

**Effect of physical activity as a moderator on the association between perceived racial
discrimination and depression in African Americans**

by

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A thesis submitted to graduate faculty
in partial fulfillment of the requirements for the degree
MASTER OF SCIENCE

Major: Kinesiology

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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred. Iowa State University

Ames, Iowa

2019

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ACKNOWLEDGEMENTS

I would like to thank my major professor Dr. Duck-chul Lee and his Post-doctoral fellow, Dr. Angelique Brellenthin. Both of these people were instrumental to my success as a student and have been tremendously helpful and supportive throughout this process. I would also like to thank my committee members Dr. Carolyn Cutrona, for allowing me to use her dataset, and Dr. Jacob Meyer, for his guidance and support from the very inception of this idea through the thesis process. I also must recognize the support I have received from my fellow graduate students, the undergraduate research assistants and professional research staff in our lab. I also would like to thank everyone who participated in the FACHS cohort, my family, friends, and numerous mentors that have inspired me.

ABSTRACT

Purpose: To evaluate the relationship between perceived racial discrimination and major depressive disorder (MDD) in a sample of African Americans, and then to test if physical activity (PA) can moderate the association if such exists.

Methods: This cross-sectional analysis consists of 775 African Americans (mean age= 45.3) from the Family and Community Health Study (FACHS). Perceived racial discrimination was assessed via the Schedule of Racists events, MDD was diagnosed with the University of Michigan Composite International, self-reported depression scores were assessed with the Mini-Mood and Anxiety Symptom Questionnaire, and PA was measured with two questions created by the FACHS research team. Participants were categorized into tertiles based on their discrimination scores. Logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals (95% CIs) of having MDD diagnosis within the past 12-months. Linear regression was also used to test the association between racial discrimination, depression, and PA. Participants were further dichotomized into low or high discrimination groups, and physically inactive or active groups to test the combined associations of discrimination and PA with MDD.

Results: Discrimination was found to be positively associated with both self-reported depression in the linear regression [Standardized β = 0.15 (p <0.01)] and with MDD diagnosis in the logistic regression [OR (95% CI) 3.34 (1.26-8.81)] in the upper tertile compared to the lower tertile] after adjusting for age, education (year), sex, PA, and heavy alcohol use. A stratified analysis was conducted to test the possible effect modification by PA on the association between discrimination and MDD. Among participants who were active (meeting the PA guidelines), participants in the middle and upper categories of discrimination had no increased odds of MDD

compared to the lower discrimination group. However, among participants who were inactive, odds of MDD were significantly higher for those in the upper tertile of discrimination compared to the lower tertile [(OR (95% CI) 7.24 (1.54-34.15)] after adjusting for possible confounders. Although the interaction term was not significant ($p=0.18$) created from racial discrimination (Lower, Middle, and Upper) and physical activity (Inactive or Active), possibly due to the very small numbers of cases in all six groups ($n=2-11$) with wide 95% CIs, the above result from the stratified analysis by physical activity levels clearly suggests a possible effect modification by physical activity on the association between racial discrimination and depression in this cohort of African American. However, further studies with larger sample size and more cases of depression are warranted. In the joint analysis, we observed a similar trend suggesting no increased odds of MDD in the high discrimination group if they were active.

Conclusion: Perceptions of racial discrimination show a positive, linear association with MDD in African Americans, and meeting the PA guidelines may reduce the increased odds of depression due to experiencing greater levels of discrimination. However, further prospective studies are needed to confirm the findings from this cross-sectional analyses.

CHAPTER 1: INTRODUCTION

Major depressive disorder (MDD) or depression, is among the most prevalent and debilitating diseases in the world. According to the World Health Organization (WHO), approximately 350 million people worldwide are suffering from the disease, and MDD ranks as the leading cause of disability (WHO, 2018). Clinically, MDD is defined as a mental health condition characterized by an inescapable and ongoing low mood often accompanied by low self-esteem and loss of interest or pleasure in activities that a person previously found enjoyable (Mental Health America, 2017). MDD patients also experience physical symptoms; such as poorer sleep quality, increased fatigue, and weight instability. (Greco, Eckert, & Kroenke, 2004). Diagnosis for MDD is based on the criteria listed in the 5th edition of Diagnostic and Statistical Manual of Mental Disorders, symptoms of depression must be present nearly every day for at least 2 weeks (DSM-IV) (American Psychiatric Association, 1994). Like several other chronic diseases, MDD results from a complex interaction of biological and psychosocial factors, and outcomes of the disorder tend to be disparate for racial and ethnic minority groups. Compared to white people, members of racial and ethnic minority groups in the United States are less likely to have access to mental health services, less likely to use community mental health services, more likely to use inpatient hospitalization and emergency rooms, and more likely to receive lower quality care (Wang et.al., 2014; Samnaliev, McGovern, & Clark 2009, Alegría et.al., 2008). These findings along with similar findings from other studies illustrate how depression continues to be not only under-recognized, but undertreated in racial and ethnic minority groups (Akincigil et.al., 2012).

Racial discrimination presents a unique risk factor for racial and ethnic minorities that stems from larger systems of racism and increases their likelihood of developing MDD. Racism can be viewed as a set of organized systems within societies that cause avoidable and unfair inequalities in power, resources, capacities, and opportunities across racial or ethnic groups (Berman & Paradies, 2010). Racism exists at the individual, institutional, and cultural level and can manifest through beliefs, stereotypes, prejudices, or discrimination. This encompasses everything from open threats and insults to phenomena deeply embedded in social systems and structures (Berman & Paradies, 2010). Exposure to racial discrimination, in particular, has been conceptualized as a significant stressor, and a growing body of literature documents associations between self-reported exposure to racial discrimination and poor health outcomes (Paradis, 2006; Ayalon & Gunn, 2011; Landrine & Klonoff, 1996; Walker et.al., 2014; Pascoe & Richman, 2009). The impacts of racism on the dysregulation of cognitive-affective regions such as the prefrontal cortex, anterior cingulate cortex, amygdala and thalamus share similarities with pathways leading to anxiety, depression and psychosis (Berger & Sarnyai, 2014). Several studies and meta-analytic reviews have been published establishing the link between racial discrimination and depression (Paradis et.al., 2006; Paradis et.al., 2015; Schultz 2006; Chou et.al., 2012; Matthews et.al., 2013; Barnes et.al., 2004).

There is a large body of literature documenting the relationship between physical activity (PA) and depression. PA has been shown to have strong antidepressant effects, reducing depressive symptomatology and inducing remission at comparable rates as medication and other common forms of treatment (Mead et.al., 2009; Cooney et.al., 2013; Blumenthal et.al., 2007; Blumenthal et.al., 1999; Schuch et.al., 2016). Despite racial and ethnic minorities engaging in lower amounts of PA, PA is efficacious for reducing risk for a litany of diseases, inexpensive,

and relatively adverse-effect free (CDC, 2014; Crespo et.al., 2000; Brownson et.al., 2000; Hu et.al., 2004). However, the potential moderating effect that physical activity has on the relationship between racial discrimination and depression is unclear.

The current investigation serves to determine if PA is able to moderate the relationship between perceived racial discrimination and depression in a cohort of 776 African American adults. The hypothesis is that participants who have perceived more racial discrimination will be able to lower their elevated risk of depression by being physically active.

Specific Aims

Aim 1: To determine the association between racial discrimination and depression.

Hypothesis a: Increasing levels of discrimination will be associated with higher odds of MDD.

Hypothesis b: Increasing levels of discrimination will be associated with more severe depression symptoms.

Aim 2: To determine whether meeting the physical activity guidelines moderates the relationship between perceived discrimination and depression.

Hypothesis: Participants meeting the physical activity guideline will have lower odds of having a MDD diagnosis than participants not meeting the guidelines. **Figure 1** illustrates the relationship that will be tested.

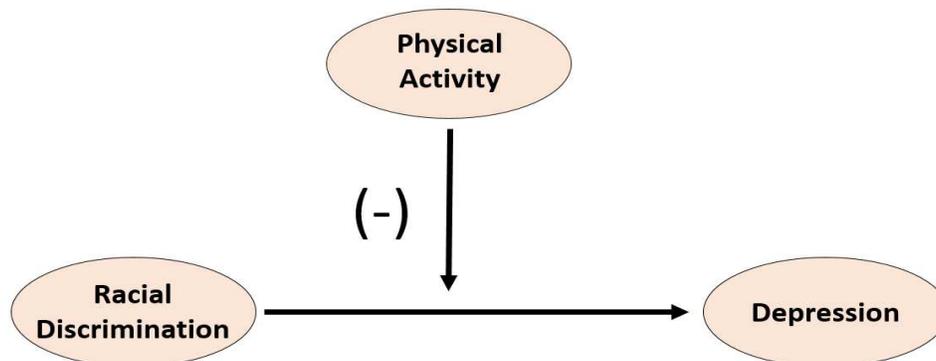


Figure 1. Depicts the conceptual study design. The (-) denotes how increasing physical activity is hypothesized to negate the depression inducing effects of racial discrimination.

CHAPTER 2: LITERATURE REVIEW

The purpose of this literature review is to provide an overview of: 1) Depression's societal impact, associated costs, and treatment patterns, 2) racial discrimination and its relationship with depression, 3) the association between PA and depression, 4) the differences in PA patterns by race, and 5) the potential moderating effect of PA on racial discrimination and depression.

Depression

Depression is a pervasive disease. During any 2-week period, over 7.6% of people aged 12 and older are currently have depression (CDC, 2015). Lifetime prevalence rates range from 3-20% in developed countries, with about 1 in 6 people in the U.S. suffering from the disease at least once in their lives (Andrade et.al., 2003). Depression is a chronic disease that typically occurs several times throughout the course of someone's life. After the first episode, depression recurs in about 60% of patients within 5 years. Recurrence climbs to 70-90% after multiple bouts of depression (Culpepper, 2010). The disease is even more prevalent among women whose odds of a depressive episode are about twice as high as men's (Andrade et.al., 2003).

The cost of the disease is tremendous as well, both economically and psychosocially. The World Health Organization (WHO) conducted a global burden of disease analysis and concluded that worldwide, MDD is the most burdensome disease for middle aged adults. This was true in both developing and developed nations, and no other disease accounted for even half of the burden of depression (Murray et.al., 1996). It is estimated that in the U.S. alone, depression costs about \$83 billion dollars from loss of work production and increased medical costs (Greenberg et.al., 2003). The majority of the costs, \$51.5 billion dollars' worth, can be explained by

workplace related costs. Employees suffering from depression work significantly less productively than their non-depressed peers, losing on average 5.6 hours of productivity per week when they are depressed (Stewart et.al., 2003). A cross-sectional analysis of the association between employment and depression found people with diagnosed MDD have an unemployment rate seven times higher than those who are not clinically depressed (Lerner et.al., 2004).

Given the large body of evidence of its severity and the high prevalence of the disease, the need for adequate and effective treatment is apparent. When left untreated, people suffering from depression have an increased risk for self-neglect, suicide, morbidity, early mortality, and decreased cognitive and social functioning (Fiske, Wetherell, & Gatz 2009). Typically, depression is managed through treatment from clinical practitioners such as a psychologist or psychiatrist, counseling, and most commonly, antidepressant medication. (DHHS). Despite the extensive use of antidepressant medication, their effectiveness is in question. Approximately 30-60% of people do not respond to medication, and meta-analytic reviews of FDA studies suggest that medication is only marginally effective compared to placebo (Baldesserani, 1989; Pigott et.al., 2010; Trivedi et.al., 2008). One of the most common forms of antidepressant medications are selective serotonin reuptake inhibitors (SSRIs) due to their increased safety and tolerability relative to other forms of medication. SSRIs however have several side effects, most prominently: sexual dysfunction, sleep disturbance and weight gain (Ferguson, 2001). Psychological therapy is an effective form of treatment that is generally free of any adverse effects, but people may avoid it due to a perceived stigma or their lack of a positive expected outcome. Furthermore, general practitioners are unable to correctly diagnose about half of their patients. Mitchell and colleagues conducted a meta-analysis of 118 studies assessing the

accuracy of depression diagnosis and found that practitioners only correctly identified depression in 47.3% of patients (Mitchell et.al., 2009).

Racial Discrimination and Depression

Despite all of the societal advances in the U.S., race-based discrimination is a major issue within our nation today. In reports from both the Surgeon General and Institute of Medicine, racism was identified as a fundamental contributor to disparities in health outcomes (Smedley et.al., 2003; USDHHS, 2001). Racism and its ideologies are subversively ingrained in American social life and in its institutions. Disproportionate rates of incarceration, seemingly insurmountable gaps in wealth, and racially patterned disciplinary policies in schools are all systemic issues that African Americans face today (Wang et.al., 2014; Anyon et.al., 2018; Holland 2016). Institutionalized racism leads to prejudicial beliefs and attitudes towards racial groups, which in turn can induce the discriminatory treatment of African Americans (Bonilla-Silva et.al., 1997). An individual's awareness and experiences influence their subsequent perceptions of discrimination, which can significantly affect health outcomes. Chronic exposure to racial discrimination is thought to set in motion a series of physiological responses that lead to the development of disease (Mays, Cochran & Barnes et.al., 2007).

A large body of literature has consistently shown that members of racial and ethnic minority groups experience racial discrimination and the effects are deleterious to their health (Paradies et.al 2015; Williams et.al., 2009; Krieger et.al., 1998; Kessler et.al., 1999; Guyll, Matthews & Bromberger, 2001; Barnes et.al., 2004; Russell et.al., 2018). African Americans are subjected to both a greater frequency of discriminatory events and events of greater magnitude. Nearly half of older African Americans reported experiencing a major discrimination event relative to 30% in the general population (Ayalon & Gunn, 2011). In an analysis of lifetime and

recent experiences of racial discrimination, Landrine and colleagues found that only 2% of Black Americans reported having no experience of discrimination in their lifetime. In that same analysis, investigators found a significant association between lifetime and past year discriminatory events with elevated psychiatric symptoms (Landrine & Klonoff, 1996).

Racism, and more importantly, the individual's interpretation of the racism likely has direct and indirect impacts on African Americans. Directly, conditions of being ostracized and dehumanized cause feelings of detachment from society. Indirectly, a diminished sense of self-worth—a byproduct of discrimination—is associated with depression symptomatology (Walker et.al., 2014). In a comprehensive review of discrimination and its association with health outcomes, Pascoe and colleagues found that discrimination has a significant negative effect on both mental and physical health, in part due to the heightened stress response caused by discrimination. In their analysis, discrimination showed a significant association with depression and other psychiatric disorders. **Figure 2** illustrates the pathways through which racial discrimination may affect mental and physical health. In path A., perceptions of discrimination have a direct effect on mental and physical health. Pathway B shows the relationship between perceived discrimination and health being mediated through stress responses. Included in this path are chronic states of heightened physiological stress responses such as cardiovascular reactivity and cortisol responses. The allostatic load from the chronic stress then causes poor physical and mental health outcomes, as shown in path C. Path D depicts the behaviors that emerge from coping with discrimination, and E illustrates how these may have negative effects on health and contribute to the development of disease (Pascoe & Richman, 2009).

Imagine an African American woman named Janet. Janet has worked hard for several years to establish herself in a company and when the position she has worked for finally becomes

available, she is passed over for a less experienced colleague whom she feels is not as qualified for the position. She rationalizes being looked over as a function of her race, and she begins developing depressive symptoms like diminished self-worth and loss of interest in many routine activities (pathway A). At home, Janet is bombarded with negative online images of African American men and women being harassed by the police, negative portrayals of African Americans in television shows, and articles shared on social media detailing the disparate promotion rates and workplace treatment of African Americans. In response, she finds herself at a consistently higher level of stress (pathway B), and over time this elevated stress response leads to the onset of a chronic disease such as MDD (pathway C). After finding out that she was being passed over for her promotion, Janet couldn't shake her dejected feeling and began drinking to help cope with it (pathway D). Janet soon began needing to drink more and more in order numb her pain, and soon developed an alcohol dependency (pathway E).

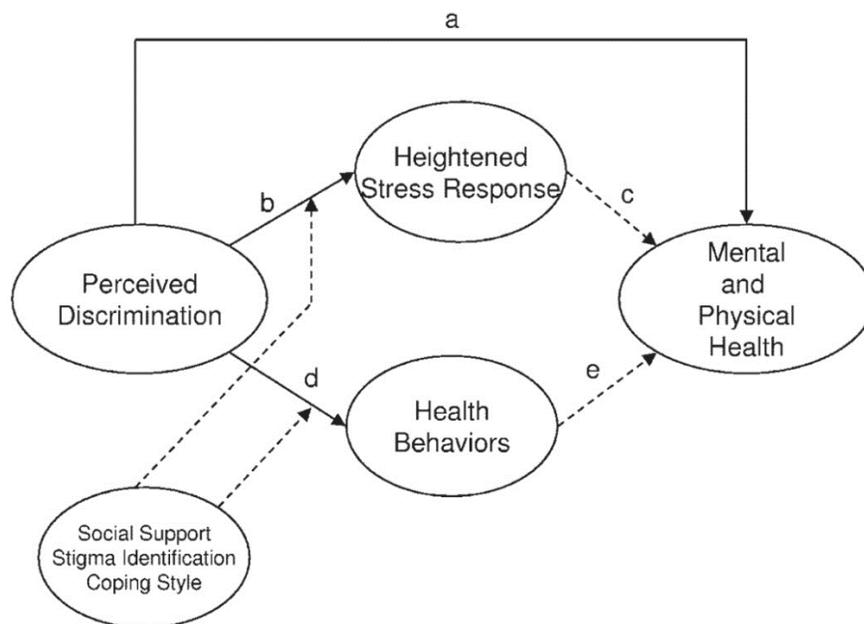


Figure 2. Theoretical and analyzed pathways by which perceived discrimination affects physical and mental health. Solid lines are pathways that were analyzed in studies included in the review and dashed lines are hypothesized by previous research. From Pascoe & Richman, 2009.

In a review of 293 studies using self-reported racial discrimination, it was concluded that racial discrimination has negative effects on mental health outcomes, and adds that evidence from longitudinal studies suggests that perceived racial discrimination *precedes* poor mental health outcomes (Paradis et.al., 2013). Several cross sectional and longitudinal studies conducted with African Americans populations have found that higher perceived discrimination is associated with increases in depressive symptoms and decreases in self-reported general health (Schultz 2006; Chou et.al., 2012; Matthews et.al., 2013; Barnes et.al., 2004). Sadly, the depression inducing effects of racial discrimination are even observed in African American children (mean age= 10.5 years) (Simons et.al., 2002).

Despite substantial evidence that discrimination leads to an increased risk for depression, disparities exist in the treatment of depression among African Americans (Noh & Kasper 2003; Finch, Kolody & Vega 2000; Simons et.al., 2002; Taylor & Turner 2002; Paradis et.al., 2006; Schultz et.al., 2006). Compared to non-Hispanic white Americans, African Americans are less likely to receive a depression diagnosis and to receive treatment for their depression (Akincigil et.al., 2012; Alegría et.al., 2008; Das et.al., 2006). When African Americans do receive treatment, they have appreciably lower odds of receiving quality care. A potential alternative to traditional treatments is PA. PA removes several of the barriers to depression treatment that African Americans face by removing any accessibility limitations or cost prohibitions that accompany pharmacotherapy, and it lacks the stigma associated with psychiatry treatment, although one must be able to surmount physical disabilities to engage in physical activity.

Physical Activity and Depression

The WHO defines physical activity as “Any bodily movement produced by skeletal muscles that requires energy expenditure” (WHO, 2017). Exercise thus is a category of physical activity that focuses on fitness improvements and is repetitive, planned and structured. The newly released 2018 physical activity guidelines recommend that adults accumulate at least 150 minutes of moderate, or 75 minutes of vigorous aerobic activity per week and perform muscle-strengthening activities on at least two days per week (US Department of Health and Human Services, 2018).

The benefits of engaging in regular physical activity are tremendous. People who engage in regular physical activity experience lower risk of death from cardiovascular disease and all-cause mortality, lower risk of at least 13 forms of cancer (e.g., breast cancer, colon cancer), lower risk of and better management of diabetes, improved bone health, lower risk of hypertension, lower rates of obesity, and lower rates of depression among many other physical and mental health benefits (Cooney et.al., 2013; Lee et.al., 2014; Moore et.al., 2016; Kyu et.al 2016; Warburton et.al., 2006; Diaz et.al., 2013; Booth et.al., 2012). The scope of the benefits of physical activity extend beyond prevention, with evidence mounting that PA has therapeutic effects on several chronic diseases such as depression as well.

The potential of physical activity as a cost effective and adverse effect free alternative, or complement, to traditional depression treatment has received considerable attention. Recent evidence indicates there is no difference between psychological therapy, pharmacological treatment, and exercise as a form of treatment for mild to moderate depression. Several meta analyses and RCTs demonstrate that the reduction in depression symptomatology and rates of remission that are expected with the common forms of treatment can be achieved with exercise

(Mead et.al., 2009; Cooney et.al., 2013; Blumenthal et.al., 2007; Blumenthal et.al., 1999). When assessing the effects of exercise in patients with diagnosed MDD, large antidepressant effect sizes have been seen when comparing exercisers to non-exercising control groups in a recent meta-analysis including 25 studies, which found a pooled standardized mean deviation (SMD) of 0.98, (95% CI [0.68-1.28])(Schuch et.al., 2016) for depression symptoms (**Figure 3**). SMDs are a meta-analytic tool that allows an outcome measure (depression) that is assessed in several different ways to be assessed on a uniform scale. SMDs tell us the effect size of the intervention (exercise) relative to the comparison group (non-exercising control group). While not all of the studies included demonstrated a significant relationship exists between PA and depression, the majority did. None of the studies suggested that exercise has a negative, or depression inducing effect, while several show very large (SMD>2) antidepressant effects. The largest effects were seen in interventions using aerobic exercise at moderate or vigorous intensity levels, SMD= 1.04 (95% [CI 0.65-1.43]) and 1.34 (95% [CI 0.43-2.24]) respectively. Studies including people with MDD showed a larger decrease in depression symptoms when compared to studies in samples without a clinical diagnosis of MDD (SMD = 1.135, 95% [CI 0.46- 1.81]). Also noteworthy was that the effect of aerobic exercise on depression was significant in interventions independent of the supervision of a trained exercise professional (Schuch et.al., 2016).

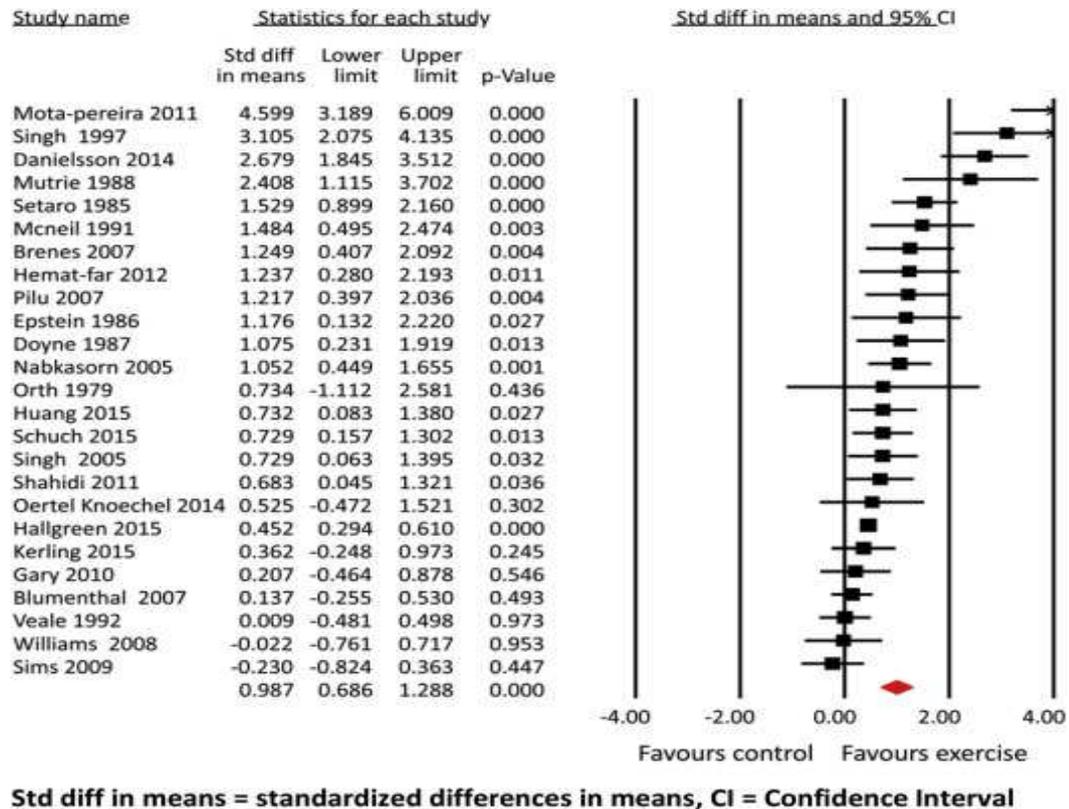


Figure 3. Standardized mean difference for depression symptoms of 25 studies and the pooled SMD. From Schuch et.al., 2016.

In two interventions, Blumenthal and colleagues compared the effectiveness of 16 weeks of aerobic exercise to antidepressant medications in 202 adults and 156 older patients, all with clinically diagnosed MDD. In both studies, exercise was effective at reducing depression symptomatology and achieving remission rates comparable to that of medication. (Blumenthal et.al., 2007; Blumenthal et.al., 1999). **Figure 4** illustrates the magnitude of depression reduction in the different treatment groups from Blumenthal's earlier investigation. In either exercise alone, or in combination with medication, large depression reducing effects are observed. Of all of the participants, 60.4% in the exercise group, 68.8% of the medication group, and 65.5% of the combination group were able to achieve depression remission.

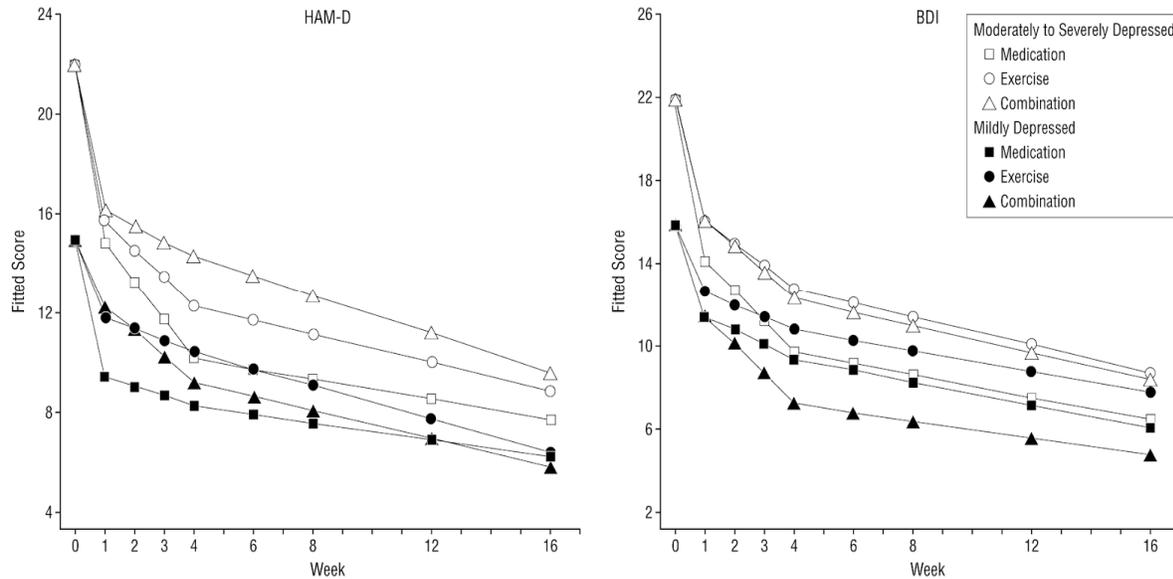


Figure 4. The Hamilton Rating Scale for Depression (HAM-D) and Beck Depression Inventory (BDI) are clinician-delivered depression diagnosis tools. From Blumenthal et.al., 1999.

In the most severe cases of depression, PA presents a tremendous complement to pharmacotherapy. Both severely depressed, and medication-resistant patients experience higher remission rates, improved quality of life, and greater functioning when exercise is used in combination with medicine, compared to medication use alone (Schuch et.al., 2015; Mota-Periera et.al., 2011). Several studies have illuminated the therapeutic effects of exercise in non-clinically depressed populations as well. A review of several meta-analyses published on exercise and non-clinical depression concluded that engaging in exercise had a moderate anti-depressive effect (SMD = -0.50, 95% CI: -0.93 to -0.06) (Rebar et.al., 2015). Correlational studies of both clinical and non-clinical patients have also shown that an inverse association between physical activity and depression symptomatology exists when analyzing large populations (Galper et.al., 2006) (Hassem et.al., 2000).

Mammen and Faulkner conducted an analysis of 30 longitudinal studies to determine the preventative effects of PA on depression. The majority of the studies included in the analysis

(25/30) suggested that baseline levels of aerobic PA have a negative association with future onset of depression (Mammen & Faulkner, 2013). An earlier review of PA and the likelihood of developing depression also showed that there was a diminished chance of developing depression for participants who were physically active (Teychenne, Ball, & Salmon, 2008). In both of these reviews, a reduction in the risk of developing depression was seen with even low levels of PA. Engaging in as little as one hour per week of aerobic activity was associated with a reduced risk of depression.

Although it is well established that exercise is effective at combating depression, few studies have attempted to examine the optimal dose of physical activity needed to confer benefits. In an analysis by Dunn and colleagues, four groups were created with either high or low energy expenditure with a frequency of either three or five days per week. Results from the analysis found that no difference existed between frequencies of exercise, but the high energy expenditure groups, which were equivalent to meeting the physical activity guideline, saw a 47% reduction in their baseline depression scores. No difference was seen between the control and people active below the threshold of the guidelines, suggesting that the current recommendations present an adequate objective for MDD patients (Dunn et.al., 2005).

Differences in Physical Activity by Race

National data on physical activity shows that 48% of Americans report achieving the recommended amount of weekly physical activity (CDC, 2014). African Americans report leisure time inactivity levels at about twice the rate of white Americans (18% vs. 35%) and lower levels of physical activity across a litany of variables that encompass social class including: family income, occupation, poverty status, employment status, marital status and education (Crespo et.al., 2000). This indicates that the determinants of inactivity among African Americans

may transcend the individual level and may be a response to the social and environmental conditions in which African Americans live. When interpreting race-based disparities in physical activity, it is important to consider the geographic region. The U.S. still experiences tremendous residential segregation, and this contributes to differences in health-related resources such as environments with adequate access to places to engage in physical activity (Sohn et.al., 2017). Communities with higher proportions of African Americans have been shown to have fewer physical activity settings (Powell et.al., 2004).

Differences in physical activity participation vary by gender as well. Men tend to be more active than women, and African American women represent the least active group of any sex and race demographic, meeting the physical activity guidelines only 34% of the time (CDC, 2014). African American women are more likely than African American men or white women to engage in no leisure time activity (Brownson et.al., 2000). A key element researchers need to consider when assessing physical activity related health disparities in African American women are the specific barriers that limit their participation in physical activity. In a review of the barriers to physical activity for women, researchers categorized barriers as either intrapersonal, interpersonal, or neighborhood/community level. The primary barrier identified was lack of time with work schedule and family/caretaking responsibility being the most common explanations. Several of the barriers identified were specific to African American women including, hair care maintenance and preference for a full-figure. The importance of family and caretaking roles appear to be tied to both the cultural norms of African Americans and gender roles (Joseph et.al., 2015).

Although no study was identified investigating the relationship between physical activity and racial discrimination, there is still evidence of an underlying association. The New York

Times recently published an article chronicling the legacy of denial and harassment African Americans have faced at swimming pools and continue to face today (Choski, 2018). Although practices of institutional segregation are no longer legal today, the implications from so many years of denied access still exist. The article includes a study from U.S.A Swimming that details the disproportionate rate of African Americans that have poor, or no, swimming ability (U.S.A Swimming Foundation, 2017). African Americans who live in more segregated areas also perceive their environment as less pleasant for PA than African Americans who are in less segregated environments (Boslaugh et.al., 2004).

Physical activity and the Association between Racial Discrimination and Depression

While the effects of PA on the relationship between racial discrimination and depression are currently unknown, other investigations have found that PA is able to buffer the association between perceived stress, which can be increased by racial discrimination as depicted in Figure 2, and depression. In a cross-sectional analysis of stressful life events and depression, stress was found to be a significant predictor of depressive symptoms. In the moderation analysis, the interaction of stress and exercise had a significant effect, suggesting that the effects of stressful life events on depression are lessened for individuals who engage in more PA (Ensel and Lin, 2004). A longitudinal study by Harris and colleagues followed 424 depressed adults for 10 years, and assessed whether PA could buffer the effects of stressful life events on depression. PA was associated with a significant decrease in concurrent depression, while stressful life events were associated with more depressive symptoms. In the analysis, the buffering effects of PA were uncovered. PA was split into 4 groups based on their activity levels (e.g., group 1= not active, group 4= highly active). An increase of one negative life event was associated with a 3.90

($p < .001$) point increase in depressive symptoms and a one unit incremental (e.g., moderately active to very active) increase in PA was associated with a 0.89 ($p < .01$) point decline in symptoms. To conceptualize this, if a person in the most active group experienced one negative life event, their depressive symptoms score would be roughly equivalent to someone who was sedentary and had no negative life events (Harris, Cronkite & Moos, 2006). However, other investigations suggest that exercise may not be able to buffer stress. One study assessed whether PA could moderate the association between stressful life events and psychological illnesses and concluded that there was not a statistically significant effect in their interaction analysis. A negative association existed, however, with beta (β) = -0.22 ($p = 0.14$), showing that PA had a depression reducing trend in the relationship. A major limitation of this study is that it was conducted with a convenience sample of college students studying Kinesiology who had baseline activity levels higher than the general population, which likely underestimated the influence of PA (Carmack et al., 1999).

The primary difference between these previous studies and the current analysis is that each of the earlier studies utilized a measurement of stressful life events as their exposure. An individual's perceptions of racism, however, has been conceptualized as a mental stressor in earlier research (Paradis et al., 2006). Studies have also shown that in samples of African American women, racial discrimination is correlated with other stressful events, and both are independently associated with psychological distress (Steven-Watkins et al., 2014; King, 2003; Moradi & Subich, 2003). Research suggests that racial discrimination may actually present as a more important exposure variable than stressful life events when attempting to prevent depression. In an analysis by Utsey and Greisbrecht, it was shown that in an African American sample, racial discrimination was a significantly more powerful risk factor for predicting the

onset of poor mental health outcomes than stressful life events (Utsey & Greisbrecht, 2008). Given this, the present investigation seeks to determine if the effect modifying attributes of PA still persist when race-based discrimination is the stressor of interest (Paradis et.al., 2006; Paradis et.al., 2013).

Conclusion

The pandemic nature of depression is well documented, ranking as one of the most burdensome and debilitating diseases in the world (WHO, 2018; Murray et.al., 1996; Greenberg et.al., 2003; Andrade et.al., 2003). It is a recurrent and costly disease that increases risk for CVD, fibromyalgia, substance abuse, and suicide (Stewart et.al., 2003; Kouzis & Eaton 1994; Joiner 2010; Bahorik et.al., 2017; Lerner et.al., 2004; Stewart et.al., 2013; Goodwin, 2006). Depression, like many other chronic diseases is disparate among African Americans, being both underdiagnosed and undertreated (Akincigil et.al., 2012; Alegría et.al., 2008). Compounding these issues is the fact that African Americans are also subjected to a greater frequency and magnitude of racially discriminating events, which have been shown to be depression inducing (Paradis et.al., 2015; Williams et.al., 2009; Ayalon & Gunn, 2011; Schultz 2006).

In the U.S., the most common form of treatment for depression is pharmacological therapy. For a relatively large amount of the population, antidepressant medication is not successful at achieving full remission, and for those who do experience remission, antidepressant medication is often accompanied by side effects (Baldesserani, 1989; Pigott 2010; Trivedi et.al., 2008; Ferguson, 2001). Several studies investigating the relationship between PA and depression have shown that engaging in adequate amounts of PA is effective at reducing depressive symptomatology and remitting depression at the same rate as antidepressants and other common

forms of treatment (Blumenthal et.al., 2007; Blumenthal et.al., 1999; Schuch et.al., 2016; Mead et.al., 2009).

To date, no study has investigated if the ability of PA, with its ability to attenuate depression, can serve as a moderator in the association between perceived racial discrimination and MDD. The institutionalized nature and legacy of racism in the U.S. makes eliminating African Americans' experiences of racialized discrimination an insurmountable challenge. However, a more feasible solution may be increasing the amount of PA they engage in to combat an increased risk of depression caused by racial discrimination, especially in African Americans.

CHAPTER 3: METHODOLOGY

Participants and Data Collection

The Family and Community Health Study (FACHS) is a multi-site cohort study of African American families in Iowa and Georgia. Participants in the analysis were taken from the fourth wave of the study and were 775 African Americans, 93% of whom are women, who are the primary caregiver (PC) to a 10- or 11-year old. IRB approval was obtained from Iowa State University prior to enrolling any participants into the study. In order to be included in the cohort study, the PC had to have a child who identified as African American and was between 10 and 11 years of age at the time of recruitment. The current study conducts secondary analyses of existing FACHS data that provide all necessary information on physical activity, racial discrimination, and depression. In this analysis, participants are excluded for missing PA, discrimination, or depression data.

This analysis looks only at data collected in wave 4, which took place between March of 2005 and August of 2006. Waves prior to wave 4 did not have PA as a measurement. Data were collected through in-home visits by interviewers that lasted approximately 2½-3½ hours to complete. In order to optimize the interview, sessions were conducted one -n-one and questions were administered from a computer prompt while the interviewer recorded the responses. All of the interviewers were African American and thoroughly trained, completing 40 hours of classroom training prior to conducting field interviews. All participants filled out informed consent prior to their first interview.

Perceived Racial Discrimination

Perceived discrimination was assessed using the Schedule of Racist Events (SRE) questionnaire (Landrine & Klonoff, 1996). The SRE is an 18-item self-report inventory that measures the frequency of racial discriminatory events that someone has encountered throughout their life. Results show that the questionnaire is both internally consistent and reliable (Landrine & Klonoff, 1996). The SRE is listed in Appendix A, and the average of participant's responses across items is used for the analysis.

Physical Activity (PA)

PA was measured using two questions that were created by the FACHS study team and included as part of their interview. Both questions used for this investigation are listed in **figure 5**. For our analysis, the first question was considered to be gauging vigorous intensity activities based on their metabolic equivalent (MET) values derived from the 2011 compendium of PA (Ainsworth et.al., 2011). According to the WHO, PA > 6.0 METs is categorized as vigorous intensity, and each of the activities included in the example were above that threshold (WHO, 2014). The average MET value for the four activities was 9.0 METs. The second question is considered as moderate intensity for analytical purposes. Activities between 3-6 METs are considered moderate intensity activities, and each of these activities, besides skating (MET=7 for roller skating and MET=5.5 for ice skating <9mph), were categorized as moderate (Ainsworth et.al., 2011; WHO, 2014).

1.) On how many of the past **7 days** did you exercise or participate in physical activity for **at least 30 minutes** that made you breathe hard (such as basketball, soccer, running, or riding a bicycle hard)?

1. 0 days
2. 1 or 2 days
3. 3 or 4 days
4. 5 or 6 days
5. All 7 days

2.) On how many of the past **7 days** did you exercise or participate in physical activity for **at least 30 minutes** that **did not make you breathe hard**, but was still exercise (such as fast walking, slow bicycling, skating, pushing a lawn mower, or doing active household chores)?

1. 0 days
2. 1 or 2 days
3. 3 or 4 days
4. 5 or 6 days
5. All 7 days

Figure 5) Physical Activity questions distributed in wave 4 from the FACHS questionnaire. *Bolding and underlining are added for emphasis and not included in the actual question*

For the analysis, PA was converted into minutes by taking the mean days of their selected response (ex: 1.5 days if “1 or 2 days” was selected) and multiplying by 30 minutes for the question that we identified as indexing moderate intensity exercise or 60 minutes for the question that indexed vigorous activity. Thirty minutes was selected to provide a conservative estimate of time since that was the minimum bout of exercise that the question considered. Sixty minutes were given for vigorous intensity activities based on the U.S. PA Guidelines, which consider one minute of vigorous intensity exercise equivalent to two minutes of moderate intensity PA (UHDHHS, 2018). Once converted into minutes, both moderate and vigorous intensity questions were combined into one variable following the same method as an earlier study (Schroeder et.al.,

2017). To simplify the moderation analysis and improve the clarity of the results, the participants were categorized into two groups: meeting the PA Guidelines or not meeting the PA Guidelines according to the current PA Guidelines.

Depression

Depression data were captured in two ways. The primary outcome is MDD, which was assessed through the University of Michigan Composite International Diagnostic Interview (UM-CIDI), which is a structured psychiatric diagnostic interview (Kessler, 1991). The UM-CIDI was designed to be administered by a lay interviewer in large scale community studies and to render DSM-IV diagnoses in the FACHS cohort. The UM-CIDI yields lifetime, past 12 months, and current depression diagnosis. Another subjective measure of depression was used in this study and it is derived from The Mini Mood and Anxiety Symptom Questionnaire (mini-MASQ) (Clark and Watson, 1995). The mini-MASQ is an abbreviated version of the 90 question Mood and Anxiety Symptom Questionnaire (Clark and Watson, 1991). The mini-MASQ is a 5 question survey that quantifies the frequency of depressive symptoms over the past week. An example of a question is: "During the past week, how much have you felt like a failure?" with the potential responses of: (1) not at all (2) somewhat (3) extremely. The average of the responses to the mini-MASQ were used in the analysis.

Covariates

Heavy alcohol use was included as a covariate. Participants were categorized into the heavy alcohol group if they reported having at least two of the three following issues over the past 12 months due to drinking: having family problems, too much time taken up, feel like you

need to cut down. These three domains of problem drinking were taken from The National Institute on Alcohol Abuse and Alcoholism's (NIAAA) definition of Alcohol Use Disorder (AUD). AUD is defined as meeting two of 11 criteria during the same 12 month period and each of the three domains we used were one of the 11 listed criteria from the NIAAA (National Institute on Health).

Statistical Analysis

Descriptive statistics were calculated using χ^2 or analysis of variance (ANOVA) models. Analyses took into account sex, age, and education as covariates. Additional analyses account for heavy alcohol use. Participants were split into tertiles based on their discrimination scores. For a joint analysis, participants were grouped into tertiles of discrimination and whether they met the PA Guidelines or not.

Aim 1: To determine the association between racial discrimination and depression.

Hypothesis a: Increasing levels of discrimination will be associated with more severe depression symptoms (mini-MASQ).

Hypothesis b: Increasing levels of discrimination will be associated with higher odds of past 12-month diagnosis of MDD (UM-CIDI).

Analysis: A multivariable logistic regression was used to determine the odds ratios (ORs) and 95% confidence intervals (95% CIs) of being diagnosed with MDD (UM-CIDI) across perceived discrimination categories (e.g., tertiles). Multivariable linear regression analysis using continuous variables of racial discrimination and depression symptoms were conducted to

analyze associations between PA, perceived discrimination, and depression symptoms (mini-MASQ) with adjustments for potential confounders (e.g., sex, age, and education). They were then re-assessed with the inclusion of additional confounding variables (e.g., heavy alcohol consumption).

Aim 2: To determine whether meeting the physical activity guidelines moderates the relationship between perceived discrimination and depression.

Hypothesis: Participants meeting the physical activity guideline will have lower odds of having a MDD diagnosis (UM-CIDI) than participants not meeting the guidelines.

Analysis: Logistic regression was used to conduct a stratified analysis. Participants were stratified by whether they met the PA Guidelines (Active) or not (Inactive) and assessed across tertiles of discrimination. Also, an interaction term was created using discrimination tertiles (Lower, Middle, and Upper) and physical activity levels (Active vs. Inactive) and tested to see a possible moderation by physical activity on the association between racial discrimination and depression using logistic regression. Further, a joint analysis using logistic regression was conducted to test the combined effects of meeting the PA Guidelines and discrimination on depression.

Statistical analyses were performed using the SAS software (SAS Institute, Cary, NC), and all of the P values are 2-sided, with an *a priori* α -level of <0.05 determined to be significant.

CHAPTER 4: RESULTS

Sample Characteristics

After removing participants with missing data, there were 775 individuals included in the analysis. The average age of the participants was 45 years old, and most were women (93%). On average, the women completed 13 years of education and were active, engaging in 178 minutes of moderate-vigorous PA (MVPA) per week and had an average discrimination score on the SRE of 1.8. Participants were categorized into tertiles (thirds) based on their perceived discrimination scores, and their baseline characteristics are listed in Table 1. Participants who reported higher levels of discrimination completed more years of education, and had an increased prevalence of depression diagnosis at some point during their lifetime.

Table 1. Characteristics of Study Participants by Tertiles of Racial Discrimination

Characteristic	Tertiles of racial discrimination				P-value
	Overall	Lower	Middle	Upper	
N	775	259	264	252	
Age, years	45.3 (8.2)	44.9 (8.6)	44.8 (7.6)	46.1 (8.2)	0.14
Education, years	13.0 (2.9)	12.3 (3.0)	13.0 (2.4)	13.6 (3.1)	<0.01
Female, n (%)	723 (93)	239 (93)	249 (94)	235 (93)	0.65
Discrimination (score) ¹	1.8 (0.7)	1.1 (0.1)	1.8 (0.2)	2.7 (0.4)	<0.01
MVPA, minutes/week ²	178 (167)	168 (159)	178 (164)	188 (177)	0.40
Meet Physical Activity ³ Guidelines, n (%)	351 (45)	116 (45)	120 (45)	115 (46)	0.98
Depression Diagnosis in past 12 months ⁴ , n (%)	34 (4)	6 (2)	11 (4)	17 (7)	0.05
Lifetime Depression Diagnosis ⁵ , n (%)	199 (26)	40 (16)	75 (28)	84 (33)	<0.01
Depression Symptoms ⁶ (score)	6.3 (1.8)	6.2 (1.7)	6.3 (1.7)	6.5 (2.0)	0.06
Heavy Alcohol Use, n (%) ⁷	415 (54)	144 (56)	133 (50)	138 (55)	0.44

Values are means (SD) unless indicated otherwise

¹ Sum from Schedule of Racist Events Questionnaire ² MVPA stands for Moderate-Vigorous Physical Activity and is recorded in minutes per week. ³ Meeting the physical activity guidelines is categorized by accumulating ≥ 150 minutes/week of MVPA. ⁴ Determined by the University of Michigan Composite International Diagnostic Instrument. ⁵ Determined by the University of Michigan Composite International Diagnostic Instrument. ⁶ Measured with the Mini-Mood and Anxiety Symptom Questionnaire. ⁷ Defined as drinking to the extent that it causes at least two of the following: family problems, feeling the need to reduce drinking or feeling as though it is taking up too much time.

Primary Analysis

Results of the multiple regression analysis predicting depressive symptoms from perceived discrimination are shown in Table 2. Discrimination was a significant predictor of depressive symptoms in both models, demonstrating a positive association with depression ($p < 0.01$ or $p = 0.01$). Education showed an inverse and significant relationship with depressive symptoms in both models 1 and 2.

Table 2. Multiple Linear Regression Analysis of Racial Discrimination and Depression Symptoms

	Model 1			Model 2		
	B (SE B)	β	P-Value	B (SE B)	β	P-Value
Discrimination (score) ¹	0.39 (0.10)	0.15	<0.01	0.40 (0.10)	0.15	<0.01
Age (years)	-0.02 (0.01)	-0.07	0.04	-0.02 (0.01)	-0.07	0.06
Education (years)	-0.07 (0.02)	-0.11	<0.01	-0.07 (0.02)	-0.11	<0.01
Female	0.25 (0.27)	0.03	0.33	0.23 (0.27)	0.03	0.39
MVPA, minutes/week ²	-	-		-0.0006 (0.0004)	-0.05	0.13
Heavy Alcohol Use ³	-	-		-0.09 (0.14)	-0.02	0.52

Outcome is sum of self-reported symptoms of depression from Mini-Mood and Anxiety Symptom Questionnaire
B stands for Beta

SE B stands for the standard error of Beta

β is standardized beta

¹ Sum from Schedule of Racist Events Questionnaire. ² MVPA stands for Moderate-Vigorous Physical Activity and is recorded in minutes per week. ³ Defined as drinking to the extent that it causes at least 2 of the following: family problems, feeling the need to reduce drinking or feeling as though it is taking up too much time.

Model 1: Adjusted for age, education (years) and sex.

Model 2: Adjusted for model 1 and MVPA, and heavy alcohol use additionally.

Multivariable logistic regression was used to examine the association of discrimination with past 12-month depression diagnosis in Table 3. Being in the upper tertile of discrimination was associated with an increased OR (95% CI) of 3.29 (1.25-8.65) compared with the lower tertile when adjusted for age, sex and education in model 1. The relationship persisted when

further adjusted for the lifestyle factors including MVPA and heavy alcohol consumption [OR (95% CI) 3.34 (1.26-8.81)]. We tested an interaction term for meeting the guidelines and discrimination on the association of discrimination and past 12 month depression diagnosis and found insignificant results.

Table 3. Odds Ratios of Past 12 month Depression by Tertiles of Racial Discrimination

	n	Case	Odds Ratios (95% CI)	
			Model 1	Model 2
Lower	259	6	1.00 (reference)	1.00 (reference)
Middle	264	11	1.72 (0.61-4.87)	1.72 (0.61-4.89)
Upper	252	17	3.29 (1.25-8.65)	3.34 (1.26-8.81)
<i>P</i> for linear trend			0.01	0.01

CI, confidence interval; MVPA, moderate-vigorous physical activity. “Active” was defined as meeting the physical activity guidelines is categorized by accumulating ≥ 150 minutes/week of MVPA
 Model 1: Adjusted for age, education (years) and sex.
 Model 2: Adjusted for model 1 and MVPA and heavy alcohol use additionally.

Stratified analysis using logistic regression was also conducted to examine the odds of past 12-month depression diagnosis among tertiles of discrimination stratified by meeting the PA guidelines (i.e., active) or not (i.e., inactive). Among inactive participants, the odds of having a depression diagnosis were 3.36 (0.66-17.18) and 7.24 (1.54-34.15) for the middle and upper discrimination tertiles, respectively, compared with the lower discrimination tertile in the full model (Table 4). Among active participants, we observed no significant association between discrimination and depression diagnosis with the odds of 0.89 (0.21-3.75) and 1.48 (0.40-5.59) for the middle and upper discrimination tertiles, respectively, compared with the lower discrimination tertile in the full model (Table 4). A significant p-value for the linear trend was observed in the inactive group, highlighting the positive, dose-response association between discrimination category and MDD diagnosis. On the other hand, in the active group, there was

not a significant linear P-trend as you move across discrimination tertiles. We tested an interaction term combining the variables for discrimination tertiles (Lower, Middle, and Upper) and meeting the PA guideline (Inactive and Active) in the logistic regression and observed no significant interaction ($p=0.18$), possibly due to the small cases of depression ($n=2-11$) in all 6 groups with wide 95% CIs.

Table 4. Stratified Analysis by Activity Status of Odds of Past 12 month Depression by Racial Discrimination Tertiles

	n	Cases	Odds Ratios (95% CI)	
			Model 1	Model 2
Inactive				
Lower	143	2	1.00 (reference)	1.00 (reference)
Middle	144	6	3.32 (0.65-16.95)	3.36 (0.66-17.18)
Upper	137	11	6.89 (1.46-32.36)	7.24 (1.54-34.15)
<i>P</i> for linear trend			0.01	<0.01
Active				
Lower	116	4	1.00 (reference)	1.00 (reference)
Middle	120	5	0.89 (0.21-3.74)	0.89 (0.21-3.75)
Upper	115	6	1.49 (0.40-5.60)	1.48 (0.40-5.59)
<i>P</i> for linear trend			0.28	0.53

CI, confidence interval; MVPA, moderate-vigorous physical activity. “Active” was defined as meeting the physical activity guidelines is categorized by accumulating ≥ 150 minutes/week of MVPA
 Model 1: Adjusted for age, education (years) and sex.
 Model 2: Adjusted for model 1 and MVPA and heavy alcohol use additionally.

A joint analysis was conducted to test the combined effects of racial discrimination and PA (**Figure 6**). The “high” discrimination group was created by combining the middle and upper tertile based on the results in Table 4 and to simplify a complication of the joint analysis used in earlier analysis. The “low” discrimination group remained as the lower tertile. Participants were categorized into active or inactive PA groups based on whether they met the PA guidelines. Discrimination categories were also created by combining the middle and upper tertiles to create a “high” discrimination group, and the “low” discrimination group remained as the lower tertile.

This dichotomization is based on the independent association between discrimination and depression (Table 3) showing higher ORs of depression in the middle and upper tertiles and to preserve same size and depression case in the combined categories. Compared to the low discrimination and active group (reference), the odds of depression were 0.36 (0.05-2.42), 1.28 (0.39-4.25), and 1.77 (0.45-6.95), in the low discrimination and inactive, high discrimination and active, and high discrimination and inactive groups, respectively, in the full model. This result suggests no increased odds of depression in the active participants even though they have a high level of discrimination, which is consistent with the stratified analysis by PA (Table 4).

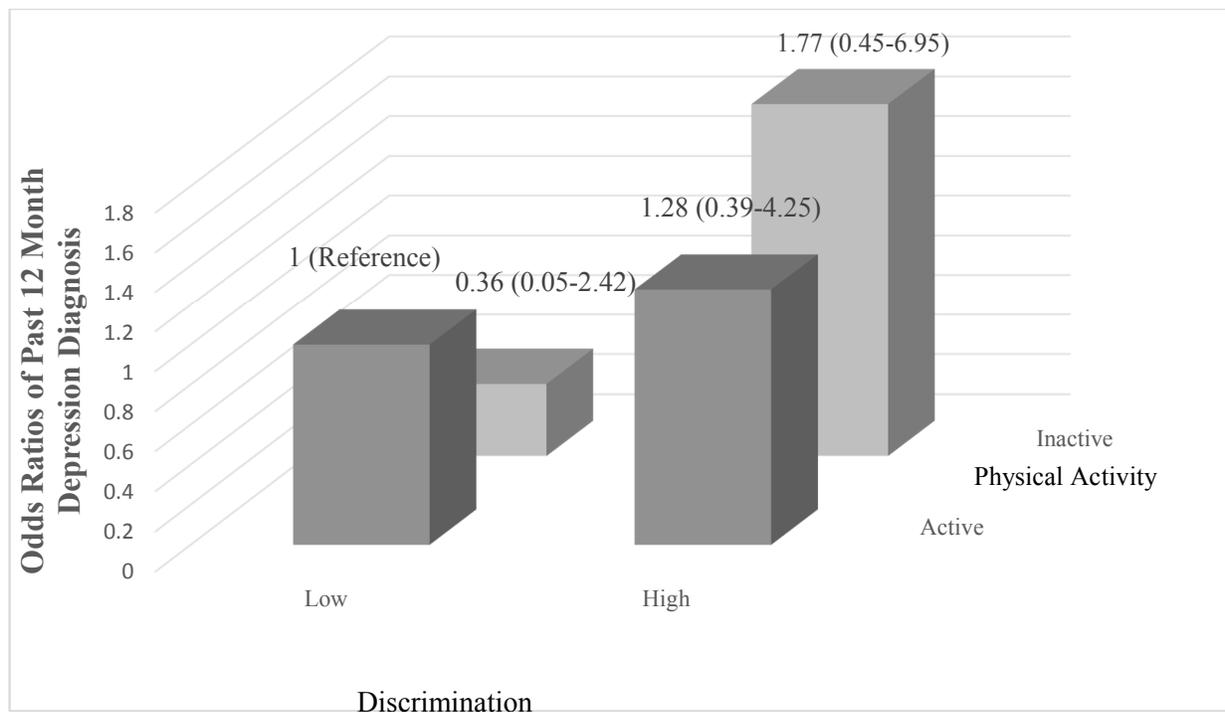


Figure 6. Odds Ratios (95% confidence interval) of Past 12 Month Depression by Combined Racial Discrimination and Physical Activity

Lower discrimination was defined as lower tertile of discrimination and high discrimination as middle and upper tertiles of discrimination based on the Schedule of Racists Events questionnaire. Inactive was defined as < 150 minutes per week of MVPA and active as \geq 150 minutes per week of MVPA.

Adjusted for age, sex, education (years), MVPA and heavy alcohol use. The number of participants (case of past 12 month depression) in the low discrimination & active, low discrimination & inactive, high discrimination & active, high discrimination & inactive were 116 (4), 143 (2), 235 (11), and 281 (17) respectively.

CHAPTER 5: DISCUSSION

Experiences of racial discrimination are very common for African Americans, and their effects can have serious health implications (Mays, Cochran & Barnes et.al., 2007; Paradies et.al., 2015). The results of our investigation support two main findings about the relationship between discrimination and depression, and the effect modification of PA. In this investigation, it was hypothesized that increasing perceptions of racial discrimination would be associated with a higher likelihood of having been diagnosed with MDD in the past 12 months. Consistent with previous findings, it was found that perceived racial discrimination was associated with both past 12-month depression diagnosis and self-reported depression scores. Standardized Beta values for the association of discrimination and depression in our analysis ($\beta = 0.15$ $p < 0.01$) were comparable to those seen in previous studies involving an African American population ($\beta = 0.101$ $p < 0.01$) (Watkins et.al., 2011). Based on the earlier work of Paradies and colleagues, it is reasonable to believe that discrimination may precede depression and not the other way around (Paradis et.al., 2013). While the present cross-sectional study found a positive linear relationship between depression and discrimination, further prospective studies are needed to determine directionality.

Results from the logistic regression presented similar results as previous studies of racial and ethnic minorities as well, where participants who experienced high levels of discrimination had odds of depression diagnosis three times that of people experiencing no or low levels of discrimination (Karlsen & Nazroo, 2002; Karlsen et.al., 2005). The logistic regression also showed that regardless of age, sex, education attainment, heavy alcohol or PA, the relationship between discrimination and depression diagnosis was unchanged.

Our second main finding was that although the interaction term was not significant ($p=0.18$) possibly due to the very small numbers of depression cases in all 6 groups ($n=2-11$) with wide 95% CIs, the stratified analysis (Table 4) by physical activity levels (Inactive or Active) clearly suggests a possible effect modification by physical activity on the association between racial discrimination and depression in this cohort of African American. In both models of our stratified analysis (Table 4), there was no significant difference in the odds of a depression diagnosis across discrimination groups when participants were categorized as active. However, when they were inactive, there were large increases in the odds of depression. Being inactive and in the upper tertile of discrimination resulted in a 7-fold increased odds of depression diagnosis with an OR (95% CI) of 7.24 (1.54-34.15). In a joint analysis, although not significant due to the small numbers of depression cases, we observed a similar trend suggesting a lower odds of depression in “Active” group compared to “Inactive” group among “High” discrimination groups. This suggests that if people are highly discriminated, moving from inactive to active could possibly decrease their odds of having depression although this study cannot infer the causality due to its cross-sectional design. Therefore, further studies with larger sample size and more cases of depression is warranted to confirm the findings.

Because limited studies have investigated PA as a moderator on the discrimination-depression relationship, there is limited research available for comparison; however, a few studies have examined how PA can buffer the relationship between stress and depression (Ensel & Lin, 2004; Harris, Cronkite & Moos, 2006). It should be noted that the PA questions specifically asked about PA in the past 7 days. However, PA surveys that ask about recent PA tend to be correlated with and validated against habitual levels of activity (Friedenreich et.al., 2006).

Implications

Racism is a pervasive societal construct that is systemically ingrained into American culture. Acts of racism and discriminatory practices are not just additional stressors that African Americans face, they are psychological taxes that they must pay and are a nearly unavoidable pathogen that has been linked to the development of MDD. Earlier research on the implications of neighborhood and individual level discrimination has identified that being entrenched within a prejudicial culture itself is a sufficient cause of depression (Russell et.al., 2018). Vontress and colleagues propose that due to the culturally derived discontent and their appraisal of rejection, hatred, and social discrimination, many African Americans are subjected to chronic, low-grade depression (Vontress, Woodland, & Epp, 2007). The implications of racism extend beyond depression-inducing effects, permeating into education systems, criminal justice, and housing policies among many other things. Given the ever-present legacy of the racism in the U.S., in order to truly combat its effects, there needs to be a litany of political and legislative changes, the creation of social programs, shifts in public education, cultural education practices, community-level dialogues and potentially more to end racism and mitigate its impact. It is unlikely that this will transpire within the near future, so the focus needs to be put on how to manage the effects of racism. Several studies have shown that the depression-inducing effects of racial discrimination can be buffered in African Americans. Church-based social support, high quality personal relationships, optimism, close family ties, and racial pride are all proposed buffers that have been shown to moderate the effects of discrimination on depression in African Americans (Odom & Vernon-Feagans, 2010; Utsey & Geisbrecht, 2008; Russell et.al., 2018). Each of these requires dependence on other people or are dispositional and may be difficult to change. Nadimpalli and colleagues have questioned the effect that various psychological and social factors have on the

relationship between discrimination and depression, reporting that neither psychological or social resources were able to moderate the depressant effects of race-based discrimination (Nadimpalli et.al., 2015). Being physically active is independent of other people and is not based on one's disposition. Being physically active is cost-effective and is also associated with numerous other physical and mental health benefits (Cooney et.al., 2013; Lee et.al., 2014; Moore et.al., 2016; Kyu et.al 2016; Warburton et.al., 2006; Diaz et.al., 2013; Booth et.al., 2012). Future research, especially prospective studies, are needed to examine the effect modification by PA on discrimination and depression and other psychological and social coping mechanisms.

Limitations

The sample of participants included in this investigation is not representative of all African Americans. It is almost exclusively women, and participants were included if they lived in either Iowa or Georgia and were a parent or primary caregiver to a child. The sample also had a small number of participants who were diagnosed with depression within the past 12 months (4%) in our sample. This is slightly lower than what you would expect based on nationally representative data for the past 12 months MDD in African Americans (5.9%) (Williams et.al., 2007). African Americans, in general, tend to have lower rates of MDD than non-Hispanic whites, but when they do, it tends to be more severe and disabling (Williams et.al., 2007). Our rationale for choosing the past 12-months was because it increased our case size. Although it is incongruent with the timespan of our other measurements (PA and discrimination), the prevalence of current depression was even smaller, with only approximately 2% (n=17) of our sample being currently depressed. The investigation is also limited by being cross-sectional, therefore, we are unable to determine a causal relationship. The study design also hinders our ability to report changes in

discrimination appraisal over time or to determine the direction of the relationship between discrimination and depression. Another barrier is that in each of our primary variables, different time frames of observation were utilized. Discrimination was assessed over the course of a lifetime, depression diagnosis was over the past 12 months, and both self-reported depression symptoms and PA were assessed over the past week. Our proposed moderator, PA, was self-reported and likely overestimated, but was still in line with national data on PA. It was also non-specific. The PA questions asked for the number of times in the past week a participant was active for at least 30 minutes, but does not specify the amount of time that they were actually active. Our utilization of the data may have resulted in an underrepresentation of the minutes per week of PA of our participants.

Conclusion

Racial discrimination is a unique stressor that takes a psychological toll on many African Americans. It increases one's vulnerability to depression and can induce symptoms associated with depression. PA has been well established in the literature as being effective at reducing depression symptomatology and inducing depression remission at rates equivalent to psychological or pharmaceutical treatment (Mead et.al., 2009; Cooney et.al., 2013; Blumenthal et.al., 2007; Blumenthal et.al., 1999). PA was also discovered in this analysis to be effective at buffering the discrimination and depression relationship. Race-based discrimination exists in many domains of life and can be hard to escape. However, meeting the PA guidelines may reduce the increased odds of depression due to experiencing greater levels of discrimination. However, prospective studies on this important topic is clearly warranted.

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APPENDIX A. THE SCHEDULE OF RACIST EVENTS QUESTIONNAIRE

Reference: Landrine, H., & Klonoff, E. A. (1996). The schedule of racist events: A measure of racial discrimination and a study of its negative physical and mental health consequences. *Journal of Black Psychology*, 22, 144-168.

Coding Scheme: (1) never (2) once or twice (3) a few times (4) frequently

Questions:

How often has someone said something derogatory or insulting to you just because you are African American? Has it been...

How often has a store owner, sales clerk, or person working at a place of business treated you in a disrespectful way just because you are African American? Has it been...

How often have the police hassled you just because you are African American? Has it been...

How often has someone ignored you or excluded you from some activities just because of your race or ethnic background?

How often has someone suspected you of doing something wrong just because you are African American? Has it been...

How often has someone yelled a racial slur or racial insult at you? Has it been...

How often has someone threatened to harm you physically just because you are African American? Has it been...

How often have you encountered whites who are surprised that you as an African American person did something really well?

How often have you been treated unfairly because you are African-American instead of white? Has it been...

How often have you encountered whites who didn't expect you to do well just because you are African American? Has it been...

How often has someone discouraged you from trying to achieve an important goal just because you are African American? Has it been...

How often have close friends of yours been treated unfairly just because they are African American? Has it been...

How often have members of your family been treated unfairly just because they are African American? Has it been...

APPENDIX B. THE MINI MOOD AND ANXIETY SYMPTOM QUESTIONNAIRE

Reference: Clark, L. A., & Watson, D. (1995). The Mini Mood and Anxiety Symptom Questionnaire (mini-MASQ), Unpublished manuscript, University of Iowa, Iowa City.

Coding Scheme: (1) not at all (2) somewhat (3) extremely

Questions:

During the past week, how much have you...felt depressed? Was it...

During the past week, how much have you...felt discouraged? Was it...

During the past week, how much have you...felt hopeless? Was it...

During the past week, how much have you...felt like a failure? Was it...

During the past week, how much have you...felt worthless? Was it...

APPENDIX C. INSTITUTIONAL REVIEW BOARD APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date: 11/02/2018

To: Carolyn Cutrona

From: Office for Responsible Research

Title: Family and Community Health Study Wave 7

IRB ID: 14-575

Submission Type: Continuing Review

Review Type: Expedited

Approval Date: 11/01/2018

Date for Continuing Review: 10/31/2019

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, including the **recruitment materials and informed consent documents that have the IRB approval stamp.**
- **Retain signed informed consent documents** for 3 years after the close of the study, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study.
- **Inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project** with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an [eligible PI](#) to remain open.
- **Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems** involving risks to subjects or others.
- **Stop all human subjects research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Human subjects research activity can resume once IRB approval is re-established.
- **Submit an application for Continuing Review** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

- Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**
- Please be advised that your research study may be subject to [post-approval monitoring](#) by **Iowa State University's Office for Responsible Research**. In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.
- Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure to officially close the project. For information on instances when a study may be closed, please refer to the [IRB Study Closure Policy](#).

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.