (Schöndube, Kanning, & Fuchs, 2016). Carels, Coit, Young, and Berger (2007) found that among overweight individuals, when participants
exhibited positive affect in the morning, they were more likely to exercise, and when they exhibited negative affect, they were less likely to exercise. Additionally, a study investigating the impact of affective and cognitive messages compared to a no messages on exercise behavior found that the affective messages consistently produced the greatest increases in exercise, indicating the importance of positive affective valence in exercise behavior prediction (Conner, Rhodes, Morris, McEachan, & Lawton, 2011).

Spirituality is increasingly being researched as a construct related to physical activity, physical and psychological health (Salsman, Fitchett, Merluzzi, Sherman, & Park, 2015). Studies on spirituality and religiosity and their relationships to physical activity and physical and psychological health outcomes have often used spirituality, religion, and religiousness interchangeably or as overlapping terms, while other studies have specifically addressed religiosity or religious involvement (Mueller, Plevak, & Rummans, 2001; Salsman et al., 2015). Research has found that religious involvement and spirituality are associated with reduced mortality, greater longevity, and decreased cardiovascular disease, blood pressure and hypertension (Hixson, Gruchow, & Morgan, 1998; Mueller et al., 2001; Oleckno & Blacconiere, 1991). Religiosity and religious involvement is shown to be associated with more exercise, although the majority of studies assessing this relationship have explicitly addressed religiosity rather than spirituality and spiritual well-being (Oleckno & Blacconiere, 1991; Strawbridge, Shema, Cohen, & Kaplan, 2001; Wallace & Forman, 1998). Studies have also found that higher religious involvement is associated with higher physical activity (Strawbridge et al.,
2001; Wallace & Forman, 1998), and higher spirituality is associated with lower sedentary behavior in racial and ethnic minority populations (Silfee et al., 2017).

Studies have also shown that religious involvement and spirituality are associated with greater coping skills and health-related quality of life, and lower anxiety and depression (McCullough & Larson, 1999; Mueller et al., 2001). A review examining the relationship between religious involvement and depression found that religiously involved persons had fewer depressive symptoms and less depression, and that some forms of religious involvement may have a protective effect against the incidence and persistence of depressive symptoms or disorders (McCullough & Larson, 1999). Studies have found that religious involvement is associated with decreased recent and lifetime anxiety, and that individuals with higher levels of spiritual well-being have lower levels of anxiety (Kaczorowski, 1989; Koenig, Ford, George, Blazer, & Meador, 1993). Another study found that greater depth of spiritual perspective was associated with greater sense of well-being (Reed, 1987).

In sum, given the aforementioned associations between physical activity and stress, depression, anxiety, positive and negative affect, and spirituality, interventions aiming to increase physical activity among rural and racial/ethnic minorities should aim to improve these psychosocial factors.

**Physical activity promotion in underserved populations**

Reviews of existing physical activity intervention research have noted the limited physical activity intervention research among underserved populations and have called for an increase in the numbers of racial/ethnic minority participants to permit ethnic-
specific analyses as well as an increase in the number of studies targeted to specific racial/ethnic minority groups (Marcus et al., 2006; Yancey et al., 2004). Due to cultural differences and life experiences, strategies for promoting physical activity and other health behaviors that have been successful in other populations may not be easily transferable to racial/ethnic minorities (Scarinci et al., 2014). Interventions targeted to the general population also often do not reach racial/ethnic minorities, and some studies have found that such interventions have limited effects on health behavior (Jepson, Harris, Platt, & Tannahill, 2010; Kreuter, Lukwago, Bucholtz, Clark, & Sanders-Thompson, 2003). Furthermore, racial/ethnic minorities are less likely to volunteer to participate in exercise programs offered in the community and have lower attendance and retention rates compared to Caucasians (Dornelas, Stepnowski, Fischer, & Thompson, 2007; Lemacks, Wells, Ilich, & Ralston, 2013). Given that the effectiveness of community level physical activity interventions depends to a large extent on adherence to the intervention (Garmendia et al., 2013), there remains a critical need improving intervention attendance and retention in this population (Dornelas et al., 2007; Lemacks et al., 2013).

Cultural-tailoring

Culturally-tailoring interventions, which can include making adaptations such as matching materials to group characteristics or targeting cultural values of the population, may be an effective strategy for improving intervention attendance and retention among rural and racial/ethnic minorities (Resnicow, Baranowski, Ahluwalia, & Braithwaite, 1999). Rural residents and racial/ethnic minorities face unique barriers to physical activity (Gavarkovs, Burke, & Petrella, 2015; Gothe & Kendall, 2016; Osuji, Lovegreen, Elliott, & Brownson, 2006), and the effectiveness of culturally-tailored interventions for
improving behavioral health outcomes among racial/ethnic minority participants are highly supported in the literature (Eyles & Mhurchu, 2009; Hawthorne, Robles, Cannings-John, & Edwards, 2010; Hovell et al., 2008; Mier, Ory, & Medina, 2010; Sarkisian, Brown, Norris, Wintz, & Mangione, 2003; Scarinci et al., 2014; Van Duyn et al., 2007; Whittemore, 2007), as they address cultural factors such as individual, behavioral, and social characteristics that have value, identity, or special meaning to that population, which may be directly or indirectly associated with the acceptance and adoption of health promotion programs (Pasick, D’Onofrio, & Otero-Sabogal, 1996). Reviews of interventions targeting rural adults have also indicated that the most effective and impactful interventions on physical activity outcomes are those that are tailored to meet the unique needs and preferences of and address the barriers that are relevant to rural communities, and have concluded that there is a need for additional research to identify effective approaches for rural populations (Cai & Richards, 2016; Smith & Ansa, 2016).

Church-based interventions

Among both racial/ethnic minority and rural populations, the use of church-based interventions is a promising strategy for addressing health behaviors and health outcomes. Church-based health behavior programs have been conducted in and have potential to reduce disparities among various underserved groups, including African Americans (Campbell et al., 2007), rural white adults and low-income Latinas (Bowen et al., 2009). A review of church-based health promotion interventions concluded that these types of interventions can have great potential for reducing health disparities, and that
churches and faith organizations are essential partners in the effort to reduce health disparities (Campbell et al., 2007).

Religion plays a strong role in African American communities, as the Black church has historically served as the center of spiritual, social, and political life, with many Black churches functioning beyond traditional worship and spiritual growth, and contributing to the social, economic, and political welfare of their community (Campbell et al., 2007; Markens, Fox, Taub, & Gilbert, 2002). Health interventions that incorporate spiritual and cultural contextualization have been found to be effective among African Americans (Campbell et al., 2007). One study found that a church-based intervention was effective at clinically important improvements in cardiovascular disease risk profiles among African American women (Yanek, Becker, Moy, Gittelsohn, & Koffman, 2001). Tussing-Humphreys and colleagues assessed the effectiveness of a 6-month, church-based, lifestyle intervention to improve diet quality and increase physical activity in rural African American adults in Mississippi and found that the intervention led to significant increases in both aerobic physical activity and strength/flexibility physical activity (Tussing-Humphreys, Thomson, Mayo, & Edmond, 2013). A similar church-based study also found improvements in physical activity and dietary habits in urban, southern, African American adults (Resnicow et al., 2005). Furthermore, a review of behavioral interventions among African American adults found that some of the highest participant retention rates were among programs conducted in churches (Lemacks, Wells, Ilich, & Ralston, 2013).
Similar to African American communities, faith-based programs are likely to have large reach, credibility, and sustainability in Latino communities, and church-based interventions have also found promising results for improving physical activity in Latino populations (Arredondo et al., 2017). Arrendendo et al. found that a physical activity intervention for Latinas, which consisted of physical activity classes, motivational interviewing calls, and health education handouts, in a faith-based setting significantly increased MVPA compared with an attention-control comparison condition. Additionally, the dose–response analyses for class attendance showed that greater class attendance was associated with significant increases in self-reported leisure-time MVPA and a smaller waist circumference, however, attendance was not significantly associated with changes in accelerometer-based MVPA or body mass index (Arredondo et al., 2017).

Given the evidence for culturally-tailored and church-based interventions in underserved populations, the incorporation of an innovative strategy for increasing physical activity in a church-based or faith-based intervention may be promising for improving physical activity and health outcomes in rural and racial/ethnic minorities.

Mind-body interventions

One potential innovative strategy for promoting physical activity and improving psychosocial outcomes is the use of mind-body practices. Mind-body interventions include a wide range of practices, including mindfulness and meditation, which aims to achieve attentional control by focusing on current bodily sensations, breath, thoughts, emotions, sights, and/or sounds with nonjudgmental acceptance, relaxation and breathing techniques, and yoga (Wahbeh, Elsas, & Oken, 2008). The use of yoga or meditation to
manage stress is on the rise, with 12% of U.S. adults using yoga or meditation as a coping method for stress in 2017 compared to 9% in 2016 (American Psychological Association, 2017). Yoga practice is shown to produce physiological changes in heart rate, blood pressure, galvanic skin response, respiratory rate, fasting blood glucose (Ospina et al., 2007), and mind-body interventions have been shown to be effective for a number of physical and psychological outcomes (Astin, Shapiro, Eisenberg, & Forys, 2003; Stefanaki et al., 2015).

A review examining the efficacy of mind-body interventions found considerable evidence for the treatment of coronary artery disease, insomnia, disease and treatment-related symptoms of cancer, and improving postsurgical outcomes (Astin et al., 2003). Mind-body techniques such as breathing techniques, relaxation, and yoga have been successful in the treatment of chronic back pain and headaches (Wahbeh et al., 2008). Some evidence exists for mild reductions in blood pressure through the use of meditation or breathing exercises, and there is promising but inconclusive evidence for mind-body interventions in the treatment of fibromyalgia and multiple sclerosis (Wahbeh et al., 2008). An 8-session clinical Mindfulness Based Cognitive Therapy (MBCT) and Mindfulness-Based Stress Reduction (MBSR) program found increases in mindfulness and well-being, and decreases in stress and symptoms (Carmody & Baer, 2008). Another 8-week mindfulness stress management program for women with poly-cystic ovarian syndrome found significant reductions in stress, depressive and anxiety symptoms, and salivary cortisol concentrations (Stefanaki et al., 2015). A review of MBSR interventions found evidence for significant improvements in pain burden and physical health, and
significant beneficial effects on anxiety, depression, depressive symptoms, and depression relapses (Gotink et al., 2015).

Despite the growing body evidence for efficacy of mind-body interventions, there is noticeably less research on the utilization of mind-body health interventions for addressing health disparities (Woods-Giscombé & Black, 2010). Compared to faith-based and church-based interventions, the use of mind-body strategies in rural and racial/ethnic minority groups is not well understood, as the majority of previous interventions included mostly urban and Caucasian adults (Cherkin et al., 2016; Hughes et al., 2013; Miller et al., 2015). However, the limited studies in racial/ethnic minority populations have shown that mind-body interventions can also be culturally-tailored to improve effectiveness, which is promising (Kim, Chang, Lee, & Lee, 2018; Schuette, 2017). Given the evidence for mind-body practices for improving both physical and psychological outcomes, further research exploring culturally-tailored mind-body interventions among rural and racial/ethnic minorities is warranted.

**Theoretical framework**

The culturally-tailored mind-body intervention in the current study included constructs from the social cognitive theory, which posits that behavior can be altered through the interplay of personal, behavioral, and environmental factors (Bandura, 1986, 1997; Baranowski, Perry, & Parcel, 2002), which can explain the proposed association between attending the intervention and improvements in physical activity and sitting time outcomes. In the social cognitive theory, self-efficacy and behavioral capabilities are among core determinants of behavior (Bandura, 2004; Baranowski et al., 2002). The trained instructor leading the mind-body intervention sessions provided participants with
the knowledge and skills in completing the mind-body sessions to promote behavioral capabilities. The mind-body stretches were practiced in the same order so that participants were able to learn the routine, and the instructor provided feedback during sessions to ensure that participants were proficiently completing the stretches and challenged them to hold longer stretches over the course of the intervention, all which can promote self-efficacy. Thus, participants with higher attendance at the mind-body intervention sessions would have increased opportunities of building behavioral capabilities and self-efficacy, which can lead to improvements in physical activity and sitting time outcomes.

In addition to these personal factors, the current faith-based mind-body intervention also targeted interpersonal and environmental factors that influence behavior. The social ecological model, a theory-based framework for understanding the effects of personal and environmental factors that determine behavior (Bauman et al., 2012), posits that interventions that target multiple levels of influence, including individual, interpersonal, organizational, and environmental levels, should be more effective in changing behavior than those targeting a single level (Golden & Earp, 2012). The use of a faith-based setting targeted the environmental level of influence on behavior change, and the in-person mind-body intervention sessions in the current study provided participants with social support among other people with similar cultural values. A supportive social environment, compared to a supportive physical and policy environment, has been shown to be a stronger predictor of being physically active (Stahl et al., 2001). Additionally, given that social support helps individuals start and maintain physical activity and is predictive of exercise adherence and maintenance (McAuley,
Jerome, Elavsky, Marquez, & Ramsey, 2003), participants with higher attendance at the intervention sessions may have increased improvements in physical activity due to increased opportunities of receiving social support.

**Conceptual framework and purpose**

The purpose of the current study was to increase our understanding of an optimal level of adherence to a culturally-tailored mind-body intervention on improving psychosocial outcomes, increasing physical activity and decreasing sitting time among rural Appalachian residents and racial/ethnic minorities, in order to inform the broader implementation efforts of culturally-tailored mind-body interventions in this hard-to-reach population to ultimately reduce rural and racial/ethnic health disparities. Given that there was no single previously developed theoretical framework to explain the association between attendance at a mind-body intervention and improvements in psychosocial and physical activity outcomes, a conceptual framework (Figure 1), based on both a socioecological framework and the social cognitive theory, was developed to guide and provided the basis for the current study. Figure 1 represents the specific aims and corresponding hypotheses of the current study, as described below:

**Aim 1.** To determine the associations between mind-body intervention attendance and changes in psychosocial outcomes (perceived stress, depressive symptoms, positive and negative affect, and spirituality), physical activity, and sitting time over time.

Based on previous research showing the associations between increased physical activity and improvements in stress (Shields et al., 2018; Stults-Kolehmainen & Sinha, 2014), depression (Azevedo Da Silva et al., 2012), anxiety (Wipfli et al., 2008), positive and negative affect (Schwerdtfeger et al., 2010), and spirituality (Wallace & Forman,
1998), previous research on mind-body interventions for decreasing stress, depressive and anxiety symptoms (Stefanaki et al., 2015), and previous research demonstrating a dose–response relationship between attendance at a culturally-tailored church-based intervention and increases in self-reported physical activity, it was hypothesized that:

**Hypothesis 1a:** Increased attendance in a culturally-tailored faith-based mind-body intervention will be associated with improvements in psychosocial outcomes, increases in physical activity, and decreases in sitting time from baseline (T1) to post-intervention (T2).

**Hypothesis 1b:** A dose-response relationship exists between intervention attendance and changes in psychosocial measures, physical activity, and sitting time, with higher attendance being associated with greater improvements in psychosocial outcomes, physical activity, and sitting time.

**Aim 2.** To explore the associations between changes in psychosocial outcomes and changes in physical activity or sitting time over time.

Based on previous research showing that bi-directional associations between physical activity and stress (Burg et al., 2017), depression and anxiety (Azevedo Da Silva et al., 2012), positive and negative affect (Liao et al., 2015; Schwerdtfeger et al., 2010). (Azevedo Da Silva et al., 2012), and previous research showing that higher religious involvement and spirituality is associated with higher physical activity and lower sedentary behavior (Silfee et al., 2017; Strawbridge et al., 2001; Wallace & Forman, 1998), it was also hypothesized that:

**Hypothesis 2:** Improvements in psychosocial outcomes will be associated with increases in physical activity and decreases in sitting time from T1 to T2.
Chapter 2: Methods

Study Design

The current study is a secondary analysis of data collected from the Harmony & Health Houston and Harmony & Health State College studies (Mama et al., 2018).

Harmony & Health Houston

Harmony & Health Houston was a 14-week randomized controlled pilot study conducted in Houston, TX from 2014-2015. The purpose of the study was to assess the feasibility and acceptability of a culturally-adapted yoga-based mind-body intervention among a church-based sample of sedentary and overweight or obese African American adults, and to explore the efficacy of the intervention for improving physical activity and psychosocial well-being and quality of life. The study was approved by the Institutional Review Board (IRB) at The University of Texas MD Anderson Cancer Center (protocol ID: 2014-0083), and written informed consent was obtained from all participants prior to taking part in study activities.

Participants were recruited though an existing church partnership and were recruited face-to-face at church services through announcements from the pulpit and an information table, and through a recruitment announcement through an email listserv. Interested participants completed a telephone or in-person screening to assess initial eligibility. Eligibility criteria included self-identifying as African American, aged 18 to 65 years, able to read and write in English, overweight or obese (BMI ≥25.0 kg/m², <45 kg/m²), sedentary or not currently regularly exercising (doing >75 minutes per week or >15 minutes per day), and generally healthy and able to pass the Physical Activity
Readiness Questionnaire (PAR-Q) (Thomas, Reading, & Shephard, 1992). To confirm eligibility, BMI and blood pressure were measured in-person prior to completing the baseline assessment. Exclusion criteria included being less than 18 years of age, morbidly obese (BMI ≥ 45 kg/m²), diabetic or taking anti-inflammatory medications, pregnant or thinking about becoming pregnant during the study period, or having participated in a mind-body intervention (e.g., yoga, tai chi, qigong) in the last six months.

Eligible participants were randomized to either the mind-body intervention (n=26) or a wait-list control group (n=24). All participants completed physical assessments, sociodemographic, physical activity, and psychosocial questionnaires, and accelerometry protocols at baseline (T1), post-intervention (T2), and 6-week follow-up (T3). Participants randomized to the mind-body intervention group (n=26) completed 16 mind-body sessions over 8 weeks. Participants in the wait-list control group received the mind-body intervention at the end of the study (after completion of follow-up assessments).

Harmony & Health State College

Harmony & Health State College was a 14-week feasibility study conducted in State College, PA from 2016-2017. The purpose was to determine explore the feasibility and efficacy of a culturally-adapted yoga-based mind-body intervention to increase physical activity, reduce sedentary time, and reduce stress among a church-based sample of sedentary and overweight or obese adults. The study was approved by the IRB at The Pennsylvania State University (protocol ID: STUDY00004310), and written informed consent was obtained from all participants prior to completing study activities.

Participants were recruited though an existing church partnership, and were recruited face-to-face at church services through announcements from the pulpit and an
information table, and through distribution of recruitment flyers. Interested participants completed a telephone or in-person screening to assess initial eligibility. Eligibility criteria included being at least 18 years of age, able to read and write in English, overweight or obese (BMI ≥25.0 kg/m$^2$), sedentary or not currently regularly exercising (doing <120 minutes per week), and generally healthy and able to pass the PAR-Q (Thomas et al., 1992). To confirm final eligibility, BMI and blood pressure were measured in-person prior to completing the baseline assessment. Exclusion criteria included being less than 18 years of age, morbidly obese (BMI ≥ 45 kg/m$^2$), diabetic or taking anti-inflammatory medications, pregnant or thinking about becoming pregnant during the study period, or having participated in a mind-body intervention (e.g., yoga, tai chi, qigong) in the last six months.

Eligible participants ($N=46$) completed physical assessments, sociodemographic, physical activity, and psychosocial questionnaires, and accelerometry protocols at baseline (T1), post-intervention (T2), and 6-week follow-up (T3). One wave of participants completed the intervention in fall 2016 ($n=21$), and a second wave completed the intervention in spring 2017 ($n=25$). One mind-body session in the spring wave was cancelled due to inclement weather; thus, spring participants were offered a total of 15 versus 16 sessions.

**Current study**

The current study is a secondary analysis of Harmony & Health Houston and Harmony & Health State College. The current study sample ($N=72$) was restricted to Houston participants in the mind-body intervention group ($n=26$) and all State College participants ($n=46$). Participants randomized to the wait-list control group in Houston
(n=24) were excluded from the current study, as they did not receive the mind-body intervention until the end of the study data collection period.

**Intervention Procedures**

Mind-body intervention specialists and senior church members provided input on the development of the Harmony & Health mind-body intervention session routine in order to culturally adapt it for an overweight/obese, church-based African American population (Mama et al., 2018). The mind-body components of the intervention sessions included yoga-like stretches and poses, relaxation and breathing techniques. The culturally-tailored components of the intervention included the incorporation of a scripture of the day for each session, all of which were reviewed by a senior church member to ensure appropriateness, instruction to focus on the scripture and God’s word during guided relaxation instead of emptying the mind of thoughts, and the incorporation of culturally and physically appropriate stretches and poses in place of traditional worship, salutation, or physically limited poses (Mama et al., 2018).

Participants took part in 16 mind-body sessions over eight weeks and completed assessments at baseline (T1), post-intervention (T2), and 6-week follow-up (T3). Mind-body sessions intervention sessions were led by a trained certified yoga instructor and began with a 5-minute introduction, followed by 30 minutes of stretching. During the stretching portion of the session, the instructor provided feedback to participants on their stretches and encouraged them to hold their stretches for longer over the course of the intervention. Sessions concluded with 10 minutes of breathing and guided relaxation, during which participants were instructed to relax, reflect on the scripture of the day, and to focus on their breathing and God’s word (Mama et al., 2018).
Measures

Demographics

Participants reported age, gender, race/ethnicity, education, annual income, and employment status. Height and weight were measured by research staff at in-person assessments and were used to compute body mass index (BMI= kg/m²). Demographic variables were categorized, and categorical variables and corresponding treatments are summarized in Table 1.

Attendance

Participant attendance data was collected via in-person sign-in sheets at each intervention session. Participants who attended zero sessions (n=12) were excluded from data analyses. To determine 1) the association between session attendance and changes in psychosocial outcomes, physical activity, and sitting time, 2) whether there were differences in changes in psychosocial outcomes, physical activity, or sitting time over time between low attenders and high attenders, and 3) a dose-response relationship between attendance and changes in outcomes, intervention attendance was treated via three approaches:

1) A continuous attendance variable, the percentage of sessions attended out of the total sessions, was calculated to account for the difference in total offered sessions between participants (16 sessions for Houston and fall State College participants vs. 15 sessions for spring State College participants).

2) A categorical attendance variable, attendance group, was computed based on an a priori Harmony & Health feasibility objective that participants complete a minimum of 10 out of 16 sessions. Participants who attended at least 10
sessions were categorized into the high attendance group (10-16 sessions), and participants who attended at least one but less than 10 sessions were categorized into the low attendance group (1-9 sessions).

3) A continuous attendance variable, the total sessions attended, was calculated for each participant. Total sessions attended ranged from 1-16.

**Psychosocial outcomes**

Perceived stress was assessed using the shortened Perceived Stress Scale (PSS-4), which consists of 4 items assessing the degree to which individuals appraise situations in their life as stressful (Cohen, Kamarck, & Mermelstein, 1983). Participants indicated how often they felt or thought a certain way during the last month from “never” to “very often”. Scores are obtained by summing across all four items. Scores range from 0 to 16, with higher scores indicating greater perceived stress. The PSS-4 has established acceptable psychometric properties (Cronbach’s alpha's = .60-.82, r=.60) for assessing stress in various populations (Karam et al., 2012; Lee, 2012).

Depressive symptoms were assessed via Center for Epidemiological Studies Depression Scale (CES-D), which consists of 20 items measuring depressive symptoms (Radloff, 1977). Participants indicated how they felt or behaved during the past week using a four-point scale from “rarely or none of the time” to “most or all of the time.” Scores are obtained by summing across all 20 items. Scores range from 0 to 60, with higher scores indicating greater depressive symptoms. The CES-D has established psychometric properties (Cronbach's alpha's=.80-.86, r=.41-.70) for assessing depressive symptoms in diverse and minority populations (Gonzalez et al., 2017; Naughton & Wiklund, 1993).
Anxiety was assessed via the Beck Anxiety Inventory (BAI), which consists of 21 items assessing cognitive and physiological symptoms of anxiety (Beck, Epstein, Brown, & Steer, 1988). Participants indicated how much they have been bothered by a symptom during the past month using a four-point scale from “not at all” to “severely – it bothered me a lot.” Total scores are calculated by summing the responses for each of the 21 items. Scores range from 0 to 63, with higher scores indicating greater anxiety. The BAI has established psychometric properties (Cronbach's alpha=.88-.89, r = .63) for assessing anxious symptoms in diverse and minority populations (Contreras, Fernandez, Malcarne, Ingram, & Vaccarino, 2004).

Positive and negative affect were assessed via the Positive and Negative Affect Scale (PANAS), which consists of two scales with 10 items each assessing positive affect and negative affect (Watson, Clark, & Tellegen, 1988). Participants indicated to what extent they felt a certain way over the past week using a five-point scale from “very slightly or not at all” to “extremely.” The total score is obtained by summing the 10 positive items, and then the 10 negative items. Scores range from 10-50 for both sets of items. For the total positive score, a higher score indicates more of a positive affect. For the total negative score, a lower score indicates less of a negative affect. The PANAS has established psychometric properties (Cronbach's alpha=.87-.88, r = .63) for assessing positive and negative affect in diverse and minority populations (Merz et al., 2013).

Spirituality was assessed via the Functional Assessment of Chronic Illness Therapy-Spiritual Well-Being (FACIT-Sp), which consists of three subscales, Faith, Meaning, and Peace, with 4 items each assessing spiritual well-being (Peterman, Fitchett, Brady, Hernandez, & Cella, 2002). Participants indicated to what extent aspects of
spirituality and/or religious faith have contributed to health-related quality of life over the past seven days using a 5-point scale ranging from “not at all” to “very much”. Two items are negatively worded and reverse coded. A total score is obtained by summing scores across all three subscales. Scores range from 0 to 48, with higher scores indicating higher spiritual well-being. The FACIT-Sp has established psychometric properties (Cronbach's alpha's=.89) for assessing spiritual well-being in diverse and minority populations (Munoz, Salsman, Stein, & Cella, 2015).

Physical activity

Self-reported physical activity was assessed via the International Physical Activity Questionnaire (IPAQ) long form, which assesses types (e.g., occupation, transportation, domestic, leisure) and intensities (e.g., walking, moderate, vigorous) of physical activity (Sjostrom, Bull, & Craig, 2002). Participants reported activities in days per week and minutes and/or hours per day over the last seven days, which were then converted to minutes per week using a standardized scoring protocol (Ainsworth et al., 2000; Craig et al., 2003; Sjostrom et al., 2002). The IPAQ is a valid (Spearman’s ρ=.30) and reliable (Spearman’s ρ=.80) instrument for assessing physical activity in diverse populations (Craig et al., 2003).

Objective physical activity was assessed via accelerometry. Houston participants were provided a tri-axial ActiGraph GT3X accelerometer (ActiGraph, LLC, Pensacola, FL) and instructed to wear the accelerometer around their waist during waking hours for seven consecutive days following their in-person assessment. State College participants were provided a tri-axial ActiGraph GT9X accelerometer (ActiGraph, LLC, Pensacola, FL) and instructed to wear the accelerometer on their wrist during waking hours for seven
consecutive days following their in-person assessment. Accelerometer data was collected as counts per 60 seconds, and counts per minute were translated into minutes spent in moderate-to-vigorous physical activity (MVPA) per day during the 7-day period using an established cutpoint (Freedson, Melanson, & Sirard, 1998; Trost, McIver, & Pate, 2005). The average MVPA per day for each participant was used for analyses.

**Data Analysis**

Histograms were examined to determine skewness and kurtosis; with the exception of self-reported IPAQ physical activity, all variables were normally distributed. All IPAQ data were natural log transformed to meet assumptions of normality, and log transformed IPAQ data were used in all analyses. Means, standard deviations, and frequencies were computed to describe characteristics of the study sample at baseline and post-intervention. In order to inform covariates to include in analyses, independent samples t-tests were used to test for significant differences in psychosocial measures, physical activity, and sitting time at T1 by study site (State College vs. Houston) and weight status (overweight vs. obese), a one-way analysis of variance (ANOVA) was used to test for significant differences in psychosocial measures, physical activity, and sitting time at T1 by race/ethnicity (White, African American or Black, or Other), and Pearson correlations were computed to determine whether there were any significant relationships between T1 psychosocial measures. Based on the current sample size and previous recommendations for the inclusion of covariates in regression analyses (Green, 1991) it was determined that a single additional covariate would be included in regression models, in addition to controlling for T1 measures, and study site was chosen as it accounted for
both geographic setting and race/ethnicity. Paired samples t-tests were used to assess changes in psychosocial outcomes, physical activity, and sitting time from T1 to T2.

To determine the associations between session attendance and changes in psychosocial outcomes, physical activity or sitting time over time (Aim 1), linear regression models were conducted using the percentage of sessions attended as the independent variable, and psychosocial measures, physical activity, or sitting time at T2 as the dependent variable, controlling for T1 psychosocial measures, physical activity, or sitting time in unadjusted models and study site in adjusted models. Study site was chosen as an additional covariate to include in adjusted models as it accounted for both geographic setting and race/ethnicity.

To explore whether there were differences in changes in psychosocial outcomes, physical activity, or sitting time over time between low attenders and high attenders, repeated measures ANOVA were used to examine changes in psychosocial outcomes, physical activity, or sitting time from T1 and T2 between attendance groups (low vs. high attendance). To assess whether there was a three-way time by attendance group by study site interaction effect, repeated measures ANOVA were used to examine changes in psychosocial outcomes, physical activity, or sitting time from T1 and T2 by attendance group (low vs. high attendance) and study site (Houston vs. State College).

To determine whether there was a dose-response relationship between intervention attendance and changes in psychosocial outcomes, physical activity, or sitting time, repeated measures ANOVA were conducted examining changes in psychosocial outcomes, physical activity, or sitting time from T1 and T2 by number of sessions attended (total sessions, range 1-16). To assess whether there was a three-way
time by attendance by study site interaction effect, repeated measures ANOVA were conducted examining changes in psychosocial outcomes, physical activity, or sitting time from T1 and T2 by number of sessions attended (total sum of sessions) and study site (Houston vs. State College).

To determine the associations between changes in psychosocial outcomes and changes in physical activity or sitting time (Aim 2), linear regression models were conducted using psychosocial change score as the independent variable, and physical activity or sitting time at T2 as the dependent variable, controlling for T1 physical activity or sitting time in unadjusted models and study site in adjusted models. Psychosocial change scores were calculated by subtracting mean-centered T1 psychosocial scores from mean-centered T2 psychosocial scores.

All statistical analyses were performed using SPSS 24.0 (IBM SPSS Statistics, Armonk, NY), with statistical significance inferred at $p < .05$.

**Power calculations**

Power calculations were performed using G*Power 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007). Based on a power analysis, the available sample size ($n=60$) after excluding participants who attended zero sessions, with level of significance of .05, was sufficiently powered (power=1–β =80%) to detect an effect size of 0.17 in regression analyses exploring the associations between session attendance and changes in psychosocial outcomes, physical activity or sitting time, and the associations between session attendance and changes in psychosocial outcomes, physical activity or sitting time, and the associations between changes in psychosocial outcomes and changes in physical activity or sitting time. Based on a separate power analysis, the available sample
size \((n=60)\), with level of significance of .05, was sufficiently powered (80\%) to detect an effect size of 0.18 in differences in changes in psychosocial outcomes, physical activity, or sitting time over time between attendance groups.
Chapter 3: Results

Sample characteristics

On average, participants were 49.5 years old (SD=12.6). The majority of participants were African American or Black (65.3%), female (87.5%), and obese (BMI $\geq$30.0 kg/m$^2$, 69.4%). Most participants were employed for wages (75.0%), earned a bachelor’s degree or higher (58.3%), and reported an average annual household income of $40,000 or more (70.8%). On average, participants attended 8.96 out of 16 intervention sessions (SD=5.2). The majority (51.4%) of participants attended at least 10 sessions (high attendance group), and 38.9% attended 1-9 sessions (low attendance group). Seven participants did not attend any sessions. Participant demographic characteristics and attendance by study site are summarized in Table 2.

There were no statistically significant differences in psychosocial measures at T1 by study site or weight status. Depressive symptoms ($m$=9.6 African American or Black, $m$=10.2 White, $m$=25.0 other, $F(2,69)$= 5.372, $p$=.007), positive affect ($m$=31.6 African American or Black, $m$=36.7 White, $m$=19.7 other, $F(2,69)$= 7.517, $p$=.001), and spirituality ($m$=38.7 African American or Black, $m$=35.4 White, $m$=23.0 other, $F(2,68)$= 5.622, $p$=.005) were statistically significantly different by race/ethnicity at T1. There were no other statistically significant differences in psychosocial measures at T1 by race/ethnicity.

IPAQ walking ($m$=1471.4 Houston vs. $m$=810.2 State College, $t$=1.7, $p$=.028) and accelerometer MVPA ($m$=29.9 Houston vs. $m$=117.7 State College, $t$=-8.0, $p$=.001) differed by study site. There were no other statistically significant differences in physical
activity or sitting time by study site. IPAQ walking (m=732.4 overweight vs. m=1209.2 obese, t=-1.1, p=.040) and IPAQ vigorous (m=84.2 overweight vs. m=936.5 obese, t=-1.6, p=.004) differed by weight status; there were no other statistically significant differences in physical activity or sitting time by weight status. Accelerometer MVPA (m= 67.6 African American or Black, m=116.6 White, m=158.0 other, F(2,65)=8.414, p=.001) differed by race/ethnicity; there were no other statistically significant differences in physical activity or sitting time by race/ethnicity.

Changes in psychosocial measures, physical activity, and sitting time over time

Changes in psychosocial measures, physical activity and sitting time from T1 to T2 by site and among total participants are summarized in Table 3. In Houston, participants reported significant increases in spirituality (∆=3.7, t=2.9, p=.010. In State College, participants reported significant decreases in depressive symptoms (∆=-2.2, t=-3.5, p=.001), negative affect (∆=-1.6, t=-2.7, p=.010), and sitting time (∆=-1.6, t=-3.4, p=.002) from T1 to T2. Across study sites, participants reported significant decreases in stress (∆=-0.6, t=-2.0, p =.049), decreases in depressive symptoms (∆=-2.1, t=-3.0, p=.004), decreases in negative affect (∆=-1.2, t=-2.4, p=.022), increases in spirituality (∆=1.4, t=2.2, p=.035), and decreases in sitting time (∆=-1.4, t=-3.8, p<.001) from T1 to T2.

Associations between intervention attendance and changes in psychosocial outcomes, physical activity, and sitting time over time

Linear regression analyses indicate that increased session attendance (percentage of sessions attended) was significantly associated with increased spirituality (β=.1, p=.047) from T1 to T2, and this association remained significant after adjusting for study
site (β=.2, p=.013). Session attendance (percentage of sessions attended) was not
significantly associated with changes in perceived stress, depressive symptoms, anxiety,
positive affect, negative affect, physical activity, or sitting time over time. Unadjusted
and adjusted regression models are summarized in Table 4.

Repeated measures ANOVA demonstrated a significant relationship between
attendance group and changes in depressive symptoms (F(1,55)=4.746, p=.034), as
shown in Figure 2, with participants in the low attendance group (attended 1-9 sessions)
experiencing greater decreases in depressive symptoms from T1 to T2 than participants in
the high attendance group (attended 10-16 sessions). No statistically significant time by
attendance group interaction effects were found for perceived stress, anxiety, positive
affect, negative affect, spirituality, physical activity or sitting time.

Repeated measures ANOVA also demonstrated a significant three-way interaction
between changes in positive affect, attendance group, and study site (F(1,53)= 7.839,

p=.007), shown in Figures 3a-b. Among Houston participants, the low attendance group
had increases in positive affect from T1 to T2, whereas among State College participants,
those in the low attendance group (attended 1-9 sessions) experienced decreases in
positive affect from T1 to T2 while those in the high attendance group (attended 10-16
sessions) experienced increases. There were no statistically significant three-way time by
attendance group by study site interaction effects for perceived stress, depression,
anxiety, negative affect, spirituality, physical activity or sitting time.

Repeated measures ANOVA demonstrated a significant interaction between total
sum of sessions attended and changes in spirituality (F(12,31)= 2.393, p=.025). As
shown in Figure 4, participants who attended 2, 8, or 11 sessions had slight decreases in
spirituality from T1 to T2, while all other participants had increases, with participants who attended 15 and 16 sessions demonstrating the greatest increases in spirituality over time, respectively. No statistically significant time by sum of sessions attended interaction effects were found for perceived stress, depression, anxiety, positive affect, negative affect, physical activity or sitting time.

Repeated measures ANOVA also demonstrated a significant three-way interaction between changes in perceived stress, attendance, and study site \((F(10,33)= 3.679, p=.002)\). As shown in Figure 5a-b, among Houston participants, participants who attended 2, 5, or 16 sessions experienced increases in stress and participants who attended 8 sessions did not see any changes in stress, while all other participants experienced decreases in stress over time. Among State College participants, participants who attended 3, 8, or 10 sessions experienced increases in stress while all other participants experienced decreases in stress over time. Repeated measures ANOVA also demonstrated a significant three-way interaction between changes in spirituality, attendance, and study site \((F(9,31)= 2.891, p=.013)\). As shown in Figure 6a-b, among Houston participants, participants who attended 2 or 11 sessions experienced decreases in spirituality, while all other participants experienced increases in spirituality over time, with participants who attended 15 or 16 sessions demonstrating the greatest increases in spirituality. Among State College participants, participants who attended 2, 7, or 8, or 10 sessions experienced decreases in spirituality, while all other participants experienced increases in spirituality over time.
There were no statistically significant three-way time by sum of sessions attended by study site interaction effects for any other psychosocial outcomes, physical activity, or sitting time among participants.

**Associations between changes in psychosocial outcomes and changes in physical activity and sitting time over time**

Linear regression analyses indicate that increases in stress were significantly associated with increases in IPAQ walking time ($\beta=2.2$, $p=.035$), and this association remained significant after adjusting for study site ($\beta=.3$, $p=.030$). There were no other statistically significant associations between changes in psychosocial outcomes and changes in physical activity and sitting time over time. Adjusted linear regression models are summarized in Table 5.
Chapter 5: Discussion

The purpose of the current study was to increase our understanding of an optimal level of adherence to a culturally-tailored mind-body intervention for improving psychosocial outcomes, increasing physical activity and decreasing sitting time among racial/ethnic minorities and rural Appalachian residents. More specifically, the study aimed to 1) determine the associations between mind-body intervention attendance and changes in psychosocial outcomes (perceived stress, depressive symptoms, positive and negative affect, and spirituality), physical activity, and sitting time over time, and determine whether there is a dose-response relationship between intervention attendance and changes in psychosocial measures, physical activity, and sitting time, and 2) explore the associations between changes in psychosocial outcomes and changes in physical activity or sitting time over time.

In sum, statistically significant findings showed that 1) increased intervention attendance was associated with increased spirituality, 2) there were differences in changes in depressive symptoms over time between low and high attenders, with low attenders experiencing greater decreases in depressive symptoms, 3) there were differences in changes in positive affect between attendance group and study site, 4) differences in changes in spirituality by number of sessions attended, with for the most part, greater increases in spirituality experienced with greater session attendance, 5) there were differences in changes in perceived stress and spirituality by number of sessions attended between study sites, and 6) increased self-reported walking was associated with increased perceived stress.
For Aim 1, it was hypothesized that increased mind-body intervention attendance would be associated with improvements in psychosocial outcomes, increases in physical activity levels, and decreases in sitting time from T1 to T2. This hypothesis was supported with regard to spirituality, with findings indicating that higher intervention attendance was associated with increased spirituality, contributing to the previous literature on the relationship between spirituality and physical activity, as although spirituality and religious involvement has typically been shown to be associated with increased physical activity, the majority of studies explicitly addressed religiosity rather than spirituality or have used those terms interchangeably (Oleckno & Blacconiere, 1991; Strawbridge et al., 2001; Wallace & Forman, 1998).

Although these were not statistically significantly associations, results suggest that participants attending more sessions experienced increases in self-reported moderate and total physical activity, decreases in stress and increases in positive affect. The increase in self-reported physical activity may be due to participants attending more intervention sessions having more opportunities to build self-efficacy and behavioral capabilities, and receive social support, all key determinants of behavior (Bandura, 1986; Bauman et al., 2012). Additionally, with mind-body practices such as yoga, individuals who regularly practice experience the greatest health benefits (Alexander et al., 2010; Rice, 2001), which can explain why increased mind-body session attendance was associated with decreases in stress and increases in positive affect. These findings are also consistent with previous research on mind-body interventions, which have generally found effectiveness for improvements in physical and psychological outcomes, including reductions in stress and increases in self-reported physical activity (Carmody & Baer,
The only statistically significant difference in changes in psychosocial outcomes, physical activity, and sitting time between low attenders and high attenders was in depressive symptoms. Although the finding that participants in the low attendance group (1-9 sessions) experienced significantly greater decreases in depressive symptoms from T1 to T2 than participants in the high attendance group (10-16) was surprising, it may be explained by the participants in the low attendance group (1-9 sessions) reporting higher depressive symptoms at T1 and therefore being able to experience greater benefits over the course of the mind-body intervention. This is similar to previous findings with participants with higher depression at baseline, or participants with depression compared to those without, experiencing greater improvements in outcomes following an intervention (Baron, Corden, Jin, & Mohr, 2011; Milani, Lavie, & Cassidy, 1996). One study assessing the effects of a psychotherapy intervention on insomnia symptoms found that higher depression at baseline was associated with a greater improvement in total insomnia score (Baron et al., 2011). Another study assessing the effect of cardiac rehabilitation and exercise training on depression after major cardiac events found favorable outcomes among both depressed and non-depressed participants, however, when compared to the non-depressed participants, depressed participants demonstrated statistically greater benefits in depression, anxiety, total quality of life, well-being, functional status, general health and mental health (Milani et al., 1996).

It was somewhat surprising that there were no other statistically significant differences in changes in psychosocial outcomes, physical activity, and sitting time
between low attenders and high attenders, as it was hypothesized that high attenders would experience significantly greater improvements in psychosocial outcomes, physical activity, and sitting time than low attenders, which would have suggested that attending at least 10 intervention sessions was necessary for optimal benefits. Results indicate that this was not the case. Given that the cut-off of attending at least 10 sessions to be categorized as a high attender was based simply on a priori feasibility objectives, there may have been significant differences in changes in psychosocial outcomes, physical activity, and sitting time between low attenders and high attenders had the cut-off been different. Further research, exploring different cut-offs for the high attendance group, to ascertain whether there is a minimum number of intervention sessions for optimal benefits should be continued.

The only significant difference in changes in psychosocial outcomes, physical activity, and sitting time between low attenders and high attenders by study site was in positive affect. Among Houston participants, the low attendance group had significantly higher increases in positive affect from T1 to T2, whereas among State College participants, those in the low attendance group experienced decreases in positive affect from T1 to T2 while those in the high attendance group experienced increases. Aside from the low attendance group in State College, the increases in positive affect in all other groups are in line with previous research findings showing that low-dose bodily movement are associated with improvements in positive affect (Ekkekakis, Hall, VanLanduyt, & Petruzzello, 2000; Schwerdtfeger et al., 2010). In Houston, the finding that the low attendance group had significantly higher increases in positive affect may
again be explained by participants in the low attendance group demonstrating lower positive affect scores at baseline and thus able to gain greater increases.

Finding this difference in changes in positive affect between low attenders and high attenders by study site is not surprising, given the difference in the geographic setting (large, metropolitan vs. non-metro) and racial/ethnic makeup of the samples between study sites. Previous research have similarly shown differences in behavioral intervention outcomes between rural and urban settings and between racial and ethnic groups. One study assessing whether the impact of a health promotion and disease self-management intervention on physical function and health care expenditures varied by urban or rural residence found that the intervention had a stronger positive effect among participants who lived in rural areas (Meng et al., 2009). A study examining differences in weight loss, physical activity, and dietary intake between African American and white adults in response to a behavioral intervention found that white adults lost more weight and had higher levels of objectively measured physical activity compared to African American participants (Davis et al., 2015).

The hypothesis that there would be a dose-response relationship between intervention attendance and changes in psychosocial measures, physical activity, and sitting time, with greater improvements in psychosocial measures, physical activity, and sitting time seen with greater attendance, was somewhat supported in spirituality. Participants who attended 2, 8, or 11 sessions had slight decreases in spirituality from T1 to T2, but aside from those, all other participants had increases in spirituality, with participants who attended 15 and 16 sessions demonstrating the greatest increases in spirituality over time, respectively. These findings among our sample of diverse
Appalachian and racial/ethnic minorities are highly promising. Spirituality has been shown to be an important component in the care and treatment of patients with serious illness (Puchalski, 2007). In individuals with HIV, increases in spirituality were found to be predictive of slower disease progression (Ironson, Stuetzle, & Fletcher, 2006), and among cancer patients treated by chemotherapy, objective tumor regressions was significantly higher in patients with spiritual faith (Messina et al., 2010). Research has also shown that spirituality and religiosity plays a considerable role in mortality rate reductions (Lucchetti, Lucchetti, & Koenig, 2011). The current study findings that indicate a dose-response relationship between mind-body intervention attendance and spirituality, with greater increases in spirituality generally seen with higher intervention attendance, suggest that researchers should explore strategies to improve and increase intervention attendance rates in order to increase the potency of the intervention in increasing spirituality, and in turn potentially reducing mortality rates among rural Appalachian and racial/ethnic minority populations.

Another future direction worth considering is the assessment of spirituality as a mediator or moderator in the relationship between mind-body intervention attendance and other psychosocial outcomes, physical activity, and sitting time. Other psychosocial factors, for example, level of mindfulness, should also be addressed in future studies as mediators or moderators in the relationship between mind-body intervention attendance and physical activity and sitting time. Carmody and Baer (2008) previously investigated the practice of mindfulness meditation exercises and levels of mindfulness, medical and psychological symptoms, perceived stress, and psychological well-being in an eight session mindfulness-based stress reduction program, and found the relationships between
practice time and psychological symptoms to be completely mediated by increases in mindfulness skills (Carmody & Baer, 2008). Increases in mindfulness skills may have a similar mediating effect on the relationship between attendance at a mind-body intervention and improvements in psychosocial outcomes and physical activity, and further research assessing this is warranted.

To the author’s knowledge, no studies to date have explored a dose-relationship between faith-based mind-body intervention attendance and psychosocial outcomes, physical activity or sitting time. A previous study assessed a dose-response relationship between attendance at a faith-based intervention and physical activity, and similar to the current study, found mixed results in outcomes, with greater class attendance associated with significant increases in self-reported leisure-time MVPA and smaller waist circumference, but not accelerometer-based MVPA or BMI (Arredondo et al., 2017). Further research, with a larger sample size and longer intervention duration, is needed to definitively assess whether a dose-relationship exists between mind-body intervention attendance and psychosocial outcomes, physical activity and sitting time.

For Aim 2, it was hypothesized that improved psychosocial outcomes would be associated with increased physical activity and decreased sitting time, which was not supported by study results. Findings suggest that increases in self-reported walking were associated with increases in stress, which was unexpected and did not support the hypothesis. However, it is important to note that these were survey-based measurements, which are subject to self-reporting bias, reducing some confidence in results.
Although an optimal number of mind-body sessions for improving psychosocial outcomes, increasing physical activity and decreasing sitting time among rural Appalachian residents and racial/ethnic minorities was not determined, given that the majority of previous research assessing physical activity intervention adherence has mainly addressed determinants of adherence (Farrance, Tsoflou, & Clark, 2016; Garmendia et al., 2013; van Gool et al., 2006), and that the majority of mind-body interventions has been conducted among Caucasian and urban adults (Cherkin et al., 2016; Hughes et al., 2013; Miller et al., 2015), the current study contributed unique insight to the literature regarding adherence to a mind-body intervention on improving psychosocial outcomes, increasing physical activity and decreasing sitting time among rural Appalachian and racially/ethnically diverse adults. However, the current study was not without limitations, which must be considered when interpreting the results.

**Limitations**

One limitation of the current study was the relatively small sample size, and uneven session attendance among participants, particularly when addressing the dose-response relationship between intervention attendance and improvements in psychosocial outcomes, physical activity and sitting time. There was only one participant who attended 16 sessions, and 2 who attended 5 or 9 sessions, making it difficult to definitively determine a dose-response relationship. Larger studies with more equal session attendance among participants should be considered.

Additionally, study site was chosen as the single covariate in the current study as it accounted for both geographic setting and race/ethnicity, based on previous
recommendations for the inclusion of covariates in regressions (Green, 1991). However, given that some psychosocial and physical activity measures were significantly different among race/ethnicity and weight category at baseline, these may have been important to include in analyses as additional covariates. Future studies with larger samples should aim to include these potentially important covariates for a greater understanding of the associations between mind-body intervention attendance and psychosocial outcomes, physical activity, and sitting time, and the associations between psychosocial outcomes and physical activity and sitting time.

Additional covariates to consider in future studies are determinants of physical activity intervention attendance, which the current study did not consider. Van Gool and colleagues (2006) found no significant determinants of exercise session attendance in the initiation phase of a physical activity intervention, but found that high session attendance during the initiation phase, exercising at home, and not having cardiovascular disease were significant determinants of high session attendance in the maintenance phase among overweight and obese older patients with knee osteoarthritis (van Gool et al., 2006). Garmendia and colleagues (2013) found that depression, diabetes mellitus, percentage of impoverished households and rate of arrests for neighborhood crimes predicted less physical activity intervention adherence, while being retired, participation in physical activity prior to the intervention, and green areas per habitant were positively associated with adherence among older Latin American adults. Future studies should aim to consider these factors, as well as assess determinants of physical activity intervention attendance that may be specific rural racial/ethnic minorities.
Another limitation of this study was that religiosity was not specifically assessed. Religious involvement may have a mediating or moderating effect on the relationship between intervention attendance and physical activity and psychological outcomes, given that religious involvement has been shown to be associated with increased physical activity and lower anxiety and depression (Jurkowski, Mosquera, & Ramos, 2010; McCullough & Larson, 1999; Mueller et al., 2001). Additionally, while past research has used spirituality, religion, and religiousness interchangeably or as overlapping terms, the Pew Research Center found that a growing number of U.S. adults self-identify as spiritual but not religious, a trend that is observed across all races/ethnicities (Lipka & Gecewicz, 2017). In 2017, a quarter of Americans viewed themselves as spiritual but not religious, 48% reported being both religious and spiritual, and 6% reported being religious but not spiritual (Lipka & Gecewicz, 2017). Given these distinctions, future studies should aim to assess both spirituality and religiosity.

Another limitation was the use of the PSS-4 in assessing stress among study participants. Although the PSS-4 has established acceptable psychometric properties, it is not as valid or reliable in measuring stress as the longer forms, particularly among diverse and minority populations (Lee, 2012). This may be attributable to the PSS-14 and PSS-10 including more items than the PSS-4, as Cronbach’s alpha tends to increase with the number of items in an instrument (Macdonald, 1992). Future studies in this population should therefore consider using the longer 10-item or 14-item PSS. In addition to the PSS-4, the current study used survey-based assessments of the other psychosocial outcomes, some physical activity outcomes and sitting time, which are subject to self-reporting bias.
Lastly, the study sample was predominantly female, African American adults with relatively higher socioeconomic status, thus limiting the generalizability of study findings to men, other racial/ethnic minorities, and lower socioeconomic status populations.

Conclusions

Despite the noted limitations, the current study contributed to the limited literature on faith-based mind-body interventions for increasing physical activity in diverse Appalachian and racial/ethnic minority populations. This study was unique in that it was able to compare a culturally-tailored mind-body intervention among diverse participants from two geographically distinct settings, which may provide insight into the translation of interventions from urban to rural settings, and provided preliminary directions for informing the broader implementation efforts of culturally-tailored mind-body interventions among rural Appalachian residents and racial/ethnic minorities to ultimately reduce health disparities in these underserved populations.
Appendix A: Tables & Figures

Table 1. Categorical variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categorical treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Status</td>
<td>1=Overweight (BMI 25-29.9 kg/m²)</td>
</tr>
<tr>
<td></td>
<td>2=Obese (BMI ≥30.0 kg/m²)</td>
</tr>
<tr>
<td>Gender</td>
<td>1=Male</td>
</tr>
<tr>
<td></td>
<td>2=Female</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td>1=White</td>
</tr>
<tr>
<td></td>
<td>2=African American or Black</td>
</tr>
<tr>
<td></td>
<td>3=Other</td>
</tr>
<tr>
<td>Education</td>
<td>1=&lt;Bachelor’s degree</td>
</tr>
<tr>
<td></td>
<td>2=Bachelor’s degree</td>
</tr>
<tr>
<td></td>
<td>3=&gt;Bachelor’s degree</td>
</tr>
<tr>
<td>Annual income</td>
<td>1=&lt;$40,000</td>
</tr>
<tr>
<td></td>
<td>2=$40,000-$79,999</td>
</tr>
<tr>
<td></td>
<td>3=≥$80,000</td>
</tr>
<tr>
<td>Employment status</td>
<td>1=Employed</td>
</tr>
<tr>
<td></td>
<td>2=Not employed</td>
</tr>
<tr>
<td></td>
<td>3=Retired</td>
</tr>
<tr>
<td>Attendance group</td>
<td>1=Low attendance (1-9 sessions)</td>
</tr>
<tr>
<td></td>
<td>2=High attendance (10-16 sessions)</td>
</tr>
</tbody>
</table>
Table 2. Participant baseline characteristics and attendance by study site

<table>
<thead>
<tr>
<th></th>
<th>Houston (N=26)</th>
<th>State College (N=46)</th>
<th>Total (N=72)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years) [M ± SD]</strong></td>
<td>50.1 ± 9.7</td>
<td>49.1 ± 14.0</td>
<td>49.5 ± 12.6</td>
</tr>
<tr>
<td><strong>Attendance (number of sessions) [M ± SD]</strong></td>
<td>8.9 ± 5.1</td>
<td>9.0 ± 5.2</td>
<td>9.0 ± 5.2</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>24 (92.3)</td>
<td>39 (84.8)</td>
<td>63 (87.5)</td>
</tr>
<tr>
<td>Male</td>
<td>2 (7.7)</td>
<td>7 (15.2)</td>
<td>9 (12.5)</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>0 (0.0)</td>
<td>22 (47.8)</td>
<td>22 (30.6)</td>
</tr>
<tr>
<td>African American or Black</td>
<td>26 (100.0)</td>
<td>21 (45.7)</td>
<td>47 (65.3)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0.0)</td>
<td>3 (6.5)</td>
<td>3 (4.2)</td>
</tr>
<tr>
<td><strong>Weight status</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Overweight (BMI 25-29.9 kg/m²)</td>
<td>5 (19.2)</td>
<td>15 (32.6)</td>
<td>20 (27.8)</td>
</tr>
<tr>
<td>Obese (BMI ≥30.0 kg/m²)</td>
<td>21 (80.8)</td>
<td>29 (63.0)</td>
<td>50 (69.4)</td>
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<tr>
<td><strong>Education</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt; Bachelor’s degree</td>
<td>14 (53.8)</td>
<td>16 (34.8)</td>
<td>30 (41.7)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>7 (26.9)</td>
<td>16 (34.8)</td>
<td>23 (31.9)</td>
</tr>
<tr>
<td>&gt; Bachelor’s degree</td>
<td>5 (19.2)</td>
<td>14 (30.4)</td>
<td>19 (26.4)</td>
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<td><strong>Annual income</strong></td>
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<td></td>
</tr>
<tr>
<td>&lt; $40,000</td>
<td>7 (26.9)</td>
<td>11 (23.9)</td>
<td>18 (25.0)</td>
</tr>
<tr>
<td>$40,000-$79,999</td>
<td>12 (46.2)</td>
<td>16 (34.8)</td>
<td>28 (38.9)</td>
</tr>
<tr>
<td>≥ $80,000</td>
<td>7 (26.9)</td>
<td>16 (34.8)</td>
<td>23 (31.9)</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
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<tr>
<td>Employed</td>
<td>21 (80.8)</td>
<td>33 (71.7)</td>
<td>54 (75.0)</td>
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<td>Not employed</td>
<td>2 (7.7)</td>
<td>7 (15.2)</td>
<td>9 (12.5)</td>
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<tr>
<td>Retired</td>
<td>3 (11.5)</td>
<td>6 (13.0)</td>
<td>9 (12.5)</td>
</tr>
<tr>
<td><strong>Attendance group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High attendance (10-16 sessions)</td>
<td>16 (61.5)</td>
<td>25 (54.3)</td>
<td>41 (56.9)</td>
</tr>
<tr>
<td>Low attendance (1-9 sessions)</td>
<td>6 (23.1)</td>
<td>13 (28.3)</td>
<td>19 (26.4)</td>
</tr>
</tbody>
</table>
Table 3: Changes in psychosocial measures, physical activity, and sitting time from baseline (T1) to post-intervention (T2) by study site

<table>
<thead>
<tr>
<th></th>
<th>Houston</th>
<th>T1</th>
<th>T2</th>
<th>Δ</th>
<th>p</th>
<th>State College</th>
<th>T1</th>
<th>T2</th>
<th>Δ</th>
<th>p</th>
<th>Total</th>
<th>T1</th>
<th>T2</th>
<th>Δ</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M±SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M±SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M±SD</td>
<td></td>
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</tr>
<tr>
<td>Perceived stress</td>
<td>4.5±2.5</td>
<td>3.7±3.0</td>
<td>-0.8</td>
<td>.210</td>
<td></td>
<td>4.4±3.1</td>
<td>3.8±3.2</td>
<td>-0.6</td>
<td>.137</td>
<td></td>
<td>4.4±2.8</td>
<td>3.8±3.1</td>
<td>-0.6</td>
<td>.049</td>
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<tr>
<td>Depressive symptoms</td>
<td>9.5±7.9</td>
<td>7.6±7.5</td>
<td>-1.9</td>
<td>.223</td>
<td></td>
<td>9.9±8.3</td>
<td>7.7±7.9</td>
<td>-2.2</td>
<td>.001</td>
<td></td>
<td>9.8±8.1</td>
<td>7.7±7.7</td>
<td>-2.1</td>
<td>.004</td>
<td></td>
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<tr>
<td>Anxiety</td>
<td>5.3±7.0</td>
<td>6.7±7.6</td>
<td>1.4</td>
<td>.230</td>
<td></td>
<td>6.1±5.4</td>
<td>6.3±6.6</td>
<td>0.2</td>
<td>.811</td>
<td></td>
<td>5.8±6.0</td>
<td>6.4±6.9</td>
<td>0.7</td>
<td>.339</td>
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<tr>
<td>Positive affect</td>
<td>37.5±9.3</td>
<td>38.7±8.3</td>
<td>1.2</td>
<td>.290</td>
<td></td>
<td>34.0±8.8</td>
<td>34.5±8.2</td>
<td>0.6</td>
<td>.523</td>
<td></td>
<td>35.3±9.1</td>
<td>36.2±8.4</td>
<td>0.8</td>
<td>.237</td>
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<tr>
<td>Negative affect</td>
<td>14.9±5.9</td>
<td>14.3±4.0</td>
<td>-0.7</td>
<td>.504</td>
<td></td>
<td>15.6±5.1</td>
<td>14.1±5.4</td>
<td>-1.6</td>
<td>.010</td>
<td></td>
<td>15.4±5.4</td>
<td>14.1±4.9</td>
<td>-1.2</td>
<td>.022</td>
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<tr>
<td>Spirituality</td>
<td>38.1±8.7</td>
<td>41.9±7.1</td>
<td>3.7</td>
<td>.010</td>
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<td>37.8±9.1</td>
<td>37.9±8.9</td>
<td>0.1</td>
<td>.865</td>
<td></td>
<td>37.9±8.9</td>
<td>39.3±8.4</td>
<td>1.4</td>
<td>.035</td>
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<tr>
<td>IPAQ (MET-min/week)</td>
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<tr>
<td>Walking</td>
<td>1471.4±1823.7</td>
<td>2072.4±2223.7</td>
<td>601.0±1213.5</td>
<td>.463</td>
<td>810.2±1260.3</td>
<td>1074.8±1560.8</td>
<td>264.6±1705.3</td>
<td>.541</td>
<td>1054.3±1965.3</td>
<td>1418.8±2790.4</td>
<td>364.5±806.7</td>
<td>984</td>
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<tr>
<td>Moderate</td>
<td>1354.9±1711.4</td>
<td>2955.9±3655.7</td>
<td>1601.0±1297.3</td>
<td>.070</td>
<td>1043.7±2079.1</td>
<td>1444.0±1458.6</td>
<td>400.3±2790.4</td>
<td>.057</td>
<td>1158.6±2970.4</td>
<td>1965.3±3790.4</td>
<td>806.7±192.9</td>
<td>.429</td>
<td></td>
<td></td>
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<tr>
<td>Vigorous</td>
<td>889.3±1813.3</td>
<td>1211.6±1563.2</td>
<td>322.3±2126.0</td>
<td>.365</td>
<td>549.3±1819.8</td>
<td>686.7±2008.5</td>
<td>137.4±1740.0</td>
<td>.681</td>
<td>674.8±192.9</td>
<td>867.7±192.9</td>
<td>192.9±.344</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3715.6±3870.5</td>
<td>6239.9±4759.3</td>
<td>2524.3±37.230.0</td>
<td>.062</td>
<td>2403.1±4128.2</td>
<td>3205.6±3801.9</td>
<td>802.5±4552.9</td>
<td>.083</td>
<td>2887.7±4251.9</td>
<td>4251.9±1364.2</td>
<td>283</td>
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<tr>
<td>MVPA (min/day)</td>
<td>29.2±18.6</td>
<td>27.3±16.8</td>
<td>-1.9</td>
<td>.591</td>
<td></td>
<td>119.0±49.5</td>
<td>128.6±54.3</td>
<td>9.6</td>
<td>.150</td>
<td></td>
<td>86.1±59.7</td>
<td>91.5±66.1</td>
<td>5.4</td>
<td>.222</td>
<td></td>
</tr>
<tr>
<td>Sitting time (hours/day)</td>
<td>7.3±3.6</td>
<td>6.1±2.6</td>
<td>-1.2</td>
<td>.091</td>
<td></td>
<td>7.6±3.3</td>
<td>6.1±2.8</td>
<td>-1.6</td>
<td>.002</td>
<td></td>
<td>7.5±3.4</td>
<td>6.1±2.7</td>
<td>-1.4</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Regression models exploring associations between intervention session attendance (percentage of sessions attended) and changes in psychosocial outcomes, physical activity, or sitting time from T1 to T2

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted</th>
<th></th>
<th></th>
<th>Adjusted</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>t</td>
<td>p</td>
<td>β</td>
<td>t</td>
<td>p</td>
</tr>
<tr>
<td>Perceived stress</td>
<td>-.1</td>
<td>-7</td>
<td>.473</td>
<td>-.1</td>
<td>-8</td>
<td>.541</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>.1</td>
<td>1.6</td>
<td>.113</td>
<td>.1</td>
<td>1.6</td>
<td>.107</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.0</td>
<td>.2</td>
<td>.816</td>
<td>.0</td>
<td>.3</td>
<td>.762</td>
</tr>
<tr>
<td>Positive affect</td>
<td>.1</td>
<td>.8</td>
<td>.406</td>
<td>.1</td>
<td>1.1</td>
<td>.296</td>
</tr>
<tr>
<td>Negative affect</td>
<td>.1</td>
<td>1.1</td>
<td>.268</td>
<td>.1</td>
<td>1.2</td>
<td>.238</td>
</tr>
<tr>
<td>Spirituality</td>
<td>.1</td>
<td>2.0</td>
<td>.047</td>
<td>.2</td>
<td>2.6</td>
<td>.013</td>
</tr>
<tr>
<td>IPAQ (MET-min/week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td>-.1</td>
<td>-.4</td>
<td>.676</td>
<td>-.0</td>
<td>-.1</td>
<td>.887</td>
</tr>
<tr>
<td>Moderate</td>
<td>.0</td>
<td>.2</td>
<td>.824</td>
<td>.2</td>
<td>.8</td>
<td>.402</td>
</tr>
<tr>
<td>Vigorous</td>
<td>-.1</td>
<td>-.5</td>
<td>.611</td>
<td>.0</td>
<td>-.2</td>
<td>.867</td>
</tr>
<tr>
<td>Total</td>
<td>.0</td>
<td>.0</td>
<td>.984</td>
<td>.1</td>
<td>.4</td>
<td>.673</td>
</tr>
<tr>
<td>Accelerometer MVPA (min/day)</td>
<td>-.1</td>
<td>-.9</td>
<td>.348</td>
<td>-.0</td>
<td>-.7</td>
<td>.466</td>
</tr>
<tr>
<td>Sitting time (hours/day)</td>
<td>.1</td>
<td>1.1</td>
<td>.272</td>
<td>.1</td>
<td>1.2</td>
<td>.237</td>
</tr>
</tbody>
</table>

*Adjusted for study site*
Table 5. Adjusted regression models exploring associations between changes in psychosocial outcomes and changes in physical activity or sitting time from T1 to T2

<table>
<thead>
<tr>
<th>Perceived stress</th>
<th>IPAQ</th>
<th>Accelerometer MVPA</th>
<th>Sitting time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Walking</td>
<td>Moderate</td>
<td>Vigorous</td>
</tr>
<tr>
<td>β</td>
<td>.3</td>
<td>.2</td>
<td>.030</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>-.1</td>
<td>-.7</td>
<td>.464</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-.0</td>
<td>-.2</td>
<td>.868</td>
</tr>
<tr>
<td>Positive affect</td>
<td>-.1</td>
<td>-.8</td>
<td>.444</td>
</tr>
<tr>
<td>Negative affect</td>
<td>-.1</td>
<td>-.4</td>
<td>.715</td>
</tr>
<tr>
<td>Spirituality</td>
<td>.0</td>
<td>.1</td>
<td>.922</td>
</tr>
</tbody>
</table>

*Adjusted for study site*
Figure 1. Conceptual framework for study
Figure 2. Changes in depressive symptoms from T1 to T2 by attendance group, indicating a significant relationship between attendance group and changes in depressive symptoms ($F(1, 55) = 4.746, \ p = 0.034$), with participants in the low attendance group experiencing greater decreases in depressive symptoms from T1 to T2 than participants in the high attendance group.
Changes in positive affect from T1 to T2 by attendance group and study site, demonstrating a significant three-way interaction between changes in positive affect, attendance group, and study site (F(1,53) = 7.839, p = .007). In Houston participants, the low attendance group had increases in positive affect from T1 to T2, whereas among State College participants, those in the low attendance group experienced decreases in positive affect from T1 to T2 while those in the high attendance group experienced increases.
Figure 4. Changes in spirituality from T1 to T2 by total sum of sessions attended, demonstrating a significant interaction between total sum of sessions attended and changes in spirituality ($F(12,31)= 2.393, p=0.013$). Participants who attended 2, 8, or 11 sessions had slight decreases in spirituality from T1 to T2, while all other participants had increases, with participants who attended 16 sessions demonstrating the greatest increases in spirituality over time.
Figure 5a-b. Changes in perceived stress from T1 to T2 by total sum of sessions attended, demonstrating a significant three-way interaction between changes in perceived stress, attendance, and study site ($F(10,33)= 3.679$, $p=0.002$). Among Houston participants, participants who attended 2, 5, or 16 sessions experienced increases in stress and participants who attended 8 sessions did not see any changes in stress, while all other participants experienced decreases in stress over time. Among State College participants, participants who attended 3, 8, or 10 sessions experienced increases in stress while all other participants experienced decreases in stress over time.
Figure 6a-b. Changes in perceived stress from T1 to T2 by total sum of sessions attended, demonstrating a significant three-way interaction between changes in perceived stress, attendance, and study site ($F(9,31) = 2.891, p = .013$). In Houston, participants who attended 2 or 11 sessions experienced decreases in spirituality, while all other participants experienced increases in spirituality over time, with participants who attended 15 or 16 sessions demonstrating the greatest increases in spirituality. In State College participants, participants who attended 2, 7, or 8, or 10 sessions experienced decreases in spirituality, while all other participants experienced increases in spirituality over time.
References


Alexander, G. K., Innes, K. E., Brown, C. J., Kulbok, P., Bourguignon, C., Bovbjerg, V. E., &
Taylor, A. G. (2010). “I Could Move Mountains”: Adults With or at Risk for Type 2
Diabetes Reflect on Their Experiences With Yoga Practice. Diabetes Educ, 36(6), 965-975. doi:10.1177/0145721710381802

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental
Disorders (5th ed.). Washington, DC.


Washington, D.C.:
https://www.arc.gov/assets/research_reports/Health_Disparities_in_Appalachia_August_2017.pdf


of the science, implications for practice. J Am Board Fam Pract, 16(2), 131-147.

Behaviors of Middle-Aged and Older Adults. Journal of General Internal Medicine,
26(3), 245-250. doi:10.1007/s11606-010-1514-7


Group on Quality of Care and Outcomes Research. *Circulation, 114*(24), 2739-2752.
doi:10.1161/circulationaha.106.179683

doi:10.1161/circulationaha.106.179683

promotion programs: lessons from the Los Angeles Mammography Promotion in

Matthews, K. A., & Gump, B. B. (2002). Chronic work stress and marital dissolution increase
risk of posttrial mortality in men from the Multiple Risk Factor Intervention Trial. *Arch


Mental Health: Policy Implications. *Health Affairs, 27*(2), 393-403.
doi:10.1377/hlthaff.27.2.393

Rural Differences in the Effect of a Medicare Health Promotion and Disease Self-
Management Program on Physical Function and Health Care Expenditures. *The

Original and Short Forms in an African American Community Sample. *Journal of

Enhancement of the efficacy of cancer chemotherapy by the pineal hormone melatonin


from the American Cancer Society's Studies of Cancer Survivors. *Cancer, 121*(11), 1838-1844. doi:10.1002/cncr.29286


