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Patterns of Sedentary Behavior and Association with Health Risks Among African American Adults

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DEDICATION

To my late grandfather, Mr. Donald Thompson "The Captain" Warren and my late brother-in-law, Jarvis D. Jones – we did it!

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ABSTRACT

Introduction: There is growing and compelling evidence suggesting time spent in sedentary behaviors (SB) is a unique contributor to health risk that appears to be independent of time spent in moderate- and/or vigorous-intensity physical activity (PA). However, few studies have examined these associations in women and even fewer studies have included ethnic minority populations.

Purpose: The major objectives of this study were to: (1) describe patterns of objectively measured sedentary and PA behaviors and variation in these behaviors in African American (AA) adults; (2) assess the association between bouts of and breaks in SB and waist circumference risk, body mass index, and hypertension; and (3) examine AA women's perceptions around SB and propose novel strategies to reduce these behaviors.

Methods: Using a mixed-methods approach, five aims were addressed. To address major objectives and aims in Manuscript 1 and 2 (i.e. *Objectives 1 & 2; Aims 1-3*), sociodemographic and health-related variables were collected from 266 AA adults recruited from African Methodist Episcopal (AME) churches. Total time spent in sedentary, light-intensity, and moderate-to vigorous-intensity behaviors; time of day most sedentary and weekday vs. weekend day differences in SB; and total number of SB bouts and breaks in SB were examined by sociodemographic and health-related characteristics. Bivariate associations and logistic regression analyses tested the independent associations between bouts of and breaks in SB and obesity, hypertension, and increased waist circumference. To address *Aims 4 & 5* in Manuscript 3, 32 overweight and obese AA

women participated in three focus groups. Focus groups were digitally recorded, transcribed verbatim, and analyzed separately by two coders utilizing NVivo 9.

Results: Regarding Manuscript 1 and 2, most participants were obese, hypertensive, and had a substantially increased waist circumference. On average, participants spent 65% (9.5 hours/day) of waking time in SB, 33% (4.8 hours/day) in light-intensity PA, and <2% (15.0 minutes/day) in moderate-to vigorous-intensity PA. Regarding *Aim 1*, participants had significantly fewer minutes per day of SB in the morning compared to the afternoon and evening. No weekday and weekend day differences were observed in SB. Age, education, and weight status were positively associated with variations and patterns of SB. For *Aim 2*, participants on average engaged in daily SB bouts lasting 6.6 ± 2.1 minutes. All participants engaged in ≥1 daily bout of SB lasting ≥10 and ≥30 minutes, and most participants (93%) engaged in ≥1 bout lasting ≥60 minutes. After controlling for all covariates in the total sample, total SB time was inversely associated with hypertension; and total SB time was positively associated with obesity after controlling for sociodemographic variables *only*. Total number of SB bouts ≥10 and ≥30 minutes were positively associated with higher rates of substantially increased waist circumference after controlling for sociodemographic variables *only* in the total sample. Similarly, total number of SB bouts ≥10, ≥30 and ≥60 minutes were positively associated with obesity after controlling for sociodemographic variable *only.* Among women *only*, total SB time was positively associated with obesity and negatively associated with hypertension; total number of SB bouts ≥10 minutes was positively associated with obesity; whereas, total number of SB bouts ≥60 minutes was inversely associated with substantially increased waist circumference, after controlling for *all* covariates.

Regarding *Aim 3*, on average, participants took 93.2 ± 16.6 breaks from SB; each break lasted 3.3 ± 1.0 minutes and mean intensity of breaks from SB was 446.2 ± 81.2 cpm (light intensity). Total number of SB breaks was beneficially associated with obesity in women *only* and each additional break in SB was associated with a 5% decreased risk of obesity. Lastly, for *Aims 4 and 5*, focus groups indicated most women spent a majority of time at home and work engaged in SB. Culture, environmental influences, and life stressors were the most commonly cited reasons for engaging in SB. While relaxation, personal time and productive time were considered enjoyable aspects of SB, many women described disliking the health consequences associated with SB.

Conclusions: Few studies have examined the associations between total volume and patterns of SB and health risk in AAs. This dissertation presents both an objective and subjective analysis of the associations of SB and health risks in the lives of AA living in the south.

Keywords: African-American, Sedentary Behavior, Physical Activity, Health Disparities

PREFACE

I spent many hours sitting to complete this dissertation project about the patterns (total SB time, SB bouts, and SB breaks) of sedentary behaviors and associated health risks. It is my hope that it will inspire many people to become aware of the amount of time they spend sitting and that they will actively try to change their sedentary behavior patterns to promote a healthier lifestyle and reduce any exposure to health risks. Are you tired of sitting? Well stand up for your health!

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LIST OF ABBREVIATIONS

AA.. African American(s)
ACSM ....American College of Sports Medicine
AHA ....American Heart Association
AME.. African Methodist Episcopal
ATUS ....American Time Use Survey
BAR .... Bouchard Activity Record
BMI .... Body Mass Index
BP.. Blood Pressure
BRFSS..Behavioral Risk Factor Surveillance System
CDC ....Centers for Disease Control and Prevention
CI..Confidence Interval
CM .... Centimeters
CPM .... Counts Per Minute
CVD ....Cardiovascular Disease
DHHS...Department of Health and Human Services
FAN.. Faith, Activity, & Nutrition
GED .... General Education Degree
HS .... High School
METS..Metabolic Equivalent of Task
MIN...Minute(s)
MOA ....Memorandum of Agreement

NCI.. National Cancer Institute

NHIS .... National Health Interview Survey

NIH ....National Institutes of Health

NHANES ....National Health and Nutrition Examination Survey

OR ....Odds Ratios

RR ....Relative Risk

PA ....Physical Activity

PAG...Physical Activity Guidelines for American

SB...Sedentary Behavior(s)

SBQ... Sedentary Behavior Questionnaire

SD ....Standard Deviation

SE ....Standard Error

WHO ....World Health Organization

CHAPTER 1

INTRODUCTION

I. Health Disparities in the United States

The Secretary's Task Force report on Black and Minority Health marked the beginning of a national agenda aimed at eliminating health disparities in the United States (DHHS, 1986). The Task Force report analyzed mortality data from the early 1980s which identified six causes of death (i.e., cancer, cardiovascular disease (CVD), diabetes, cirrhosis, homicide/suicide/accidents, and infant mortality) that together account for 80 percent of the mortality observed among African Americans that are in excess of that of the White population (1986). As a result, the Task Force issued public health recommendations to increase health information and education, the delivery of services, and cooperative efforts with non-federal sectors to address these issues in the African American community (1986). Despite the fact that national efforts have targeted health disparities for the last three decades, disparities still exist among African Americans (DHHS, 2008). Currently, national data show convincing evidence of health disparities for CVD morbidity and mortality and associated health conditions (i.e., obesity, diabetes, and hypertension), with African Americans experiencing higher rates compared to Whites (Rosamond et al., 2007). Exacerbating, and likely contributing to, the issue, there are substantial racial/ethnic disparities in physical activity (PA) participation and sedentary behaviors (SB) among adults in the United States (DHHS, 2008).

II. Physical Activity in the United States

Most Americans do not meet PA recommendations issued by the Federal Government (DHHS, 2008), making physical inactivity a major public health problem in the United States. Recent PA recommendations state that adults should engage in at least 150 minutes per week of moderate-intensity PA or 75 minutes per week of vigorous-intensity PA or a combination of the two to help prevent and manage multiple chronic conditions, including CVD, obesity, type 2 diabetes, and some cancers (DHHS, 2008). Although 52% of Americans report not meeting PA recommendations (CDC, 2005; CDC, 2007a), accelerometry estimates from the most recent National Health and Nutrition Examination Survey (NHANES) indicate only 3.2% of American adults meet public health PA recommendations (Tudor-Locke et al., 2010). Furthermore, women report significantly less PA participation compared to men, and of all races, ethnicities and genders, African American women consistently report the lowest rates of PA (DHHS, 2008). Similar to self-reported gender differences, men in the NHANES study engaged in greater minutes per day of accelerometry-assessed PA than did women across all age categories (Tudor-Locke et al., 2010). However, race differences in PA consistently observed with self-report measures were not observed in the NHANES study (Troiano et al., 2008).

III. Sedentary Behavior in the United States

The health risks associated with low levels of PA and high levels of SB have received increased attention in recent years. SB is defined as a distinct class of behaviors (e.g., sitting, watching television, driving) characterized by little physical movement and low energy expenditure (≤1.5 METs) (Pate et al., 2008; Tremblay et al., 2010). Most

Americans report participating in high levels of daily sedentary activities (Dong et al., 2004). Until recently, only sleeping and lying down were categorized as sedentary activities (Hamilton et al., 2007). The Bureau of Labor statistics (Tudor-Locke et al., 2010) determined the ten most frequently reported non-work and non-sleep activities by intensity. The most-frequently reported sedentary activity was eating and drinking (95.6%, MET = 1.50), followed by TV viewing (80.1%, MET = 1.33) and riding in a vehicle (20.4%, MET = 1.0) (Tudor-Locke et al., 2010). Sedentary activities such as TV viewing, computer use, video game use, workplace sitting, and sitting while commuting in a vehicle have been associated with an increased risk of CVD morbidity and mortality (Dunstan et al., 2010; Jakes et al., 2003; Katzmarzyk, et al., 2009b; Proper et al., 2011b; Warren et al., 2010), diabetes (Grontved & Hu, 2011; Hamilton et al., 2007; Healy et al., 2008; Proper et al., 2011b; Thorp et al., 2009; Thorp et al., 2011), obesity (Healy et al., 2008; Hu, 2003; Hu et al., 2003; Jakes et al., 2003; Shields & Tremblay, 2008; Thorp et al., 2009; Thorp et al., 2011; Tremblay et al., 2010; Wijndaele et al., 2010), cancer (Dunstan et al., 2010; Hu et al., 2005; Katzmarzyk et al., 2009b; Owen et al., 2010; Owen et al., 2011; Proper et al., 2011b; Thorp et al., 2011) and all-cause mortality (Dunstan et al., 2010; Grontved & Hu, 2011; Katzmarzyk et al., 2009a; Wijndaele et al., 2010).

IV. Project Purpose and Aim

Community-based participatory research has become a preferred process by which researchers and community members come together to develop, implement, evaluate and disseminate health programs (Minkler and Wallerstein, 2003). The Faith, Activity, and Nutrition (FAN) program used a community-based participatory approach to target moderate-to vigorous-intensity PA, increased fruit and vegetable consumption, and improved blood pressure in African American adult members of African Methodist Episcopal (AME) churches (Wilcox et al., 2010; Wilcox et al., 2013). Partnerships between faith communities and university communities provide a way to deliver culturally and ethnically appropriate health information to community members. In addition, these cooperative partnerships have great potential to contribute to eliminating health disparities, a major goal of Healthy People 2020 (Newland, 2009).

Given well-documented disparities in PA and SB, the primary aims for this dissertation were to: 1) characterize the total amount, breaks and bouts of objectively measured sedentary, light-intensity, and moderate-to vigorous-intensity PA in a sample of African American adults in the FAN study, 2) examine associations between bouts of SB and several health risks and chronic health conditions, 3) examine the association between breaks in SB and several health risks and chronic health conditions, 4) qualitatively assess perceptions and beliefs toward SB in a sample of African American women, and 5) use qualitative findings to propose novel strategies for reducing SB in the home, work, and social environments of African American women.

Study Aims by Manuscript

Specific aims of this project by manuscript are described below.

<u>Manuscript 1 Objective</u>: Describe patterns of and variations in objectively measured SB and PA in the FAN study.

<u>Aim 1</u>

1. Characterize the patterns of time spent in sedentary, light-intensity, and moderate- to vigorous-intensity behaviors and examine these patterns according

to sociodemographic and health-related variables in a sample of African American adults.

a. Describe the time spent in total sedentary, light-intensity, and moderate-to vigorous-intensity behaviors by sociodemographic factors (gender, age, education level, marital status, and employment status), and health-related factors (smoking status, fruit and vegetable consumption, self-rated health, body mass index (BMI), and waist circumference).
b. Describe variations in and patterns of SB (times of day and weekday vs. weekend day) and describe whether these patterns differ according to the sociodemographic characteristics and health-related behaviors listed in 1a.
c. Report the number of bouts of sedentary, light-intensity, and moderate-to vigorous-intensity PA experienced during the day and examine these bouts according to the sociodemographic characteristics and health-related behaviors listed in 1a.
d. Report the number of breaks in SB experienced during the day and examine these breaks according to the sociodemographic characteristics and health-related behaviors listed in 1a.

Manuscript 2 Objective: Assess the association between bouts of and breaks in SB and health-related variables in the FAN study.

Aim 2

2. Examine the associations of bouts of SB with body mass index, waist circumference, and blood pressure. Hypothesis: Greater bouts of sedentary time will be significantly associated with health-related variables in all participants.

a. It is hypothesized that a greater number of bouts of sedentary time will be associated with a higher BMI.

b. It is hypothesized that a greater number of bouts of sedentary time will be associated with a higher waist circumference.

c. It is hypothesized that a greater number of bouts of sedentary time will be associated with higher blood pressure.

Aim 3

3. Examine the associations of breaks in SB with BMI, waist circumference, and blood pressure. Hypothesis: More frequent breaks in sedentary time will be associated with favorable health-related variables in all participants.

    a. It is hypothesized that more frequent breaks in sedentary time will be associated with a more favorable BMI.

    b. It is hypothesized that more frequent breaks in sedentary time will be associated with a more favorable waist circumference.

    c. It is hypothesized that more frequent breaks in sedentary time will be associated with a more favorable blood pressure.

Manuscript 3 Objective: Examine African American women's perceptions of SB and propose novel strategies to reduce these behaviors.

Aim 4

4. Conduct focus groups to explore perceptions and beliefs towards SB.

    a. Describe how personal factors influence time spent in SB.

    b. Describe how the social and physical (work and home) environment influence time spent in SB.

Aim 5

5. Explore novel strategies to reduce SB in the home, work, and social environment of African American women.

V. Public Health Benefits of Dissertation Project

There is growing evidence to suggest that time spent in SB is a distinct contributor to health risk (Grontved & Hu, 2011; Healy et al., 2011b; Owen et al., 2011; Proper et al., 2011b; Thorp et al., 2011), and that this risk appears to be independent of time spent in moderate and/or vigorous-intensity PA (Ekelund et al., 2006; Katzmarzyk et al., 2009b; Warren et al., 2010). Successful, efficient, and innovative intervention approaches are needed to address the health concerns of Americans. For individuals at increased risk for diseases and health conditions who have not embraced an organized or structured program of daily PA, reducing SB may be a more achievable and viable approach to increasing movement and energy expenditure (Tremblay et al., 2010), eventually resulting in reduced health risk (i.e., weight loss, reduced waist circumference, and blood pressure).

African Americans, and African American women in particular, are disproportionately affected by adverse health conditions (Hu, 2003; Kramer et al., 2004; Pate, 2009). In addition, traditional health promotion programs have been less successful among African American women compared to White women (Befort et al., 2008; Kumanyika et al., 2007; Seo & Sa, 2008; West, et al., 2008; Yancey et al., 2004). Thus, programs that speak to the needs of African American women are essential in combating health disparities. This dissertation both describes behaviors and explores novel strategies to address these needs.

CHAPTER 2

Review of the Literature

I. Health Disparities

Addressing health disparities as part of our national public health agenda needs to be made a priority. Public health efforts must combat the challenges posed by physical inactivity and sedentary behavior (SB) on the health and well-being of Americans, particularly populations most affected. African Americans, and African American women in particular, have high rates of many health conditions associated with low levels of PA and high levels of SB (Matthews et al., 2008). African Americans who are physically inactive and the most sedentary among the United States population stand to gain the most from engaging in routine daily PA. However, weight loss programs aimed at improving health outcomes by increasing PA, improving diets, and promoting weight loss have been less successful in African Americans compared to Whites (Befort et al., 2008; Kumanyika et al., 2007; Seo & Sa, 2008; West et al., 2008; Yancey et al., 2004). Thus, continued national efforts to increase PA participation and decrease SB among this population are important for combating the high rates of chronic conditions such as CVD, obesity, hypertension, and type 2 diabetes (Pate, 2009).

Cardiovascular disease

CVD, a class of diseases that involve the heart and blood vessels (i.e. arteries and veins) (DHHS, 1996) is the leading cause of death for American adults (Heron &

Smith, 2007). The United States ranks 14th and 16th among industrialized nations for the prevalence of CVD in women and men, respectively (Lloyd-Jones et al., 2009). Approximately 33.6% (83 million) of the United States population currently lives with one or more forms of CVD (Lloyd-Jones et al., 2009). CVD is not a single disease or health condition; rather, it is a group of conditions that affect the heart and blood vessels. Some of the most common forms of CVD are heart disease, stroke, angina, hypertension, heart failure, and atherosclerosis (DHHS, 2008).

Heart disease and stroke are the two leading types of CVD (Lloyd-Jones et al., 2009). In 2010, heart disease and stroke were the 1st and 4th leading causes of death in the United States (Go et al., 2013). It is estimated that more than 1.5 million American adults experience a heart attack or stroke annually (Go et al., 2013). Heart disease and stroke are also among the leading causes of disability in the United States; with more than 4 million people reporting disabilities from these conditions (Go et al., 2013).

Overall death rates from CVD in the United States appear to be declining. However, the incidence and death rates for heart disease and stroke continue to be relatively high among African Americans (Lloyd-Jones et al., 2009), and clear gender and race differences exist. Age-adjusted death rates from CVD are 37% higher among African Americans compared to Whites (Lloyd-Jones et al., 2009). The prevalence of CVD in African American females is 44.7%, compared to 32.4% in White females (Lloyd-Jones et al., 2009). These types of disparities are also observed in other health-related conditions, such as diabetes, hypertension, and obesity (CDC, 2005).

Diabetes

Diabetes is a metabolic disease in which a person has high blood sugar, either because of the body's inability to produce sufficient insulin (type 1 diabetes) or because cells are unresponsive to the insulin that is produced (type 2 diabetes) (NMA, 2005). Diabetes is the seventh leading cause of death in the United States (Heron & Smith, 2007). Type 2 diabetes accounts for approximately 90 to 95% of all diagnosed cases of diabetes in adults, whereas type 1 diabetes accounts for about 5% of all diagnosed cases (NMA, 2005). There are 25.8 million people in the United States - 8.3% of population – who have diabetes (CDC, 2011). It is estimated that there are approximately 13 million men and 12.6 million women age 20 years or older who have diabetes (CDC, 2011).

Diabetes is commonly listed as an underlying cause or contributing factor to many causes of morbidity and mortality in the United States (NMA, 2005). Diabetes is the most frequently reported cause of kidney failure in the United States (CDC, 2011). In 2008, it was the underlying cause in 44% of patients starting end stage renal disease treatment (CDC, 2011). Diabetes is also a major cause of heart disease and stroke (Lloyd-Jones et al., 2009). Among people with diabetes, the risk for stroke as well as heart disease mortality is two to four times higher compared to adults without diabetes (Lloyd-Jones et al., 2009). Diabetes and hypertension are also strongly linked. As many as two out of three adults with diabetes also have hypertension (CDC, 2011).

The burden of diabetes is greater for minority populations than for Whites. For example, 12.6% of African Americans have diabetes compared with 7.1% of Whites (CDC, 2011). African Americans have more end stage renal disease and kidney failure compared to Whites. African Americans also have higher rates of diabetes-related neuropathy and peripheral vascular disease (CDC, 2011). As a result, African Americans have higher rates of lower-extremity amputations compared to Whites (CDC, 2011).

Overall, African Americans have the highest diabetes-related morbidity and mortality of any other racial/ethnic population in the United States (CDC, 2011).

Hypertension

Hypertension is a leading cause of heart disease, stroke, and diabetes (Lloyd-Jones et al., 2009). Hypertension is a term used to describe high blood pressure. Blood pressure is usually classified based on the systolic and diastolic pressures. Based on the American Heart Association classifications, a normal blood pressure is 120/80 mmHg and hypertension is 140/90 mmHg (Lloyd-Jones et al., 2009). Persons with diabetes or kidney disease should aim for blood pressure readings lower than 130/80 mmHg (Lloyd-Jones et al., 2009).

Currently about one in three (33.5%) American adults have hypertension (CDC, 2005). Unfortunately, like many other health conditions and diseases, hypertension occurs more often in African Americans (CDC, 2005). More than 40% of African Americans have hypertension as compared to 27% of Whites (Lloyd-Jones et al., 2009). Compared to Whites, African Americans have earlier onsets and more severe cases of hypertension (CDC, 2005). African American women also have slightly higher rates of hypertension than do African American men (44% vs. 42%, respectively). Higher rates of diabetes and obesity appear to place African Americans at greater risk for hypertension and related complications (CDC, 2007).

Obesity

Obesity has far-reaching health consequences and is defined as a health condition in which excess body fat has accumulated to the extent that it may have adverse health effects (Flegal et al., 2010). BMI, a measure that compares weight to height and classifies individuals into a weight category, is often used to estimate obesity. A normal BMI range is 18.5 – 24.9 kg/m^2 (Flegal et al., 2010). Overweight is defined as having a BMI between 25 kg/m^2 and 29.9 kg/m^2, and obese is defined as having a BMI greater than or equal to 30 kg/m^2 (Flegal et al., 2010). Overweight and obesity result when a person's caloric intake exceeds the energy expenditure. It is understood that to retain a healthy weight, caloric intake and energy expenditure must be balanced over time (Flegal et al., 2010).

Over the past two decades, obesity rates have increased to epidemic proportions across the world, the United States, and in South Carolina. In the United States it is estimated that approximately 68% of the population is overweight or obese (BMI > 25 kg/m2), 33.8% of the population is obese (BMI>30 kg/m2), and 32% of adults meet the recommended normal BMI range (Flegal et al., 2010). The National Center for Health Statistics estimates that more than 70 million American adults do not meet the recommended weight range (Ogden et al., 2011). In 2010, the CDC reported that all states in the United States had an obesity prevalence of 20% or higher, while 36 states had a rate of equal or greater than 25% (CDC, 2010).

Additionally, the United States prevalence rate for obesity was 32.6% and 44.1% for Whites and African Americans, respectively (Flegal et al., 2010). Rates of overweight and obesity are also higher in women than in men (Flegal et al., 2010). Currently, more than 77% of African American women and 59% of African American men have a BMI >25 compared to 69% of Caucasian men and 52% Caucasian women (CDC, 2009). Additionally, compared to any other racial and/or gender subgroup, African American women report the highest prevalence rates for obesity (64%), and health-related risk factors (CDC, 2007; CDC, 2005; Flegal et al., 2010; SC DHEC, 2007).

Physical Activity – Overview

Over the last 40 years a number of organizations in the United States have recognized the low PA rates of the population and the associated negative health consequences (Leitzmann et al., 2007; Pate, 2009; Pate et al., 1995; DHHS, 1996; DHHS, 2008; WHO, 2009). The United States National Physical Activity Plan includes over 250 recommendations for increasing PA, where PA is defined as any bodily movement produced by skeletal muscle that increases energy expenditure and enhances health (Pate, 2009). It is well-documented that regular participation in PA has many physical and mental health benefits for both men and women of all ages, ethnicities, and racial backgrounds (DHHS, 2008). Further, American adults not achieving the PA public health recommendations are considered underactive and/or physically inactive and are at increased risks for the development of various diseases and health conditions (Pate, 2009; Pate et al., 1995; DHHS, 2008).

Given the high prevalence of not meeting PA recommendations combined with the substantial associated health risks, physical inactivity is a major public health problem. In fact, the World Health Organization (WHO) describes it as a global public health problem because worldwide almost 3.2 million deaths each year are attributable to insufficient PA (WHO, 2009). The WHO also reports that almost 50% of women and 40% of men are insufficiently active in the Americas (WHO, 2009). In 2008, the Physical Activity Guidelines for Americans (PAG) defined inactivity as no activity beyond baseline activities of daily living and reported that inactivity was unhealthy for Americans of all ages and abilities (DHHS, 2008). Physical inactivity is a major risk factor for CVD (Haapanen-Niemi et al., 2000), obesity (Buchowski et al., 2010), stroke

(Kiely et al., 1994; Kohl, 2001), hypertension (Beunza et al., 2007), diabetes (Jeon et al., 2007), and some cancers (Hardman, 2001; Lee, 2003; Monninkhof et al., 2007). Furthermore, physical inactivity is associated with all-cause mortality (Andersen et al., 2000; Blair et al., 1989; Lee & Skerrett, 2001; Paffenbarger et al., 1986). Action is needed at the individual, community, and global levels to help Americans become more physically active and achieve public health recommendations for PA.

a. Public Health Physical Activity Recommendations

In 2008, PA recommendations for Americans were issued by the Department of Health and Human Services (DHHS) (DHHS, 2008). The 2008 Physical Activity Guidelines for Americans (PAG) support the 1995 American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention (CDC) recommendations which state that all Americans should accumulate 30 minutes of moderate-intensity (3.0 to 6.0 METS) PA on five days each week or vigorous-intensity aerobic PA for a minimum of three days each week, and/or a combination of moderate- and vigorous-intensity PA can be performed to meet this recommendation (DHHS, 2008). They also recommend that Americans should perform resistance training PA at least 2 days per week (DHHS, 2008). However, as a result of recent epidemiological findings, DHHS made slight changes to the ACSM and CDC recommendations. The changes promote the accumulation of time (e.g., 150 minutes per week) spent engaged in total PA per week, rather than the regularity of 30 minutes per day, 5 days per week (DHHS, 2008).

The 2008 PAG suggest 3 major recommendations: (1) adults should accumulate 150 minutes per week of moderate-intensity (3.0 to 5.9 METS) or 75 minutes per week of vigorous-intensity ($\geq$ 6.0 METS) PA in bouts of at least 10 minutes to achieve health benefits; (2) adults should perform 2 days of resistance training PA on all muscle groups to promote muscular endurance and muscular strength; and (3) additional benefits can be achieved by increasing moderate-intensity PA to 300 minutes per week or participating in more vigorous PA (DHHS, 2008). With the first recommendation health benefits can be achieved a variety of ways. For example, an individual can meet PA recommendations in any of the following 3 ways: (a) 30 minutes of moderate-intensity PA each day; (b) 25 minutes of vigorous-intensity PA 3 days per week; or (c) 45 minutes of moderate-intensity PA 2 days per week and 20 minutes of vigorous PA 1 day per week (DHHS, 2008). This level of PA performed on a regular basis has been shown to increase overall physical and mental health, as well as decrease the risk of adverse health conditions and diseases (DHHS, 2008).

b. Health Benefits of Physical Activity/Health Risks of Physical Inactivity

The benefits of PA are well-established. The health benefits associated with regular PA include decreased risk for all-cause mortality, CVD (i.e., coronary heart disease and stroke), type 2 diabetes, metabolic syndrome, some cancers (i.e., breast and colon), dyslipidemia, hypertension, and obesity (Lee & Skerrett, 2001; Pate, 2009). Participation in regular PA also increases cardiorespiratory fitness, flexibility, strength, endurance, and overall functional capacity (Paalanne et al., 2009; DHHS, 1996). There are also psychological benefits of PA and these include decreased symptoms of depression, anxiety, and stress, improved mood, self-esteem and body image, and improved feelings of energy and self-efficacy in physical abilities (Lewis et al., 2002). The American Heart Association (AHA) (Fletcher et al., 1997), the CDC and ACSM (Pate et al., 1995), Surgeon General's Report (DHHS, 1996), Healthy People 2010/2020 objectives (Koh, 2010; Marwick, 2000), PAG (DHHS, 2008), and the National Physical Activity Plan (Pate, 2009), have all outlined the immense physiological and psychological benefits of PA. However, despite the known physical and mental benefits of PA, a majority of American adults are not meeting recommended levels of PA to achieve the associated health benefits. Thus, the negative health risks associated with physical inactivity should be a major concern to most American adults.

Physical inactivity is associated with increased morbidity or worsening of many chronic diseases and health conditions, such as obesity, heart disease, and cancer (Mokdad et al., 2005). The WHO estimates that physical inactivity is the cause of about 22% of ischemic heart disease cases, about 10-16% of breast, colon and rectal cancers and diabetes cases, and nearly 3 million deaths annually (Margetts, 2004; Waxman, 2004). Research has indicated that less-active and less-fit individuals are at increased risk of developing many chronic health conditions, resulting in increased mortality rates among less-active individuals (Haapanen-Niemi et al., 2000). Moreover, PA can help to better manage conditions such as obesity, hypertension, and diabetes (Anderssen et al., 2007; Hamer & Chida, 2007; Jeon et al., 2007; Paffenbarger et al., 1983). Overall, research suggests that by increasing PA individuals can decrease the health risks for the following: all-cause mortality by 30%; CVD by 20-35%; type 2 diabetes and metabolic syndrome by 30-40%; and breast and colon cancer by 20% and 30%, respectively (DHHS, 2008).

c. Prevalence Rates of Physical Activity

National patterns and trends in PA for adults have been monitored for the past 40 years (CDC, 2008). Despite the nationwide efforts to promote PA among Americans

(Pate, 2009), trend data have shown low and stable participation rates over time (CDC, 2008). National surveys, including the Behavioral Risk Factor Surveillance System (BRFSS) (CDC, 2008), NHANES (Troiano et al., 2008), and the National Health Interview Survey (NHIS) (Lethbridge-Cejku et al., 2004) have assessed the PA prevalence rates among Americans across sociodemographics. Based on the 2007 BRFSS, more than 50% of United States adults reported that they were not meeting PA recommendations (CDC, 2007). However, adherence to PA recommendations is significantly lower when PA is measured by accelerometers (Troiano et al., 2008). In fact, data from the 2003-2004 NHANES report that only 3-5% of American adults meet national PA recommendations when measured by accelerometers (Troiano et al., 2008). National self-report and objective data show that physical inactivity levels also differ according to sociodemographic (i.e. age, gender, education, income, and race/ethnic) variables.

Age

Age is negatively associated with PA participation (CDC, 2007a). According to the 2007 BRFSS, 59% of adults age 18-24, 53.2% age 25-34, 49.6% age 35-44, 46.6% age 45-64, and 39.3% age 65 and older were regularly active according self-reported data (CDC, 2007a). In addition, more than 50% of adults (across all age groups) were insufficiently active (i.e. doing more than 10 minutes per week of moderate-to vigorous-intensity PA but less than recommended levels of PA) or physically inactive (i.e., doing less than 10 minutes per week of moderate- to vigorous-intensity PA) (CDC, 2007a). Older adults (age ≥ 65 yrs old) have the highest rates of inactivity (23.7% are classified as physically inactive and 36.9% as insufficiently active), resulting in more than 60% of older adults who are not meeting PA recommendations (CDC, 2007a). There are several consequences for the limited mobility observed among middle-age and older adults which include balance and coordination impairments, increased risk of falling, and most importantly, age-related declines in health (Stewart et al., 2001; Topolski et al., 2006). Older Americans engaging in a physically active lifestyle can better manage health conditions and improve their ability to function (DHHS, 2008).

Gender

Gender differences in activity levels exist for all age groups. Women of all ages are less active than their male counterparts (CDC, 2007a). Men participate in significantly more moderate and vigorous intensity activities and females participate in more light-intensity activities (Troiano et al., 2008).Women have greater rates of physical inactivity (inactive + insufficiently active) compared to men, 53% vs. 49.3%, respectively (CDC, 2007a). The gender patterns seen in self-reported data are also seen in NHANES, which again uses accelerometers to obtain estimates (Troiano et al., 2008).

Education

On average, individuals with lower educational attainment report lower PA rates than persons who attended college or graduated from college (CDC, 2007a). Accordingly, individuals who report graduating from high school also report more physical inactivity than individuals who report graduating from college (61% vs. 47.1%) (CDC, 2007a). Differences in educational attainment are also strongly related to income in the United Sates (Ogden et al., 2011; Sallis et al., 2009).

Income

Income is associated with PA rates observed among Americans (DHHS, 2008).

Based on self-reported leisure-time PA, persons with an annual household income <$10,000 have the highest prevalence of physical inactivity and associated chronic conditions, including high blood pressure, high cholesterol, diabetes, and obesity (CDC, 2007a). Among low-income individuals, neighborhood characteristics (e.g. crime rates, vandalism, school quality, and property values) and less access to PA resources may be related to lower participation in PA (Larson et al., 2009; Sallis et al., 2009).

Race/Ethnicity

Race and ethnicity patterns also emerge for PA. Certain demographic groups (e.g., African American women) appear to be especially at risk for physical inactivity (Robert & Reither, 2004; Wilbur et al., 2002). However, it still remains unclear as to what extent the racial and ethnic differences are explained by socioeconomic factors such as income and educational attainment (Drewnowski & Specter, 2004; Eyler et al., 2004; Koh, 2010; Sharma et al., 2004). Whites (51.7%) report the highest PA rates compared to African Americans (40.4%) and Hispanics (42.1%) (CDC, 2007a). In contrast to self-reported data, however, Mexican American men and women had higher mean counts of accelerometer assessed activity compared to African Americans and Whites in NHANES (Troiano et al., 2008). Further, with the exception of women aged 60 years or older, where White females were more active than African American females, no other racial/ethnic disparities were observed when assessing PA objectively (Troiano et al., 2008).

Population-wide surveillance data show a high prevalence of physical inactivity for African Americans (CDC, 2007a). African Americans (59.6%) compared to Whites (48.3%), Hispanics (57.9%), and other racial/ethnic groups (54.7%), report the highest rates of physical inactivity (CDC, 2007a; CDC, 2009). Of all subgroups in the United States, African American women have the highest reported levels of physical inactivity, with roughly 63.7% of this population self-reporting less than the recommended 150 minutes per week of moderate-to vigorous-intensity lifestyle activities (CDC, 2007a; Hawkins, 2007). National agendas have been aimed at eliminating pronounced health disparities among African Americans in general (CDC, 2000) and African American women in particular (Airhihenbuwa & Liburd, 2006; Hawkins, 2007).

d. Gaps

Traditionally, public health promotion efforts addressing health disparities have focused on increasing PA in populations most affected by adverse health conditions. However, interventions and programs tested to date to address obesity concerns have not been as successful in increasing PA, improving diets, and promoting weight loss in persons at highest risks for health conditions and diseases (Befort et al., 2008; Kumanyika et al., 2007; Seo & Sa, 2008; West et al., 2008; Yancey et al., 2004). Recent research has shown that adults are not only reducing PA but they are also replacing time spent active with SB such as TV viewing, computer use, and occupational sitting (Troiano et al., 2008). Moreover, these SB are shown to have a negative association with health (Pate et al., 2008; Proper et al., 2011a; Proper et al., 2011b; Salmon et al., 2003; Salmon et al., 2011; Sardinha et al., 2008; Sugiyama et al., 2008; Thorp et al., 2011; Warren et al., 2010), independent of time spent physically active (Grontved & Hu, 2011; Hu et al., 2001; Proper et al., 2011b; Thorp et al., 2011; Warren et al., 2010). Therefore, physically inactive individuals have the potential to substantially increase their risk of chronic health conditions by further increasing SB (Hamilton et al., 2007). Thus, researchers and public health professionals need to think about health promotion as not only increasing PA but also as decreasing time spent engaged in SB.

Important public health initiatives such as Healthy People 2010 (Marwick, 2000) and, more recently, the United States National Physical Activity Plan (Pate, 2009), have had increased PA as an important goal; however, national PA health objectives have not been met over the last two decades for children or adults (Koh, 2010). Gaps have been highlighted in the approaches used to increase PA and improve health among children (Pate, 2009). Recent public health recommendations for children not only address PA but also include recommendations for reducing SB (DHHS, 2008). Current recommendations state that children should aim to reduce daily screen time (e.g., TV, computer, and video game use) to less than two hours daily because it limits time for PA (DHHS, 2008). Unlike pediatric recommendations that address PA and SB, recommendations for adults do not specifically target SB (DHHS, 2008); although, the case for doing so has been presented (Hamilton et al., 2007).

SB should be considered an independent influence on health risk. The health concerns of SB are *in addition to* the still very important clinical and public health problem of physical inactivity. Although physical inactivity and SB are related, they are two distinct and independent behaviors. Spanier et al. (2006) aptly stated that research has addressed what people are *not* doing (inactivity) rather than what people *are* doing (SB). As a result, researchers have often used the terms “physical inactivity” and “sedentary behaviors” interchangeably. However, there are differences between these two terms. Physically inactive individuals are persons not meeting current PA recommendations (moderate-to vigorous-intensity PA). Among individuals who are physically inactive, they may engage in both SB and light-intensity PA (Pate et al., 2008). There has been confusion in the literature in the use of these terms. The term “sedentary behaviors” has often been used to describe people not meeting PA recommendations (i.e. moderate to vigorous intensity PA) rather than people who do not report any light-, moderate- or vigorous-intensity PA (Matthews et al., 2008). Thus, the ability to accurately classify and assess SB, separate from physical inactivity, will greatly advance the field of exercise science.

II. Sedentary Behavior - Overview

In today’s modern society, there are rapidly evolving innovations that have led to an increase in labor-saving devices, technological advances, and expansion of work force. These technological advances have been associated with decreases in energy expenditure and increases in SB (Bauman et al., 2011). Sitting during sedentary activities has essentially been engineered into our lives across many settings including home, workplace and transportation (Bauman et al., 2011). The American Time Use Survey (ATUS) has shown increases in SB such as TV viewing, computer use, and car ownership and usage patterns (Tudor-Locke et al., 2010). It appears that SB has been embedded into our daily practices, and as a result, Americans are reporting engaging in higher levels of SB than ever before (Troiano et al., 2008). This shift in lifestyles has impacted total daily energy expenditure and overall health and well-being.

Decreasing time spent in SB is of significant interest to the field of public health because SB is prevalent and is associated with multiple chronic diseases. Thus, SB is becoming an important component of the PA and health relationship. Sedentary pursuits represent a unique aspect of human behavior and should not be viewed as simply the extreme low end of the PA continuum (Warren et al., 2010). Instead, SB is defined as any activity that does not increase energy expenditure above resting levels, and until recently, sedentary activities typically included only sleeping and lying down (Hamilton et al., 2008). However, research has shown that there are other activities that make up SB (Dong et al., 2004; Tudor-Locke et al., 2010). These activities include, but are not limited to, TV viewing, riding in a vehicle, computer and video game use, and workplace sitting.

In order to determine the role that SB plays in the relationship between PA and health, it is important to determine the prevalence and associated health risks of SB (Owen, Sparling et al., 2010). This area of inquiry has important public health implications because it may substantially change how professionals and lay persons view health. Up until the turn of the century, PA has been a major emphasis of the public health discussion and SB has been essentially ignored. PA studies have usually focused on higher intensities (i.e. moderate and vigorous) of the PA continuum to examine health relationships (Salmon et al., 2011). However, recent studies show that SB may have a large deleterious impact on the public's health (Healy et al., 2011b; Owen et al., 2011; Proper et al., 2011b; Salmon et al., 2011; Thorp et al., 2011).

a. Defining Sedentary Behaviors

The definition of SB has been evolving during the last decade. In the past, "sedentary" behaviors have most often been defined as a lack of participation in moderate-to vigorous-intensity PA or not meeting current recommendations for PA (Pate et al., 2008). Most now view SB as a discrete behavior separate from PA (Hamilton et al., 2008), and it should be viewed as the absolute low end of the activity intensity continuum (Pate et al., 2008). Thus, SB is defined as any activity ≤1.5 METs and light-intensity PA, which is often grouped with SB, is defined as ambulatory activity ≥ 1.6 METs and < 3.0 METs (Pate et al., 2008). SB refers to activities such as sleeping, sitting, lying down, driving or riding in a car, watching television, and engaging in other screen-based behaviors. Light-intensity PA includes activities such as standing, slow walking, cooking food, and washing dishes.

In most studies, SB is defined as TV viewing time. However, due to the rapid growth and technological advances in electronics, total screen time, including computer and video game use, and not just TV viewing time, has been viewed as the largest contributing factor to time spent in SB (Dong et al., 2004). Assessments of SB should include both sedentary leisure-time behaviors as well as occupational SB to adequately reflect the total amount of time spent sedentary.

b. Measures of Sedentary Behavior

Describing and measuring SB has posed some challenges. As previously discussed, current definitions of SB vary in the literature, and few validated measures of SB exist. SB has been measured by both self-report and objective assessment tools. Traditionally, self-report tools have been used to measure higher intensity physical activities (i.e. moderate-to-vigorous) that people can often recall and describe in great detail. Additionally, self-report questionnaires such as those used in the BRFSS and NHANES have been shown to be more accurate in measuring higher intensity physical activities (Yore et al., 2007). Some self-report questionnaires have begun to include questions about SB (i.e., TV viewing, talking on the phone, reading, riding in a car, attending meetings) with hopes to capture time spent engaged in sedentary activities (Hamilton et al., 2008; Owen, Healy et al., 2010). Tremblay et al. (2010) states that there needs to be a consensus on the methodology that can reliably quantify SB. Therefore, valid and reliable measurements are important for the credible development of the field.

Self-report

There are problems with measuring SB through self-report methods because SB tends to be intermittent behaviors occurring throughout the day (Hart et al., 2010). Also, because they are pervasive and rather "unremarkable," they may not be easily and accurately recalled (Hart et al., 2010). Population approaches to capture the prevalence of SB has focused on including behaviors that people can recall and quantify (e.g., how much time an individual spends commuting in a car) (Healy et al., 2011; Tudor-Locke et al., 2010). However, Sugiyama et al. (2008) says this population approach may present a problem because although capturing most notable SB is informative, no single behavior represents the majority of time spent in sedentary activities during the day. Some of the most common forms of self-report measures used for capturing SB include interviews, diaries, logs, automobile usage recalls, and elevator/escalator recalls (Hart et al., 2010).

NHANES assesses SB (e.g., TV viewing and computer use) among adults. Additionally, the International Physical Activity Questionnaire (IPAQ) assesses time spent sitting and has been shown to be reliable and valid (Rosenberg et al., 2010). Rosenberger et al. (2010) found a moderate association (r =.33) between an objective measure of SB and the IPAQ measure for SB. Epidemiological surveys, such as the BRFSS, were originally developed to assess PA but have since been used to measure sedentary activity (Yore et al., 2007). However, when the BRFSS is used in this manner, it is actually capturing time spent *not* physically active (e.g. moderate-to vigorous-intensity PA), which may include both sedentary activity and light-intensity PA (CDC, 2008).

Similar to the BRFSS, the Bouchard Activity Record (BAR) is a PA log that assesses varying PA levels, including behaviors at the very low end of the physical spectrum such as sitting and lying (Hart et al., 2010). Hart et al. (2010) examined the validity of the BAR relative to the ActiGraph and ActivPal accelerometers. The findings showed the BAR self-report measure detected less sedentary time compared to both objective measures (Hart et al., 2010). Convergence in detecting walking (r =.53) and SB (r =.87) was observed for the ActivPal and BAR (Hart et al., 2010).

To date there are very few self-report surveys developed specifically to assess SB for adults (Hart et al., 2010). The Sedentary Behavior Questionnaire (SBQ), adapted from a measure used in children, has been used to assess SB among adults (Rosenberg et al., 2010). The SBQ is a 9-item survey assessing the amount of time spent doing nine SB (i.e., watching television, playing computer/video games, sitting while listening to music, sitting and talking on the phone, doing paperwork or office work, sitting and reading, playing a musical instrument, doing arts and crafts, sitting and driving/riding in a car, bus, or train) (Rosenberg et al., 2010). Rosenberg et al. (2010) demonstrated acceptable reliability of SBQ items but low validity when compared with accelerometers (Rosenberg et al., 2010). Although self-report measures provide an estimate of time spent in SB, objective techniques such as accelerometers may be more accurate as they overcome some of the limitations inherent in recall (Hart et al., 2010; Matthew, 2005).

Accelerometers

Accelerometers are commonly used to measure multiple intensities of PA

(Hendelman et al., 2000; Matthew, 2005; Troiano, 2007). In response to limitations of self-report assessments, researchers have begun to use objective measures to quantify SB (Troiano et al., 2008; Gibbs et al., 2014). Including accelerometers in population-level public health research has advanced the study of the physiology of sedentary and light-intensity behaviors (Hamilton et al., 2008; Tremblay et al., 2010). Researchers are able to overcome the barriers of subjective methods and examine associated health factors, determinants of health, and intervention outcomes related to SB (Tremblay et al., 2010).

An accelerometer is a device that continuously measures movement (i.e., acceleration) from hip displacements during motion such as walking (Chen & Bassett, 2005). It records time spent engaged in SB, as well as PA, during specified time intervals (Chen & Bassett, 2005). Based on established age-specific cut-points, researchers have the ability to capture the amount of time individuals spend at any given intensity level (Freedson et al., 1998; Matthews et al., 2008). As suggested by Matthews et al. (2008), counts below 100 per minute reflect SB.

Accelerometers have been commonly used to validate other types of measures of PA (Ward et al., 2005). The ActiGraph and ActivPal are two accelerometers that have been validated as accurate objective measures of frequency, intensity and duration of PA in adults (Freedson et al., 1998; Godfrey et al., 2007). Recently, validity studies have examined the use of these accelerometers to measure SB in adults (Hart et al., 2010; Kozey-Keadle et al., 2011). Researchers concluded this may be due to differences in cut-points used to determine SB in the objective tools (Hart et al., 2010).

Kozey-Keadle et al. (2011) also examined the validity of the ActivPal and ActiGraph relative to direct observation to assess SB among overweight and physically inactive individuals. They concluded that the ActivPal is an accurate and precise monitor for measuring SB and is sensitive to measuring reductions in sitting time (Kozey-Keadle et al., 2011). Another major finding of this study was to show that the ActiGraph cut-point of 150 counts per minute appears to be the most accurate cut-point to define SB (Kozey-Keadle et al., 2011). Hart et al. (2010) and Kozey-Keadle et al. (2011) raised technical questions (e.g. time sampling intervals, intensity cut-points, and data-treatment) related to using accelerometers to assess SB among adults. However, they concluded that having instruments that can objectively measure both SB and PA will enhance options for examining associations with health related outcomes (Hart et al., 2010; Kozey-Keadle et al., 2011).

c. Sedentary Behavior Prevalence

Estimating the prevalence of SB among American adults is difficult and has been over simplified in the past (Biddle, 2007). SB is not merely the absence of moderate- to vigorous-intensity PA (Tremblay et al., 2010). Instead, it is defined as engagement in pursuits that require low energy expenditure (i.e. <1.5 METS) (12). Typically, individuals are classified as being active or not, and inactive is equated with being sedentary (Matthews et al., 2008). For population surveillance measures such as the BRFSS, sedentary has been defined as no PA or irregular PA (CDC, 2008). Prevalence rates using BRFSS data have classified more than 58% of American adults as sedentary (CDC, 2008). Data from NHIS, which measures the self-reported health of the civilian non-institutionalized populations of the United States, show similar trends. About 40% of American adults were classified as sedentary (Lethbridge-Cejku et al., 2004). Women (43.2%) were more likely to be sedentary than men (36.5%) (Lethbridge-Cejku et al., 2004). Among men and women, African Americans had higher rates of SB than White adults, and SB was also inversely associated with education (Lethbridge-Cejku et al., 2004).

The measurement of SB is not a well-developed field. To accurately assess the prevalence of SB among the population, and its association with health outcomes, overall time spent engaged in SB, as well as domain-specific SB (e.g., leisure-time activities, work place sitting, and travel) should be assessed (Kozey-Keadle et al., 2011). However, no such instruments currently exist (Healy et al., 2011). The ATUS data includes the average amount of time per day that individuals work, do household activities, and engage in leisure and sports activities (Tudor-Locke et al., 2010). In 2010, on average nearly all adults engaged in some form of sedentary leisure activity, such as TV viewing, or socializing. TV viewing was the most commonly reported SB (Tudor-Locke et al., 2010).

According to ATUS, in a typical day, adults spend 7.5 hours on the computer, 4 hours watching TV, 1.5 hours commuting in a vehicle, and approximately 1 hour in meal time, resulting in 14 hours per day of sitting (Dong et al., 2004; Tudor-Locke et al., 2010). Although the ATUS captures specific time engaged in different activities, more SB (e.g. computer and video game use) could be captured. Matthews et al. (2008) were the first to estimate the amount of time spent in SB in the United States population using accelerometer data from NHANES. They found that adults spent 54.9% of monitored time or 7.7 hours per day in SB (Matthews et al., 2008). The most sedentary group was older adults' (≥60 years), spending about 60% of their waking time in sedentary pursuits (Matthews et al., 2008).

The average adult has 16 waking hours (after 8 hours of sleep), and this time can be allocated to a variety of activities ranging from sedentary and light-intensity activities to moderate- to vigorous-intensity activities (Dunstan et al., 2010; Hamilton et al., 2008; Healy et al., 2007). Many adults spend most of their waking hours engaged in SB like TV viewing and computer use (Dong et al., 2004). As discussed earlier, the definition of sedentary has continued to evolve and the ability to measure the total amount of daily time engaged in SB is imperative to advances in the field. Accurate measurements of SB will not only allow researchers to describe the prevalence, patterns, and correlates of SB but also allow researchers to fully explain the relationship between SB and various health outcomes.

d. **Relationship of Total Sedentary Time with Major Health Outcomes**

There is evidence linking SB with morbidity and mortality in adults (Dunstan et al., 2010; Haapanen-Niemi et al., 2000; Katzmarzyk et al., 2009b; Wijndaele et al., 2010). There appears to be an independent deleterious association between SB and health (Beunza et al., 2007; Blanck et al., 2007; Hamilton et al., 2007; Hu et al., 2001; Hu et al., 2003; Katzmarzyk et al., 2009b; Proper et al., 2011a; Warren et al., 2010; Wijndaele, et al., 2010), even when controlling for PA levels (Warren et al., 2010; Wijndaele et al., 2010). Additionally, epidemiological studies have established a dose-response relationship between SB and obesity (Aadahl et al., 2007b; Bowman, 2006; Dunstan et al., 2010; Hamilton et al., 2007), metabolic disease (Hamilton et al., 2007; Healy et al., 2008; Thorp et al., 2009; Wijndaele et al., 2010), and cancer (Hu et al., 2005; Katzmarzyk et al., 2009b; Patel et al., 2006). It is important to highlight that the participants in these studies are primarily White adults. The current project addresses this gap in the literature by examining whether the associations between SB and various health-related variables are also seen in African Americans.

Cardiovascular Disease

Several studies have examined the relationship between TV viewing time and cardiovascular health in adults. The majority of these studies have reported detrimental associations and none have reported beneficial associations. During the last decade, numerous epidemiological studies have shown that indicators of SB such as TV viewing, driving in a car, and sitting are strongly associated with the risk of developing CVD (Aadahl et al., 2007b; Hamilton et al., 2007; Jakes et al., 2003). Jakes et al. (2003) examined cross-sectional relationships between TV viewing and markers of CVD risk in the EPIC Norfolk study. They concluded that the CVD risk profile was worse for men and women who watched more than four hours/day of TV compared with those who report watching less than two hours/day. Katzmarzyk et al. (2009b) demonstrated a strong link between sitting and cardiovascular mortality in the 14-year prospective Canadian Fitness Survey study. In this study, the risk of CVD was 1.54 times higher in those who sat the most compared to those who sat the least (Katzmarzyk et al., 2009b). The study also showed a dose-response relationship between sitting time and CVD mortality, independent of leisure-time PA (Katzmarzyk et al., 2009b).

Some studies have also revealed that SB may increase the risk for CVD mortality (Warren et al., 2010, Katzmarzyk et al., 2009b, Jakes et al., 2003; Hu et al., 2005). Early work by Morris and Crawford (1958) showed a positive relationship between men with sedentary occupations and incidence of CVD mortality. In 2010, Warren et al. (2010) examined the relationship between two SBs (riding in a car and TV viewing) and CVD mortality in men in the Aerobics Longitudinal Study (ACLS). Major findings were that men who reported >10 hours/week of riding in a car and >23 hours/week of combined SB (i.e. TV viewing and riding in a car) had 82% and 64% greater risk of dying from CVD than those who reported <11 hours/week, respectively (Warren et al., 2010). Multivariate-adjusted analyses of time spent riding in a car (>10 hours/week) and combined SB (>23 hours/week) remained significantly associated with a 48% and 37% increase risk of CVD mortality, respectively (Warren et al., 2010). Similar prospective findings were observed in the EPIC Norfolk Study for TV viewing (Wijndaele et al., 2010). A 1 hour/day increase in TV viewing time was associated with an increased hazard of death from CVD of 8% (Wijndaele et al., 2010).

Grontved et al. (2011) conducted a recent meta-analysis assessing TV viewing and risk of fatal or nonfatal CVD. Findings from this study showed that the pooled relative risk (RR) for each 2 hours/day of TV viewing was 1.15 for fatal and nonfatal CVD. Results also showed a linear relationship. Based on current incidence rates in the United States, the authors estimated that the absolute risk difference (i.e. annual cases per 100,000 individuals) for every 2 hours/day of TV viewing is 38 cases of fatal CVD per 100,000 individuals per year (Grontved & Hu, 2011).

Hypertension

Hypertension is a risk factor for CVD (Lloyd-Jones et al., 2009). Children who engage in more SB have an increased incidence of hypertension (Ekelund et al., 2006; Mark & Janssen, 2008; Martinez-Gomez et al., 2009; Pardee et al., 2007), however, few studies have observed this association in adults (Aadahl et al., 2007a; Aadahl et al., 2007b). Aadhal et al. (2007b) examined the relationship between time spent in TV viewing and vigorous PA and hypertension. For both men and women, TV viewing time was significantly and associated with higher systolic and diastolic blood pressure (2007b). However, in one of the earliest assessments examining the association of TV viewing and CVD risk factors in young adults, no cross-sectional association was observed between self-reported TV viewing and hypertension (Sidney et al., 1996). Additionally, one prospective study that examined the relationship between different SB (TV viewing, computer use and driving) and self-reported incidence of hypertension found no significant relationship in a cohort of university graduates (Beunza et al., 2007).

Systematic reviews including longitudinal studies (Grontved & Hu, 2011; Proper et al., 2011a; Thorp et al., 2011) have been conducted to examine the association between SB and various health outcomes in adults. Most recent reviews have concluded that there is insufficient evidence to conclude that a relationship exists between SB and biomarkers of cardiometabolic health, such as hypertension. Overall there is inconsistency in findings, as well as a lack of high methodological quality in studies.

Type 2 Diabetes

Three studies have examined the association between SB and diabetes, and all have reported a positive association. Dunstan et al.'s (2010) cross-sectional study found an association between greater TV viewing time and increased risk of abnormal glucose metabolism in adults. The ORs of having abnormal glucose metabolism were 1.16 in men and 1.49 in women who watched TV >14 hours/week compared with those who watched ≤7 hours/week. Additionally, higher TV viewing (>14 h/week) was associated with an increased risk of new type 2 diabetes cases in men and women (Dunstan et al., 2010).

Two large prospective studies (Hu et al., 2001; Hu et al., 2003) have reported significant positive associations between diabetes and increased sitting. Hu et al. (2001) examined the relationship between time spent TV viewing and type 2 diabetes over a 10-year period among male health professionals. In this Health Professional's Follow-Up Study (HPFS), each 2 hour/day increase in TV viewing was associated with a 20% increase in the risk for developing diabetes for men (Hu et al., 2001). Several years later, similar findings were seen in the Nurse's Health Study among women (Hu et al., 2003). Each 2 hour/day increase in TV viewing was associated with a 14% increase in risk for developing diabetes (Hu et al., 2003). Additionally, each 2 hour/day increase in sitting at work was associated with 7% increase risk for developing diabetes (Hu et al., 2003). Proper et al. (2011a) concluded from their systematic review of these prospective studies that there is moderate evidence that time spent sitting is related to an increased risk for type 2 diabetes. They reported that two of these studies were of low quality, thus limiting their ability to make stronger conclusions.

Obesity

The health impact of physical inactivity and SB is of substantial interest in the area of obesity, given the high obesity rates in the United States (WHO, 2009). People who are physically inactive tend to gain more weight because their caloric output does not equal or exceed their caloric intake (Dubbert et al., 2002; Fang et al., 2003). Several cross-sectional studies have examined the relationship between SB and risk for overweight and obesity (Cameron et al., 2003; Pardee et al., 2007; Parsons et al., 2008; Shields & Tremblay, 2008; Steffen et al., 2009; Tremblay et al., 2010; Viner & Cole, 2005). The Australian Diabetes, Obesity, and Lifestyle Study demonstrated the earliest association in adults (Cameron et al., 2003). They found that TV viewing time was more strongly associated with overweight and obesity than lack of leisure-time PA (Cameron et al., 2003). Similar findings were observed in adults in the 2007 Canadian Community Health Survey (Shields & Tremblay, 2008). For men who reported ≤5 hours/week of TV viewing, the prevalence of obesity was 14% compared to 25% among men averaging ≥21 hours/week. For women the prevalence of obesity was 11% and 24%, respectively, in these two TV viewing groups (Shields & Tremblay, 2008). Several studies have also shown a positive association between TV viewing and weight, independent of PA levels (Healy et al., 2008; Proper et al., 2011b; Thorp et al., 2011; Tudor-Locke et al., 2010).

Longitudinal studies have shown mixed findings in the relationship between SB and obesity in adults (Proper et al., 2011b; Thorp et al., 2011). The prospective Nurses Health Study provides convincing evidence for the association between SB and obesity. After adjustments for PA and dietary habits, each 2 hour/day increase in TV viewing time was associated with a 23% increase in obesity (Hu et al., 2003). Additionally, each 2 hour/day increase in sitting at work was associated with a 5% increased risk of obesity. Novak et al. (2006) also found a positive association between TV viewing and overweight among men and women. Brown et al. (2005) reported weight gain in women with increased sitting time. After five years, women who sat more than 4.5 hours per day were more likely to gain over 5 kilograms during that period relative to women who sat less (Brown et al., 2005). A review of prospective studies concluded that greater time spent in SB is consistently associated with increased risk for obesity in children and adolescents (Thorp et al., 2011). However, they concluded that results for adults have been less consistent. Some studies show only gender-specific associations between time spent sedentary and increased risk of obesity (i.e., weight gain, waist circumference, BMI) (Thorp et al., 2011).

In summary, there is evidence that sedentary time is associated with increased risk of obesity (Lajunen et al., 2007; Mitchell et al., 2009; Parsons et al., 2008; Shields & Tremblay, 2008; Steffen et al., 2009; Thorp et al., 2009; Wijndaele et al., 2010) and weight gain (Blanck et al., 2007; Lajunen et al., 2007). However, due to limitations in measures and inconsistency of measures across studies, more evidence is needed to conclude that SB during adulthood is a strong predictor of obesity and that this association holds across different ethnic/racial groups (Thorp et al., 2011). There is, however, sufficient epidemiological evidence and biological plausibility to alert the public of the risks of large amounts of sitting from domain-specific behaviors such as TV viewing and occupational sitting (Thorp et al., 2011).

e. Breaks in and Bouts of Sedentary Behaviors

In addition to total sedentary time and types of SB, the manner in which SB is accumulated may also be important (Healy et al., 2008). Technological advances and social factors have made prolonged sitting a part of regular daily routines in American adults. Adults spend extended periods of time being sedentary during work, domestic, and recreational time (Healy et al., 2008) and have sporadic PA patterns. Two factors that may be associated with the accumulation of SB are breaks in sedentary time and bouts of sedentary time.

Two studies have examined the association between breaks in objectively measured sedentary time and health risks. Healy et al. (2008) reported that an increased number of breaks in SB are associated with an improved cardio-metabolic health in

Australian adults. In a more recent population-based study by Healy et al. (2011a), findings for White Americans were consistent with those observed among Australian adults (Healy et al., 2008). Researchers concluded that fewer breaks from sedentary time were detrimental to one's health whereas regular breaks (as short as 1 minute) from sedentary activities decreased health risks. In addition, this study was unique in that it examined differences in the association between SB and health risk by race/ethnicity (Healy et al., 2011a). Contrary to expectations, they found that increased sedentary time was associated with *decreased* waist circumference in African Americans but not in Whites. Although these results may have been driven by unmeasured confounding factors, the authors underscored the importance of this field or research expanding beyond White populations (Healy et al., 2011a).

To date only one study has examined both the associations of breaks in SB and bouts of SB and health (Carson & Janssen, 2011); however, this study was conducted with children and adolescents. The study found no association between overall volume, breaks in, and bouts of SB with cardio-metabolic risk factors in a large sample of children and adolescents (Carson & Janssen, 2011).

Studies focusing on breaking up bouts of sedentary time are scarce in adults. Bankoski et al. (2011) found that persons with metabolic syndrome spent more time in SB, had longer average SB bouts, and had fewer breaks in sedentary behavior time compared to persons without metabolic syndrome. Swartz et al. (2011) conducted an experimental study to quantify the total energy expenditure of three different durations of PA breaks within a 30-minute sedentary bout. Study participants completed four consecutive 30-minute bouts of sitting with interruptions (1, 2 and 5 minute breaks of walking) and without interruptions of light-intensity PA. The potential benefits of interrupting SB with PA for weight control was also examined (Swartz et al., 2011). They found that significantly more energy was expended when study participants included breaks of light-intensity PA in a bout of 30-minutes of sedentary activity. The study demonstrated that making small changes such as breaking up sedentary time with light-intensity activity could yield beneficial weight control and weight loss results (Swartz et al., 2011).

f. Gaps

The studies reviewed thus far suggest SB has a detrimental effect on CVD, hypertension, type 2 diabetes, and obesity. However, few studies have examined these associations in women (Beunza et al., 2007; Healy et al., 2008; Inoue et al., 2008; Owen et al., 2011; Sidney et al., 1996; Sugiyama et al., 2008) and even fewer studies have included minority populations (Inoue et al., 2008; Sidney et al., 1996). Of the studies that have included minority populations, only one included African American women (Sidney et al., 1996). This omission is problematic. Researchers at Pennington Biomedical Research Center are currently conducting a study to assess the prevalence and associated health outcomes of SB among African American adults. In addition, they have developed interventions targeting increases in PA participation and decreases in time spent in SB as a way to promote health among this population who experiences some of the worst health outcomes.

Just as focusing exclusively on moderate- to vigorous-intensity PA ignores the substantial daily contribution of both light-intensity and sedentary activity, focusing only on the total time spent in SB might overlook important issues, such as the impact of accumulating long uninterrupted periods of SB (Healy et al., 2011a). Emerging evidence in adults suggests that breaks in (Healy et al., 2008; Healy et al., 2011a) and bouts of (Swartz et al., 2011) SB may be related to health, independent of PA and total sedentary time; however, this association has only been observed in Whites. Additional work is needed in this growing field to examine multiple patterns (i.e. breaks in and bouts of) of sedentary time in adults from different racial/ethnic backgrounds (Healy et al., 2011a).

The idea of intervening solely to reduce SB in adults is a relatively new concept. Very few interventions to decrease SB have been conducted to date. Most interventions have been aimed at TV watching reduction in children (Salmon et al., 2011) or increasing options for breaking sitting time in workplace settings (Owen et al., 2011). Modest effects have been shown for adults using treadmill and height-adjustable workstations to decrease SB time at work (Levine & Miller, 2007). In 2011, no studies to-date have used actual measures of SB and have shown success in decreasing SB in home and social environments (Salmon et al., 2011). Many studies claiming to decrease SB have not measured SB time as an outcome measure. Additionally, more research is needed to assess other SB (i.e. computer use, TV viewing, driving in a car) observed at home or during transport. It is important that as we start to understand the importance of both PA and SB as separate constructs, we measure both at baseline and at the end of interventions. There is also a need to incorporate different strategies in interventions to address decreasing domain-specific SB time in work, home and social environments.

III. Focus of Dissertation

With high rates of obesity, physical inactivity and SB reported among African Americans, it is important to promote a healthier, more active, and less sedentary lifestyle. PA may be a difficult behavior for individuals who are overweight and obese, many of whom also have multiple chronic health conditions, to adopt (Owen, Healy et al., 2010; Owen, Sparling et al., 2010). Innovative approaches are needed to address barriers to change. Programs that speak to the needs of African Americans are essential in eliminating health disparities. Therefore, interventions that are focused not only on increasing PA, but also decreasing SB such as TV viewing, computer use, and commuting in a vehicle, may be vital to the success of initial and long term health maintenance. Additionally, this approach may be more accepted and appealing among obese African American women.

This dissertation used data from the Faith, Activity and Nutrition (FAN) program, a health promotion intervention set in African Methodist Episcopal (AME) churches in South Carolina (Wilcox et al., 2010; Wilcox et al., 2013). FAN used a community based-participatory research model that included the AME church as a vital partner in the development, implementation, evaluation, and dissemination of the program. Study one and two evaluated objectively measured SB and PA patterns among African American adult church members. Study three explored the beliefs and perceptions of African American women about physical inactivity and SB. Specifically, study three examined novel strategies to reduce SB in the home, work, and social environment of African American women.

CHAPTER 3

METHODOLOGY

Introduction

The purpose of the present dissertation is to describe and examine the patterns of sedentary behavior (SB) and physical activity (PA) among African Americans living in South Carolina. This dissertation used baseline data collected by the Faith, Activity, and Nutrition (FAN) study, a five-year faith-based intervention program funded by the National Institutes of Health (NIH) (Wilcox et al., 2010; Wilcox et al., 2013). This chapter provides an overview of the FAN program and its primary and secondary outcomes, including data collection methods. The chapter will then describe the dissertation study sample, design, measurement scales, and data analysis. Data from the FAN study addressed Aims 1 , 2, and 3 of the dissertation: to characterize the patterns of time spent in sedentary, light-intensity, and moderate-to vigorous-intensity behaviors and to examine the association between breaks in and bouts of sedentary activity and sociodemographic and health-related variables. Primary data collection was conducted to explore aims 4 and 5 of the project: examining perceptions of SB in African American women and developing novel strategies for decreasing overall behaviors.

Overview of the FAN Program

The FAN program was a five year study (2006-2011) that developed and evaluated a PA and nutrition intervention (Wilcox et al. 2013). FAN used community-based participatory research framework to guide the development and implementation of the intervention in the 7th Episcopal District of the African Methodist Episcopal (AME) church. The 7th Episcopal District, located in South Carolina, consists of approximately 600 AME churches from six geographically located conferences. Within each conference, there are two to three districts for a total of seventeen districts. Each district has a presiding elder, who has been appointed by the bishop, to provide oversight for both pastors and churches in their respective districts.

FAN was developed in the context of a partnership between the AME church, the University of South Carolina, the Medical University of South Carolina, Clemson University, and Allen University. A planning committee of representatives from the church and academic communities met regularly throughout the study to plan intervention, evaluation, and dissemination activities. The AME church has an established health commission and the goals of this ministry are to: (1) help the denomination understand health as an integral part of the faith of the Christian church, (2) promote the health concerns of its members, (3) advocate access to health as a right and not a privilege, (4) challenge and work to reform the unjust structure of the health delivery system, (5) seek to make the denomination a healing faith community, (6) collaborate with community organizations to improve the health care system, (7) encourage each connectional organization to include a health component in its life and work, and (8) review and receive monthly, quarterly and annual reports of the work and progress of the Episcopal Health Commission to ensure accountability. FAN strongly complemented these AME health commission goals through its emphasis on health promotion.

FAN used a randomized design with a delayed intervention control group that took place across three waves. Within each wave, half of the churches were randomized to receive the intervention immediately after baseline measurements and remaining churches received the intervention after the post-program measurement. Outcome measurements were taken at baseline and 15 months later (post program). At post program, delayed intervention churches had an opportunity to receive training in the FAN program and implement program activities at their church, but no further measurements were taken. The primary outcomes of FAN were to examine the effect of the intervention on moderate- to vigorous-intensity PA (self-reported minutes/week), fruit and vegetable consumption, and blood pressure. Secondary outcomes included PA (accelerometer measured minutes/week) and fat and fiber-related behaviors. This dissertation used only baseline data, thus intervention components are not described. A detailed overview of the intervention and study design (Wilcox et al., 2010) as well as study outcomes have been previously published (Wilcox et al., 2013). Briefly, results of the trial indicated that the FAN intervention positively impacted leisure-time moderate-to vigorous-intensity PA and fruit and vegetable consumption. Although small effect sizes were observed, findings were statistically significant. Researchers concluded that FAN could be meaningful is implemented broadly and sustained overtime (Wilcox et al., 2013). The present dissertation used cross-sectional data from FAN at baseline.

<u>Study 1</u>

Purpose

This study addressed Objective 1: to describe objectively measured sedentary and PA behaviors and variations in these behaviors in the FAN study.

The goals and the subgoals of Study 1 were to:

1. Characterize the patterns of time spent in sedentary, light-intensity, and moderate- to vigorous-intensity behaviors and examine these patterns according to sociodemographic and health-related variables in a sample of African American adults.
    a. Describe the total time spent in total sedentary, light-intensity, and moderate-to vigorous-intensity behaviors by sociodemographic factors (gender, age, education level, marital status, and employment status), and health-related factors (smoking status, fruit and vegetable consumption, self-rated health, body mass index, and waist circumference).
    b. Describe variations and patterns of SB (times of day that are most sedentary and weekday vs. weekend differences in SB) and describe whether these patterns differ according to the sociodemographic characteristics and health-related behaviors listed in 1a.
    c. Report the number of bouts of sedentary, light-intensity, and moderate-to vigorous-intensity PA experienced during the day and examine these bouts according to the sociodemographic characteristics and health-related behaviors listed in 1a.
    d. Report the number of breaks in SB experienced during the day and examine these breaks according to the sociodemographic characteristics and health-related behaviors listed in 1a.

Study Design

This study used a cross-sectional design. In a cross-sectional study, all data are collected at a single time point. Thus, only associations can be assessed and causality cannot be claimed from associations.

Recruitment

Recruitment of participants into the FAN study took place from 2007-2010 (Wilcox et al., 2013). Pastors, local health directors, and churches from four districts (Columbia, Georgetown, Kingstree and Mt. Pleasant) in the 7th Episcopal District were invited to participate in the FAN program via a letter from presiding elders. Interested churches were asked to complete and return a FAN contact information form to FAN staff. FAN staff then followed up with church liaison (i.e. pastor, health director, health champion, or FAN coordinator) to answer additional questions or concerns about the FAN program. Churches agreeing to participate in FAN were asked to complete a Memorandum of Agreement (MOA). Church liaisons coordinated with FAN staff to recruit church members, schedule measurement sessions, and coordinate FAN committee and cooks trainings. Church liaisons and/or pastors confirmed church size with FAN staff prior to the start of recruitment. Recruitment goals were based on church size. Church size (i.e. small, medium, and large) was determined by the average member attendance during Sunday worship services. Churches who reported less than 100 members were considered a small church and asked to recruit 13 members. Churches reporting an average membership of 101-500 congregants were considered a medium church and asked to recruit 32 members. Lastly, large churches determined by an average membership of more than 500 congregants were asked to recruit 63 members. FAN staff provided bulletin inserts, flyers, and announcements to help churches with recruitment efforts.

Procedures

Liaisons recruited members from the congregation to participate in a measurement session. All participants completed an informed consent form that was approved by the Institutional Review Board at the University of South Carolina and the FAN planning committee (comprised of church leaders, lay members, and university representatives). To be eligible for participation in the FAN study, churches agreed to be randomized and to participate in all FAN trainings. Participants had to be at least 18 years of age, free of serious medical conditions or disabilities that would make participation in PA difficult, attend worship services at least once a month, and not plan to move from the area over a two-year period.

Upon providing consent to participate in the FAN study, participants completed a survey that assessed sociodemographic characteristics; PA, dietary, and other health-related practices, and psychosocial variables. In addition, FAN staff conducted physical measures with each participant, including height, weight, blood pressure, and waist circumference. A subsample of participants were randomly chosen to wear an activity monitor (ActiGraph LLC, Fort Walton Beach, FL) following the measurement session. If a participant declined to wear the ActiGraph, the next participant was asked until a participant agreed. Refusals were tracked. Participants who agreed to wear the activity monitor were asked to wear the small device for all waking hours for 7 consecutive days. Detailed instructions on how to properly wear the monitor, along with an activity monitor log were given to participants in an effort to increase participant compliance. A prestamped envelope was given to each participant to mail back the ActiGraph and completed activity monitor log. Participants were asked to sign a commitment form agreeing to wear the activity monitor and send it back after 7 days as instructed.

Participants were called mid-week to see if there were any questions or concerns about the use of the activity monitor. During this call participants were reminded of the date to mail back the ActiGraph and activity monitor log to FAN staff. If activity monitors were not received by three days after the expected arrival date, participants received a follow-up call. If staff was unable to reach participant by phone after 3 phone contacts, letters were sent to participant homes reminding them of their commitment to return activity monitors. If the letter prompted no return of the ActiGraph, follow-up letters were sent to the participant's local church health director and pastor to ask for their assistance in reaching the participant.

Measures

Sociodemographic and Health-related Variables

Participants reported their gender, race, age, smoking status, marital status, employment status, and highest grade or years of education completed. Presence of health conditions was assessed by asking participants about the presence or absence of health-care provider diagnosed diabetes, hypertension, hypercholesterolemia, myocardial infarction, angina or coronary heart disease, stroke, arthritis, osteoporosis, and asthma. Participants also rated their general health status on a scale from 1 (excellent) to 5 (poor).

Objective Physical Activity

The ActiGraph accelerometer (GT1M model, ActiGraph, LLC, Fort Walton Beach, FL) was used to measure PA. The ActiGraph is a small and lightweight device, which provides a direct, objective measure of PA and SB. The ActiGraph was worn on the right hip and measured accelerations of the body. Participants were instructed to wear the ActiGraph all waking hours, except when sleeping or immersed in water, for 5 to 7 consecutive days. In addition to wearing the ActiGraph, participants were asked to keep concurrent PA logs in which they summarized the amount of participation in selected activities performed during the day.

The GT1M model of the ActiGraph self-calibrates and utilizes a direct USB connection to initialize and download data. A 60-second epoch (time interval) was used. To be included in analyses, participants had to wear the monitor for a minimum of 3 days, including at least 1 weekend day and for at least 10 hours per day. This amount of monitoring has been recommended by Trost et al. (2005) to reliably estimate habitual PA among adults. Additionally, ActiGraph data that recorded zeros consecutively for sixty minutes or more were removed from analysis. It was assumed that the activity monitor was not worn during this time.

Matthews' et al. (2008) SB accelerometer cut-point was used to convert the activity count data into mean minutes of SB per day. As defined by Matthews et al. (2008), SB is considered counts <100 per minute. Freedson's et al. (2000) three-category accelerometer cut-points assessed activity at higher intensity levels: light <1952 counts/minute, moderate 1952-5724 counts/minute, and vigorous ≥5725 counts/minute. In a sample of adults, data obtained from treadmill exercise at 3 different intensity levels showed that CSA accelerometer counts were highly correlated with energy expenditure (r=0.93) (Freedson et al., 1998). For the purpose of this study, the moderate- and vigorous-intensity categories were collapsed together. Additionally, since Matthews' cut-points of SB were used for analysis, light-intensity PA was defined as counts of 100-1951 per minute.

Fruit and Vegetable Consumption

The National Cancer Institute (NCI) fruit and vegetable 9-item all-day screener was used to assess participant's fruit and vegetable consumption. This measure asks about different types of fruits and vegetables and portion sizes for each. This scale has been shown to correlate moderately with 24-hour dietary recall measures of fruit and vegetable consumption (Thompson et al., 2002), which are considered the gold standard in dietary research (Karvetti & Knuts, 1985).

Body Mass Index

Measurements of height and weight were obtained by trained FAN staff. Participants were asked to remove shoes, excess or bulky clothing, and all items from their pockets. Height to the nearest quarter inch was measured using a stadiometer (Seca). A scale (Seca 770) was used to measure participant's weight to the nearest tenth of a kilogram. Height in inches was then converted to height in meters by dividing by 0.0254. Lastly, body mass index (BMI) was calculated as kg/m^2 using standard procedures (DHHS, 2007)). Measurements of BMI were categorized as normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese ($\geq$30 kg/m^2).

Waist Circumference

Participants were asked to remove all excess clothing before measurements were taken by trained staff. The narrowest part of the participant's torso (or the minimum circumference between the rib cage and the iliac crest) was then located. An anthropometric measuring tape was applied to the identified area, with the participant standing upright and at the end of expiration. The circumference of the waist was measured two times and recorded to the nearest tenth of a centimeter. If the two measures varied by more than three centimeters, a third measure was taken. The average of the two closest measurements (within two centimeters) was used for statistical analyses. Participants were categorized as normal (<80 cm for women; <101 cm for men), increased risk (80-88 cm for women; 101-108 cm for men), or substantially increased risk (>88 cm for women; >108 cm for men).

High Blood Pressure

Participants were asked to sit quietly for five minutes with legs uncrossed. The automated DinaMap ProCare Monitor (DPC -100X-EN) was used to obtain resting blood pressure taken three times on the right arm with sixty seconds rest in between each measurement. The average of the second and third measures was used for statistical analyses. Participants with a systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg were classified as hypertensive. Because participants may have controlled hypertension, self-reported presence or absence of hypertension was also assessed by asking participants, "Have you ever been told by a doctor, nurse, or other health professional that you may have high blood pressure?" A participant was considered to have hypertension if his/her measured blood pressure indicated hypertension or if he/she self-reported hypertension.

Participants

At baseline, the FAN study participants included 1307 African American adult church members from 74 churches. For the purposes of this present study only 464 participants were selected to wear the ActiGraph; 410 agreed to wear it and 266 had usable complete data. Monitors were not returned from 29 participants, 5 monitors malfunctioned and did not produce usable data, an additional 82 did not meet the monitor wear criteria, and 28 were missing covariates or outcomes.

Statistical Analyses

Aim 1a.

The distribution of all variables was examined for violations in normality assumptions. To achieve normality, log transformations were performed as necessary. Descriptive statistics (mean ± standard deviation, median, and frequencies) were reported for sedentary, light-intensity, and moderate- to vigorous-intensity behaviors for the sample as a whole and then associations between these behaviors and personal characteristics were examined. Data from the ActiGraph, recorded as activity counts per minute, were used to determine the minute-by-minute intensity level for each day the activity monitor was worn. Count cut-points recorded by the ActiGraph were used to calculate the total minutes of time spent in sedentary, light-intensity, and moderate-to-vigorous-intensity PA. Total time was divided by the total number of days the participant wore the monitor for a minimum of ten hours per day, resulting in the average minutes per day spent in sedentary, light-intensity, or moderate-to vigorous-intensity behaviors. To determine if SB and PA patterns varied by the independent variables of interest, T-tests were conducted to compare dichotomous independent variables (gender, five or more fruits and vegetables per day, marital status, smoking status, employment status, and substantially increased waist circumference). Pearson's correlation coefficients were used for continuous independent variables (age, BMI, education, self-rated health, continuous measure of waist circumference).

Aim 1b.

Mean minutes per day spent in sedentary, light-intensity, and moderate-to vigorous-intensity activities, by weekday vs. weekend, and by time of day, were also calculated. To elucidate PA patterns for weekday vs. weekend and time of day, data were separately examined. Morning was defined as 6am to noon, afternoon as noon to 6pm, and evening as 6pm to midnight. Patterns of activity were examined by sociodemographic factors (age, gender, education level, marital status, and employment status) and health-related factors (smoking, fruit and vegetable consumption, self-rated health, BMI, and waist circumference). To determine if time of day, weekday, and weekend day varied by the independent variables of interest, T-tests were conducted to compare dichotomous independent variables (gender, five or more fruits and vegetables per day, marital status, smoking status, employment status, and substantially increased waist circumference). Pearson's correlation coefficients were used for continuous independent variables (age, BMI, education, self-rated health, continuous measure of waist circumference).

Aim 1c.

The sedentary and activity bout pattern was first determined by summing continuous minutes of sedentary, light-intensity and moderate-to vigorous-intensity behaviors with no allowable interruptions in the sedentary and PA bout range. Other researchers (Bankoski et al., 2011) have allowed for interruptions outside of the bout range when examining raw output for accelerometer data. Allowing interruptions may present a problem with identifying bouts of PA in the raw data because, according to PAG, the minimum bout of moderate-intensity PA associated with health benefits is at least ten minutes in duration (DHHS, 2008). However, accelerometers measure acceleration and when there are pauses (e.g., stopping to tie shoe laces while walking or stopping at a crosswalk) in PA the raw output may record zeros or intensity levels outside of the range. Thus, multiple short bursts may be observed instead of a longer continuous bout of activity. In the present study no bout interruptions in the sedentary and/or PA behavior bout ranges were allowed.

The following bouts of moderate-to vigorous-intensity PA were examined: ≥10 minutes, ≥30 minutes, and ≥60 minutes. Since there isn't a meaningful criterion for determining the appropriate bout length for SB and light-intensity PA the same bout categories were used. Bouts in sedentary, light-intensity, and moderate-to vigorous-intensity time were examined by sociodemographic factors (age, gender, education level, marital status, and employment status) and health-related factors (smoking status, fruit and vegetable consumption, BMI, and waist circumference). ActiLife 5 program was used to determine the bouts of sedentary time variables. T-tests were conducted to compare dichotomous independent variables (gender, five or more fruits and vegetables per day, marital status, smoking status, employment status, and substantially increased waist circumference) and Pearson's correlation coefficients were used for continuous independent variables (age, BMI, education, self-rated health, continuous measure of waist circumference).

Aim 1d.

Breaks in sedentary time were defined as interruptions or transitions from sedentary (<100 counts per min) to an active state (≥100 counts per minute). The breaks in sedentary time variable were derived from the ActiLife 5 (Pensacola, Fl). The number of breaks (minimum 1 minute) and mean duration of breaks were calculated (Healy, Dunstan, Salmon, Cerin et al., 2008; Healy, Matthews et al., 2011a). Breaks in sedentary time were examined by sociodemographic factors (age, gender, education level, marital status, and employment status) and health-related variables (smoking status, fruit and vegetable consumption, self-rate health, BMI, and waist circumference). T-tests were conducted to compare dichotomous independent variables (gender, five or more fruits and vegetables per day, marital status, smoking status, employment status, and substantially increased waist circumference) and Pearson's correlation coefficients were used for continuous independent variables (age, BMI, education, self-rated health, continuous measure of waist circumference). All statistical analyses were performed using SAS (version 9.2; SAS Institute, Inc., Cary, N.C.).

Study 2

Purpose

This study addressed two major aims: study Aim 2: to assess the association between bouts of SB and health-related variables and Aim 3: to assess the association between breaks in SB and health-related variables in the FAN study.

The goals and hypotheses for Study two were as follows:

2. Examine the associations of bouts of SB with body mass index, waist circumference, and blood pressure. Hypothesis: Greater bouts of sedentary time will be significantly associated with health-related variables in all participants.
    a. It was hypothesized that a greater number of bouts of sedentary time will be associated with a higher body mass index.

b. It was hypothesized that a greater number of bouts of sedentary time will be associated with a higher waist circumference.

c. It was hypothesized that a greater number of bouts of sedentary time will be associated with higher blood pressure.

3. Examine the associations of breaks in SB with body mass index, waist circumference, and blood pressure. Hypothesis: More frequent breaks in sedentary time will be associated with favorable health-related variables in all participants.

    a. It was hypothesized that more frequent breaks in sedentary time will be associated with a more favorable body mass index.

    b. It was hypothesized that more frequent breaks in sedentary time will be associated with a more favorable waist circumference.

    c. It was hypothesized that more frequent breaks in sedentary time will be associated with a more favorable blood pressure.

Study 2 used the same sample of participants as described above for Study 1. Given the study design, recruitment procedures, measures, and participants are identical as above, they are not described here.

Statistical Analyses

The distribution of all variables were examined for violations in the normality assumption. To achieve normality, log transformations were performed as necessary. Descriptive statistics (mean ± SD) for demographic variables, age, BMI, waist circumference, systolic blood pressure, and diastolic blood pressure will be reported. Frequencies for gender, BMI category, waist circumference category, hypertension, fruit and vegetable consumption, education level, employment status, marital status, smoking status, and self-reported health status were also reported.

Aim 2

Within each bout of SB, the number of break minutes as those minutes equal to light-intensity (101-1952 counts per minute) or moderate- to vigorous-intensity PA (≥ 1952) was also determined. Pearson's correlations were used to examine the relationship between the sedentary bout period and health-related variables of interest (BMI, waist circumference and hypertension). To address this study aim, linear regression models for each health-risk dependent variable (BMI, waist circumference, and hypertension) were tested in a series of models: model 1: the bouts of SB and each dependent variable; model 2: the bouts of SB measure and all sociodemographic variables: age, gender, education level, employment status, and marital status; model 3: the bouts of SB measure and all health-related variables: smoking status, total fruit and vegetable consumption, moderate- to vigorous-intensity PA, general health rating, BMI, waist circumference, and hypertension; and model 4: the bout of SB measure and all previously mentioned sociodemographic and health-related variables, total sedentary time and mean intensity of sedentary breaks.

Aim 3

Pearson's correlations were used to examine the relationship between breaks in sedentary time and health-related variables of interest (BMI, waist circumference and hypertension). To address this study aim, linear regression models were performed to examine the associations of breaks in sedentary time with BMI, waist circumference, and blood pressure as dependent variables in a series of models. Model 1: the breaks in sedentary measure and each dependent variable; model 2: the breaks in sedentary measure and all potential sociodemographic confounders: age, gender, education level, employment status, and marital status; model 3: the breaks in sedentary measure and all health-related variables, smoking status, fruit and vegetable consumption, moderate- to vigorous-intensity PA, general health, BMI, waist circumference, and hypertension; model 4: the breaks in sedentary measure and all sociodemographic and health-related variables, and total sedentary time. All aforementioned data are presented as odds ratios (OR) ± 95% confidence interval. Statistical significance was set at $P<0.05$. All statistical analyses were performed using SAS (version 9.2; SAS Institute, Inc., Cary, N.C.)

Study 3

Overview of Qualitative Study

A supplement to the FAN grant was awarded to promote diversity in health-related research. As part of this funded supplement, three focus groups were conducted with a total of 32 African American women living in urban communities in South Carolina. Focus group research is one qualitative method that can be used as a tool to capture the spirit, experiences, and knowledge of the group under study (Hughes & Dumont, 1993). Although quantitative research has provided insight into how factors (i.e. personal, social, and physical environments) may individually contribute to low levels of PA participation among African American adults, the field is lacking a richer and more integrated understanding of how these factors interact to promote or discourage SB. Moreover, the use of qualitative methods allows researchers to gain insight into underserved communities intrapersonal and environmental assets and challenges.

Advantages of conducting qualitative research include the ability to gain a rich, in-depth exploration of a phenomenon that is presented from the world view, vocabulary, and experiences of the participants (Denzin & Lincoln, 2000). Qualitative methods are especially useful for examining areas with limited research, such as health behaviors in minority populations (Hughes & Dumont, 1993). Kumanyika et al. (2005) stressed the importance of and need for increase qualitative research in African American communities because of its unique ability to identify deeply-rooted cultural variables that may impact the outcome of interventions related to PA and weight issues in African American adults.

African American women are more likely to become obese and more likely to be moderately to severely obese compared to African American men (Hawkins, 2007). Congruent with their higher rates of obesity, African American women are less likely to engage in regular PA and more likely to engage in higher amounts of SB (Hawkins, 2007). More work is needed to better understand how to maximize the potential for African American women to be successful in health promotion efforts. Learning from these women in their own voice, provides depth and richness that quantitative data cannot.

A grounded theory approach (Strauss & Corbin, 2008) was used to examine the factors that influence participating in SB in the home, work, and social environments, including perceived benefits and barriers of sedentary activities. These qualitative findings were used to propose novel strategies for reducing SB. Participants in this study were also asked to complete a basic survey to assess demographic variables (Appendix

D). Measurements of height and weight were also taken. Approval from the University of South Carolina Institutional Review Board was obtained prior to beginning the study.

Purpose

This study addressed Aim 4: to examine African American women's perceptions of SB and Aim 5: propose novels strategies to reduce SB.

The goals of the study were to:

4. Conduct focus groups to explore perceptions and beliefs towards SB.
    a. Describe how personal factors influence time spent in SB.
    b. Describe how the social and physical (work and home) environment influence time spent in SB.
5. Explore novel strategies to reduce SB in the home, work, and social environment of African American women.

Study Design

This study used a qualitative study design. A grounded theory approach (Strauss & Corbin, 2008) was employed. Unlike traditional models of research, where a theoretical framework is chosen and applied to the phenomenon being studied (Strauss & Corbin, 2008), grounded theory makes no such assumptions. A grounded theory research approach includes four primary stages of analysis: (1) identify key points of data to be gathered into *codes*, (2) collect codes of similar content that allows the data to be grouped into *concepts*, (3) *categorize* broad groups of similar concepts, and (4) use these categories to generate a *theory*, which is a collection of explanations that clarify the subject of the research (Strauss & Corbin, 2008).

Recruitment

Recruitment for Study 3 took place in December 2011-March 2012. The primary mechanism for recruitment was posting flyers (Appendix A) in the local Columbia area (e.g., community centers, fitness centers, senior centers, and hair and nail salons) and by word of mouth. Participants were also recruited through the parent grant FAN study via phone call invitations to Columbia district pastors and health directors. Flyer announcements were sent to church liaisons via email to recruit interested church participants.

Procedure

The protocol and discussion guide questions (Appendix C) for the focus groups were developed based on the social ecological model. Questions were primarily aimed at increasing the understanding of how intrapersonal factors, and the social and physical environment influence time spent in SB. Questions also explored perceived benefits and barriers to engaging in sedentary activities. Focus group discussions additionally explored novel strategies for reducing SB in the home, work, and social environments of African American women. The dissertation candidate took courses in qualitative methods and attended trainings in qualitative analysis as part of the funded supplement. These trainings provided an overview of qualitative approaches and technical training in the use of NVIVO, the software used in this study for qualitative data analysis. Training also included the development of codes, a code book and coding methods, as well as qualitative analyses.

The focus group sessions were moderated by the dissertation candidate using the standardized protocol of questions and probes presented in Appendix C. A total of three focus groups were conducted. Focus groups were held in a conference room at the Public Health Research Center at the University of South Carolina. Participants were responsible for providing their own transportation to the session. Prior to each session, research staff collected informed consent (Appendix B). All participants were paid $20 for their participation in the focus groups (see Appendix E).

Participants were asked to complete a short survey on demographic information, which included items related to age, education, income and health-related behaviors. At the beginning of each focus group session, the moderator discussed the schedule and assured participants that there are no "right or wrong answers" to the questions about to be asked. Confidentiality of responses was stressed. Focus groups lasted no longer than 90 minutes, including a ten minute break at the midpoint. All sessions were audio-taped and transcribed verbatim into Microsoft Word by a professional transcription service and verified by the dissertation candidate to facilitate systematic analysis of the discussions. A note-taker was present as a back-up to the audio-tapes and to document the process of the focus groups. Transcripts were reviewed for accuracy and the participants names were removed and replaced with identification numbers to ensure confidentiality of the participants was maintained. Once the focus group session was over, participants had their height and weight measurements taken.

Measures

Sociodemographic and Health-related Variables

Participants reported their age, smoking status, marital status, employment status, and highest grade or years of education completed. Presence of health conditions (e.g., diabetes or hypertension) was assessed by asking participants about the presence or absence of health-care provider diagnosed diabetes, hypertension, hypercholesterolemia, myocardial infarction, angina or coronary heart disease, stroke, arthritis, osteoporosis, and asthma. Participants also rated their general health status on a scale from 1 (excellent) to 5 (poor).

Anthropometric Measures

Participants had their height and weight measurements taken. Participants were asked to remove shoes, excess or bulky clothing, and all items from their pockets. Height to the nearest quarter inch was measured using a stadiometer (Seca). A scale (Seca 770) was used to measure participant's weight to the nearest tenth of a kilogram. Height in inches was then converted to height in meters by dividing by 0.0254. Lastly, body mass index (BMI) was calculated as kg/m^2 using standard procedures (57). Measurements of BMI were categorized as normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese ($\geq$30 kg/m^2).

Participants

Thirty-two African American women who live within the greater Columbia area were recruited into the focus groups. The total sample included women ages 45-65 years.

Data Analysis

Qualitative Analyses

Analysis for this project was based on a grounded theory approach (Strauss & Corbin, 2008). One of the advantages of this approach is that it uses an inductive approach and allows categories and concepts to emerge from the data (Strauss & Corbin, 2008). Categories and concepts are linked together in the data analysis process until theoretical saturation is achieved (Strauss & Corbin, 2008). Theoretical saturation occurs when no new themes emerge from the data (Strauss & Corbin, 2008). This approach allows the data to speak for themselves. A coding scheme was used to guide the manner in which the qualitative data were analyzed (Strauss & Corbin, 2008). Decision rules were developed to guide and facilitate the coding of the data. The decision rule strategies reflected the major advisor and dissertation candidate discussions on how to handle the given situation for various types of participant responses.

All coders were provided with a copy of the decision rules along with the coding scheme, or code book. When a coder was unsure or confused about the appropriate way to code a specific response, decision rules were examined. Before all of the transcripts were coded, an acceptable level of inter-rater reliability based on percent agreement (i.e., r =.75) was established. The transcripts were then coded independently by two raters. Prior to analysis, each pair of raters met to discuss each coding disagreement until a consensus was met regarding the final codes.

The coding scheme was composed of levels of categorization of the qualitative data. Codes were applied systematically to all transcripts. These codes were then used to separate participant responses into manageable themes. The data were analyzed within each group, as well as across groups, to identify similarities and difference among the emerging themes. These themes were used to summarize the data. A theme was considered as something that was commonly cited in the focus groups. For example, if similar comments were observed in two out of the three focus groups, it was considered a theme.

The qualitative software QSR NVIVO (version 8, QSR International PTY Ltd) was used to perform content-analysis of the themes derived from the focus group data.

Each focus group was imported into QSR NVIVO as a rich text document, and as a collection, they were treated as a project. Next, the exact coding scheme used to code transcripts was developed in QSR NVIVO. Each rich text transcript was then coded. Once codes are applied to all transcripts, QSR NVIVO was used to extract coded participant responses by the matrix intersection of location, question, and response nodes.

Quantitative analysis

Descriptive statistics (mean ± SD and frequencies) were calculated to describe participant demographics for age, smoking status, marital status, employment status, highest grade or years of education completed, and BMI.

CHAPTER 4

RESULTS: MANUSCRIPT ONE

OBJECTIVELY MEASURED PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR AND PATTERNS OF BEHAVIORS IN AFRICAN-AMERICAN ADULTS[1]

Background: With objective measures, researchers are able to overcome many of the problems of self-report measures and examine variations and patterns in sedentary behavior (SB) and physical activity (PA), associated health outcomes, determinants of health, and intervention outcomes.

Purpose: The purpose of this study was to examine objectively-measured PA and SB and patterns of behavior in a sample of African American adults. The specific objectives were to: (1) describe the total time spent in total sedentary, light-intensity, and moderate-to vigorous-intensity behaviors; (2) describe variations and patterns of SB (i.e. time of day and weekday vs. weekend day); (3) report the number of bouts of sedentary, light-intensity, and moderate-to vigorous-intensity PA experienced during the day; and (4) report the number of breaks in SB experienced during the day. Within each of these objectives, sociodemographic and health-related differences in behaviors and patterns of behavior were also examined.

Methods: This study uses baseline data collected in a faith-based PA and nutrition study funded by the National Institutes of Health (NIH) in South Carolina, USA. PA and SB were assessed with the ActiGraph GT1M accelerometer. Basic descriptive statistics

[1]Warren-Jones, T.Y., S. Wilcox, B. Hutto, R. Pate, S. Blair, and H.M. Brandt. To be submitted to *Medicine & Science in Sports & Exercise*

included means and standard deviations or frequencies and percentages. Mean minutes of total SB time, light-intensity PA, and moderate-to vigorous-intensity PA were computed and assessed according to time per day and day of week. SB, light-intensity PA, moderate-to vigorous-intensity PA bout patterns and breaks in SB by sociodemographic and health-related variables were assessed.

Results: A total of 1307 participants from 74 churches were recruited into the larger FAN study and had baseline data. The final sample includes 266 participants with usable ActiGraph data. Participants wore the monitor on average 875.5 minutes/day (14.6 hours/day). Participants were sedentary 567.1 minutes/day (65.1% of wear time), engaged in 293.7 minutes/day of light intensity PA (33.2%), and 15.2 minutes/day of moderate- to vigorous-intensity PA (1.7%). Participants who were men; younger; had increased fruit and vegetable consumption; normal BMI; normal blood pressure and normal waist circumference risk had more mean daily minutes of moderate-to vigorous-intensity PA. Additionally, normal weight participants had less total SB time compared to overweight and obese participants. Participants had 93.6 daily bouts of SB lasting 6.6 minutes; 100.6 bouts of light intensity PA lasting 2.9 minutes; and 8.5 bouts of moderate-to vigorous-intensity PA lasting 1.7 minutes.

Conclusions: Participants engaged in low levels of PA and high levels of SB. PA may be a difficult behavior for individuals who are overweight and obese to adopt, many of whom also have multiple chronic health conditions. Public health efforts should continue to focus of increasing PA; however, a more realistic approach for this population might be decreasing SB time and increasing breaks in SB.

Keywords: Physical Activity, Sedentary Behavior, Accelerometer, African American

INTRODUCTION

There are substantial racial/ethnic disparities in physical activity (PA) participation (1). While the prevalence of sedentary behavior (SB) is high among adults in the United States (2), African Americans have been highlighted as a particularly sedentary population, and the negative effects of a sedentary lifestyle have been exposed in recent years (2, 3). National data show clear and convincing evidence of health disparities for cardiovascular (CVD) morbidity and mortality and associated health conditions (i.e. obesity, diabetes, and hypertension), with African Americans experiencing higher rates than Whites (4). Decreasing time spent in SB is of significant interest to the field of public health because SB is prevalent and associated with multiple chronic diseases.

The definition of SB has been evolving during the last decade. In the past, "sedentary behavior" has most often been defined as a lack of participation in moderate- to vigorous-intensity PA or not meeting recommendations for PA (5). Most now view SB as a discrete behavior separate from PA (6) and agree that it should be viewed as the absolute low end of the activity intensity continuum (5). SBs are characterized by little physical movement and low energy expenditure (≤1.5 METs) and typically refer to activities such as sleeping, sitting, lying down, driving or riding in a car, watching television, and engaging in other screen-based behaviors (5).

Most of the past literature quantifying time spent in SB and associated health risk factors has been based on self-report data. In response to growing concerns about the limitations inherent in self-report assessments, particularly for sedentary and light intensity behaviors, researchers have begun to use objective measures to quantify SB (7, 8). Including accelerometers in population-level public health research has advanced the study of the health impact of SB (2). With objective measures, researchers are able to overcome many of the problems of self-report measures and examine variations and patterns in SB, associated health outcomes, determinants of health, and intervention outcomes (2).

Matthews et al. (9) were the first to estimate the amount of time spent in SB in the United States population using accelerometer data from the National Health and Nutrition Examination Survey (NHANES). They found that adults spent 54.9% of monitored time or 7.7 hours per day in SB (9). The most sedentary group was older adults (≥60 years), spending about 60% of their waking time in sedentary pursuits (9). However, few racial/ethnic differences were observed. Mexican Americans spent less time in SB compared to Whites and African Americans, and there were no differences in total sedentary time between Whites and African Americans (9).

Public health efforts must combat the challenges posed by physical inactivity and SB on the health and well-being of Americans, particularly populations most affected by chronic disease morbidity and mortality. African American adults have high rates of many health conditions that could be reduced by increasing PA and decreasing SB (9). Sedentary activities such as TV viewing, computer and video game use, and workplace sitting and sitting while commuting in a vehicle have been associated with an increased risk of CVD morbidity and mortality (10-13), diabetes (6, 10, 14), obesity (13, 14), cancer (10, 12, 14) and all-cause mortality (11,12). Although many studies have examined total time spent in SB, very few studies have examined SB patterns (i.e. time of day, day of week) and even fewer have included minority populations (15-18). Of the studies that have included minority populations, only one has objectively quantified the volume (including patterns) of SB and breaks in SB in African Americans (18). Baurth et al. (18) reported that African-American women living in the South engaged in more SB than that reported by national data.

The purpose of this study was to examine objectively-measured PA and SB and patterns of behavior in a group of African American adults. The specific objectives were to: (1) describe the total time spent in SB, light-intensity, and moderate-to vigorous-intensity behaviors; (2) describe variations and patterns of SB (i.e. time of day and weekday vs. weekend day); (3) report the number of bouts of SB, light-intensity, and moderate-to vigorous-intensity PA experienced during the day; and (4) report the number of breaks in SB experienced during the day. Within each of these objectives, we also examined sociodemographic and health-related differences in behaviors and patterns of behavior.

METHODS

This study uses baseline data collected in the Faith, Activity, and Nutrition (FAN) study, a faith-based PA and nutrition study conducted in South Carolina, USA (19, 20). FAN was a partnership between the African Methodist Episcopal (AME) church, the University of South Carolina, the Medical University of South Carolina, Clemson University, and Allen University. Recruitment of participants into the FAN study took place from 2007-2010. The primary goals of FAN were to increase moderate- to vigorous-intensity PA and fruit and vegetable consumption, and to improve blood pressure (19, 20).

Recruitment

This manuscript uses baseline data from FAN and thus is a cross-sectional analysis. As reported elsewhere in more detail (19, 20) pastors from AME churches within four geographically located districts in South Carolina were invited to participate in the study via a letter from presiding elders. Designated liaisons from the church were asked to recruit members from the congregation to participate in a measurement session. All participants completed an informed consent form that was approved by the Institutional Review Board at the University of South Carolina and the FAN planning committee (comprised of church leaders, lay members, and university representatives). To be eligible for participation, churches agreed to be randomized and to participate in all trainings. Participants had to be at least 18 years of age, free of serious medical conditions or disabilities that would make participation in PA difficult, attend worship services or activities at least once a month, and not plan to move from the area over the next two years.

Upon providing consent to participate in the FAN study, participants completed a survey that assessed sociodemographic characteristics; PA, dietary, and other health-related practices; and psychosocial variables. In addition, FAN staff conducted physical measurements with each participant, including height, weight, blood pressure, and waist circumference. A subsample of participants were randomly chosen to wear an activity monitor (ActiGraph LLC, Fort Walton Beach, FL) at the end of the measurement session.

Measures

Sociodemographic and Health-related Variables

Participants reported their gender, race, age, smoking status, marital status, employment status, and highest grade or years of education completed. Participants also rated their general health status on a scale from excellent (1) to poor (5).

Objective Measure of Physical Activity and Sedentary Behavior

The ActiGraph accelerometer (GT1M model, ActiGraph, LLC, Fort Walton Beach, FL), a small and lightweight device, provided a direct, objective measure of PA and SB. The ActiGraph was worn on the right hip and measured accelerations of the body. Participants were instructed to wear the ActiGraph all waking hours, except when sleeping or immersed in water, for 7 consecutive days. In addition to wearing the ActiGraph, participants were asked to keep concurrent PA logs in which they recorded when the monitor was put on and taken off as well as any times in which it was removed for more than 15 minutes.

The GT1M model of the ActiGraph self-calibrates and utilizes a direct USB connection to initialize and download data. A 60-second epoch (time interval) was used. To be included in analyses, participants had to wear the monitor for a minimum of 3 days, including at least 1 weekend day and for at least 10 hours per day. This amount of monitoring has been recommended by Trost et al. (21) to reliably estimate habitual PA among adults. Additionally, in instances where there were consecutive zeroes for sixty minutes or more these data were removed from analysis as it was assumed that the activity monitor was not worn during this time.

Matthews' et al. (22) accelerometer cut-points were used to convert the activity count data into mean minutes of SB per day, defined as counts <100 per minute. Freedson's et al. (23) three-category accelerometer cut-points categorized activity at higher intensity levels: light was defined as <1952 counts/minute, moderate as 1952-5724 counts/minute, and vigorous as ≥ 5725 counts/minute. In a sample of adults, data obtained from treadmill exercise at 3 different intensity levels showed that CSA accelerometer counts were highly correlated with energy expenditure (r=0.93) (24). For the purpose of this study, the moderate- and vigorous-intensity categories were collapsed together. Additionally, since Matthews' cut-points of SB were used for analysis, light intensity PA was defined as counts of 100-1951 per minute.

The sedentary and activity bout patterns were determined by summing continuous minutes of sedentary, light-intensity, and moderate-to vigorous-intensity behaviors with no allowable interruptions in the sedentary and PA bout ranges of ≥10 minutes, ≥30 minutes and ≥60 minutes. A break in sedentary time was defined as an interruption or transition from a sedentary (<100 counts per min) to an active (≥100 counts per minute) state. The number of breaks (minimum 1 minute), mean duration of breaks, and mean intensity of breaks were also calculated (25, 26). Mean minutes per day spent in SB, by weekday vs. weekend day, and by time of day, were also determined. Morning was defined as 6am to noon, afternoon as noon to 6pm, and evening as 6pm to midnight. Data were examined separately for weekday vs. weekend day and time of day patterns.

Fruit and Vegetable Consumption

The NCI fruit and vegetable 9-item all-day screener was used to assess participant's fruit and vegetable consumption. This measure asks about different types of fruits and vegetables and portion sizes for each in the past 30 days. This scale has been shown to correlate moderately with 24-hour dietary recall measures of fruit and vegetable consumption which are considered the gold standard in dietary research (27).

Body Mass Index

Height and weight were obtained by trained FAN staff. Participants were asked to remove shoes, excess or bulky clothing, and all items from their pockets. Height to the nearest quarter inch was measured using a stadiometer (Seca, Hanover, MD). A scale (Seca 770, Hanover, MD) was used to measure participant's weight to the nearest tenth of a kilogram. Body mass index (BMI) was calculated as kg/m^2 using standard procedures. Measurements of BMI was categorized as normal weight (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (≥30 kg/m^2).

Waist Circumference

Participants were asked to remove all excess clothing before measurements were taken by trained staff. The narrowest part of the participant's torso (or the minimum circumference between the rib cage and the iliac crest) was then located. An anthropometric measuring tape was applied to the identified area, with the participant standing upright and at the end of expiration (28). The circumference of the waist was measured two times and recorded to the nearest tenth of a centimeter. If the two measures varied by more than two centimeters, a third measure was taken. The average of the two closest measurements (within two centimeters) was used for statistical analyses. Participants were categorized as having a waist circumference that was within normal limits (<80 cm for women; <101 cm for men) or one that placed them at increased risk (80-88 cm for women; 101-108 cm for men), or substantially increased risk (>88 cm for women; >108 cm for men) for chronic diseases (28).

High Blood Pressure

Participants were asked to sit quietly for five minutes with legs uncrossed. The automated DinaMap ProCare Monitor (DPC -100X-EN) was used to obtain resting blood pressure taken three times on the right arm with at least 60 seconds rest between each measurement. The average of the second and third measures was used for statistical analyses. Participants with a systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg classified as hypertensive. Because participants may have controlled hypertension, self-reported presence or absence of hypertension was also assessed by asking participants, "Have you ever been told by a doctor, nurse, or other health professional that you may have high blood pressure?" A participant was considered to have hypertension if his/her measured blood pressure indicated hypertension or if he/she self-reported hypertension.

Statistical Analyses

Basic descriptive statistics included means and standard deviations or frequencies and percentages of sociodemographic and health-related variables. Distributions were examined for violations in normality. Estimated daily averages of total volume of sedentary, light intensity, and moderate- to vigorous-intensity behaviors were computed. Separate models were tested to examine whether each of the dependent variables differed by sociodemographic and health-related independent variables. The first set of dependent variables was total minutes per day of SB, light intensity PA and moderate- to vigorous-intensity PA. The next set of dependent variables was minutes per day of SB in the morning (6 am to noon), afternoon (noon to 6pm), and evening (6pm to midnight). The final set of dependent variables was minutes per day spent in SB on weekdays and minutes per day spent in SB on weekend days.

For each set of analyses, ANOVA was used to compare groups of dichotomous independent variables (gender, hypertension, marital status, smoking status, five or more fruits and vegetables) adjusted for wear time. For categorical independent variables (age, education, employment status, weight status, waist circumference, self-rated health), an analysis of variance tested for a group difference adjusted for wear time. If the overall model was statistically significant, a tukey post-hoc test indicated pairwise differences. Additionally, the relationship between SB and time of day according to sociodemographic and health-related variables (time of day x sociodemographic/health interaction $p<.05$) and the relationship between SB and day of week according to sociodemographic and health-related variables (day of week x sociodemographic/health interaction $p<.05$) were examined.

Finally, the SB, light-intensity PA, and moderate-to vigorous-intensity PA bout patterns were examined. Total number and mean length of ≥10 minute, ≥30 minute, and ≥60 minute bouts of behaviors were computed and differences by sociodemographic and health-related variables were assessed. The total number of breaks, mean length of breaks, and mean intensity of breaks in SB were also examined. Differences in the estimated daily averages of breaks by sociodemographic and health-related variables were assessed. All statistical analysis was performed using SAS (version 9.2; SAS Institute, Inc., Cary, N.C.).

RESULTS

A total of 1307 participants from 74 churches were recruited into the larger FAN study and had baseline data. A total of 464 participants were selected to wear the ActiGraph; 410 agreed to wear it. Twenty-nine participants did not return their monitor and an additional 115 participants had unusable data. The final sample includes 266 participants with usable data (Figure 1).

Participant Characteristics

Table 1 presents the characteristics of the sample with usable data. A majority of participants were female (79.0%), married (56.8%), and had at least some college education (64.0%). The mean age was 53.4 years. The majority of participants (90.2%) were overweight or obese, with a mean BMI of 32.7 kg/m^2, and 57.5% had substantially increased waist circumference risk, with a mean circumference of 96.8 cm. More than half of the sample (59.0%) had self-reported or objectively measured hypertension. Participants wore the monitor on average 875.5 ± 106.1 minutes per day (14.6 hours/day). Participants were sedentary 567.1 minutes per day (65.1% of wear time), engaged in 293.7 minutes per day of light intensity PA (33.2%), and 15.2 minutes per day of moderate- to vigorous-intensity PA (1.7%).

Sedentary, Light, and Moderate- to Vigorous-Intensity Activity by Sociodemographic and Health Characteristics

The means and standard errors of total daily SB, light PA, and moderate- to vigorous-intensity PA by sociodemographic and health-related characteristics are shown in Table 2. Participants <50 years (p=.0026) and 50-59 years (p=.0001) had significantly more minutes per day in light-intensity PA than adults ≥ 60 years. Participants <50 years (p=.0005) and 50-59 years (p=.0063) had significantly more minutes per day in moderate-to vigorous-intensity PA than adults ≥ 60 years. Men had significantly more minutes per day in moderate- to vigorous-intensity PA than women (p=.0395). Participants consuming ≥5 cups/day of fruits and vegetables had significantly more minutes per day in light-intensity PA (p=.0166) compared to participants consuming <5 cups/day. Obese participants had significantly more minutes per day of SB than normal weight participants (p=.0191) and overweight participants (p=.0091). Additionally, overweight participants had significantly more minutes per day of light-intensity PA than obese participants (p=.0096) and normal weight participants had significantly more minutes per day of moderate-to-vigorous-intensity PA than obese participants (p=.0196). Individuals with a normal waist circumference risk had significantly more minutes per day of moderate-to vigorous-intensity PA compared to participants with an increased waist risk (p=.0374) and substantially increased risk (p=.0014). Mean minutes per day of light PA differed significantly by general self-rated health. Participants self-rating their health as "fair" had significantly less minutes per day in light PA compared to participants with a self-rating of "very good" (p=.0023) and "good" (p=.0035). No other significant associations were observed.

Patterns of Sedentary Behavior by Sociodemographic and Health Characteristics

*T*able 3 presents the mean number of minutes per day spent in SB in the morning, afternoon, and evening, by sociodemographic and health-related variables. Participants spent on average 144.7 minutes sedentary in the morning (26% of daily sedentary time), 225.9 minutes sedentary in the afternoon (40% of daily sedentary time), and 180.4 minutes sedentary in the evening (32% of daily sedentary time). SB differed significantly by time of day (p<.0001). Participants had significantly fewer minutes per day of SB in the morning compared to the afternoon and evening (p<.0001). Participants also had significantly fewer minutes per day of SB in the evening compared to the afternoon (p<.0001).

Participants ≥ 60 years had significantly more minutes per day in afternoon SB than adults <50 years (p=.0059) and 50-59 years (p=.0051). Obese participants had significantly more minutes per day of evening SB than overweight participants (p=.0011). No other significant differences were observed according to sociodemographic and health-related variables. Additionally, the relationship between SB and time of day did not differ according to sociodemographic and health-related variables (time of day x sociodemographic/health interaction p values >.05).

Table 4 presents the mean number of minutes spent in SB, separately for weekdays and weekend days, by sociodemographic and health-related variables. Participants spent on average 572.9 (65.8% of the day) minutes of SB on the weekdays. On weekends participants spent an average of 557.8 (63.8% of the day) minutes in SB. This difference was not statistically significant (p=.1370). College graduates had significantly more minutes per day in weekday SB than all other education groups (p=.0097). Obese participants had significantly more minutes per day in weekday SB than overweight participants (p=.0174). Obese participants had significantly more minutes per day in weekend day SB than normal (p=.0419) and overweight (p=.0150) participants. No other differences were observed according to sociodemographic and health-related variables. Additionally, the relationship between SB and day of week did not differ according to sociodemographic and health-related variables (day of week x sociodemographic/health interaction p values >.05).

Bouts of Sedentary, Light, and Moderate-to Vigorous-Intensity Physical Activity

In the total sample, the mean intensity of total wear time was 234.7 counts per minute (i.e., equivalent to light intensity PA). The number of bouts (total any duration, ≥10, ≥ 30, and ≥60 minutes) of SB, light PA, and moderate-to vigorous-intensity PA are shown in Table 5. On average, participants engaged in 93.6 bouts of SB per day, each bout averaged 6.6 minutes. Participants engaged in 100.6 bouts of light PA per day, and each bout averaged 2.9 minutes. Participants engaged in 8.5 bouts of moderate-to vigorous-intensity PA per day, and each bout averaged 1.7 minutes.

All participants (n=266) had bouts of SB lasting longer than 10 and 30 minutes. Ninety-three percent (n=247) of participants had a bout of SB lasting longer than 60 minutes. On average, there were 15.2 bouts of daily SB lasting ≥10 minutes (mean duration = 23.0 minutes), 3.0 bouts lasting ≥ 30 minutes (mean duration= 50.8 minutes), and 0.7 bouts lasting ≥60 minutes (mean duration= 86.6 minutes).

All participants had bouts of light PA lasting longer than 10 minutes. Forty-eight percent (n=127) of participants had a bout of light PA lasting longer than 30 minutes and 7% (n=19) of participants had bouts lasting longer than 60 minutes. On average, there were 4.2 bouts of daily light PA lasting ≥10 minutes (mean duration= 14.3 minutes), 0.2 bouts lasting ≥30 minutes (mean duration= 38.4 minutes), and 0.02 bouts lasting ≥60 minutes (mean duration=74.7 minutes).

Twenty-four percent (n=64) of participants had at least one bout of moderate-to vigorous-intensity PA lasting longer than 10 minutes. On average, there were 0.1 bouts of moderate- to vigorous-intensity PA (mean duration = 24.5 minutes). Ten percent (n=27) of participants had bouts of moderate-to vigorous-intensity PA. On average, there were 0.03 bouts of moderate-to vigorous-intensity PA per day (mean duration = 42.4 minutes). Only 4 participants had at least one bout of moderate-to vigorous PA lasting longer than 60-minutes. On average there were 0.005 bouts (mean duration = 65.9 minutes).

Bouts of Physical Activity and Sedentary Behavior by Sociodemographic and Health Characteristics

All bouts (total any duration, ≥10 minutes, ≥30 minutes, ≥60 minutes) of SB, light PA, and moderate-to vigorous-intensity PA was assessed by sociodemographic and health-related characteristics (Table 6).

Bouts of Sedentary Behavior

Participants <60 years had significantly more total, ≥ 30 minute, and ≥ 60 minute bouts of SB compared to all other age groups (p=.0076, p=.0048, p=.0019, respectively). Women had more total bouts of SB than men (p<.0001). However, men had more ≥ 30 minute (p=.0031) and ≥ 60 minute bouts (p=.0005) of SB than women. College graduates had significantly more ≥10 minute bouts of SB compared to all other educational groups (p=.0137). Individuals with some college education had significantly more ≥60 minute bouts of SB than persons with a high school graduation (p=.0353) or less than HS graduation (p=.0130). Participants reporting ≥$60,000 in income had more ≥10 minute bouts of SB compared to participants who did not report their income or those reporting ≤$39,999 (p=.0120). Obese participants had significantly more ≥10 minute bouts (p=.0056) and ≥30 minute bouts (p=.0122) of SB compared to overweight and normal weight participants. All waist risk groups differed significantly from one another in total bouts of SB (p=.0003). Substantially increased waist risk participants had significantly more total bouts of SB than the normal waist risk group (p=.0064). Increased waist risk participants had significantly more total bouts of SB than the normal waist risk group (p<.0001) and substantially increased waist risk group (p=.0258).

Bouts of Light-Intensity Physical Activity

Participants' <60 years had significantly more total bouts of light-intensity PA compared to participants ≥60 years (p<.0001). Additionally, 50-59 year olds had significantly more bouts of light-intensity PA ≥10 minutes compared to participant's ≥60 years (p=.0157). Women had more total bouts of light-intensity PA than men (p=.0004). Individuals with less than a high school graduation had significantly less total bouts of light-intensity PA compared to persons with a high school graduation or more (p=.0205). Participants reporting a household income ≥$60,000 had significantly less ≥10 minute bouts of light-intensity PA compared to those with $20,000-$39,999 (p=.0032) and $40,000-$59,999 incomes (p=.0187). Participants consuming ≥5 cups/day of fruits and vegetables had significantly more ≥10 minute bouts of light-intensity PA compared to those consuming <5 cups/day (p=.0304). Overweight participants had significantly more ≥10 minute bouts of light-intensity PA compared to obese participants (p=.0157). Increased waist risk participants had significantly more total bouts of light-intensity PA than the normal waist risk group (p=.0022) and substantially increased waist risk group (p=.0212). Participants who rated their health as fair had significantly less total bouts of light-intensity PA compared to those rating their health as poor (p=.0492), good (p=.0028), and very good (p=.0075).

<u>Bouts of Moderate-to Vigorous-Intensity Physical Activity</u>

Participants' <60 years had significantly more total bouts of moderate-to vigorous-intensity PA compared to participants ≥60 years (p<.0001). Men had significantly more total bouts of moderate-to vigorous-intensity PA than women (p=.001). Participants consuming ≥5 cups/day of fruits and vegetables had significantly more total bouts of moderate-to vigorous-intensity compared to those consuming <5 cups/day (p=.0259). Normal weight participants and overweight participants had significantly more total bouts of moderate-to vigorous-intensity PA compared to obese participants (p=.0112). Participants with normal blood pressure had significantly more total bouts of moderate-to vigorous-intensity PA compared to hypertensive participants (p=.0059). Normal waist risk participants had significantly more total bouts of moderate-to vigorous-intensity PA compared to increased risk and substantially increased waist risk groups (p=.0049).

Breaks in Sedentary Behavior by Sociodemographic and Health Characteristics

On average, participants had 93.2 breaks per day in SB (Table 7). The mean duration of the breaks in SB was 3.3 minutes and the mean intensity of the sedentary break was 446.2 counts per minute (i.e., equivalent to light-intensity PA). Total number of breaks of SB was assessed by sociodemographic and health-related characteristics (Table 8). Participants <50 years and those 50-59 years had significantly more breaks in SB per day than adults ≥ 60 years (p=.0065). Women had significantly more breaks in SB per day than men (p<.001). All waist risk groups differed significantly from one another in total breaks in SB (p=.0002). Substantially increased waist risk participants had significantly more total breaks in SB than the normal waist risk group (p=.0057). Increased waist risk participants had significantly more total breaks in SB than the normal waist risk group (p<.0001) and substantially increased waist risk group (p=.0271).

DISCUSSION

With high rates of obesity, physical inactivity and SB reported among African Americans, it is important to promote a healthier, more active, and less sedentary lifestyle. Physical activity may be a difficult behavior for individuals who are overweight and obese to adopt, many of whom also have multiple chronic health conditions (2, 3). Decreasing sedentary time and increasing breaks in SB might be more realistic for this population. Despite national efforts (29), marked health disparities exist in the African American population (30). In our study, 90.2% of participants were overweight or obese, 59% of the sample had self-reported and/or objectively measured hypertension, and 57.5% had substantially increased risk for waist circumference. Two behaviors that may contribute to the disparities in chronic health conditions are low PA participation and high SB. This study examined objectively-measured PA and SB and patterns of behavior in a group of African American church members from South Carolina (20).

Participants spent approximately 65% of their waking hours, or 9.4 hours/day, in SB. Additionally, less than 2% (15.2 minutes) of time was spent in moderate-to vigorous-intensity PA. Further gender differences were observed in PA participation in the FAN study. Men engaged in significantly more daily moderate-to vigorous-intensity PA than women. Additionally in our study, participants with significantly more moderate-to vigorous-intensity PA had a healthier profile (younger, normal BMI, non-hypertensive, and normal waist circumference). These findings are consistent with the high estimates of SB participation in previously published population-based estimates among adults in the United States (22, 25). Compared to NHANES reports, US adults are sedentary approximately 57-58% of the day (22, 25). However, Baruth et al. (18) reported higher rates of SB among African American women living in South Carolina enrolling in a weight loss study, 72.0% or 10.2 hours/day.

Little is known about the pattern of SB in African American adults across time of day (morning, afternoon, and evening), and weekdays and weekend days, although they are at higher risk of many chronic conditions. In this study, mean minutes per day spent in SB, light PA, and moderate-to vigorous-intensity PA, by weekday vs. weekend day, and by time of day, was examined. SB was significantly different by time of day. Participants had significantly more minutes per day of SB in the afternoon (40% of daily sedentary time) and evening (32% of daily sedentary time) compared to the morning (26% of daily sedentary time). However, participants spent similar amounts of time sedentary on weekdays and weekend days. Our sample differed from previous reports on time of day SB in African Americans (18). Baruth et al. (18) used the same time of day cut points (morning= 6 am to noon; afternoon= noon to 6pm; and evening= 6pm to midnight) and showed that participants SB in the morning, afternoon, and evening accounted for 28.6%, 42.6%, and 28.8% of daily sedentary time, respectively.

Scheers et al. (31) examined objectively measured patterns of PA and SB according to day of the week and determined that activity patterns differed between subgroups of normal-weight, overweight, and obese Flemish middle-aged adults, with the largest difference on Saturday for the male BMI group. In the present study older participants accumulated more SB in the afternoon compared to middle-aged and younger participants, and obese participants (BMI≥30 kg/m^2) accumulated more evening SB compared to overweight participants. These findings may be particularly important when designing obesity prevention strategies in targeted and/or at-risk populations (31). Educational attainment differences were observed in sedentary time during the weekdays. College graduates had significantly more sedentary time on the weekday than all educational groups. This difference may be due to the SB associated with occupational activities. Research has shown that individuals with higher educational attainment tend to have more sedentary activities associated with their jobs (i.e. computer use, business meetings, and conference calls) (2, 3). Obesity was associated with higher amounts of SB on both weekdays and weekend days. Baruth et al. (18) examined type of day differences in SB among obese women. Obese women were slightly more sedentary on weekdays (65% of day) compared to weekend days (63%).

In addition to total sedentary time and types of SB, the manner in which SB is achieved and accumulated may also be important (26, 32). Technological advances and social factors have made prolonged sitting a part of regular daily routines in American adults. Adults spend extended periods of time being sedentary during work, domestic, and recreational time (33-35) and have sporadic PA patterns. Two factors that may be associated with the accumulation of SB are bouts of SB and breaks in SB.

Baruth et al. (18) and Healy et al. (26) were the first groups to publish findings on the bout and break patterns of SB in African American adults, respectively. The present study expands on previous literature by examining the mean bouts (total any duration, ≥10 minutes, ≥30 minutes, and ≥60 minutes) of SB, light-intensity PA, and moderate-to vigorous-intensity PA. In the present study, participants had 93.6 bouts of SB per day averaging 6.6 minutes per bout and 8.5 bouts of moderate-to vigorous-intensity PA per day averaging 1.7 minutes per bout. All participants had bouts of SB lasting longer than 30 minutes; and 92.9% had bouts lasting longer than 60 minutes. Our sample had more long bouts compared to 83% reported by Baruth et al. (18). Further, unique to our study, all bouts (total any duration, ≥10 minutes, ≥30 minutes, ≥60 minutes) of SB, light PA, and moderate-to vigorous-intensity PA was assessed by sociodemographic and health-related characteristics. These findings can help to inform public health interventions and public health guidelines regarding SB in adults. Current national PA recommendations state that Americans should accumulate moderate-to vigorous-intensity PA in bouts of 10 minutes or longer, for a total of 150 minutes per week of moderate-intensity PA or 75 minutes per week of vigorous-intensity.

Participants' break patterns in SB were examined and were comparable to previous studies (18, 26). Participant's averaged 93.2 breaks in SB per day. The mean break duration was 3.3 ± 1.0 minutes per day, and the mean intensity of the break was light PA (446.2 ± 81.2 cpm). Breaks in SB were also examined by sociodemographic and health-related variables. Age, gender and waist circumference risk differences were observed. Older participants (≥60 years), men, and normal waist circumference risk participants had fewer breaks in daily SB. Emerging evidence in adults suggest that breaks in (25, 26) and bouts of (36, 37) SB may be related to health, independent of PA and total sedentary time, however this association has only been observed in Whites. Additional work is needed in this growing field to examine multiple patterns (i.e. breaks in and bouts of) of sedentary time in adults from different racial/ethnic backgrounds (25). No evidence exists yet to say that these longer bouts have a deleterious effect on African American adult's health.

This study has several strengths including the use of objective measures of SB and PA in a moderately large sample of African American adults. We also recognize study limitations including the relatively low number of men in our sample. In addition, selection/representativeness should be cited as a limitation. All participants were recruited from one denomination of churches in several regions of one state in the Southeast region. Another limitation to be noted is the use of ActiGraph in accurately differentiating between sitting and standing (37). Gibbs et al. (37) concluded that a research priority should include the development and validation of novel devices capable of assessing posture and standardization of research practices for SB assessments by accelerometry.

Nonetheless, the high rates of hypertension, obesity and substantially increased risk waist circumference in our sample, combined with the low levels of moderate-to vigorous-intensity PA and high levels of SB, substantiate the need for additional health promotion programs aimed at increasing PA, decreasing SB and improving other health behaviors among African American adults. Interventions, such as FAN, may play a central role in the efforts of reducing health disparities among adults in the United States. Based on the findings of the present study there are subgroups that seem most at risk based on total SB, long bouts of SB, and fewer breaks in SB accumulated. Older adults (≥60 years old) and individuals with increased waist risk or substantially increased risk appear to be a likely target group for interventions focused on improving health profiles through patterns and variations of SB . Increasing total daily moderate-to vigorous-intensity PA, decreasing total daily SB, increasing number of breaks in SB and replacing prolonged periods of SB with light PA is justly an area of further exploration.

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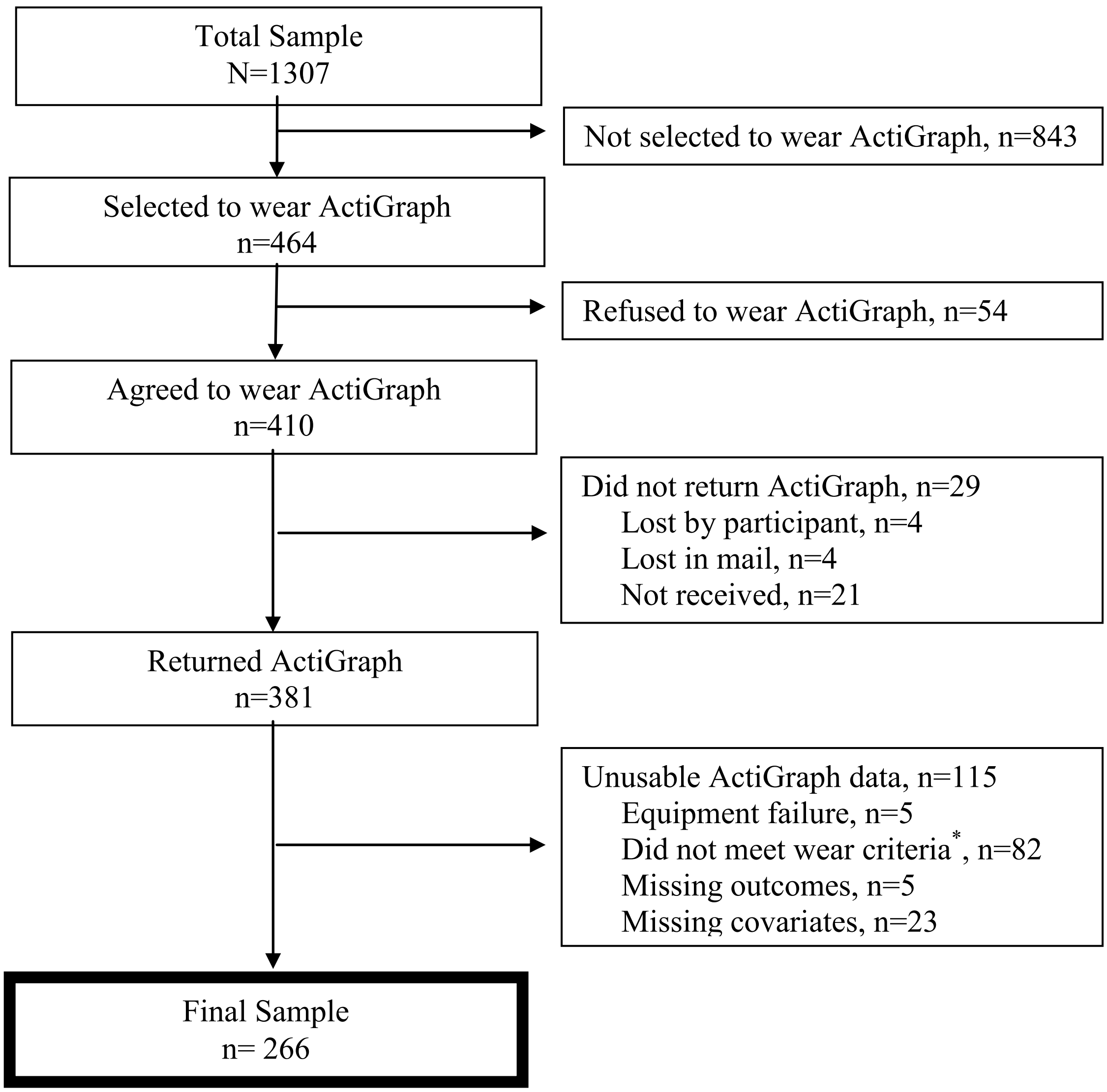

*Study participants did not meet wear criteria of ≥3 days of valid accelerometer data including at least 1 weekend day and ≥10 hrs/day

Figure 4.1 Study inclusion flow chart.

Table 4.1 Characteristics of the Sample (N=266)

	N	% or Mean (SD) [a]
Age, years	266	53.4 (11.9)
BMI, kg/m^2	266	32.7 (7.3)
Fruit and Vegetable Consumption (cups/day)		
Total (0-11 cups per day)	266	3.4 (1.8)
<5 cups per day	204	76.7
≥5 cups per day	62	23.3
Moderate- to-Vigorous PA (min/day) [b]	266	15.2 (13.6)
Light PA (mean min/day) [b]	266	293.7 (82.5)
Sedentary Behavior (mean min/day) [b]	266	567.1 (106.6)
Gender		
Male	56	21.1
Female	210	79.0
Education		
Less than HS graduate	24	9.0
HS grad or GED	72	27.1
Some college (1-3 years)	85	32.0
College graduate (4+ years)	85	32.0
Marital status		
Married	151	56.8
Not Married	115	43.2
Smoking status		
Smoker	15	5.6
Not Smoker	251	94.4

Income		
Not reported	28	10.5
<$20,000	53	19.9
$20,000-$39,000	66	24.8
$40,000-$59,000	64	24.1
≥$60,000	55	20.7
Self-rated health		
Excellent	16	6.0
Very good	71	26.7
Good	137	51.5
Fair	40	15.0
Poor	2	0.8
Weight status		
Normal weight (BMI<25)	26	9.8
Overweight (25≥BMI<30)	83	31.2
Obese (BMI≥30)	157	59.0
Waist Circumference for women (cm)		
Total (65.1 cm – 160.2 cm)	210	96.7 (15.2)
Normal (<80cm)	22	10.5
Increased Risk (80-88cm)	44	21.0
Substantially Increased Risk (>88cm)	144	68.6
Waist Circumference for men (cm)		
Total (71.8 cm – 131.4 cm)	56	97.5 (11.3)
Normal (<101cm)	37	66.0
Increased Risk (101-108cm)	10	17.9
Substantially Increased Risk (>108cm)	9	16.1

Hypertension		
Yes	157	59.0
No	109	41.0

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree

[a]Unadjusted for monitor wear time.

Table 4.2 Sedentary, Light-Intensity, and Moderate- to Vigorous-Intensity Activity Levels of Participants, by Sociodemographic and Health-Related Variables.

		Sedentary Behavior	**Light Physical Activity**	**Moderate-Vigorous Physical Activity**
	n	Mean min/day (SE)[a]	Mean min/day (SE)[a]	Mean min/day (SE)[a]
Total Sample	266	567.1 (6.5)	289.8 (5.1)	15.0 (0.8)
Age group				
<50 years	92	569.1 (10.1)	300.8 (8.1)[b]	17.8 (1.4)[b]
50-59 years	96	556.3 (9.9)	310.6 (7.9)[b]	16.2 (1.4)[b]
≥60 years	78	578.0 (11.0)	264.5 (8.8)[c]	10.7 (1.5)[c]
		p=.3307	p=.0004	p=.0016
Gender				
Men	56	572.9 (13.1)	283.5 (10.8)	18.5 (1.8)[b]
Women	210	565.5 (6.7)	296.4 (5.5)	14.3 (0.9)[c]
		p=.6166	p=.2902	p=.0395
Education				
Less than HS graduate	24	554.4 (19.6)	274.3 (16.2)	8.1 (2.7)
HS grad or GED	72	560.9 (11.3)	303.6 (9.4)	16.1 (1.6)

Some college (1-3 years)	85	552.3 (10.4)	299.2 (8.7)	16.3 (1.5)
College graduate (4+ years)	85	590.6 (10.4)	285.4 (8.6)	15.2 (1.5)
		p=.0516	p=.2811	p=.0604
Marital status				
Married	151	567.9 (7.9)	295.1 (6.5)	15.8 (1.1)
Not married	115	565.9 (9.0)	291.9 (7.4)	14.3 (1.3)
		p=.8678	p=.7520	p=.3697
Income				
<$20,000	53	558.5 (13.3)	280.7 (10.9)	12.5 (1.8)
$20,000-$39,999	66	557.2 (11.9)	312.6 (9.8)	13.5 (1.7)
$40,000-$59,999	64	570.2 (12.1)	298.4 (10.0)	15.9 (1.7)
≥$60,000	55	593.5 (13.0)	277.7 (10.7)	19.2 (1.8)
Not reported	28	547.5 (18.3)	294.5 (15.0)	14.4 (2.5)
		p=.1713	p=.1083	p=.0845
Fruit and Vegetable Consumption				
<5 (servings/day)	204	568.7 (6.8)	287.2 (5.5)[b]	14.3 (0.9)
≥5 (servings/day)	62	561.7 (12.4)	315.0 (10.1)[c]	18.1 (1.7)
		p=.6210	p=.0166	p=.0519

Smoking status				
Smoker	15	554.3 (25.2)	293.5 (20.8)	19.3 (3.5)
Not smoker	251	567.8 (6.1)	293.7 (5.0)	14.9 (0.9)
		p=.6024	p=.9905	p=.2240
Weight Status				
Normal weight (BMI<25)	26	534.7 (18.7)[b]	293.5 (15.5)[b,c]	20.2 (2.6)[b]
Overweight (25≥BMI<30)	83	548.3 (10.5)[b]	312.0 (8.7)[b]	16.6 (1.5)[b,c]
Obese (BMI≥30)	157	582.3 (7.6)[c]	284.1 (6.3)[c]	13.6 (1.1)[c]
		p=.0067	p=.0348	p=.0341
Hypertension				
Yes	157	569.1 (7.8)	286.8 (6.3)	12.9 (1.1)[b]
No	109	564.2 (9.4)	303.7 (7.7)	18.3 (1.3)[c]
		p=.6915	p=.0943	p=.0015
Waist Circumference, cm				
Normal	24	554.1 (12.7)	286.7 (10.5)	20.1 (1.8)[b]
Increased Risk	53	559.6 (13.2)	310.4 (10.8)	14.8 (1.8)[c]
Substantially Increased Risk	189	574.7 (7.8)	290.5 (6.4)	13.4 (1.1)[c]
		p=.3205	p=.2184	p=.0060

Self-rated health				
Excellent	16	594.5 (24.2)	275.2 (19.6)[b,c]	15.0 (3.4)
Very good	71	560.3 (11.6)	306.2 (9.4)[c]	17.5 (1.6)
Good	137	561.8 (8.3)	299.3 (6.7)[c]	15.3 (1.2)
Fair	40	585.1 (15.4)	257.7 (12.4)[b]	10.6 (2.1)
Poor	2	586.1 (68.5)	333.5 (55.6)[b,c]	15.4 (9.5)
		p=.4807	p=.0179	p=.1720

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree

[a]Adjusted for monitor wear time

[b,c]Different letter superscripts indicate between group differences

Table 4.3 Patterns of Sedentary Behavior by Time of Day, According to Sociodemographic and Health-Related Variables.

		Morning 6am to 12pm	**Afternoon 12pm to 6pm**	**Evening 6pm to 12am**	**$P_{interaction}$**
	n	Mean min/day (SE)[a]	Mean min/day (SE)[a]	Mean min/day (SE)[a]	
Total Sample	266	144.7 (2.6)	225.9 (2.6)	180.4 (2.6)	
Age, years					
<50	92	145.6 (4.5)	221.0 (3.8)[b]	177.7 (4.8)	
50-59	96	147.2 (4.4)	220.9 (3.8)[b]	174.7 (4.7)	
≥60	78	140.7 (4.9)	236.7 (4.2)[c]	188.0 (5.3)	
		p=.5977	p=.0068	p=.1515	p=.0761
Gender					
Men	56	144.5 (5.8)	223.6 (5.1)	184.2 (6.3)	
Women	210	144.8 (3.0)	226.1 (2.6)	178.4 (3.2)	
		p=.9618	p=.6598	p=.4153	p=.3658
Education					
Less than HS graduate	24	145.5 (8.8)	229.7 (7.6)	173.5 (9.5)	
HS grad or GED	72	140.0 (5.1)	221.9 (4.4)	180.4 (5.5)	
Some college (1-3 years)	85	142.9 (4.7)	223.4 (4.1)	174.5 (5.1)	
College graduate (4+ years)	85	150.3 (4.7)	229.6 (4.1)	185.9 (5.1)	

		p=.4841	p=.5184	p=.3970	p=.9322
Marital status					
Married	151	147.7 (3.5)	224.3 (3.0)	181.9 (3.8)	
Not married	115	140.9 (4.0)	227.1 (3.5)	176.6 (4.3)	
		p=.2028	p=.5484	p=.3620	p=.4023
Income					
<$20,000	53	137.4 (5.9)	233.0 (5.1)	176.0 (6.5)	
$20,000-$39,999	66	142.5 (5.3)	217.2 (4.6)	179.7 (5.8)	
$40,000-$59,999	64	147.1 (5.4)	223.2 (4.6)	179.0 (5.9)	
≥$60,000	55	155.5 (5.8)	233.6 (5.0)	185.7 (6.3)	
Not reported	28	137.5 (8.1)	220.6 (7.0)	175.7 (8.9)	
		p=.1863	p=.0647	p=.8353	p=.5532
Fruit and Vegetable Consumption					
<5 (servings/day)	204	146.0 (3.0)	226.9 (2.6)	181.7 (3.3)	
≥5 (servings/day)	62	140.4 (5.5)	221.1 (4.8)	172.8 (5.9)	
		p=.3718	p=.2826	p=.1879	p=.9360
Smoking status					
Smoker	15	139.8 (11.2)	215.8 (9.7)	182.8 (12.1)	

Not smoker	251	145.0 (2.7) p=.6510	226.1 (2.4) p=.3033	179.4 (2.9) p=.7851	p=.8610
Weight Status					
Normal weight (BMI<25)	26	129.5 (8.4)	217.8 (7.3)	175.4 (9.0)[b,c]	
Overweight (25≥BMI<30)	83	145.2 (4.7)	219.8 (4.1)	166.6 (5.0)[c]	
Obese (BMI≥30)	157	147.0 (3.4) p=.1563	229.9 (3.0) p=.0745	187.2 (3.7)[b] p=.0042	p=.1771
Hypertension					
Yes	157	142.1 (3.4)	228.5 (3.0)	182.9 (3.7)	
No	109	148.6 (4.1) p=.2332	221.3 (3.6) p=.1278	174.9 (4.5) p=.1792	p=.0692
Waist Circumference, cm					
Normal	24	137.7 (5.6)	225.2 (4.9)	178.4 (6.1)	
Increased Risk	53	148.9 (5.8)	222.4 (5.1)	169.1 (6.3)	
Substantially Increased Risk	189	145.9 (3.5) p=.3394	226.8 (3.0) p=.7611	183.8 (3.8) p=.1347	p=.3927
Self-rated health					
Excellent	16	151.2 (10.8)	236.1 (9.3)	185.9 (11.7)	
Very good	71	144.9 (5.2)	222.3 (4.5)	177.6 (5.6)	
Good	137	143.0 (3.7)	222.7 (3.2)	176.7 (4.0)	

Fair	40	146.3 (6.8)	237.2 (5.9)	190.5 (7.4)	
Poor	2	173.2 (30.1)	218.3 (26.3)	184.5 (33.0)	
		p=.8264	p=.1592	p=.5311	p=.9014

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree

$P_{interaction}$: Tested for time of day x sociodemographic/health interaction

[a]Adjusted for monitor wear time

[b,c]Different letter superscripts indicate between group differences

Table 4.4 Patterns of Sedentary Behavior on Weekdays versus Weekend Days, According to Sociodemographic and Health-Related Variables.

		Weekday 6am to 12pm	**Weekend Day 12pm to 6pm**	**$P_{interaction}$**
	n	Mean min/day (SE) [a]	Mean min/day (SE) [a]	
Total Sample	266	572.9 (7.1)	557.8 (7.2)	
Age, years				
<50	92	576.4 (11.6)	557.4 (12.6)	
50-59	96	562.6 (11.3)	538.7 (12.5)	
≥60	78	580.2 (12.6)	582.4 (13.6)	
		p=.5362	p=.0621	p=.5270
Gender				
Men	56	571.5 (15.0)	580.8 (16.3)	
Women	210	572.8 (7.7)	552.0 (8.4)	
		p=.9422	p=.1198	p=.4284
Education				
Less than HS graduate	24	548.4 (22.3) [b]	581.2 (24.8)	
HS grad or GED	72	561.4 (12.9) [b]	560.7 (14.3)	
Some college (1-3 years)	85	555.8 (11.9) [b]	543.5 (13.3)	
College graduate (4+ years)	85	605.4 (11.8) [c]	564.4 (13.4)	

		p=.0097	p=.5093	p=.1778
Marital status				
Married	151	572.9 (9.0)	558.8 (9.9)	
Not married	115	572.0 (10.4)	557.4 (11.5)	
		p=.9499	p=.9286	p=.9552
Income				
<$20,000	53	562.7 (15.2)	560.6 (16.8)	
$20,000-$39,999	66	560.8 (13.6)	544.7 (15.4)	
$40,000-$59,999	64	579.4 (13.8)	559.2 (15.3)	
≥$60,000	55	603.0 (14.9)	565.3 (16.6)	
Not reported	28	542.7 (20.9)	567.9 (23.1)	
		p=.1070	p=.8834	p=.5145
Fruit and Vegetable Consumption				
<5 (servings/day)	204	574.9 (7.8)	558.7 (8.6)	
≥5 (servings/day)	62	564.6 (14.1)	556.6 (15.4)	
		p=.5259	p=.9078	p=.8981
Smoking status				

Smoker	15	554.0 (28.8)	561.7 (32.6)	
Not smoker	251	573.6 (7.0)	558.0 (7.7)	
		p=.5090	p=.9121	p=.4410
Weight Status				
Normal weight (BMI<25)	26	544.6 (21.5)[b]	512.7 (23.5)[b]	
Overweight (25≥BMI<30)	83	552.2 (12.0)[b]	541.4 (13.2)[b]	
Obese (BMI≥30)	157	587.9 (8.8)[c]	574.9 (9.6)[c]	
		p=.0236	p=.0164	p=.8552
Hypertension				
Yes	157	574.1 (8.9)	557.3 (9.8)	
No	109	570.2 (10.7)	559.5 (11.8)	
		p=.7769	p=.8863	p=.9401
Waist Circumference, cm				
Normal	24	556.0 (14.6)	552.6 (16.0)	
Increased Risk	53	562.2 (15.1)	556.4 (16.5)	
Substantially Increased Risk	189	582.5 (9.0)	561.1 (10.0)	
		p=.2275	p=.8953	p=.8679
Self-rated health				
Excellent	16	593.2 (27.9)	599.8 (30.2)	
Very good	71	573.4 (13.4)	534.2 (14.6)	

Good	137	565.0 (9.5)	560.2 (10.5)	
Fair	40	586.9 (17.7)	578.7 (19.1)	
Poor	2	599.9 (78.8)	521.7 (85.4)	
		p=.7435	p=.2082	p=.4709

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree

$P_{interaction}$: Tested for day of week x sociodemographic/health interaction

[a]Adjusted for monitor wear time

[b,c]Different superscript letters indicate between group differences

Table 4.5 Daily Volume and Bouts of Time Spent in Sedentary Behavior, Light-Intensity, and Moderate-to Vigorous-Intensity Physical Activity among Study Participants.

	Total (N)	Mean (SD)
Total Wear Time, mins	266	875.5 (106.0)
Mean intensity, cpm	266	234.7 (99.5)
Mean Daily Bouts of Sedentary Behavior[a]		
Total Bouts of Sedentary Behavior (any duration)		
Number of Bouts (full sample)		93.6 (16.7)
Length of Bouts (full sample)		6.6 (2.1)
≥10 minute Bouts of Sedentary Behavior		
Number of Bouts (full sample)		15.2 (3.8)
Length of Bouts (n=266)		23.0 (4.2)
≥30 minute Bouts of Sedentary Behavior		
Number of Bouts (full sample)		3.0 (1.5)
Length of Bouts (n=266)		50.8 (10.3)
≥60 minute Bouts of Sedentary Behavior		
Number of Bouts (full sample)		0.7 (0.6)
Length of Bouts (n=247)		86.6 (21.6)
Mean Daily Bouts of Light Physical Activity[b]		
Total Bouts of Light Physical Activity (any duration)		
Number of Bouts (full sample)		100.6 (18.1)
Length of Bouts (full sample)		2.9 (0.7)
≥10 minute Bouts of Light Physical Activity		
Number of Bouts (full sample)		4.2 (2.8)
Length of Bouts (n=266)		14.3 (2.2)
≥30 minute Bouts of Light Physical Activity		
Number of Bouts (full sample)		0.2 (0.4)

Length of Bouts (n=127)[d]	38.4 (7.7)
≥60 minute Bouts of Light Physical Activity	
Number of Bouts (full sample)	0.02 (0.09)
Length of Bouts (n=19)[d]	74.7 (11.7)
Mean Daily Bouts of Moderate-Vigorous Physical Activity[c]	
Total Bouts of Mod-Vig Physical Activity (any duration)	
Number of Bouts (full sample)	8.5 (6.9)
Length of Bouts (n=266)	1.7 (1.6)
≥10 minute Bouts of Mod-Vig Physical Activity	
Number of Bouts (full sample)	0.1 (0.3)
Length of Bouts (n=64)[d]	24.5 (13.4)
≥30 minute Bouts of Mod-Vig Physical Activity	
Number of Bouts (full sample)	0.03 (0.12)
Length of Bouts (n=27)[d]	42.4 (11.8)
≥60 minute Bouts of Mod-Vig Physical Activity	
Number of Bouts (full sample)	0.005 (0.06)
Length of Bouts (n=4)[d]	65.9 (7.1)

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree; Mod-Vig, moderate-vigorous

[a]A bout of SB is an uninterrupted period of time spent sedentary as defined by accelerometer counts <100 per minute.

[b]A bout of light PA is an uninterrupted period of time spent in light-intensity PA as defined by accelerometer counts 100-1951 per minute.

[c]A bout of moderate-to vigorous-intensity PA is an uninterrupted period of time spent in moderate-to vigorous-intensity PA as defined by accelerometer counts ≥1952 per minute.

[d]Number refers to how many participants engaged in a bout.

Table 4.6 Bouts of Total Time, ≥10, ≥30, and ≥60 minutes in Sedentary Behavior, Light-Intensity, and Moderate-to Vigorous-Intensity Physical Activity, According to Sociodemographic and Health-Related Variables.

Bouts of Sedentary Behavior				
	Bouts Any duration	**Bouts ≥ 10 minute**	**Bouts ≥ 30 minute**	**Bouts ≥ 60 minute**
	Mean n/day (SE)[a]	Mean n/day (SE)[a]	Mean n/day (SE)[a]	Mean n/day (SE)[a]
Age, years				
<50	95.08 (1.53)[b]	15.29 (0.38)	2.84 (0.15)[b]	0.66 (0.06)[b]
50-59	95.66 (1.50)[b]	14.86 (0.37)	2.79 (0.14)[b]	0.61 (0.06)[b]
≥60	89.16 (1.66)[c]	15.37 (0.41)	3.44 (0.16)[c]	0.91 (0.07)[c]
	p=.0076	p=.6078	p=.0048	p=.0019
Gender				
Men	84.73 (1.92)[b]	15.17 (0.49)	3.50 (0.19)[b]	0.96 (0.08)[b]
Women	95.90 (0.98)[c]	15.15 (0.25)	2.86 (0.10)[c]	0.65 (0.04)[c]
	p<.0001	p=.9777	p=.0031	p=.0005
Education				
Less than HS graduate	86.31 (3.03)	14.30 (0.73)[b]	3.37 (0.29)	0.94 (0.12)[b]
HS grad or GED	93.73 (1.75)	14.52 (0.42)[b]	2.95 (0.17)	0.79 (0.07)[b]
Some college (1-3 years)	94.31 (1.61)	14.92 (0.39)[b]	2.78 (0.15)	0.59 (0.06)[c]
College graduate (4+ years)	94.68 (1.61)	16.18 (0.39)[c]	3.15 (0.16)	0.71 (0.06)[b,c]
	p=.0945	p=.0137	p=.1939	p=.0441

Marital status				
Married	93.84 (1.21)	15.23 (0.30)	2.97 (0.12)	0.70 (0.05)
Not married	93.18 (1.39)	15.06 (0.34)	3.03 (0.13)	0.74 (0.06)
	p=.7234	p=.7001	p=.7323	p=.5920
Income				
<$20,000	91.47 (2.06)	14.67 (0.49)[b]	3.07 (0.20)	0.80 (0.08)
$20,000-$39,999	96.09 (1.84)	14.48 (0.44)[b]	2.88 (0.18)	0.65 (0.07)
$40,000-$59,999	93.57 (1.88)	15.46 (0.45)[b,c]	2.97 (0.18)	0.68 (0.08)
≥$60,000	93.31 (2.02)	16.51 (0.48)[c]	3.19 (0.19)	0.74 (0.08)
Not reported	91.96 (2.83)	14.34 (0.68)[b]	2.82 (0.27)	0.76 (0.11)
	p=.5152	p=.0120	p=.7466	p=.6642
Fruit and Vegetable Consumption				
<5 (servings/day)	92.94 (1.04)	15.19 (0.26)	3.06 (0.10)	0.75 (0.04)
≥5 (servings/day)	95.98 (1.90)	15.14 (0.47)	2.80 (0.18)	0.61 (0.08)
	p=.2248	p=.7723	p=.2233	p=.0986
Smoking status				
Smoker	88.44 (3.87)	14.37 (0.95)	2.80 (0.37)	0.77 (0.16)
Not smoker	93.86 (0.94)	15.21 (0.23)	3.01 (0.09)	0.71 (0.04)
	p=.1747	p=.3913	p=.5890	p=.7101
Weight Status				
Normal weight (BMI<25)	94.12 (2.93)	13.90 (0.70)[b]	2.59 (0.28)[b]	0.60 (0.12)

Overweight (25≥BMI<30)	94.63 (1.64)	14.45 (0.39)[b]	2.72 (0.16)[b]	0.61 (0.06)
Obese (BMI≥30)	92.89 (1.19)	15.74 (0.29)[c]	3.21 (0.11)[c]	0.79 (0.05)
	p=.6789	p=.0056	p=.0122	p=.0505
Hypertension				
Yes	93.04 (1.20)	15.14 (0.29)	3.06 (0.12)	0.75 (0.05)
No	94.28 (1.44)	15.18 (0.35)	2.90 (0.14)	0.66 (0.06)
	p=.5147	p=.9431	p=.3733	p=.2070
Waist Circumference, cm				
Normal	87.70 (1.91)[b]	14.52 (0.48)	3.16 (0.19)	0.81 (0.08)
Increased Risk	99.03 (1.97)[c]	15.05 (0.50)	2.66 (0.19)	0.55 (0.08)
Substantially Increased Risk	93.88 (1.18)[d]	15.44 (0.29)	3.05 (0.12)	0.74 (0.05)
	p=.0003	p=.2577	p=.1416	p=.0509
Self-rated health				
Excellent	91.86 (3.70)	16.30 (0.91)	3.12 (0.36)	0.78 (0.15)
Very good	93.49 (1.78)	14.97 (0.44)	2.96 (0.17)	0.64 (0.07)
Good	95.08 (1.27)	14.95 (0.31)	2.89 (0.12)	0.71 (0.05)
Fair	88.41 (2.35)	15.60 (0.58)	3.43 (0.23)	0.88 (0.09)
Poor	107.89 (10.47)	17.87 (2.58)	1.63 (1.01)	0.05 (0.42)
	p=.0817	p=.4239	p=.1779	p=.1458

Bouts of Light Intensity Physical Activity				
	Bouts Any duration	**Bouts ≥ 10 minute**	**Bouts ≥ 30 minute**	**Bouts ≥ 60 minute**
	Mean n/day (SE)[a]	Mean n/day (SE)[a]	Mean n/day (SE)[a]	Mean n/day (SE)[a]
Age, years				
<50	103.27 (1.64)[b]	4.26 (0.28)[b,c]	0.22 (0.04)	0.03 (0.01)
50-59	103.46 (1.61)[b]	4.58 (0.28)[b]	0.23 (0.04)	0.03 (0.01)
≥60	93.88 (1.78)[c]	3.57 (0.31)[c]	0.15 (0.05)	0.01 (0.01)
	p<.0001	p=.0499	p=.3374	p=.4489
Gender				
Men	93.67 (2.14)[b]	4.31 (0.37)	0.27 (0.06)	0.04 (0.01)
Women	102.43 (1.10)[c]	4.13 (0.19)	0.19 (0.03)	0.02 (0.01)
	p=.0004	p=.6648	p=.1752	p=.1387
Education				
Less than HS graduate	90.79 (3.27)[b]	4.36 (0.56)	0.26 (0.08)	0.03 (0.02)
HS grad or GED	101.08 (1.89)[c]	4.62 (0.32)	0.27 (0.05)	0.03 (0.01)
Some college (1-3 years)	101.66 (1.74)[c]	4.33 (0.39)	0.20 (0.04)	0.02 (0.01)
College graduate (4+ years)	101.85 (1.74)[c]	3.58 (0.30)	0.13 (0.04)	0.01 (0.01)
	p=.0205	p=.0981	p=.1858	p=.6181

Marital status				
Married	100.97 (1.32)	4.27 (0.22)	0.19 (0.03)	0.01 (0.01)
Not married	100.08 (1.51)	4.03 (0.26)	0.23 (0.04)	0.03 (0.01)
	p=.6564	p=.4842	p=.4148	p=.1351
Income				
<$20,000	97.63 (2.24)	3.97 (0.37)[b,c]	0.23 (0.06)	0.03 (0.01)
$20,000-$39,999	102.61 (2.00)	4.72 (0.33)[b]	0.25 (0.05)	0.03 (0.01)
$40,000-$59,999	100.45 (2.04)	4.44 (0.34)[b]	0.23 (0.05)	0.01 (0.01)
≥$60,000	101.78 (2.20)	3.25 (0.37)[c]	0.09 (0.06)	0.01 (0.01)
Not reported	99.36 (3.08)	4.44 (0.51)[b,c]	0.20 (0.08)	0.02 (0.02)
	p=.5224	p=.0390	p=.2516	p=.5150
Fruit and Vegetable Consumption				
<5 (servings/day)	99.54 (1.13)	3.97 (0.19)[b]	0.20 (0.03)	0.02 (0.01)
≥5 (servings/day)	104.01 (2.06)	4.83 (0.35)[c]	0.21 (0.05)	0.02 (0.01)
	p=.0580	p=.0304	p=.9352	p=.9417
Smoking status				
Smoker	97.91 (4.22)	4.36 (0.71)	0.33 (0.11)	0.06 (0.02)
Not smoker	100.74 (1.02)	4.16 (0.17)	0.20 (0.03)	0.02 (0.01)
	p=.5139	p=.7791	p=.2182	p=.1101
Weight Status				
Normal weight (BMI<25)	103.08 (3.17)	3.84 (0.53)[b]	0.17 (0.08)	0.02 (0.02)

Overweight (25≥BMI<30)	102.57 (1.78)	4.79 (0.30)[b]	0.22 (0.05)	0.02 (0.01)
Obese (BMI≥30)	99.12 (1.29)	3.89 (0.22)[c]	0.20 (0.03)	0.02 (0.01)
	p=.2092	p=.0437	p=.8737	p=.9000
Hypertension				
Yes	99.32 (1.30)	3.96 (0.22)	0.19 (0.03)	0.02 (0.01)
No	102.40 (1.56)	4.48 (0.26)	0.23 (0.04)	0.03 (0.01)
	p=.1335	p=.1321	p=.4459	p=.4938
Waist Circumference, cm				
Normal	96.67 (2.10)[b]	4.24 (0.36)	0.23 (0.05)	0.03 (0.01)
Increased Risk	106.03 (2.18)[c]	4.41 (0.37)	0.15 (0.06)	0.01 (0.01)
Substantially Increased Risk	100.17 (1.29)[b]	4.06 (0.22)	0.21 (0.03)	0.02 (0.01)
	p=.0080	p=.7087	p=.4805	p=.4377
Self-rated health				
Excellent	99.62 (4.00)[b,c]	3.29 (0.68)	0.09 (0.10)	0.002 (0.02)
Very good	101.89 (1.92)[b]	4.65 (0.33)	0.21 (0.05)	0.02 (0.01)
Good	101.93 (1.37)[b]	4.27 (0.23)	0.21 (0.04)	0.03 (0.01)
Fair	93.26 (2.53)[c]	3.30 (0.43)	0.22 (0.07)	0.02 (0.01)
Poor	116.18 (11.31)[b]	4.58 (1.93)	0.32 (0.29)	0.01 (0.06)
	p=.0214	p=.0952	p=.8357	p=.8245
Bouts of Moderate-to Vigorous-Intensity Physical Activity				

	Bouts Any duration	Bouts ≥ 10 minute	Bouts ≥ 30 minute	Bouts ≥ 60 minute
	Mean n/day (SE)[a]	Mean n/day (SE)[a]	Mean n/day (SE)[a]	Mean n/day (SE)[a]
Age, years				
<50	10.10 (0.70)[b]	0.10 (0.03)	0.03 (0.01)	0.01 (0.01)
50-59	9.40 (0.68)[b]	0.12 (0.03)	0.04 (0.01)	0.0001 (0.01)
≥60	5.60 (0.76)[c]	0.10 (0.03)	0.03 (0.01)	0.01 (0.01)
	p<.0001	p=.7516	p=.9733	p=.4713
Gender				
Men	11.24 (0.91)[b]	0.11 (0.03)	0.01 (0.02)	-0.001 (0.008)
Women	7.81 (0.47)[c]	0.11 (0.02)	0.04 (0.01)	0.01 (0.004)
	p=.0010	p=.9989	p=.1952	p=.3217
Education				
Less than HS graduate	5.57 (1.41)	0.03 (0.05)	0.0002 (0.03)	0.001 (0.006)
HS grad or GED	8.68 (0.81)	0.15 (0.03)	0.03 (0.01)	0.005 (0.007)
Some college (1-3 years)	8.87 (0.75)	0.13 (0.03)	0.04 (0.01)	0.01 (0.006)
College graduate (4+ years)	8.89 (0.75)	0.08 (0.03)	0.03 (0.01)	0.005 (0.006)
	p=.1832	p=.1340	p=.5004	p=.8940
Marital status				
Married	8.71 (0.56)	0.12 (0.02)	0.04 (0.01)	0.01 (0.004)
Not married	8.29 (0.65)	0.09 (0.02)	0.02 (0.01)	0.003 (0.005)

	p=.6172	p=.2865	p=.1903	p=.4622
Income				
<$20,000	7.32 (0.95)	0.07 (0.04)	0.01 (0.02)	0.0004 (0.01)
$20,000-$39,999	7.92 (0.85)	0.08 (0.03)	0.02 (0.02)	-0.0002 (0.01)
$40,000-$59,999	8.43 (0.86)	0.15 (0.03)	0.04 (0.02)	0.01 (0.01)
≥$60,000	10.51 (0.93)	0.14 (0.03)	0.06 (0.02)	0.02 (0.01)
Not reported	8.58 (1.31)	0.09 (0.05)	0.03 (0.02)	-0.001 (0.01)
	p=.1591	p=.4505	p=.3099	p=.4095
Fruit and Vegetable Consumption				
<5 (servings/day)	8.01 (0.48)[b]	0.10 (0.02)	0.03 (0.01)	0.007 (0.004)
≥5 (servings/day)	10.25 (0.87)[c]	0.13 (0.03)	0.05 (0.02)	0.002 (0.007)
	p=.0259	p=.4622	p=.3860	p=.5314
Smoking status				
Smoker	11.16 (1.79)	0.11 (0.07)	0.02 (0.03)	0.001 (0.015)
Not smoker	8.37 (0.44)	0.11 (0.02)	0.03 (0.01)	0.006 (0.003)
	p=.1314	p=.9754	p=.7399	p=.7478
Weight Status				
Normal weight (BMI<25)	11.07 (1.34)[b]	0.13 (0.05)	0.05 (0.02)	0.0001 (0.01)
Overweight (25≥BMI<30)	9.63 (0.75)[b]	0.13 (0.03)	0.03 (0.01)	0.005 (0.006)
Obese (BMI≥30)	7.53 (0.54)[c]	0.10 (0.02)	0.03 (0.01)	0.01 (0.005)
	p=.0112	p=.6171	p=.6450	p=.8228

Hypertension				
Yes	7.55 (0.55)[b]	0.08 (0.02)	0.03 (0.01)	0.007 (0.005)
No	9.95 (0.66)[c]	0.14 (0.02)	0.04 (0.01)	0.004 (0.006)
	p=.0059	p=.0611	p=.2436	p=.6311
Waist Circumference, cm				
Normal	11.06 (0.89)[b]	0.16 (0.03)	0.03 (0.02)	0.002 (0.010)
Increased Risk	8.45 (0.93)[c]	0.11 (0.03)	0.05 (0.02)	0.0002 (0.008)
Substantially Increased Risk	7.58 (0.55)[c]	0.09 (0.02)	0.03 (0.01)	0.01 (0.005)
	p=.0049	p=.2418	p=.3862	p=.4846
Self-rated health				
Excellent	9.96 (1.71)	0.05 (0.06)	0.010 (0.03)	-0.0005 (0.014)
Very good	10.02 (0.82)	0.11 (0.03)	0.023 (0.01)	0.001 (0.007)
Good	8.27 (0.59)	0.13 (0.02)	0.045 (0.01)	0.011 (0.005)
Fair	6.17 (1.09)	0.07 (0.04)	0.023 (0.02)	0.001 (0.01)
Poor	9.12 (4.85)	0.09 (0.18)	-0.002 (0.09)	-0.002 (0.04)
	p=.0701	p=.6869	p=.6009	p=.7402

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree

[a]Adjusted for monitor wear time

[b,c,d]Different superscript letters indicate between group differences

Table 4.7 Daily Breaks from Time Spent in Sedentary Behaviors among Study Participants.

	Total (N)	**Mean (SD)**
Mean Breaks in Sedentary Time, n per day[a]	266	93.2 (16.6)
Mean Duration of Break from Sedentary Time, min[b]	266	3.3 (1.0)
Mean Intensity of Break, cpm/min	266	446.2 (81.2)

Abbreviations: cpm, counts per minute; min, minutes; SD, standard deviation

[a]A break from sedentary behavior is any single count ≥100 per minute.

[b]The period of continuous counts ≥100 per minute was defined as the mean duration of break from sedentary time.

Table 4.8 Breaks in Sedentary Behavior, According to Sociodemographic and Health-Related Variables.

		Breaks in Sedentary Behavior
	N	Mean #/day (SD)[a]
Total Sample	266	93.2 (16.6)
Age group		
<50 years	92	94.70 (1.53)[b]
50-59 years	96	95.48 (1.50)[b]
≥60 years	78	88.80 (1.66)[c]
		p=.0065
Gender		
Men	56	84.34 (1.92)[b]
Women	210	95.62 (0.98)[c]
		p<.0001
Education		
Less than HS graduate	24	85.93 (3.02)
HS grad or GED	72	93.39 (1.74)
Some college (1-3 years)	85	93.96 (1.61)
College graduate (4+ years)	85	94.47 (1.60)
		p=.0865
Marital status		
Married	151	93.58 (1.21)
Not married	115	92.79 (1.39)
		p=.6700
Income		
<$20,000	53	91.11 (2.05)
$20,000-$39,999	66	95.74 (1.84)
$40,000-$59,999	64	93.40 (1.87)
≥$60,000	55	92.91 (2.02)
Not reported	28	91.68 (2.83)

		p=.5129
Fruit and Vegetable Consumption		
<5 (servings/day)	204	92.64 (1.04)
≥5 (servings/day)	62	95.22 (1.90)
		p=.2343
Smoking status		
Smoker	15	88.02 (3.86)
Not smoker	251	93.55 (0.94)
		p=.1649
Weight Status		
Normal weight (BMI<25)	26	93.76 (2.93)
Overweight (25≥BMI<30)	83	94.30 (1.64)
Obese (BMI≥30)	157	92.60 (1.20)
		p=.6915
Hypertension		
Yes	157	92.77 (1.20)
No	109	93.93 (1.44)
		p=.5380
Waist Circumference, cm		
Normal	24	87.34 (1.90)[b]
Increased Risk	53	98.69 (1.97)[c]
Substantially Increased Risk	189	93.60 (1.17)[d]
		p=.0002
Self-rated health		
Excellent	16	91.51 (3.69)
Very good	71	93.13 (1.77)
Good	137	94.81 (1.27)
Fair	40	88.05 (2.34)
Poor	2	107.54 (10.44)
		p=.0754

Abbreviations: BMI, body mass index; cm, centimeters; min, minutes; SE, standard error; HS, high school; GED, general education degree

[a]adjusted for monitor wear time

[b,c,d]Different superscript letters indicate between group differences

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CHAPTER 5

RESULTS: MANUSCRIPT TWO

ASSOCIATIONS OF SEDENTARY BEHAVIORS AND HEALTH RISKS AMONG AFRICAN-AMERICAN ADULTS[2]

Background: Few studies have examined the association between high levels of sedentary behavior (SB) and chronic health conditions. The present study examined baseline associations between total SB time as well as bouts of and breaks in SB and health-related variables in AA adults.

Methods: SB was assessed with the ActiGraph GT1M accelerometer. Mean minutes per day sedentary, as well as total number of SB bouts ≥10, 30, and 60 minutes, and mean number of sedentary breaks were calculated in 266 AA adults (mean age 53.4±11.9). Associations with hypertension, obesity, and waist circumference were examined.

Results: After adjusting for all sociodemographic and health-related variables, total SB time was inversely associated with hypertension in the sample as a whole. Due to the small number of men, analyses limited to women were also conducted. After adjusting for all confounders, total SB time was positively associated with obesity and negatively associated with hypertension in women. Total number of SB bouts ≥10 minutes was positively associated with obesity in women, whereas total number of sedentary bouts ≥60 minutes was negatively associated with substantially increased waist circumference. Lastly, total number of breaks in SB was inversely associated with obesity in women.

[2]Warren-Jones, T.Y., S. Wilcox, B. Hutto, S. Blair, R. Pate, and H.M. Brandt. To be submitted to *Journal of Preventive Medicine*.

Conclusions: As hypothesized, bouts of SB were positively and breaks in SB were negatively associated with obesity. Unexpected relationships were found for hypertension and waist circumference. Additional studies, including those that employ longitudinal designs, are needed to better understand SB-health relationships in African Americans.

Key Words: African American, Public Health, Prevention of Chronic Disease, Health Behavior, Sedentary Behavior, Physical Activity

INTRODUCTION

The health risks associated with low levels of physical activity (PA) and high levels of sedentary behavior (SB) have received increased attention in recent years. There is growing evidence to suggest that total time spent in SB is a unique and distinct contributor to health risk (1), and that this risk appears to be independent of time spent in moderate- and/or vigorous-intensity PA (2-6). On average, most Americans report participating in high levels of sedentary activities (7, 8); and, until recently, only total time spent sedentary was a focal point of research. However, in 2008 Healy et al. (9) provided the first evidence to suggest that the manner in which sedentary time is accumulated should also be considered. Healy et al. (9) found that more breaks in SB were associated with improved cardio-metabolic health in Australian adults.

In 2011, Healy et al. objectively examined total sedentary time and breaks in sedentary time in relation to cardio-metabolic and inflammatory risk biomarkers, according to gender, age, and race/ethnicity using data from NHANES (8). Healy et al. (8) demonstrated similar findings for White Americans. They concluded that regular breaks (as short as 1 minute) from sedentary activities were associated with lower waist circumference risk and C-reactive protein. In addition, this study was unique in that it examined differences in the association between SB and health risk by race/ethnicity (8). Contrary to expectations, they found that *increased* total SB time was associated with *decreased* waist circumference in African Americans but not in Whites (8). Although these results may have been driven by unmeasured confounding factors, the authors underscored the importance of studying patterns in SB in more diverse populations.

Given the strong epidemiological evidence on the deleterious effects of total time spent in SB, there is a need to understand how the patterns in which sedentary time is achieved may be associated with chronic health conditions (10). To date only one study has examined *both* the associations of breaks in SB and bouts of SB and health; however this study was conducted with children and adolescents (2). In 2011 Carson et al. (2) found no association between overall volume (i.e. total SB time), breaks in, and bouts of SB with cardio-metabolic risk factors in a large sample of children and adolescents (6-19 years old) from the NHANES data set. However, when examining specific types of sedentary behavior, children and adolescents viewing TV ≥4 hours per day were 2.5 times more likely to have high cardio-metabolic risk factors (2).

The purpose of this study was to examine how total duration of SB as well as bouts of and breaks in SB related to health-related variables in African American adults. The specific objectives were to: (1) examine the association of total time spent sedentary with body mass index, waist circumference, and blood pressure, independent of moderate-to vigorous-intensity PA; (2) examine the associations of ≥10 minute, ≥30 minute, and ≥60 minute bouts of SB with body mass index, waist circumference, and blood pressure, independent of moderate-to vigorous-intensity PA and total SB time; and (3) examine the associations of breaks in SB with body mass index, waist circumference, and blood pressure, independent of moderate-to vigorous-intensity PA and total SB time. It was hypothesized that more total time spent sedentary and longer bouts of sedentary time (i.e. bouts ≥ 30 and 60 minutes) would be significantly associated with health-related risks, while more breaks in sedentary time would be associated with more favorable health-related variables in all participants.

METHODS

The Faith, Activity, and Nutrition (FAN) program was a PA and nutrition intervention implemented in African Methodist Episcopal (AME) churches. FAN used a community-based participatory research approach and was successful in increasing moderate- to vigorous-intensity PA and fruit and vegetable consumption in members of AME churches (11, 12).

Research Design

The FAN program used a group-randomized design with a delayed intervention control group, and took place in three waves. Outcome measures were taken at baseline and 15-months later (post-program) (12). This study uses baseline data only.

Church Recruitment

A letter introducing the FAN program from the Presiding Elders of four geographically-defined districts in South Carolina was mailed to 132 pastors within their district, and FAN staff followed up with a telephone call. If the FAN staff was unable to reach the pastor via telephone, an additional letter inviting the church to take part in the FAN program was mailed to both the pastor and the church's health director. Recruitment took place from 2007-2009 (12).

Procedures

Liaisons from interested churches recruited members of their congregation to take part in a measurement session. At each measurement session, participants completed an informed consent form that was approved by the Institutional Review Board at the University of South Carolina and by the FAN planning committee (University and church members). To be eligible, participants had to be at least 18 years of age, be free of serious medical conditions or disabilities that would make PA difficult (self-identified), and attend worship services at least once a month.

Upon providing consent to participate, staff-conducted physical measures were taken and participants completed a comprehensive survey. A subsample of participants was randomly chosen to wear an accelerometer following the measurement session.

Measures

Sociodemographic and Health-related Variables

Participants reported their gender, race, age, smoking status, marital status, employment status, and highest grade or years of education completed. Participants also rated their general health status on a scale from 1 (excellent) to 5 (poor).

Objective Physical Activity

The ActiGraph accelerometer (GT1M model, ActiGraph, LLC, Fort Walton Beach, FL) measured PA and SB. The ActiGraph is a small and lightweight device, which provides a direct, objective measure of PA and SB. The ActiGraph was worn on the right hip and measured accelerations of the body. Participants were instructed to wear the ActiGraph all waking hours, except when sleeping or immersed in water, for 7 consecutive days. In addition to wearing the ActiGraph, participants were asked to keep concurrent PA logs in which they summarized the amount of participation in selected activities performed during the day.

The GT1M model of the ActiGraph self-calibrates and utilizes a direct USB connection to initialize and download data. A 60-second epoch (time interval) was used. To be included in analyses, participants had to wear the monitor for a minimum of 3 days, including at least 1 weekend day, for at least 10 hours per day. This amount of monitoring has been recommended by Trost et al. to reliably estimate habitual PA among adults (13).

Using recommendations by Matthews' et al. (14), SB was classified as counts < 100 per minute. Freedson's et al. (15) three-category accelerometer cut-points were used to categorize PA behavior: light <1952 counts/minute, moderate 1952-5724 counts/minute, and vigorous ≥5725 counts/minute. In a sample of adults, data obtained from treadmill exercise at 3 different intensity levels showed that accelerometer counts were highly correlated with energy expenditure (r=0.93) (16). For the purpose of this study, the moderate- and vigorous-intensity categories were collapsed together. Additionally, since Matthews' cut-points of SB will be used for analysis, light-intensity PA is defined as counts of 100-1951 per minute.

Using SAS 9.2 the data reduction process began by identifying periods of non-wear time. Non-wear was defined as ≥60 consecutive minutes of counts equaling zero. We assumed participants were not wearing the monitor during this time and therefore data were not included in the computation of SB. Total SB time was defined as the mean total time spent sedentary (7, 8). A bout of SB was defined as any continuous period of counts <100 counts/minute. The sedentary bout patterns were determined by summing continuous minutes of SB with no allowable interruptions in the sedentary bout ranges of ≥10 minutes, ≥30 minutes and ≥60 minutes. The number of bouts and mean length of bouts in the aforementioned ranges were calculated. A break in SB was defined as interruptions or transitions from sedentary (<100 counts/minute) to a more active state (≥100 counts/minute). The number of breaks (minimum 1 minute), mean duration of breaks, and mean intensity of breaks was also calculated (8, 9). ActiGraph data was assigned to one of three categories: (1) non-wear SB, (2) bouts of SB, or (3) breaks in SB, with no allowance for overlap.

Fruit and Vegetable Consumption

The National Cancer Institute fruit and vegetable 9-item all-day screener was used to assess participant's fruit and vegetable consumption (item regarding French fries was not asked). This measure asks about different types of fruits and vegetables and portion sizes for each in the past month. This scale has been shown to correlate moderately with 24-hour dietary recall of fruit and vegetable consumption (17), which is considered the gold standard in dietary research. The unit of measurement for the present study was cups/day of fruit and vegetable consumption.

Body Mass Index

Measurements of height and weight were obtained by trained FAN staff. Participants were asked to remove shoes, excess or bulky clothing, and all items from their pockets. Height to the nearest quarter inch was measured using a Seca stadiometer. Weight to the nearest tenth of a kilogram was measured using a Seca 770 scale. Body mass index (BMI) was calculated as kg/m^2 using standard procedures. Measurements of BMI will be categorized as normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese ($\geq$30 kg/m^2).

Waist Circumference

The narrowest part of the participant's torso (or the minimum circumference between the rib cage and the iliac crest) was then located. An anthropometric measuring tape was applied to the identified area, with the participant standing upright and at the end of expiration. The circumference of the waist was measured two times and recorded to the nearest tenth of a centimeter. If the two measures varied by more than three centimeters, a third measure was taken. The average of the two closest measurements (within two centimeters) was used for statistical analyses. Participants were categorized as normal (<80 cm for women; <101 cm for men), increased risk (80-88 cm for women; 101-108 cm for men), or substantially increased risk (>88 cm for women; >108 cm for men) on the basis of the World Health Organization's standards for increased health risk associated with waist circumference (18, 19).

High Blood Pressure

Participants were asked to sit quietly for five minutes with legs uncrossed (11). The automated DinaMap ProCare Monitor (DPC -100X-EN) was used to obtain resting blood pressure taken three times on the right arm with at least a 30 seconds rest between each measurement. The average of the second and third measures was retained. Participants with a systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg classified as hypertensive. Because participants may have had controlled hypertension, self-reported presence or absence of hypertension was also assessed by asking participants, "Have you ever been told by a doctor, nurse, or other health professional that you may have high blood pressure?" A participant was considered to have hypertension if his/her measured blood pressure indicated hypertension or if he/she self-reported hypertension.

Statistical Analyses

Means (SD) were calculated for all continuous variables, and frequencies for all categorical variables. Linear regression models for each health-risk dependent variable

(BMI and waist circumference) were conducted in a series of models. Logistic regression models for hypertension as the dependent variable were also conducted in a series of models. Separate regression models were conducted for total SB time, bouts of (≥10, 30, and 60 minutes) SB and breaks in SB as the independent variables. First, the relationship between the health outcome and each individual type of SB (total, ≥10 minute bouts, ≥30 minute bouts, ≥ 60 minute bouts, breaks) was tested separately unadjusted for confounders *(Model 1).* Next, each model was adjusted for sociodemographic variables: age, gender, education, employment status, and marital status (*Model 2)*. Next, each model was adjusted for all health-related variables: smoking status, total fruit and vegetable consumption, total moderate-to-vigorous intensity PA, general health, body mass index, waist circumference, and hypertension (*Model 3)*. Lastly, in *Model 4* for the models that tested SB bouts (≥10, 30, and 60 minutes), adjustments for total SB time and mean intensity of breaks from SB were also included in addition to sociodemographics and health-related variables. In *Model 4* for the models that tested breaks in SB, the models were also adjusted for total SB time in addition to sociodemographics and health-related variables. All models were adjusted for monitor wear time. Data are presented as odds ratios (OR) ± 95% confidence intervals. Odds ratios for a 10-, 30-, and 60-minute per day increase in total SB time relative to health outcomes are reported for final adjusted models (*Model 4*). Statistical significance was accepted at $P<.05$. All statistical analyses were performed using SAS (version 9.2; SAS Institute, Inc., Cary, N.C.).

RESULTS

At baseline, 1307 participants from 74 churches were recruited into the larger FAN study and had baseline data. A total of 464 participants were selected to wear the

ActiGraph; 410 agreed to wear it. Twenty-nine participants did not return their monitor and an additional 115 participants had unusable data (due to equipment failure, participants not meeting monitor wear time criteria, missing outcomes, and missing covariates). As shown in Figure 1, 266 participants had usable data. Participants averaged 53.4 years of age, most were women (79%), and most were overweight or obese (90%). Of the total sample, 59% had self-reported and/or objectively measured hypertension, and 57.5% had objectively measured substantially increased waist circumference. The mean BMI was 32.7 kg/m^2. Baseline characteristics of participants have been previously reported elsewhere (12). Participants wore the monitor on average 875.5 ± 106.1 minutes per day (14.6 hours per day). On average participants were sedentary 567.1 ± 106.6 minutes per day (65.1% of wear time).

Table 2 shows mean minutes of total SB time participation according to selected variables. Obese participants had significantly more total daily SB compared to normal weight and overweight participants. Obese men and men with substantially increased waist circumference had significantly more total daily SB compared to normal weight and overweight men, and men with normal waist circumference, respectively.

In the total sample, the mean intensity of total wear time was 234.7 counts per minute (i.e., equivalent to light-intensity PA). The number of bouts (total bouts of any duration, ≥10 minutes, ≥ 30 minutes, ≥60 minutes) of SB, and mean number of breaks in SB are shown in Table 3. On average, participants engaged in 93.6 bouts of (any duration) SB per day, each bout averaged 6.6 minutes. All participants (N=266) engaged in ≥1 daily bout of SB that lasted ≥10 and ≥30 minutes, and most (93%) engaged in ≥1 bout lasting ≥60 minutes. On average, there were 15.2 bouts of daily SB lasting ≥10 minutes (mean duration = 23.0 minutes), 3.0 bouts lasting ≥ 30 minutes (mean duration= 50.8 minutes), and 0.7 bouts lasting ≥60 minutes (mean duration= 86.6 minutes). On average, participants took 93.2 ±16.6 breaks from SB; each break lasted 3.3±1.0 minutes and mean intensity of break from SB was 446.2±81.2 counts per minute (i.e., equivalent to light-intensity PA).

Total Sample

Total Time in Sedentary Behavior

Table 4 shows the adjusted odds ratios (OR) and 95% confidence intervals for the health-related outcomes of interest. Total SB time was significantly and inversely associated with hypertension in *Model 4* (OR 0.996, CI 0.993-0.999). Because it is not particularly meaningful to consider one-minute increases in sedentary time relative to health outcomes, Table 5 reports odds ratios for a 10-, 30-, and 60-minute per day increase in total SB time in the total sample. A 60 minute/day increase in total SB time was associated with 21% decrease in hypertension (OR 0.790, CI 0.650-0.960). There were no significant associations between total SB time and objectively measured waist circumference (OR 0.999, CI 0.993-1.004) or obesity (OR 1.005, CI 1.000-1.011), in *Model 4* which controlled for all covariates. However, in both the unadjusted model (*Model 1*) and *Model 2* (adjusted for sociodemographic variables), total SB time was positively associated with higher rates of obesity (OR 1.004, CI 1.001-1.006 and OR 1.005, CI 1.002-1.008). No other significant associations were observed.

Bouts of Sedentary Behavior

As shown in Table 4, after adjusting for all sociodemographic and health-related variables (*Model 4*), total number of SB bouts ≥10, ≥30 and ≥60 minutes were unrelated to waist circumference risk, hypertension or obesity in the sample as a whole (p>.05). However, in *Model 2* (adjusted for sociodemographic variables) number of SB bouts ≥10 minutes and ≥ 30 minutes were significantly associated with higher rates of waist circumference risk (p<.05). In both the unadjusted model (*Model 1*) and *Model 2* (adjusted for sociodemographic variables), SB bouts ≥ 10 and ≥30 minutes were associated with higher rates of obesity. Lastly, only in *Model 2* were SB bouts ≥60 minutes associated with higher rates of obesity (OR 1.008, CI 1.002-1.013).

Breaks in Sedentary Behavior

As shown in Table 4, the number of breaks in SB was unrelated to waist circumference risk, hypertension, and obesity in all models.

Women Only Sample

Total Time in Sedentary Behavior

Due to the small number of men in the sample, and the possibility that associations could differ by gender, analysis was then restricted to women. As shown in Table 6, after adjusting for multiple confounders in *Model 4*, total SB time was negatively associated with hypertension (OR 0.994, CI 0.990-0.998). In addition, total SB time was positively associated with obesity (OR 1.007, CI 1.000-1.014). As shown in Table 7, a 60 minute/day increase in total SB time was associated with 29.4% decrease in hypertension (OR 0.706, CI 0.552-0.904) and 54.2% increase in obesity (OR 1.542, CI 1.022-2.326). Total SB time was unrelated to waist circumference risk.

Bouts of Sedentary Behavior

After adjusting for all confounders (*Model 4),* SB bouts ≥60 minutes were inversely associated with substantially increased waist circumference (OR 0.968, CI

0.942-0.995). Total number of SB bouts ≥10 minutes was positively associated with obesity (OR 1.026, CI 1.004-1.048. For unadjusted models (*Model 1*) SB bouts ≥10 and ≥30 minutes were associated with obesity in women. Additionally, total number of SB bouts ≥10, ≥30, and ≥60 minutes were associated with obesity in women in *Models 2 and 3*. Number of bouts ≥10, ≥30, and ≥60 minutes was unrelated to hypertension in all models.

Breaks in Sedentary Behavior

Every break in SB was associated with a 5% lower risk of obesity (OR 0.952, CI 0.908-0.999) among women after controlling for all covariates in *Model 4*. Total breaks in SB were unrelated to substantially increased waist circumference risk or hypertension in women.

DISCUSSION

The prevalence of obesity and hypertension is highest among African Americans (20). In the present study, 59% of the sample had self-reported and/or objectively measured hypertension and 59% were obese, rates much higher than the 44% and 36% reported by the American Heart Association and Centers for Disease Control and Prevention. One behavioral risk factor that may contribute to the disparities in chronic health conditions is low levels of PA or high levels of SB. This study examined the associations between SB (total time, bouts, and breaks) and health-related variables in African American adults.

Few studies have objectively quantified SB (total volume) and/or examined patterns (bouts and breaks in bouts) of SB (10); and even fewer have assessed the association in patterns of SB with chronic health conditions (2, 8, 9). African American adults spend a majority of their day sedentary (4) and in the present study participants were sedentary on average 9.5 hours/day. High amounts of SB among participants in this study compare to a previously published study of overweight and obese African American women entering a weight loss trial in South Carolina (10); however, proportions were greater than that found in other studies (8, 9, 14). Additionally, the amount of time spent sedentary exceeded that of an 8 hour sedentary work day which suggests that adults are accumulating SB in different environments (i.e. work, home, leisure). Thus, there is a need to understand not only how total volume of SB time may be associated with health risks in adults, but also how various patterns in which SB is achieved relates to health, in populations most at risk for chronic health conditions (i.e. minority, overweight/obese). In the present study, obese persons had significantly more SB than normal weight and overweight persons.

A novel approach employed in this study was to examine how various bout durations (≥10, 30 and 60 minutes) and break patterns of SB related to health risk among African American adults. In the final model that controlled for sociodemographics, health-related variables, and intensity of breaks in SB, the only significant finding for the full sample was one that was contrary to hypotheses: total SB time was *inversely* associated with hypertension. However, significant associations were seen for the models including fewer potential confounders. Total SB time was positively associated with obesity in the unadjusted model and in the model that only controlled for sociodemographics. The same pattern of findings was seen for number of SB bouts ≥10, ≥30, and ≥60 minutes. Waist circumference risk was also positively associated with SB bouts ≥10 and ≥30 minutes after controlling for sociodemographic variables (*Model 2*).

No associations were observed between mean number of breaks in SB and health risks in the total sample. Although this study set out to assess all African American adults there are known gender differences in PA behavior, and the number of men in the sample was very small. Therefore, analyses were repeated restricted to women.

When analyses were restricted to women, total SB time was associated with obesity and hypertension after controlling for multiple confounders. In all models, greater total SB time was associated with a greater risk of obesity in women, as predicted. However, as was seen in the overall sample, and contrary to hypotheses, *greater* total SB time was associated with a *lower* risk of hypertension in African American women.

It is difficult to explain the inverse association between total SB time and hypertension. Very few studies have examined objectively measured SB time and hypertension. Healy et al. (9) found no independent association between systolic or diastolic blood pressure and total SB time in Australian adults. It is important to note that Healy et al. controlled for medication use in statistical analysis. The present study did not assess anti-hypertensive medication use or methods for controlling high blood pressure.

More recently, Healy et al. (8) found an inverse relationship between objectively measured total SB time and waist circumference in African American women. In the present study, although substantially increased waist circumference was *not* found to be associated with total SB time in women, total number of SB bouts ≥60 minutes was associated with *lower* rates of substantially increased waist circumference. This association was unexpected but consistent with that of Healy et al. (8). A likely explanation is that prolonged periods of SB time may have significant deleterious health affects in comparison to the total SB time accumulated per day. For example, two individuals can have the same total SB time in a day but one individual accumulates their SB time in small bouts as opposed to another person who accumulates their SB in bouts ≥60 minutes.

In addition to total SB time and specific types of SB, the manner in which SB is achieved and accumulated may also be important (25-28). Successful, efficient, and innovative intervention approaches are needed to address the health concerns of Americans. For individuals at increased risk for diseases and health conditions who have not embraced an organized or structured program of daily PA, reducing total SB and even SB bout duration may be a more achievable and viable approach to increasing movement and energy expenditure (29-31), eventually resulting in reduced health risk (i.e. weight loss, reduced waist circumference, and blood pressure).

The relationships between total SB time and obesity risk in women was consistent with hypotheses and consistent with the growing evidence that shows that time spent in SB is a unique and distinct contributor to health risk (6, 21-24), and that this risk appears to be independent of time spent in moderate and/or vigorous PA (3, 7). Baruth et al. (10) provided the first assessment of SB patterns in African American women by quantifying bouts of and breaks in SB in relation to time of day and type of day. However, this sample was comprised of overweight and obese women entering a weight loss trial. Further this study did not examine bouts of and breaks in SB according to sociodemographic and health-related variables. Few studies have examined the prevalence of chronic health conditions such as obesity, hypertension, and waist circumference and objectively measured SB in a large sample of African Americans.

Our study underscores that SB bout duration also matter. While only number of bouts ≥10 minute related to obesity in the final adjusted model for women, number of bouts ≥10 minutes, ≥30 minutes, and ≥60 minutes related to obesity in all of the other models that adjusted for sociodemographics and health-related variables. Furthermore, total number of breaks in SB was associated with obesity in African American women. Two studies have examined the association between breaks in objectively measured SB and health risks (8-9). Healy et al. (9) reported that an increased number of breaks in SB were associated with an improved cardio-metabolic health in Australian adults. Additionally, compared to participants in the lowest quartile of breaks, individuals in the highest quartile had on average a 5.95cm lower waist circumference (p=0.025) and there was a trend (p-trend=0.198) for lower obesity (9).

In a more recent population-based study by Healy et al. (8), findings for White Americans and African Americans were consistent with those observed among Australian adults (9). Researchers concluded that increasing the number of breaks in SB could possibly reduce observed health risks (8). To date no other studies have previously published this positive association among African American adults. Previously cited studies assessing breaks in SB have largely been conducted with Caucasian populations (8, 9, 14, 32). Gibbs et al. (32) concluded that a major research gap is the lack of longitudinal studies with objectively-measured SB, making assessments of the association between objectively measured SB and health risks a research priority. Specifically, studies with inclusion of more diverse populations are needed (32).

This study has several strengths including the use of objective measures of SB and blood pressure in a moderately large sample of African American adults. We also recognize study limitations including the relatively low number of men in our sample. In addition, selection of study participants (i.e. recruited African American adults from one denomination of churches in several regions of one state) may have been a limitation for generalizability. In particular, the majority of participants in our sample were overweight (31.2%) or obese (59.0%), with hypertension (59.0%), and a waist circumference that placed them at risk or substantial risk for negative health outcomes. It might be necessary to have a larger proportion of participants with more favorable health profiles to see associations (i.e., restriction of range problem). Additionally, the cross-sectional study design does not allow researchers to determine the causal relationship between SB and health risks observed. In the present study, there was no medical record confirmation of hypertension and therefore measured and self-reported presence of hypertension was assessed. Lastly, there are limitations in the use of ActiGraph for measuring SBs, or when differentiating low counts of accelerometer activity for standing and sitting behaviors (32). Trost et al. (13) suggests there is more research to do in conducting accelerometer-based activity assessments in field-based research to minimize limitations with the use of ActiGraph.

African Americans, and African American women in particular, are disproportionately affected by adverse health conditions (20). In addition, weight loss programs that target PA, diet, and behavior change have been less successful in African American women related to white women. Interventions that target SB along with other health behaviors among African American women may hold promise for reducing disparities. There is a need to continue exploring novel strategies to addressing these needs. Additionally, larger samples of African American men are needed to examine whether there are gender differences in the health risks of SB. Currently, there are no current public health recommendations for SB in adults. Current recommendations for children suggest limiting SB (i.e. screen activities) to 2 hours daily. Further examination of various SB bout patterns in addition to total SB time will help to expand on current public health recommendations regarding PA and dietary behaviors in American adults.

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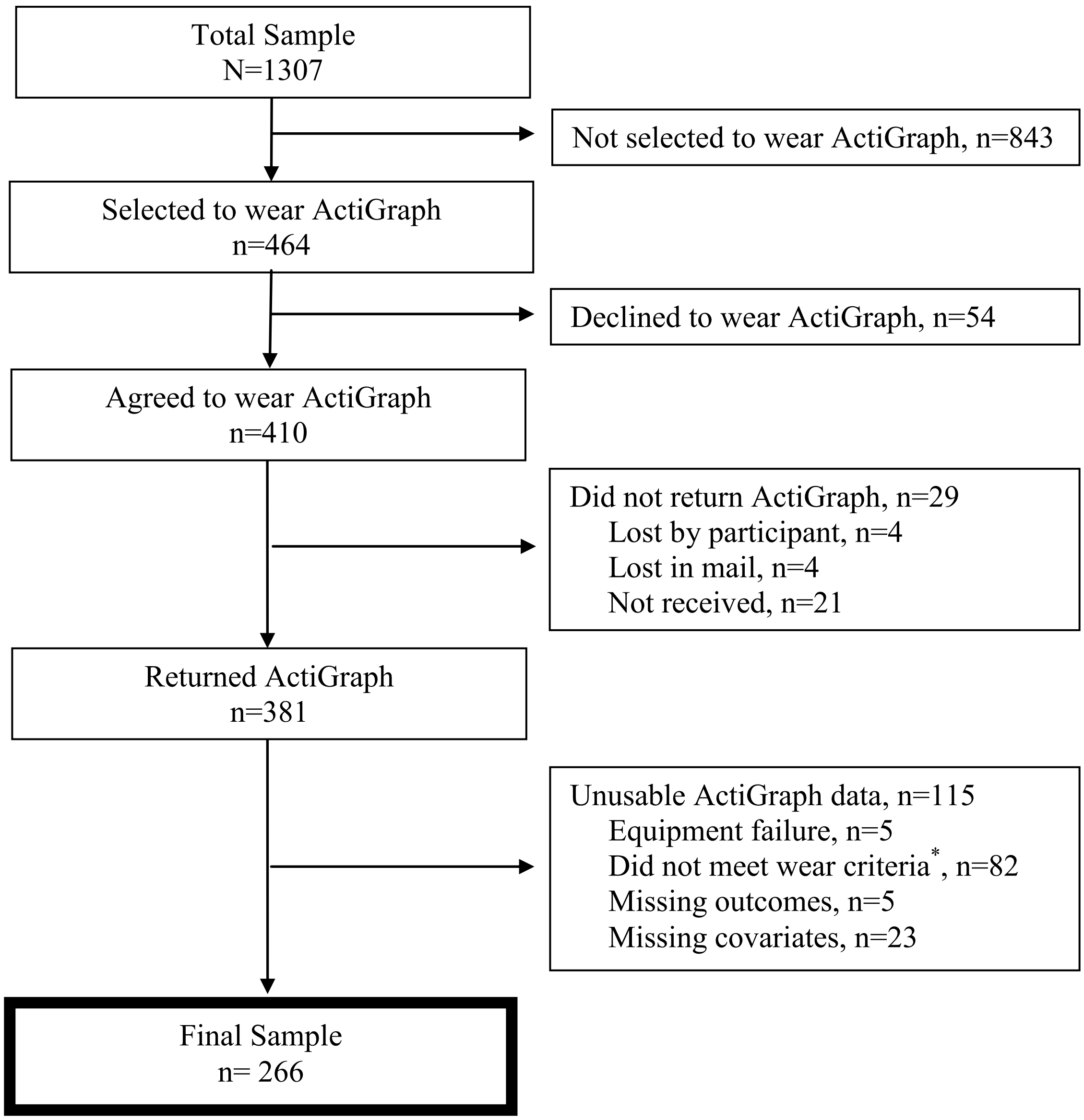

*Study participants did not meet wear criteria of ≥ 10 hours per day and/or ≥3 days of valid accelerometer data including at least 1 weekend day.

Figure 5.1 Study inclusion flow chart.

Table 5.1 Characteristics of the Sample (N=266)

	N	% or Mean (SD)
Age, years	266	53.4 (11.9)
Gender		
Male	56	21.1
Female	210	79.0
Education		
Less than high school graduate	24	9.0
High school graduate or GED	72	27.1
Some college (1-3 years)	85	32.0
College graduate (4+ years)	85	32.0
Marital status		
Married	151	56.8
Not married	115	43.2
Smoking status		
Smoker	15	5.6
Not smoker	251	94.4
Income		
Not reported	28	10.5
<$20,000	53	19.9
$20,000-$39,000	66	24.8
$40,000-$59,000	64	24.1
≥$60,000	55	20.7

Self-rated health		
Excellent	16	6.0
Very good	71	26.7
Good	137	51.5
Fair	40	15.0
Poor	2	0.8
Fruit and vegetable consumption (cups/day)	266	3.4 (1.8)
<5 cups per day	204	76.7
≥5 cups per day	62	23.3
Moderate- to vigorous-intensity PA (min/day)[b]	266	15.2 (13.6)
Light PA (min/day)[b]	266	293.7 (82.5)
Sedentary behavior (min/day)[b]	266	567.1 (106.6)
BMI, kg/m^2	266	32.7 (7.3)
Weight status		
Normal weight (BMI<25 kg/m^2)	26	9.8
Overweight (25≥BMI<30 kg/m^2)	83	31.2
Obese (BMI≥30 kg/m^2)	157	59.0
Hypertension		
Yes	157	59.0
No	109	41.0
Waist circumference for women (cm)	210	96.7 (15.2)
Normal for women (<80 cm)	22	10.5
Increased Risk for women (80-88 cm)	44	21.0
Substantially Increased Risk for women (>88 cm)	144	68.5

Waist Circumference for men (cm)	56	97.5 (11.3)
Normal for men (<101 cm)	37	66.0
Increased Risk for men (101-108 cm)	10	17.9
Substantially Increased Risk for men (>108 cm)	9	16.1

Abbreviations: BMI = body mass index; min = minutes; cm = centimeters; GED = general educational development

Table 5.2 Minutes per day of Sedentary Behavior of Participants, by Sociodemographic and Health-Related Characteristics.

	Total Sample **N=266**	**Women** **n=210**	**Men** **n=56**
	Mean min/day (SE)[#]	Mean min/day (SE)[#]	Mean min/day (SE)[#]
Total Sample	567.1 (6.5)	565.5 (6.7)	572.9 (13.1)
Age group			
<50 years	569.1 (10.1)	557.1 (10.6)	618.5 (28.4)
50-59 years	556.3 (9.9)	550.1 (10.5)	578.7 (25.5)
≥60 years	578.0 (11.0)	581.5 (11.6)	565.0 (29.1)
	p=.3307	p=.1181	p=.4080
Education			
Less than high school graduate	554.3 (19.6)	562.2 (21.5)	533.2 (47.0)
High school graduate or GED	560.9 (11.3)	557.8 (12.2)	572.7 (28.9)
Some college (1-3 years)	552.3 (10.4)	547.8 (11.1)	569.7 (28.1)
College graduate (4+ years)	590.6 (10.4)	578.5 (11.1)	637.8 (27.8)
	p=.0516	p=.2687	p=.1672
Marital status			

Married	567.9 (7.9)	558.2 (8.5)	602.3 (20.0)
Not married	565.9 (9.0)	566.0 (9.5)	564.1 (24.8)
	p=.8678	p=.5391	p=.2360
Income			
<$20,000	558.5 (13.3)	560.3 (13.7)	540.8 (40.1)
$20,000-$39,999	557.2 (11.9)	552.8 (12.4)	575.6 (34.1)
$40,000-$59,999	570.2 (12.1)	560.4 (12.9)	607.3 (31.5)
≥$60,000	593.5 (13.0)	578.3 (14.9)	633.0 (27.7)
Not reported	547.5 (18.3)	560.9 (20.1)	510.9 (42.8)
	p=.1713	p=.7746	p=.1134
Fruit and vegetable consumption			
<5 (servings/day)	568.7 (6.8)	566.0 (7.2)	578.7 (17.6)
≥5 (servings/day)	561.7 (12.4)	547.7 (12.9)	618.9 (34.0)
	p=.6210	p=.2192	p=.3003
Smoking status			
Smoker	554.3 (25.2)	583.1 (29.1)	502.4 (52.0)
Not smoker	567.8 (6.1)	560.6 (6.5)	595.6 (16.1)
	p=.6024	p=.4525	p=.0933

Weight status			
Normal weight (BMI<25)	534.7 (18.7)[a]	542.6 (20.8)	519.1 (42.5)[a]
Overweight (25≥BMI<30)	548.3 (10.5)[a]	541.3 (12.2)	567.3 (21.6)[a]
Obese (BMI≥30)	582.3 (7.6)[b]	572.8 (7.8)	633.6 (23.8)[b]
	p=.0067	p=.0615	p=.0332
Hypertension			
Yes	569.1 (7.8)	561.7 (8.1)	575.8 (22.6)
No	564.2 (9.4)	561.6 (10.2)	598.1 (21.8)
	p=.6915	p=.9948	p=.4825
Waist circumference, cm^			
Normal	554.1 (12.7)	563.4 (19.5)	559.7 (18.4)[a]
Increased risk	559.6 (13.2)	547.9 (13.8)	612.3 (35.5)[a,b]
Substantially increased risk	574.7 (7.8)	565.6 (7.6)	673.3 (37.2)[b]
	p=.3205	p=.5285	p=.0252
Self-rated health			
Excellent	594.5 (24.2)	589.7 (37.6)	608.7 (36.8)
Very good	560.3 (11.6)	563.1 (12.4)	550.4 (30.4)
Good	561.8 (8.3)	556.6 (8.6)	583.3 (24.5)

Fair	585.1 (15.4)	570.6 (16.3)	641.3 (41.1)
Poor	586.1 (68.5)	583.3 (65.1)	n/a
	p=.4807	p=.8555	p=.3238

Abbreviations: SE = standard error; GED = general education development; min = minutes; BMI = body mass index; cm = centimeters.

Different letter subscripts indicate groups differ by $p < .05$.

[#]Adjusted for monitor wear time

[^l]Waist circumference risk defined according to World Health Organization (16): normal risk, women <80 cm and men <101 cm; increased risk, women 80-88 cm and men 101-108 cm; substantially increased risk, women >88 cm and men >108 cm

Table 5.3 Daily Volume, Bouts, and Breaks in Sedentary Behavior among Study Participants.

	Total (N)	**Mean (SD)**
Total wear time, min	266	875.5 (106.1)
Mean intensity, cpm	266	234.7 (99.5)
Total bouts of sedentary behavior (any duration) [a]		
Number of Bouts[b]	266	93.6 (16.7)
Length of Bouts, min[c]	266	6.6 (2.1)
≥10 minute bouts of sedentary behavior[a]		
Number of Bouts[b]	266	15.2 (3.8)
Length of Bouts, min[c]	266	23.0 (4.2)
≥30 minute bouts of sedentary behavior[a]		
Number of Bouts[b]	266	3.0 (1.5)
Length of Bouts, min[c]	266	50.8 (10.3)
≥60 minute bouts of sedentary behavior[a]		
Number of Bouts[b]	266	0.7 (0.6)
Length of Bouts, min[c]	247[d]	86.6 (21.6)
Total breaks in sedentary behavior[e]	266	93.2 (16.6)
Duration of breaks from sedentary behavior, min[f]	266	3.3 (1.0)
Intensity of breaks from sedentary behavior, cpm/min	266	446.2 (81.2)

Abbreviations: SD = standard deviation; cpm = counts per minute; min = minutes

[a]A bout of sedentary behavior is an uninterrupted period of time spent sedentary as defined by accelerometer counts <100 per minute

[b]Number of bouts refers to the mean number of sedentary behavior bouts ≥10, 30, or 60 minutes

[c]Length of bouts refers to the mean length of a continuous sedentary behavior bout of ≥10, 30, or 60 minutes

[d]The number of participants who had at least one sedentary behavior bout of ≥60 minutes

[e]A break from sedentary behavior is any single count ≥100 per minute

[f]The period of continuous counts ≥100 per minute was defined as the mean duration of break from sedentary behavior

Table 5.4 Associations Between Sedentary Behavior and Waist Circumference Risk, Body Mass Index, and Hypertension among the total Sample of African American Adults

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Total Time in Sedentary Behavior, total mins/day SB								
Waist circumference[a,d] (substantially increased risk)	1.000	0.998-1.003	1.003	1.000-1.006	0.996	0.992-1.001	0.999	0.993-1.004
Blood pressure status[b] (hypertensive)	0.999	0.997-1.001	0.999	0.996-1.001	0.997	0.995-1.000	0.996*	0.993-0.999
Weight status[c] (obese)	1.004*	1.001-1.006	1.005*	1.002-1.008	1.004	1.000-1.008	1.005	1.000-1.011
Bouts of Sedentary Behavior, total number of bouts								
Waist circumference[a,d] (substantially increased risk)								
Number of ≥ 10 min bouts	1.001	0.998-1.003	1.004*	1.001-1.007	0.996	0.992-1.000	1.003	0.988-1.017
Number of ≥ 30 min bouts	1.000	0.998-1.004	1.004*	1.001-1.008	0.995	0.990-1.000	0.998	0.985-1.010
Number of ≥ 60 min bouts	1.001	0.996-1.005	1.006	1.000-1.012	0.994	0.987-1.002	0.997	0.981-1.013

Blood pressure status[b] (hypertensive)								
Number of ≥ 10 min bouts	1.000	0.998-1.002	0.999	0.997-1.002	0.998	0.995-1.001	1.000	0.992-1.008
Number of ≥ 30 min bouts	1.001	0.998-1.004	1.000	0.996-1.003	0.998	0.994-1.001	1.001	0.995-1.007
Number of ≥ 60 min bouts	1.002	0.998-1.007	1.002	0.996-1.007	0.998	0.993-1.004	1.003	0.995-1.011
Weight status[c] (obese)								
Number of ≥ 10 min bouts	1.004*	1.002-1.007	1.006*	1.003-1.009	1.003	0.999-1.007	1.016	1.000-1.031
Number of ≥ 30 min bouts	1.004*	1.001-1.007	1.007*	1.003-1.011	1.002	0.996-1.007	1.010	0.997-1.024
Number of ≥ 60 min bouts	1.005	1.000-1.009	1.008*	1.002-1.013	1.002	0.995-1.010	1.016	1.000-1.032
Breaks in sedentary behavior, total number of breaks SB								
Waist circumference[a,d] (substantially increased risk)	0.997	0.982-1.012	0.984	0.966-1.002	1.006	0.983-1.029	1.001	0.968-1.036
Blood pressure status[c] (hypertensive)	0.987	0.972-1.002	0.986	0.969-1.004	0.993	0.976-1.011	0.993	0.973-1.014
Weight status[b] (obese)	0.996	0.981-1.011	0.990	0.974-1.006	1.006	0.983-1.030	0.976	0.943-1.010

Abbreviations: SB= sedentary behavior, OR = odds ratio, 95% CI = 95% confidence interval

[a]Reference category is increased risk and normal combined

[b]Reference category is overweight and normal combined

[c]Reference category is normotensive

[d]Waist circumference risk defined according to World Health Organization guidelines (16): normal risk, women <80 cm and men <101 cm; increased risk, women 80-88 cm and men 101-108 cm; substantially increased risk, women >88 cm and men >108 cm

[e]Separate models were tested for each category of bout behavior (≥10, ≥30, and ≥60 minutes)

[f]Model 1 is unadjusted for covariates

[g]Model 2 adjusted for sociodemographic variables: age, gender, education, employment status, marital status; and total wear time

[h]Model 3 adjusted for health-related variables: smoking status, total fruit and vegetable consumption, moderate-to-vigorous-intensity physical activity, general health status, body mass index, and hypertension; and total wear time

[i]Model 4 adjusted for all sociodemographic and health-related variables; bouts model also adjust for total sedentary time and mean intensity of breaks from sedentary behavior; breaks model also adjust for total sedentary time and mean intensity of breaks from sedentary behavior

Table 5.5 Odds Ratios for the Presence of Waist Circumference Risk, Body Mass Index, and Hypertension per 10-, 30-, and 60-minute/day Increase in Sedentary Behavior among the total Sample of African American Adults

	10-Minute/Day[^]		**30-Minute/Day**[^]		**60-Minute/Day**[^]	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Total Sample Time in Sedentary Behavior, total mins/day SB						
Waist circumference[a,d] (substantially increased risk)	.987	0.935-1.042	0.961	0.818-1.130	0.924	0.669-1.276
Blood pressure status[b] (hypertensive)	0.961*	0.931-0.993	0.889*	0.806-0.980	0.790*	0.650-0.960
Weight status[c] (obese)	1.055	0.996-1.117	1.172	0.987-1.393	1.375	0.974-1.940

Abbreviations: OR = odds ratio, 95% CI = 95% confidence interval, mins=minutes

[a]Reference category is increased risk and normal combined

[b]Reference category is normotensive

[c]Reference category is overweight and normal combined

[d]Waist circumference risk defined according to World Health Organization guidelines (16): normal risk <80 cm; increased risk 80-88 cm and; substantially increased risk >88 cm

[^]Final Models adjusted for age, gender, education, employment status, marital status, smoking status, total fruit and vegetable consumption, moderate-to vigorous-intensity physical activity, general health status, body mass index, and hypertension; and total wear time

*$p<.05$

Table 5.6 Association of Waist Circumference Risk, Body Mass Index, and Hypertension with Sedentary Behavior among the Sample of African American Women

	Model 1		Model 2		Model 3		Model 4	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Total time in sedentary behavior, total mins/day SB								
Waist circumference[a,d] (substantially increased risk)	1.001	0.998-1.004	1.001	0.998-1.005	0.996	0.990-1.003	0.996	0.988-1.004
Blood pressure status[b] (hypertensive)	0.998	0.996-1.001	0.996*	0.993-1.000	0.997	0.994-1.000	0.994*	0.990-0.998
Weight status[c] (obese)	1.004*	1.001-1.007	1.005*	1.002-1.009	1.007*	1.001-1.013	1.007*	1.000-1.014
Bouts of sedentary behavior, total number of bouts								
Waist circumference[a,d] (substantially increased risk)								
Number of ≥ 10 min bouts	1.002	0.998-1.003	1.003	1.001-1.007	0.997	0.992-1.000	1.000	0.980-1.021
Number of ≥ 30 min bouts	1.003	0.998-1.004	1.003	1.001-1.008	0.996	0.988-1.005	0.990	0.972-1.008
Number of ≥ 60 min bouts	1.005	0.996-1.005	1.004	1.000-1.012	0.992	0.979-1.005	0.968*	0.942-0.995

Blood pressure status[b] (hypertensive)								
Number of ≥ 10 min bouts	0.999	0.997-1.002	0.997	0.994-1.000	0.998	0.995-1.001	1.000	0.992-1.008
Number of ≥ 30 min bouts	1.000	0.997-1.004	0.997	0.993-1.002	0.998	0.993-1.002	0.999	0.995-1.007
Number of ≥ 60 min bouts	1.002	0.996-1.007	0.998	0.991-1.005	0.997	0.990-1.003	0.999	0.995-1.011
Weight status[c] (obese)								
Number of ≥ 10 min bouts	1.005*	1.002-1.008	1.006*	1.003-1.010	1.008*	1.002-1.014	1.026*	1.004-1.048
Number of ≥ 30 min bouts	1.006*	1.002-1.011	1.007*	1.002-1.012	1.010*	1.001-1.019	1.016	0.997-1.036
Number of ≥ 60 min bouts	1.008	1.001-1.015	0.997*	1.001-1.016	1.015*	1.001-1.030	1.021	1.000-1.041
Breaks in sedentary behavior, total number of breaks SB								
Waist circumference[a,d] (substantially increased risk)	0.984	0.966-1.003	0.984	0.964-1.005	0.992	0.956-1.030	1.007	0.959-1.057
Blood pressure status[c] (hypertensive)	0.983	0.966-1.001	0.984	0.963-1.005	0.988	0.968-1.009	0.993	0.968-1.018
Weight status[b] (obese)	0.990	0.973-1.008	0.989	0.970-1.008	0.993	0.960-1.026	0.952*	0.908-0.999

Abbreviations: SB= sedentary behavior, OR = odds ratio, 95% CI = 95% confidence interval

[a]Reference category is increased risk and normal combined

[b]Reference category is normotensive

[c]Reference category is overweight and normal combined

[d]Waist circumference risk defined according to World Health Organization guidelines (16): normal risk <80 cm; increased risk 80-88 cm and; substantially increased risk >88 cm

[e]Model tested each individual bout of sedentary behavior separately (≥10, ≥30, and ≥60 minutes)

[f]Model 1 is unadjusted for covariates

[g]Model 2 adjusted for sociodemographic variables: age, education, employment status, marital status; and total wear time

[h]Model 3 adjusted for health-related variables: smoking status, total fruit and vegetable consumption, moderate-to vigorous-intensity physical activity, general health status, body mass index, and hypertension; and total wear time

[i]Model 4 adjusted for all sociodemographic and health-related variables; bouts model also adjust for total sedentary time and mean intensity of breaks from sedentary behavior; breaks model also adjust for total sedentary time and mean intensity of breaks from sedentary behavior

[*]$p<.05$

Table 5.7 Odds Ratios for the Presence of Waist Circumference Risk, Body Mass Index, and Hypertension per 10-, 30-, and 60-minute/day Increase in Sedentary Behavior among the Sample of African American Women

	10-Minute/Day[^]		30-Minute/Day[^]		60-Minute/Day[^]	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Women Only Time in Sedentary Behavior, total mins/day SB						
Waist circumference[a,d] (substantially increased risk)	0.964	0.890-1.045	0.897	0.705-1.140	0.804	0.497-1.300
Blood pressure status[b] (hypertensive)	0.944*	0.906-0.983	0.840*	0.743-0.951	0.706*	0.552-0.904
Weight status[c] (obese)	1.075*	1.004-1.151	1.242*	1.011-1.525	1.542*	1.022-2.326

Abbreviations: OR = odds ratio, 95% CI = 95% confidence interval, mins=minutes

[a]Reference category is increased risk and normal combined

[b]Reference category is normotensive

[c]Reference category is overweight and normal combined

[d]Waist circumference risk defined according to World Health Organization guidelines (16): normal risk <80 cm; increased risk 80-88 cm and; substantially increased risk >88 cm

[^]Final Models adjusted for age, gender, education, employment status, marital status, smoking status, total fruit and vegetable consumption, moderate-to vigorous-intensity physical activity, general health status, body mass index, and hypertension; and total wear time

*p<.05

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CHAPTER 6

RESULTS: MANUSCRIPT THREE

A QUALITATIVE STUDY OF AFRICAN-AMERICAN WOMEN'S PERCEIVED INFLUENCES ON AND STRATEGIES TO REDUCE SEDENTARY BEHAVIOR[3]

Objective: Despite a growing body of research linking sedentary behavior (SB) with adverse health outcomes, few studies have explored perceptions of this behavior. The present study describes African-American women's perceived influences on and proposed strategies for reducing SB.

Design: Three focus groups were conducted with African-American women (N=32, 53.6 ± 6.0 years, 75% obese). Groups were audio-taped, transcribed, and coded by two independent raters. QSR NVivo 9 was used to facilitate coding and organization of themes, defined as concepts discussed by ≥ 3 participants across ≥ 2 groups.

Results: Participants were unfamiliar with the term SB prior to the focus groups yet described spending a large portion of time in SB at work and home. Participants were not concerned about excessive time spent in SB during their leisure-time. They reported being "stressed out" or tired and viewed leisure-time SB as necessary for stress management, personal time, and enjoyment. Participants were more amenable to decreasing SB at work. Participants also identified personal (daily routine, health, age, enjoyment), social (social role constraints, cultural influences, family and friend influences), and environmental (home, work) factors as contributing to SB. Strategies for

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reducing SB included enlisting social support, building physical activity (PA) into daily routines, taking break at work, changing social activities, using prompts, and reducing stress. Message framing was highlighted as a key component for marketing health promotion interventions for reducing SB to African-American women. Positively framed messages may be more persuasive than negatively frame messages.

Conclusions: Interventions aimed at African-American women should first strive to increase knowledge about SB and its associated health risks. SB is a stress outlet so a direction for future work may be to find alternative stress management techniques that provide similar relief but simultaneously reduce SB during leisure-time. Approaches that target prolonged sitting at work by incorporating designated times for breaks and prompts to take breaks hold promise.

Keywords: sedentary behavior, influences, inactivity, African-American, women

Background

Obesity rates have greatly increased over time in adults, especially in ethnic minority populations [1, 2]. Compared to other racial/gender subgroups, African-American (AA) women have the highest prevalence of obesity (64%) and health-related risk factors [1]. By the year 2035, 80% of AA women are projected to be obese; while White women are not projected to reach the 80% obesity mark until the year 2082 [3]. In a national effort to stem the crisis of obesity in the United States, the state of AA women stands out as a particular challenge. Effective preventive strategies to reduce the obesity burden in this population are needed.

Increasing physical activity (PA) and encouraging the consumption of healthy foods (e.g., fruits and vegetables) have been identified as strategies for preventing obesity [4, 5]. However, less than 50% of adults report meeting national recommendations for PA [5, 6], and only 33% and 27% report meeting recommendations for fruit and vegetable intake, respectively [7]. Public health promotion efforts tested to date have been less successful in increasing PA and improving diets, lessening hopes to promote weight loss in populations most affected by adverse health conditions [8, 9].

There has also been a recent trend for adults to replace time spent active with sedentary behavior (SB), such as TV viewing, computer use, and occupational sitting [6]. Moreover, SBs are associated with negative health outcomes [10-12], independent of time spent physically active [13, 14]. Physically inactive individuals have the potential to substantially increase their risk of chronic health conditions by further increasing SB [14]. Thus, researchers and public health professionals must consider appropriate interventions targeted at increasing PA as well as decreasing time engaged in SB.

Several studies have assessed influences on screen-related SB (e.g. TV viewing, computer-use, video game use) among children and adolescents from the perspective of key adults using qualitative methods [15, 16]. However, only one study to date has explored the perceptions of and strategies to reduce SB in adults, specifically Australian women [17]. Four major themes relating to influences on greater TV viewing were depression, poor weather, children and childhood television habits [17]. The present study expands on previous qualitative work by examining factors that may impact SB in AA women [9]. Using a social ecological framework [18], this study aimed to better understand AA women's perceptions of SB by (1) describing how personal factors influence time spent in SB, (2) describing how the social and physical (work and home) environment influence time spent in SB, and (3) exploring novel strategies to reduce SB in the home, work, and social environments.

Methods

Participants

Participants were eligible for the study if they were AA women between the ages of 45-65 years and willing to participate in a small group discussion. Study participants were recruited through listserv announcements (i.e. university, social group, church), campus flyers, and word of mouth. Interested participants were contacted by phone, screened to confirm eligibility, and scheduled for one of three focus group sessions. Three women outside the target age range were allowed to participate due to a) meeting the age requirement at the time of recruitment but not during actual participation in the focus group (i.e. >65 years old) or b) meeting eligibility age requirements within a year of participation in the focus group (i.e. <45 years old).

Instrument

The semi-structured focus group guide was developed using the social ecological framework to better understand personal, social and physical environmental influences on women's SB (*Table 1*) [18]. Women were also asked to discuss possible intervention approaches for reducing SB. The guide was pilot tested with a single group of 10 AA women. Participants from the pilot group were not included in the present analyses. A brief survey was also administered to participants; specific items included age, fruit and vegetable consumption, education level, employment status, general well being, and presence of health conditions. Height and weight were obtained by trained staff for the calculation of body mass index (BMI, kg/m^2).

Procedures

This study was approved by the University of South Carolina Institutional Review Board prior to data collection. Three focus group sessions were conducted in private rooms on campus, and confidentiality of responses was emphasized. The focus groups were moderated by the lead author. Once each focus group session ended, participants completed closed-ended surveys and had height/weight measurements taken. All focus groups were audio-taped and transcribed verbatim by a professional transcription agency, and transcripts were verified by the lead author. In addition to audio-recording, notes were taken by a member of the research team for comparison with transcripts. Participants received $20 upon study completion.

Data Analysis

While focus group questions were developed using the social ecological model, the primary framework for coding focus group transcripts was based on the constant comparison method [19], which uses an inductive approach wherein categories and concepts emerge from the data [19]. Categories and concepts are linked together in the data analysis process until theoretical saturation is achieved [19]. Theoretical saturation occurs when no new themes emerge from the data [19]. As themes were identified, they were classified into categories. A code book was subsequently developed based on categories and used to code the transcripts. Discussions on how to handle given situations for coding participant responses reflected two of the coauthors' decisions.

Participant identifiers were removed from transcripts prior to coding. The transcripts were coded independently by two raters who used the code book and decision rules to guide coding. Prior to analysis, raters met to discuss each coding disagreement until consensus was reached. The data were analyzed within each focus group, as well as across focus groups, to identify similarities and difference in the emerging themes. These themes were used to summarize the data. Ideas commonly cited within and between focus groups were considered themes. Specifically, similar comments had to be made in two of the three focus groups by at least three participants to be defined as a theme. Qualitative data management software QSR NVIVO (version 9, QSR International PTY Ltd) was used to facilitate coding of data.

Results

Participant characteristics

Characteristics of study participants are shown in *Table 2*. The 32 women self-identified as AA (100%). Participants were 53.6 ± 6.0 years old, predominately employed (75.0%), and had at least some college education (87.5%). Although most women (87.5%) rated their general well being as good, very good, or excellent, a majority

(69.0%) also reported having at least one health condition. Mean fruit and vegetable consumption was 3.2 ± 1.8 servings/day.

Focus Group Themes

Focus group discussions lasted, on average, two hours. Verbatim quotations from the transcripts of the digital audio recordings are used to illustrate themes. Themes were organized into the following categories: women's perceptions and beliefs, personal factors, social factors, and physical environmental factors.

Perceptions/Beliefs

Three categories emerged related to participants' perceptions and beliefs towards SB: (1) knowledge of the term SB, (2) definition of SB and common sedentary activities, and (3) SBs associated health outcomes.

Knowledge of term sedentary behavior.

Most women had limited or no knowledge of the term "sedentary behavior" prior to the start of the focus group. Participants interpreted SB as the absence of PA rather than as a distinct mode of behavior. This lack of knowledge was reflected across all three groups and is illustrated in the following statement: 'I never heard that word before, but I know what it means because I looked it up…I never knew it's for sitting.' In fact, participants who reported limited knowledge of the term reported becoming more aware of their time spent sedentary as a result of the focus group. For example, 'I've heard the word, and I mean I know what it is, but just from when you were speaking earlier, it really made me think about how much I do sit.'

Definition of sedentary behavior and common sedentary activities.

Participants were asked to describe what made a behavior sedentary versus active. SB was most commonly defined as 'sitting and not moving.' One woman said, 'When you're just sitting there, you realize you're not active, you're not moving…your body is not in motion.' Participants additionally described common SB for women their age at home and work. These activities included TV viewing and leisure sitting (e.g. reading, socializing with family and friends) at home and occupational sitting and computer-use at work.

Associated health outcomes.

Health conditions were a major concern for many participants, and they listed a number of health outcomes they believed were caused by SB. The most commonly cited health conditions were obesity, hypertension, high cholesterol, diabetes, heart disease, and arthritis. Obesity was the most frequently discussed. One woman commented: 'I leave work, drive home, sitting, get home, sit some more to watch TV, which in turn I have put on some weight.' Women further described weight gain as the cause of the adverse health problems and not necessarily high levels of SB: 'Well sitting leads to weight gain, obesity leads to other things, like heart disease, diabetes. It all stems-well, a lot of it stems from that *[weight gain]*. Even arthritis. You know? So all of that is because of weight gain.'

Personal Factors

The most commonly described personal factors related to SB were daily routines, health, age, and enjoyment.

Daily routine.

SB was common in all participants' daily routine. However, there were differences in the amount of time spent sedentary based on the environment and likes/dislikes of the participants. A representative comment was: 'When I go home, it's me and my remote. You know? It's like I love TV, so I have to force myself to physically go out and do something. But usually…if I'm not at the track *[walking]*, I'm home with the remote at night every night, and I don't like housework.' Differences in SB at home versus work were also captured: 'I find myself more physically motivated at work than I am at home, because at home, you tend to become a couch potato because it's certain stories you wanna watch on TV, and you just sit there.' Weather also appeared to impact daily routines and SB: 'I go home, I eat, and I do what I call the horizontal lay. Bed, TV, remote. That's me. That's my winter life. When it's cold, I can't move'.

Health-related.

Women described how health-related problems contributed to higher levels of SB. Both physical and mental health conditions were mentioned as reasons for large amounts of time spent watching television. Depression and stress were commonly discussed. For example: 'I had been laying in the bed, dealing with depression for six months prior to that, and literally, I was in the bed, to the bathroom, maybe get something to eat, and go back to bed, watch TV'. Similarly, 'I tend to believe that a lot of our problems and conditions are due to stress. We stress ourselves about a lot of things unnecessarily…then you don't want to do anything but sit, relax and watch TV'. Despite the role of stress and depression in contributing to SB, there was recognition that SB also contributed to these emotions. For example, one woman stated: 'Being sedentary doesn't allow one to work off stress, and that's a major benefit of activity and variety of activity… It can help to change how one is feeling physically and emotionally. But if you're totally sedentary, those different endorphins don't come into play.'

Age-related.

Another commonly reported personal factor influencing SB was age. Participants described why they were more active and/or less sedentary in earlier times of their life (e.g., they had children in the home, physical work demands, and more community involvement). Regardless of their age, participants consistently described their current age as the time in their life when they were most sedentary. For example, "You know, I'm older now, and I'm trying to do some of the things that I used to do when I was younger, but my body is saying, 'No you can't do that.' …Something has got to let up so for me, I do it, sedentary. I'll sit, but I don't really like it.'

Enjoyment.

Most of the participants expressed positive attitudes towards SB. They believed SB was enjoyable and necessary for stress management, relaxation, personal time, and productivity. For example, 'For me, when I sit down, I feel like I've earned this. I've been going out all my life. I've earned this, and as we get older, we need to think of it as something like something we deserve because we got some people don't have sense enough to sit down. There's a lotta people don't have sense enough to sit down, to try to realize that you need to take care of yourself, and you don't wanna look so worn out.'

Despite the generally positive attitudes about SB, participants articulated that there were differences between leisure-time SB and work-related SB. Overall, participants were dissatisfied with work-related SB and satisfied with home-based SB. As a result, participants were more amenable to decreasing SB at work. One participant noted: 'Sitting all day, trying to make production. That was …repetitious. So it's hard. It was nerve wracking. If I could just get up and just have a job, where I can just go, go, go, it would help.' She further commented about home: 'But at home and stuff, sitting is relaxing for me. It's a time to exhale.'

Social Factors

Social factors, including cultural influences, social role constraints, caregiving, social role stressors, and family and friend influences, were additionally cited by participants as important contributors to SB.

<u>*Cultural influences.*</u>

Shifts in culture were discussed across focus groups as reasons why women engage in higher amounts of SB. Women described how society currently does less manual work and has more conveniences that lead to increases in SB. One participant commented: 'I think that life itself has driven us that everything is so convenient that we sit and wait for this. We sit when we go to the doctor. We sit when we – we're forever sitting whatever we do. We just sit, and I think it's just a whole total lifestyle – the convenience of everything... you don't have to cook supper anymore; you sit in your car. You go through drive-thru. You're sitting there, waiting on your dinner. You come home. You sit down, and you sit some more and you sit until you take a bath and go to bed. You know everything is just so convenient for us now.' Several participants additionally commented specifically about the effects of cultural shifts unique to AAs on SB. For example: 'I think about it a lot of time, too, what makes us sedentary a lot is that when I was growing up… I worked in a tobacco field, and have been working ever since I was eight years old. So it was always work, work, work, work, move, move, move, move. Then once I got older and went to school, then college, and got an office job where you sit, and you aren't trying to do nothing else but that *[sit]*. You know, just sitting and relaxing because all your life, that's all you was used to running, moving, moving, moving, moving. And once you as an Afro-American finally got a job, one that you find your white society has, one sitting down, an office job, you don't want to do no more than that *[sit]*.'

Cultural differences related to geography were also discussed as an influence on SB. Differences impacting SB based on living in the Northeast versus the Southeast were specifically highlighted: "I'm from New Jersey, and I find that people, women here in the south are more sedentary because they don't go anywhere. And being here in Columbia, you're definitely sedentary because nobody walks anywhere. If you're in New York, you're going to walk everywhere because the taxis are too expensive, the subways are *[cramped/crowded]* – you don't want to be bothered, so oh, it's ten blocks away. I'll walk there. I don't care if it's ten degrees outside. I'm still going to walk there. I tell myself, 'If I was in New York, I'd be skinny,' because I'd be walking everywhere. And I find that here I am *[in Columbia]*, in the winter, I am more sedentary.'

Social role constraints.

Social roles define expectations for behaviors in a social group. With each social role adopted, behavior changes to meet expectations [20]. Social role constraints are any restrictions by a social role which may impact behavior [20]. Participants reported that the multiple roles (e.g. mother, wife/partner, caregiver, grandparent, employee, church leader) women play in their families and communities contribute to these constraints.

Caregiving and social role stressors were two sub-themes that emerged as important social role constraints influencing SB.

Caregiving.

The most commonly reported contributor to time spent in SB was caregiving activities. Many participants described caring for children, grandchildren, aging parents, and/or multiple generations. The caregiving activities appeared to be inherently sedentary. For example: 'During the week is when I'm reading a book to our little one. So I would say we spend *[2-3 hours sitting]* with books – I read about two or three books to him, and then we have some little game things.' Participants generally described caregiving as exhausting and feeling like being more 'busy', (although not necessarily physically active) in their caregiving role made them seek out SB as a reprieve. One participant noted: 'I really look forward to my eight hours of sitting when I get to work because my home life is just busy, one thing after another, from homework, trying to get dinner done. For example, yesterday – and I know time management has a lot to do with this because my daughter is in elementary school. She's got dance on Tuesdays. I got class on Tuesdays. So it's a lot of shifting and shuffling that I have to do. So it's ongoing until I lay my head down on the pillow at 1:00 in the morning.'

Social role stressors.

Participants reported daily stress related to their social roles. SB served as a coping mechanism for the high perceived stress in both home and work contexts. For example: 'I love old, classic movies, and that's what I do right before going to bed. I prepare myself to get rid of all this frustration from the work day, and then I go to bed and try to get a good night's sleep, wake up, and start the whole routine over the next day.’ The multiple roles participants played also contributed to stress. One participant said: ‘It gets hectic. It gets hard. I am a student, and I’m four classes from graduating, so I, too, am in college. So that gets a little tough, too, because not only do I have my *[elementary-aged]* daughter’s schoolwork to check when I get in, but I also have my work to do…I also have a 21-year-old *[son]* that’s getting ready to graduate.”

Family and friend influences.

Family and friends were described as influencing time spent in SB. Eating and entertainment were the most commonly reported SB done with family and friends. The majority of comments focused on family supper time within the home or eating out. For example: ‘Sometimes, we just do a potluck, and everybody just brings something, and we just sit around, and we might play spades *[card game]*, or we just hang out together and talk about how the week went.’ In addition to listing specific SB with family and friends, many participants also discussed how these sedentary times were enjoyable and important (and sometimes rare) times for the family to come together. One participant commented: “We have like family discussions. You know, like if there’s something that bothers someone, we’ll sit down and say, ‘How was your day?’ We have a family discussion, and that can be sedentary.”

Physical Environment Factors

Similar to personal and social factors, choices to be active or sedentary were additionally perceived to be influenced by the physical environment. The work and home environments were highlighted as two locations for high amounts of SB. Specifically, the presence of a television and desk/computer in the home and work environments, respectively, appeared to greatly influence time spent sedentary.

Television at home.

Many participants described watching television as part of their daily morning and/or evening routines and as a way to provide stress reduction. For example: 'When I go home, I usually watch the Gospel *[television program]*. I pray. Then I go to bed. That's it.' Another participant highlighted the connection between a sedentary lifestyle and watching TV: 'I decided I was leading a sedentary lifestyle because when I'm at home, I'm one with my remote.' The removal of the television was also linked to decreased sedentary time: 'I usually wake up, and I read. I moved the television out of my room. That forces me to get out of the bed, so I haven't been watching television.'

Desk and/or computer at work.

Although approximately 75% of participants were employed, most, regardless of current employment status, reported that desk jobs and increases in computer use at work contributed to their SB. The work environment was described as the main contributor to SB: 'Your employment is the main thing, too, because most of your job is sitting at a desk and computer for most jobs.' Another participant added that in the work environment you must make a conscious effort to reduce sedentary time: 'And most jobs, you know, you're sitting behind a desk. You're not moving unless you make yourself move.' Conversely, a few participants reported jobs, or specific tasks in their jobs, that required activity or that did not involve sitting. One participant said, 'When I am in the office I just sit at my desk, but when I am in the field I am moving around constantly.' Another participant added: 'For me I don't get to sit at work. I work in the kitchen so I am constantly on my feet. I am tired when I leave work so when I go home I just want to sit and lay down.'

Commuting in a vehicle.

A theme that bridged home and work environments was commuting in a vehicle. For some, a large amount of time spent sedentary was done in a vehicle. "I head out the door, and I take my granddaughter to school, drop her off, come back to the house, finish doing little touch ups that I didn't do before I left the house. And then it's off to work, with my husband and brother dropping me off to work…we get our coffees every morning at McDonald's and then go from there to work where I sit at the desk every day. 'Thank you for calling customer service. This is …'…In the evenings we are driving everywhere to run errands".

Strategies to Reduce Sedentary Behavior

Participants were asked to describe strategies that might help them or other AA women decrease SB. These questions presented a few challenges in the focus groups because participants were generally protective of their leisure-time SB and/or home environments. They made it clear that they were not interested in a program that would 'take away' their sedentary leisure-time. One participant said, 'I fundamentally disagree with a program to reduce SB. I fundamentally disagree with that. I wouldn't go to a program to reduce SB. That's not gonna attract me. It's going to attract me based on something that I want to do…it's like when they talk about Lent. There is the 'you can give up something,' or 'you can add something.' I'm trying to add something. I'm not trying to worry about what all I need to *[give up]* -I'm trying to add, but I'm trying to add what supplements personal goals.' Most of the discussion was thus focused on strategies for reducing SB in the work environment and increasing PA during leisure-time. Participants thought reducing sedentary time at work was both important and necessary for reducing health risks. Because of this unanticipated perceived difference between environments, message framing emerged as an important component to consider for marketing health promotion interventions for reducing SB in AA women. For example: "The first thing that I would say is that for AA women, and for me, I am more motivated by hearing the question, 'what are the ways in which I can bring more movement into my life?' And at home – because when we talk about AA women – we most need more sedentary that is purposeful and not sedentary that has no purpose." When brainstorming different approaches to decreasing SB among AA women, enlisting social support, changing social activities, building PA into daily routines, reducing stress, taking breaks at work, and using prompts were most commonly mentioned.

Enlisting social support

Enlisting social support was commonly discussed as a strategy for reducing SB. However, most participants described a link between social support and increasing PA. One participant suggested, 'I would suggest, [as] opposed to sitting all day, if you're not employed working, find some group, some volunteer group to get involved with.' Another participant added, 'Get with others to be more involved. Because we have a tendency to just go home and do nothing. But if you have somebody that has an interest or someone that says, 'Oh, let's go out walking,' you may not want to walk *[but]* this person may be highly energetic that will not leave you alone until you get up and you start walking.' Participants believed that social support for healthy behaviors was lacking but greatly needed among AA women: 'We as AA women don't support each other, so we need to learn how to support each other, even when we exercise and anything that we're going through, we need to support each other. So I would say support your sisters in making sure that they get outta the house. Make sure that you walk and you do things that you need to do.'

Change social activities

Participants suggested changing social activities from SB (e.g., dinning out, movies, talking on the phone, computer-use) to more active behaviors (e.g., going for a walk, walking meetings) in order to decrease sedentary time. One participant summarized the need for this change, 'Socializing with family and friends need not be limited to eating.' Another participant described the need for social changes in the work environment, 'Bring down that server for a minute - that we all use to send each other inter office e-mails, and you be the e-mail today. I don't know if you would turn off the listserv or pretend the listserv doesn't exist, and instead of e-mailing, you can print up the e-mail and take it to the person's office. If somebody is upstairs, you take the stairs instead of the elevator, then you can kind of log in how many minutes it took you to do that, and then you would be able to have a measureable reduction in your sitting time. The human e-mail!'

Build physical activity into daily routines

Participants suggested building PA into daily routines as another strategy for reducing SB. This change could be achieved by trying different physical activities and/or joining different exercise classes. The key to building PA into the lives of participants was centered on trying new and enjoyable activities as described in the following statement: 'Be open to try new things. For example, I've always wanted to belly dance. So we went belly dancing. We tried something new, and it was a way to get out of the house, something that was different, something that was new, and something that was fun.'

Reduce stress

As previously noted, participants commonly described using SB as a way to cope with and manage stress. Participants described stress management as a necessary component to include in a health promotion program to reduce SB, 'Include a component for stress management. And you can even do some aerobics or yoga or something.'

Take breaks at work

Many participants were displeased with the amount of time spent sitting at work. A common strategy suggested for combating this problem was to take breaks at work to increase movement and decrease time spent at the desk or in front of a computer. During these breaks, participants suggested standing up, moving around or stretching. One participant said, 'Stand for a while and move around at your desk if possible.' The importance of taking breaks in the midst of a busy work schedule, even if it's only for a few minutes, was also discussed: 'One thing we could do is – most jobs, you get breaks, but we get so busy at work, we don't take those breaks…Just walk around in the area for a few minutes, even if it's 10 or 15 minutes. And I can do that myself. I just don't take the time to do it. But it's something that we could do.'

Use of prompts

The use of visual and auditory prompts was the final suggestion for reducing SB at work. Participants believed that prompts should encourage women to get up to move or make them aware of time spent sedentary. For example, 'If we have little constant reminders from time to time, a little flyer here, a little card there, or something like that, at work it would help.' Using technology at work could also prompt women to break up their SB, 'I go to work, I have to sit at the desk. But if the computer comes up with something like 'take a five-minute break' or something like that, you know scare me to death, it may do something to stimulate my mind.' Prompts on the computer could be used to not only encourage breaks but to also incorporate specific physical activities during the work break: 'your computer…could give you exercises to remind you to get up every 15 minutes and stretch your legs and move and just move your body – so *[we need]* more reminders to get up and push away from the desk.' Although only mentioned by one participant, this strategy could also potentially be adapted to the home environment: 'We could stand up and move around during commercial breaks.'

Discussion

Until recently, SB has not been viewed as a public health problem [11, 12]. The field has, instead, emphasized PA and physical inactivity (i.e. not meeting public health recommendations for moderate intensity PA), despite a growing body of research linking SB with adverse health outcomes [10-14]. Only one study in adults was located that examined participant perspectives about this behavior [17], and no studies have been done with AA women. Consistent with Teychenne and Salmon [17] most participants reported high amounts of sedentary activities, were unfamiliar with the term "sedentary behavior," and for those participants who recognized the term, SB was commonly defined as "engaging in no PA". These findings underscore the public health importance of raising awareness about SB and helping AA women understand the health risks associated with SB, independent of physical inactivity.

The field is lacking a richer and more integrated understanding of what factors promote or discourage SB. Consistent with social-ecological models, participants identified personal, social, and environmental factors as contributing to their SB. While some influences such as the lack of knowledge about SB, the presence of a television in the home, and the use of SB as a coping mechanism were similar to those reported in other general populations [17], other influences (i.e., social role constraints, cultural influences) appeared unique to AA women living in the Southeast.

The influence of culture on health behaviors and related outcomes is commonly cited as an important contributing factor to health disparities observed among AA women [21]. Participants discussed cultural influences unique to AAs, such as receiving equal employment opportunities for less labor-intensive jobs (i.e., having a desk job) comparable to their White counterparts, as influencing increases in SB. Geographical differences (i.e., a culture of less walking in the South) and societal cultural shifts (i.e., modern conveniences that lead to sitting) were also highlighted as major influences. These findings underscore the idea that culture is broader than just race and ethnicity, and other aspects of culture must be considered when developing programs to reduce SB among this target population.

One of the most salient findings from this study is that AA women described living complex and stressful lives for which they compensated by engaging in high levels of SB. Social role constraints greatly influenced time spent in SB. Specifically, the role of caregiving was highlighted as an important part of daily routines and in many cases was prioritized over self-care [22]. These findings are consistent with Hoffman [20] who found that caregivers were more likely than non-caregivers to engage in SB. Participants described how caring for children, young grandchildren, and aging parents contributed to higher amounts of time spent sedentary because caregiving activities were inherently sedentary or were exhausting therefore increasing stress and the desire for leisure-time SB. Social roles and responsibilities have been previously highlighted as barriers affecting PA participation in AA women living in South Carolina [23]. Furthermore, it is understood that the total number of social roles appears to be the most powerful predictor of stress-related physical health outcomes [22] and social roles play an essential role in preventing illness and maintaining optimal health in AAs [24].

Research literature has focused exclusively on the deleterious effects of SB, and very few studies to date have highlighted possible protective effects of SB in subgroups of the population [10]. In earlier research, a common view of AAs was that the perception of hard physical labor, both job- and family-related necessitated time for rest [22]. Rest was generally considered a “deserved” and needed time, even for regular participation in PA [22]. In the present study, almost all participants preferred to engage in leisure-time SB because it was a time for much-needed solitary pursuits, relaxation, enjoyment, and productivity (i.e., reading, writing, journaling). Participants made a strong case for the importance of engaging in SB during leisure-time to cope with daily life stressors. SB such as television viewing has been identified as a coping strategy for stress and depression among women [25]. However, this coping response may not be healthy, and in fact, may worsen depressive symptoms over time [26].

A major aim of this study was to explore possible strategies to reduce SB. Strategies included enlisting social support, changing social activities, building PA into daily routines, taking breaks at work, using prompts and reducing stress. A challenge in reducing SB may be women's perceptions. Participants were reluctant to give up leisure-time SB at home but were amenable to reducing SB in the workplace. Findings from this study also highlighted that framing messages around SB must be carefully considered. Intervention messages must be crafted to describe adding rather than taking away activity. Richter et al. [23] suggests that interventions should not discourage women from engaging in SB such as television viewing but might instead include ways to be active while viewing television in the home environment. Women's comments suggested positively framed messages (e.g., "It is important to regularly get up during commercial breaks while watching television.") may be more persuasive than negatively framed messages (e.g., "It is important to stop watching television to reduce the amount of time you spend sitting in your day.") to elicit behavioral intentions to reduce SB during leisure-time. Given SB was described as a stress outlet, another direction for future work may be to find alternative stress management techniques that provide similar relief but simultaneously reduce SB during leisure-time. Notably, many current approaches to stress management (i.e., relaxation, deep breathing) rely on sitting behaviors [26].

The use of qualitative methods was a major strength of our study and provided contextual insights about the perceived influences and strategies to reduce SB among AA women. AA women are an important target group, given the high rates of obesity, low participation rates in PA and high amounts of SB. Limitations of this study include a relatively small sample and low variability related to educational attainment. Due to the relatively small sample, it is also possible that saturation was not met. Despite these limitations, the present findings provide useful information regarding the perceptions of and suggestions for reducing SB among AA women. This study provided novel qualitative findings that could inform the development of health promotion programs to reduce SB both in the home and work environments, while simultaneously increasing PA among this target population.

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Table 6.1 Relevant focus group questions and probes.

Category/Theme	Initial Questions	Follow-up Probes
Perceptions/ Beliefs	Are most of your activities in a typical or usual day active or sedentary?	**Probe:** What makes the activity active vs. sedentary?
	How might sedentary behavior relate to your health, if at all?	**Probe:** Various health outcomes (i.e. obesity, high blood pressure, diabetes)
Personal Factors	What are your daily routines like during the week?	**Probe:** Describe your activities in a typical week. Describe your daily activities. **Probe:** What are your activities on the weekday? Weekend? Home? Work? What activities do you do the most during the week?
	Now, I want you to think about all the ways or activities that lead to women your age being sedentary. Remember that sedentary activities are activities that require a lot of sitting. Please tell me some common sedentary behavior or sedentary activities.	**Probe:** What types of sedentary behavior do woman engage in at home? At work?
	What do you like most about sedentary behavior? What is the one outcome or one thing that sedentary behavior do for you that make them worth doing? That is, what do you enjoy the most about sedentary behavior?	**Probe:** Stress relief, relaxing? Makes tasks easier?
	What do you like least about sedentary activity? What are the disadvantages – or the down side - of these sedentary behavior?	**Probe:** Health consequences? Tired? Lazy?

Social Factors	What are some of the sedentary behavior that you do with your friends and family?	**Probe:** What makes you choose these sedentary behavior?
Environmental Factors	For those of you who work outside the home, what are some of the sedentary behavior you do on your job? What are some things that you or other African American women you know could try to become less sedentary at home and at work?	**Probe:** How active is your job? How much time do you spend sitting?
Program Development	What would a program designed to decrease sedentary behavior look like?	**Probe**: Reduce TV viewing? Take breaks from sitting at work? How would you like the program to be delivered (e.g., group-based setting, home-based, worksite, individually or one-on-one, CD ROM, telephone, handouts through the mail, Text messages, YouTube or other online video source, television, combination)? **Probe**: Who would deliver the program? Doctor or health care provider, health educator, nurse, personal trainer or fitness trainer?
	If you were going to attend a program one time *each week*, about how many hours would you be willing to spend?	**Probe**: Where would the program be delivered? At home? At work?
	If you were going to attend a program one time *every two weeks*,	**Probe**: How many hours would you be

	about how many hours would you be willing to spend? What might help you to stay involved in a program targeting sedentary behavior? What things do you think would be helpful to include in a program for African American women?	willing to spend at home or work with the provided material? **Probe**: How many weeks would you be willing to do this? **Probe**: Would providing childcare, transportation, or food help you continue to participate in a weekly program? **Probe:** What types of sedentary activities would you want to target in your program?

Table 6.2 Characteristics of study participants (N=32).

	N	Mean (SD)
Age (years)	32	53.6 (6.0)
BMI (kg/m^2)	32	34.7 (5.6)
Total Fruit and Vegetable Consumption (servings/day)	32	3.2 (1.8)
	N	**%**
Race		
African American	32	100
Weight Status		
Overweight (BMI <30 kg/m^2)	8	25.0
Obese (BMI ≥30 kg/m^2)	24	75.0
Education		
High school graduate or GED	4	12.5
Some college	14	43.8
College graduate	14	43.8
Employment		
Employed	24	75.0
Unemployed	3	9.0
Retired	5	16.0
General Health Rating		
Excellent	6	18.7
Very Good	8	25.0
Good	14	43.8
Fair	4	12.5
No. of Health Conditions		
0	10	31.3
1	8	25.0
2	7	21.9
3	4	12.5
4+	3	9.4

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CHAPTER 7

DISCUSSION

This dissertation responded to the recent call for greater focus on the public health impact of sedentary behaviors (SB) in populations most affected by adverse health conditions (Rhodes et al., 2012). Further, this dissertation contributed to the paucity of literature concerning the role of SB in the lives of African American adults and offered insight for future health promotion programs. The present chapter provides an overview of the results presented in all three manuscripts in Chapter 4. This chapter will additionally present a discussion of the limitations of this dissertation; overall study implications and future directions; and an overall conclusion for this dissertation.

In Manuscript 1, the major study aim was to describe patterns of objectively measured sedentary and physical activity (PA) behaviors and variation in these behaviors among participants in the Faith, Activity, and Nutrition (FAN) study. More specifically, the Principal Investigator (PI) set out to characterize the patterns of time spent in sedentary, light-intensity, and moderate- to vigorous-intensity behaviors and examine these patterns according to sociodemographic and health-related variables in a sample of African American adults. Variations and patterns of SB among the sample were assessed to determine times of day that were most sedentary and weekday vs. weekend differences in SB. The bout patterns of sedentary, light-intensity, and moderate-to vigorous-intensity PA experienced during the day was also examined according to sociodemographic characteristics and health-related behaviors. Finally, breaks experienced throughout the day in SB were assessed.

On average, participants were sedentary 567.1 minutes per day (65.1% of wear time), engaged in 293.7 minutes per day of light-intensity PA (33.2%), and 15.2 minutes per day of moderate- to vigorous-intensity PA (1.7%). Fifty nine percent of the sample had hypertension, 57.5% had a substantially increased waist circumference and 57% was obese. Regarding *Aim 1*, obese participants had significantly more minutes per day of SB than normal weight and overweight participants. SB was significantly different by time of day. Participants had significantly fewer minutes per day of SB in the morning (26% of daily sedentary time) compared to the afternoon (40% of daily sedentary time) and evening (32% of daily sedentary time). Younger participants had significantly less minutes per day in afternoon SB than older adults. Obese participants had significantly more minutes per day of evening SB than overweight participants. SB did not vary by weekday (9.6 hours/day) or weekend (9.3 hours/day). Education and weight status were positively associated with variations and patterns of SB. College graduates had significantly more minutes per day in weekday SB than all other education groups. Obese participants had significantly more minutes per day in weekday and weekend SB than overweight and normal weight participants.

Participants on average engaged in daily SB bouts lasting 6.6 ± 2.1 minutes. All participants engaged in ≥1 daily bout of SB, ≥10 and ≥30 minutes, and most (93%) engaged in ≥1 bout ≥60 minutes. On average, participants took 93.2 ± 16.6 breaks from SB; each break lasted 3.3 ±1.0 minutes and mean intensity of break from SB was 446.2 ± 81.2 cpm (light intensity).

Manuscript 1 contributed to the literature in meaningful ways. Little is known about the pattern of SB in African American adults across time of day (morning, afternoon, and evening), and weekdays and weekend days, although they are at higher risk of many chronic conditions. Even less is known about the bout or break patterns in SB. This dissertation is one of the first studies to explore total sedentary time along with bout and break patterns in African American adults.

In Manuscript 2, the major study aim was to assess the association between bouts of and breaks in SB and body mass index, waist circumference, and blood pressure among participants in the FAN study. It was hypothesized that more bouts of sedentary time would be positively associated with higher rates of obesity, hypertension, and substantially increased waist circumference. It was also hypothesized that more frequent breaks in sedentary time would be associated with lower rates of obesity, hypertension, and substantially increased waist circumference. For *Aim 2*, after controlling for sociodemographic variables only (*Model 2*), total SB time was positively associated with obesity. Additionally, after controlling for all variables (*Model 4*), and contrary to predictions, total SB time was inversely associated with hypertension. Total number of SB bouts ≥10, ≥30 and ≥60 minutes was positively associated with obesity after controlling for sociodemographic variables only (*Model 2)*. Similarly, waist circumference was positively associated with total number of SB bouts ≥10 and ≥30 minutes in *Model 2*. No other associations between total SB time, nor bouts of and breaks in SB, were associated with obesity, hypertension, and substantially increased waist circumference risks in the sample as a whole. Among women, total SB time was positively associated with obesity and negatively associated with hypertension (*Model 4*).

Total number of SB bouts ≥10 minutes was positively associated with obesity in women, whereas total number of SB bouts ≥60 minutes was negatively associated with substantially increased waist circumference among women, after controlling for all sociodemographic and health-related variables. Regarding *Aim 3*, total number of sedentary breaks was inversely associated with obesity in women (*Model 4*).

Analyses examining total SB time showed unexpected inverse relationships (i.e. lower rates of hypertension) both in the total sample and women only. Consistent with hypotheses, after controlling for all sociodemographic and health-related covariates, total SB time was positively associated with higher rates of obesity, but in women only. Further, a priori hypotheses were partially supported such that 1) more bouts of SB were positively associated with higher rates of obesity and substantially increased waist circumference in unadjusted models, but no significant associations with hypertension were found and 2) no associations were observed with breaks in SB and lower rates of obesity, hypertension or substantially increased waist circumference in the total sample. Secondary analyses examining these variables (i.e. bouts of SB and breaks in SB) exclusively in women showed 1) more bouts of SB were positively associated with obesity (number of bouts ≥10 mins) and inversely associated with substantially increased waist circumference (number of bouts ≥60 mins) and 2) more frequent breaks were associated with lower rates of obesity.

Lastly Manuscript 3 presented an examination of African American women's perceptions of SB and proposed novel strategies to reduce these behaviors. Focus groups were conducted to explore perceptions and beliefs towards SB; describe how personal factors influence time spent in SB; describe how the social and physical (work and home) environment influence time spent in SB; and explore novel strategies to reduce SB in the home, work, and social environment of African American women. Regarding *Aim 4*, most women were unfamiliar with the term "sedentary behavior". However, focus groups revealed that most women reported spending a majority of time at home and work engaged in SB. Women's daily routines contributed to high levels of SB. Participants frequently reported TV viewing at home, sitting at a desk or computer, and commuting in a vehicle.

A challenge in reducing SB may be women's perceptions. While women recognize the importance of reducing SB in the workplace and home they were reluctant to give up these behaviors at home. Women preferred to engage in leisure-time SB because it was a time for much-needed solitary pursuits, relaxation, enjoyment, and productivity. Furthermore, women also reported frequently using time spent in SB to cope with daily stressors. Regarding the final dissertation *Aim 5,* women were able to highlight strategies to reduce SB in both social, home and work environments. Strategies included enlisting social support, changing social activities, building PA into daily routines, taking breaks at work, using prompts and reducing stress.

Strengths and Limitations

Several study limitations must be considered. In the quantitative analysis conducted with 266 African American adults in Manuscripts 1 and 2, study limitations include the relatively low number of men in the sample. Additionally, selection/representativeness may limit the generalizability to African American adults living in the Southeast. Participants were recruited into a larger PA and diet study; and were recruited from one denomination of churches in several regions of one state.

Another limitation of the study was the accelerometer response rate. Only 57% of participants selected to wear an ActiGraph were included in analyses (n=266). Out of a possible 410 participants who agreed to wear an ActiGraph, 381 returned the ActiGraph and 115 had unusable ActiGraph data for various reasons (i.e. equipment failure, not meeting wear criteria, missing outcomes, missing covariates).

In Manuscript 2 the cross-sectional study design does not allow researchers to determine the causal relationship between SB and health risks observed. Unexpected inverse associations were detected between total SB time and hypertension for both the overall sample and women only. In the present dissertation, participants with a systolic blood pressure ≥140 mmHg or diastolic ≥90 mmHg classified as hypertensive. Information on whether participants were taking anti-hypertensive medication was not collected; however, participants who self-reported a previous diagnosis of hypertension were classified as hypertensive.

Although there were limitations in the quantitative studies, these studies also have notable strengths. The use of objective measurements for a majority of outcome variables among a unique population is a major strength. Objective SB was assessed using accelerometers. Height and weight were measured by trained staff to compute BMI. Waist circumference was also measured and participants were categorized using World Health Organization standards (WHO, 2009). Very few studies have examined total SB time, and variations or patterns of SB in minority populations. This dissertation had a moderately large sample of African American adults.

In the qualitative analysis conducted, 32 African American women participated in focus groups. Inherent differences may have existed among the women who volunteered to participate in the study compared to those who did not. For instance, the majority of participants generally had a high education level; consequently, the results of the study may not generalize to less educated African American women. Demographic characteristics suggest that women in this study are not a representative sample of African American women living in South Carolina. Additionally, by employing snowball sampling techniques, similarities may also exist between those women who may have recruited other women to participate in the study. Some study participants were connected through social networks (i.e. church groups, work groups, special organizations) and thus may share similar interests and perceptions. Despite these limitations, this study provides valuable initial insight about SB and health risks through personal accounts of African American women. Employing a qualitative approach allowed the PI an opportunity to achieve a view of a relatively new and distinct health behavior beyond published quantitative research.

A major strength of the qualitative study design is the ability to explore participant perceptions about SB in depth and provided contextual insights about strategies to reduce SB in the lives of African American women. Additionally, this dissertation study provided novel qualitative findings that could inform future development of health promotion programs in a target population that is adversely affected by many chronic health conditions.

Study Implications and Future Research

The high rates of hypertension, obesity and substantially increased risk waist circumference in our sample, combined with the low levels of moderate-to vigorous-intensity PA and high levels of SB, substantiate the need for additional health promotion programs aimed at increasing PA, decreasing SB and improving other health behaviors among African American adults. There is growing and compelling evidence to suggest that time spent in SB is a unique and distinct contributor to health risk, and that this risk appears to be independent of time spent in moderate- and/or vigorous-intensity PA (Pate et al., 2008). However, few studies have examined these associations in women and even fewer studies have included minority populations (Healy et al., 2011b; Matthews et al., 2008). PA may be a difficult behavior for individuals who are overweight and obese to adopt, many of whom also have multiple chronic health conditions. Furthermore, it might be more realistic and palatable to populations most affected to focus on reducing SB rather than increasing PA. For example, proposing to stand (take a break from continuous sitting) for 2 minutes every 10 minutes/hour (equals total 12 minutes of non SB time per hour) may be more feasible than going for a 12 minute walk once/hour. Despite the fact that national efforts have targeted health disparities for the last three decades, these disparities still exist, with African Americans experiencing higher rates of chronic conditions than Whites (CDC, 2007b). Thus, programs that speak to the needs of African Americans are essential in eliminating health disparities.

PA, healthy eating, and decreasing SB may help prevent and manage multiple chronic conditions in African Americans. Few studies have examined the associations between total volume and patterns of SB and health risk in African American adults. African American adults spend a majority of the day sedentary. Compared to national data reports (Healy et al., 2011b), women engaged in more SB in the present dissertation. There may be inherent differences between African American women and African

American men in variations and patterns of SB and how these relate to health outcomes. Therefore there is a need for adequate sample size among men to continue exploring gender differences in these associations.

This dissertation presents both an objective and subjective analysis of the associations of SB and health risks in the lives of African Americans living in the south. Public health recommendations should first strive to increase knowledge about SB and its associated health risks. For some populations (i.e. African American women) SB may be an outlet for stress so a direction for future work may be to find alternative stress management techniques that provide similar relief but simultaneously reduce SB during leisure-time. Approaches that target prolonged sitting at work by incorporating designated times for breaks and prompts to take breaks also hold promise.

This dissertation provides novel qualitative findings that could inform the development of health promotion programs to reduce SB both in the home and work environments, while simultaneously increasing PA among this target population. One of the most salient qualitative findings of this dissertation was that the African-American women in this study described living complex and stressful lives, and that they compensate by engaging in high levels of SB for relaxation and enjoyment. Thus, women were reluctant to give up leisure-time SB at home but were amenable to reducing SB in the workplace. Richter et al. (2002) suggested that interventions should not discourage women from engaging in SB such as television viewing but should instead include ways to be active while viewing television in the home environment.

Message framing was highlighted as a key component for marketing health promotion interventions for reducing SB to African-American women. Positively framed messages may be more persuasive than negatively frame messages to elicit stronger behavioral intentions to reduce SB in both social and physical environments (Richter et al., 2002); and maintaining a reduced sedentary lifestyle long term may impact or even eliminate observed health disparities among African American adults (Kumanyika, 2005; Kumanyika et al., 2005).

Overall Conclusion

SB includes activities at the lowest spectrum of energy expenditure such as sitting, watching television, computer-use, or even workplace sitting (Pate et al., 2008; Tremblay et al., 2010). A habitual sedentary lifestyle has been associated with several chronic health conditions (Tremblay et al., 2010). This dissertation provides one of the first accounts assessing total volume, variations, and patterns of SB and breaks in SB and associations with health risks among African American adults. Further this dissertation begins to explore perceptions and beliefs about SB in hopes to propose novel strategies to reduce these behaviors among African American women, a population most adversely affected by chronic health conditions, poor diets, low levels of PA and high levels of SB. This dissertation showed that the volume and pattern of SB and physical activities may be important in determining recommendations around optimal combinations of PA and SB to receive maximal health benefits. Increasing total daily moderate-to vigorous-intensity PA, decreasing total daily SB, increasing the number of breaks in SB and replacing prolonged periods of SB with light PA is justly an area of further exploration.

Moreover the positive link between increased PA participation and reduced health risks is well established across populations (Pate et al., 2009; Pate et al., 1995; DHHS, 2008). Additionally, studies have used actual measures of SB and have shown success in decreasing SB in home and social environments (Gibbs et al., 2014). However, further research is needed to determine the amount of SB that increases risk of health conditions which may lead to chronic diseases (Hamilton et al., 2008; Gibbs et al., 2014). Currently there are no public health recommendations for SB in adults. Current recommendations for children suggest limiting SB (i.e. screen activities) to two hours daily (DHHS, 2008). Further examination of various sedentary bout variations and patterns (i.e. time of day; weekday vs. weekend day differences; length of sedentary bout; number of breaks in sedentary time) in addition to total SB time will help to expand on current public health recommendations regarding health behaviors in American adults.

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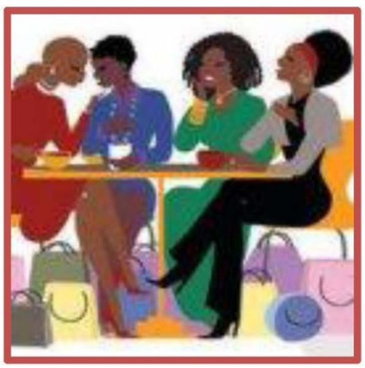
APPENDIX A – FOCUS GROUP FLYER

African American Women Needed For one-time FOCUS GROUP

The purpose of this focus group is to understand how African American women view lifestyle factors and health. We are especially interested in African American women's views about sedentary behaviors (e.g. TV viewing, riding in a vehicle, computer use, sitting). Your participation would require 2 hours of your time.

You may be eligible for the study if you are:

- an African American woman
- between the ages of 45 and 65 years old
- willing to participate in a small group discussion



Participation will include:

- focus group
- brief questionnaire
- height and weight measurements

__Compensation__ includes a $20 gift certificate for full participation

A light meal will also be provided

For more information, please contact
Tatiana Y. Warren at warrenty@mailbox.sc.edu

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APPENDIX B – FOCUS GROUP INFORMED CONSENT

UNIVERSITY OF SOUTH CAROLINA

Department of Exercise Science
Arnold School of Public Health

Sedentary Behavior Focus Group Study

Dear Study Participant,

My name is Tatiana Y. Warren. I am a graduate student in the Department of Exercise Science at the University of South Carolina (USC). I am conducting a research project as part of my doctoral requirements, and I would like to invite you to participate. This project is funded by the National Institutes of Health and led by me and supervised by Dr. Sara Wilcox.

The study is designed to gain a better understanding of the factors that affect health behaviors and beliefs of African American women. Specifically, I want to learn more about women's perceptions about sedentary behaviors (e.g. TV viewing, computer use, and sitting while commuting in a vehicle). The study results will help me to develop a health promotion program for African American women to decrease sedentary behaviors and increase physical activity participation.

If you decide to take part in the study you will be asked to complete a short questionnaire related to your health practices as well your personal information (e.g., age, education, income, etc.); and take part in measurements of your height and weight. You will also be asked to take part in a group discussion with about 8 other women. We will discuss your beliefs about health and sedentary behaviors. We will also discuss what sorts of things you think affect time spent in sedentary behaviors, including things in your work and home environments. The group discussion will last about 60 to 90 minutes and will take place at USC.

The group discussion will be audio-recorded. The audio recorded tape will be transcribed and stored in a secure location. I will analyze the transcript for themes and responses common among all participants. At the conclusion of the study, the tape will be destroyed.

Please initial that you have read this page: ______

Taking part in this study is not considered dangerous. The information provided during the group discussion will be confidential and individual names will not be associated with responses. Participation is anonymous so please do not write your name or other identifying information on any of the study materials. I will also request that you and other participants not share details about the group discussion with others outside the group; however, we cannot guarantee that information will not be discussed by participants outside the group discussion.

You may feel uncomfortable answering some of the questions. You do not have to answer any questions that you do not wish to. Although you may not benefit directly from participating in this study, the results will provide information to aid in development of future interventions for promoting physical activity and decreasing sedentary behaviors among African American women.

Taking part in the study is completely voluntary. You do not have to be in the study if you do not want to. You may leave the study at any time you choose, without any negative consequences.

The title of this study is "Sedentary Behavior Focus Group Study," and it is being conducted by me, Tatiana Y. Warren. If you have any questions about the study, please contact me at (803) 777-9905 or my supervisor Dr. Sara Wilcox at (803)-777-8141. We will be happy to answer any questions you have about the study.

If you have any questions or concerns about taking part in research by USC you may contact the Office of Research Compliance at USC 803-777-7095.

A copy of this consent form will be given.

Informed Consent for Participants

I have read and understand the description of this study. All of my questions have been answered and I have received a copy of this consent form to keep. My signature on this form means that I fully understand what is involved in this program and I agree to take part in the focus group and evaluation measurements.

______________________________ ____________________
Participant's Name (print) Date

____
Participant's Signature

______________________________ ____________________
Authorized Personnel Signature Date

Notes of Questions and Answers:

Please initial that you have read this page: _______

Appendix C – Focus Group Guide for Manuscript 3

Focus Group Protocol:

I. Welcome and Introduction

Thank you for coming to our group discussion today. The purpose of our conversation is to better understand factors related to sedentary behaviors and irregular physical activity among African American women. We are conducting a number of groups like this.

This project is funded by the National Institutes of Health and led by me and supervised by Dr. Sara Wilcox. I'm a doctoral candidate – we are both at the University of South Carolina in Columbia and Dr. Wilcox is my supervisor.

II. Order of Business

Our discussion will last about an hour to an hour and a half. After the discussion, you will receive $20 for your participation.

Please help yourself to the snacks and drinks. We won't be taking a formal break. Please feel free to leave the room if you need to use the restroom.

The restrooms are located ------.

III. Explanation of a focus group

A focus group is a guided discussion. There are no right or wrong answers. We are interested in hearing about your point of view even if it's different from what others have said. While your opinion may be different from others here, it's likely that your opinion is shared by other people in your community, so we definitely want to hear it.

IV. Group guidelines

We will be on first name basis today. If you prefer you may use a made up name or pseudonym. Before you speak each time, please say your first name or your nickname.

There are a few guidelines for the group:

A. First, we would like to hear from each of you, but only one at a time. We will be audio-taping the discussion because we don't want to miss any comments.

B. Please share all information with us. We are interested in both positive and negative comments.

C. Please be specific when you are discussing topics. Use examples whenever you can.

D. I will be guiding the discussion. I will make every effort to keep the discussion focused. If too much time is being spent on one question, I may move the conversation along so we can cover all the questions.

E. We would like all of you to participate in the discussion. All of your opinions count. Please be respectful of one another and don't judge each other. It's OK to disagree.

F. You do not have to speak directly to me. You may direct your comments to other members of the group.

V. Confidentiality

Please remember we will be on a first name basis today, but there will not be any names attached to the comments in the final reports. Your responses will never be associated with your name. We also ask that whatever is discussed here today stays in this room – please do not repeat specific comments that others make today to preserve privacy.

(Explain and pass out informed consent forms.)

ICEBREAKER ACTIVITY:

There are name cards in front of each of you. Please write your first name on this card and turn it for everyone to see. This will help everyone in the group remember each other's names. Let's go around the room and quickly introduce yourself and tell us why you chose to participate.

VI. Definitions used in the focus group interviews are as follows:

Sedentary Behaviors or Sedentary Activities: I will be using the terms "sedentary behaviors" throughout our discussion. When I use these words, I'm referring to any activities or behaviors that you have been involved in that require high amounts of sitting (e.g. TV viewing, computer use, game use, occupational work, sitting while eating, and sitting while community in a vehicle)

Are there any questions before we begin?

Please remember to say your name before answering each question.

Focus Group Questions

Sedentary Behaviors

1. What are your daily routines during the week?
   Probes: Describe your activities in a typical week. Describe your daily activities.
   Probes: What are your activities on the weekday? Weekend? Home? Work?
   What activities do you do the most during the week?

2. Are most of your activities in a typical or usual day active or sedentary? What makes the activity active vs. sedentary?

3. Now I want you to think about all the ways or activities that make woman your age sedentary. Remember that sedentary activities are activities that require a lot of sitting. Name some common sedentary behaviors or sedentary activities.
   Probe: What types of sedentary behavior do woman engage in at home? At work?

4. When in your life were you most sedentary? It could be now or an earlier time in your life. Describe what types of sedentary behaviors you engaged in during this period.
   Probe: What do you think it was about that time that made you most sedentary? Age? Specific occupations? Life factors?

5. What types of sedentary behaviors do you usually do now? Tell me about what you did in the last week?
   Probe: Why did you choose this type of activity?

6. What do you like most about sedentary activity? What do you like least about this sedentary activity?

7. What time of the day are you most sedentary? What type of activities do you usually do at this time?
   Probe: Why did you choose this type of activity?

8. What day of the week are you most sedentary? What types of activities do you usually do during this time?
   Probe: Why did you choose this type of activity?

9. What are some of the sedentary activities that you do with your friends and family?
   Probe: What makes you choose these activities?

10. What are some of the sedentary behaviors you do on your job?
    Probe: How active is your job? How much time do you spend sitting?

11. What is the one outcome or one thing that sedentary activities do for you that make them worth doing? That is, what do you enjoy the most about sedentary activities? **Probes:** Stress relief, relaxing? Makes tasks easier?

12. What are the disadvantages – or the down side - of these sedentary behaviors or sedentary activities?

13. How might sedentary behaviors relate to your health, if at all? **Probes:** Various health outcomes (i.e. obesity, high blood pressure, diabetes)

14. *Let's Brainstorm:* What are some things that you or other African American women you know could try to become less sedentary? **Probes:** At home? At work? With friends? Reduce TV viewing? Take breaks from sitting at work?

Logistics

Most people know that being physically ACTIVE is good for your health. So, for example, walking regularly and at a brisk pace reduces your risk of cardiovascular disease, high blood pressure, and diabetes. We are also beginning to learn that being LESS SEDENTARY is also good for your health, above and beyond the good effects of being active. So, for example, spending less time sitting and watching television, taking breaks at work where you get up and walk for a bit is beneficial for various health outcomes. I am interested in designing a program to help African American women be less sedentary and I need your help.

1. What would a program designed to decrease sedentary behaviors look like? **Probe**: How would you like the program to be delivered (e.g., group-based setting, home-based, worksite, individually, CD Rom, telephone, handouts through the mail, video, combination)?

   Probe: Who would deliver the program?

   Probe: Where would the program be delivered? At home? At work?

   Probe: Would you feel comfortable with someone coming to your home to deliver this type of information?

   Probe: How many hours would you be willing to spend at home or work with the provided material?

2. Would you be willing to attend a weekly or biweekly program for *one to two hours?* **Probe**: How many weeks would you be willing to do this?

3. What would help you continue to participate in a weekly or biweekly health program targeting sedentary behaviors and physical inactivity?
   Probe: Would providing childcare, transportation, or food help you continue to participate in a weekly program?
4. What things do you think would be helpful to include in a program for African American women?
   Probe: What types of sedentary activities would you want to target in your program?
5. Is there anything that you would like to add to our discussion today?

Summary

Thank you very much for your time today. We really appreciate your input and advice on these issues. Your comments will be used to help guide the development of an effective health promotion program targeting sedentary behaviors in African American women.

APPENDIX D – FOCUS GROUP DEMOGRAPHIC SURVEY

Date of Scheduled Focus Group: ________________________

Time of Scheduled Focus Group: _______________________

Dear Focus Group Participant,

Thank you for volunteering to take part in this project! Your feedback during today's focus group session will be very helpful.

Please take a few moments now to fill out this form. This form includes a few questions that are related to your health practices and demographics (e.g. education, employment). You do not have to share your answers with anyone; however, if you have questions about this survey, please ask me for help. All information provided today will be confidential and individual names will not be associated with responses. Participation is anonymous so please do not write your name or other identifying information on any of these materials.

After you have completed this survey, I will take measurements of your height and weight. Feedback about your measurements will be provided only with you and kept confidential at all times.

Thank you in advance for taking the time to complete this form and participating in measurements of your height and weight!

Sincerely,

Tatiana Y. Warren

Email: warrenty@mailbox.sc.edu

Office: (803) 777-9905

Cell: (646) 234-0645

1. How many servings of fruits do you usually eat EACH DAY? ______

2. How many servings of vegetables do you usually eat EACH DAY? ______

3. Would you say that in general your health is ………………………..?
- O Excellent
- O Very good
- O Good
- O Fair
- O Poor

4. What is your age? ______

5. What is the highest grade or year of school you completed?
- O Never attended school or only kindergarten
- O Grades 1 through 8 (elementary)
- O Grades 9 through 11 (some high school)
- O Grade 12 or GED (high school graduate)
- O College 1 year to 3 years
- O College 4 years or more (college graduate)

7. Are you currently…… (choose one)?
- O Employed for wages
- O Self-employment
- O Out of work for more than 1 year
- O Out of work for less than 1 year
- O A homemaker
- O A student
- O Retired
- O Unable to work

8. Have you ever been told by a doctor, nurse, or other health professional that you had any of the following:

Health Conditions	YES	NO
Diabetes	O	O
High Blood Pressure	O	O
Stroke	O	O
Arthritis	O	O
Asthma	O	O
Osteoporosis	O	O
High Blood Cholesterol	O	O
Heart Attack	O	O
Coronary Heart Disease	O	O

FOR STAFF ONLY:

Height ___________ ft. __________ in.   Weight ____________lbs.

Appendix E – Focus Group Participant Receipt

African American Sedentary Behavior Focus Group Study Receipt

I have received $20 for the completion of a focus group study, brief participant demographic questionnaire, and measurements of my height and weight at today's study.

____

Date

____

Printed Name

____

Signature

____

Social Security Number (last 4)

For participating in this important study!

Appendix F – Focus Group Codebook

Sedentary Behavior Focus Group Study Code Book

Code	Main Category	Sub Category	Definition/Examples
1.0	Special Code		
1.1		Participant Code	Code participant with responses and use participant IDs (i.e. 1.1.9-1.1.40)
1.2		Focus Group Guide Question Code	Code question with responses and use the question # (i.e. 1.2.1-1.2.19)
1.3		Program Development Question code	Code question with responses and use the question # (i.e. 1.3.1-1.3.5) Note: Last question in FG guide is included in program development.
2.0	Knowledge of Definition of Sedentary Behavior		
2.1		Knowledge of Definition	Make a comment which demonstrates previous knowledge of the term "Sedentary Behavior (SB)"
2.2		Limited or No Knowledge of Definition	Make a comment which demonstrates no previous knowledge of the term "SB"
3.0	Perception of the Term Sedentary Behavior		
3.1		Positive	Make a comment which demonstrates the term SB is a positive behavior to engage in
3.2		Negative	Make a comment which demonstrates the term SB is a negative behavior to engage in

4.0	Definition of being "Active" vs. "Sedentary"			
4.1		"Active"		
4.1.1			Moving	Definition which contains any form of the word "move" (etc., movement, moving), or muscle contraction
4.1.2			Increasing heart rate	Definition which refers to heart rate
4.1.3			Mostly active person	Participant describes daily life as mostly active
4.2		"Sedentary"		
4.2.1			Sitting/Not Moving	Definition which contains any form the word "sit"
4.2.2			Being a Couch Potato	
4.2.3			Mostly sedentary person	Participant describes daily life as mostly sedentary
5.0	Types of Activities			**DOUBLE-CODE ALERT: Comments can be coded more than once.**
5.1		At Home		
5.1.1			Grooming/Personal Care	Anything that involves personal care (e.g., getting dressed, brushing teeth, showering, taking medicine)
5.1.2			TV Viewing	Watching television only
5.1.3			Computer-use	Any computer time not related to work activities
5.1.4			Leisure Sitting	Sitting in sunroom, reading, socializing
5.1.5			Eating/cooking	Any consumption of food (including breakfast, lunch, dinner, snack, etc.) and beverages (coffee, juice, water) or

				comments about preparing/cooking food
5.1.6			Sleeping	Comments, “go to bed”, “go to sleep”
5.1.7			Phone-use	Talking on phone or cell phone, texting, apps,
5.1.8			Laying around	Laying or resting in the bed or on the couch
5.1.9			Physical activity	Structured exercise (aerobics, walking) or unstructured daily activity (e.g., gardening)
5.1.10			Faith-based activity	Attending services or Bible study, daily devotional, prayer, scripture reading
5.1.11			Care-giving activity	Engaging in activity which involves the care of another individual (e.g., picking up grandchildren from school)
5.1.12			Other	Comments about completing assignments
5.1.13			Household chores	Cleaning, vacuuming, dusting, laundry
5.2		At Work		
5.2.1			Computer-use	Computer work-related activities
5.2.2			Leisure computer-use	Comments about playing computer games, online shopping or surfing the internet while at work.
5.2.3			Breaks	Cigarette, sleeping/napping
5.2.4			Eating	Any consumption of food (including breakfast, lunch, dinner, snack, etc.)
5.2.5			Occupational Sitting	Any sitting done at work (e.g., at desk, while on computer, during meetings/trainings)
5.2.6			Other	Other type of activity at work not captured by any of the above categories (e.g. standing and serving others)

5.2.7			Physical activity	Structured exercise (aerobics, walking, stretching)
5.3		At Other Location		
5.3.1			Commuting	Sitting in a vehicle while in transit (car, bus, etc.)
5.3.2			Attending seated events	Movies, sporting events (sitting in the bleachers), meetings, “going on dates”
5.3.3			Religious Services	Attending church services or Bible study
5.3.4			Physical activity	Attends gym or Exercise session
5.3.5			Eating	
6.0	When in Life Most Sedentary			
6.1		By Age		
6.1.1			Teenage years	≤ 19 years old
6.1.2			20’s	20-29 years old
6.1.3			30’s – early 40’s	30-44 years old
6.1.4			Current age	45-65 years old
6.2		By life circumstances		
6.2.1			Employment	Having a job that requires SB
6.2.2			Retirement	SB time increases as a result of retirement
6.2.3		*	Relationship status	Marriage, divorce
6.2.4			Health issues	Health issues associated with SB’s (e.g., arthritis, injuries asthma, weight-related)
6.2.5		*	Change in Family Structure	Kids no longer living at home, kids return to live at home, care-giving of grandchildren or parents.
7.0	Reasons for Engaging in SB’s			

7.1		Age-related	Comments about getting older so SB increase
7.2		Employment-related	Employment status (working, retired)
7.3		Health-related	Mental and physical health outcomes (e.g., CVD, depression, HBP, menopause, injury)
7.4		Stress-related	Daily hassles, major life stressors
7.5		Financial/Economics	Cannot afford a more active lifestyle, talk about the economy as a barrier
7.6		Family/Friend influences	Comments about family/friends doing it
7.7		Environmental influences	Safety concerns so stay inside and sit, mentions structural changes, or environmental changes that occur
7.8		Technological advances	Comments about technology advances making things easier (e.g., driving in a car)
7.9	*	Culture *Note: African American Culture and Societal Shifts/American Culture*	Ancestral roots (e.g., manual labor during youth vs. "higher status" desk job); desire to "sit" at work like Caucasian counterparts; comments about cultural shifts
7.10		Previous Life Burdens	I have earned this, work hard in life, past work has been hard and caused them to be tired/burned out which causes them to rest now.
7.11		Reward	Providing self with rest as a reward for a long work day.
7.12		Leisure-time	Comments LT SB are very important. Denotes time spent in SB as personal leisure time or "me time"
7.13		Tired	Comments that express feeling tired and

			"burned out"
7.14		Dietary	Link eating habits to sitting behavior
7.15		Other	"removes personal choice"
8.0	Likes of SB's		What makes participants like SB's or why SB's are worthwhile
8.1		Productive time	Engage in SB's described as fulfilling (reading, journaling, etc.)
8.2		Relaxation	Time for relaxing, resting, and having tranquility
8.3		Habit	Comments convey some sort of habit (e.g., "Comfortable with it," "Like it just because")
8.4		Personal Time	Designated time to be still and quiet, focus on individual needs, no need for friends or social life
8.5		Stress Management	Comments convey engaging in SB's as a strategy for coping with stress
8.6		Rewarding	Engage in SB's to achieve a particular reinforcing outcome
8.7		Other	Comments on anything else not previously mentioned
9.0	Dislikes of SB's		What makes participants dislike SB's or why SB's are not worthwhile
9.1		Health consequences/concerns	Too much SB can lead to ill health effects (physical and mental)
9.2		Boredom or Wasted Time	Participant reports being bored or not having anything to do; reports time being wasted (e.g., not using time efficiently)
9.3		Tired	Comments makes you more tired,

			exhausted, or have low energy
9.4		Laziness	Comments SB make you a more lazy or couch potato
9.5		Routine/repetitious	Frequency with which SB are required
9.6		Other	Comments on anything else not previously mentioned
10.0	Time of Day Most Sedentary		
10.1		Mornings	
10.2		Afternoons	
10.3		Evenings	
11.0	Time of Week Most Sedentary		
11.1		Weekdays	
11.2		Weekend days	
11.3		Other	During inclement weather
12.0	Season of Year Most Sedentary		
12.1		Fall	
12.2		Winter	
12.3		Spring	
12.4		Summer	
13.0	Sedentary Behaviors with family/friends		(Question-based only)
13.1		Eating	Comments about dinning out, potluck dinners, etc.

13.2		Entertainment	Comments about attending the movie theaters, comedy shows, sporting events
13.3		Games	Comments about playing card games (uno), board games (monopoly) or video games (Xbox).
14.0	Why these sedentary behaviors with family/friends		(Question-based only)
14.1		Designated Family Time or Family activity	Acknowledges a special time to bond with family or friends. A time for communication of daily/weekly activities.
14.2		Enjoy	Comments on enjoyment or fun time spent with family or friends.
14.3		Relaxing	Time for relaxing, resting, or having tranquil/peaceful moments with family or friends.
14.4		Inexpensive	Reports that it is not costly to engage in SB with family/friends.
15.0	How much time do you spend sitting at home?		
15.1		Mostly sitting	Comments on mostly sitting or lying down while at home.
15.2		Mostly active	Comments on mostly moving around, cleaning, or active at home.
16.0	How much time do you spend sitting at work?		

16.1		Mostly sitting		Comments on mostly sitting or lying down while at work.
16.2		Mostly active		Comments on mostly moving around, cleaning, serving, or active at work.
17.0	Associated Health Outcomes			Participant reports the following conditions may be associated with sedentary behaviors or time spent sitting.
17.1		Obesity		
17.2		High Blood Pressure		
17.3		High Blood Cholesterol		
17.4		Diabetes		
17.5		Heart Disease		
17.6		Stroke		
17.7		CVD		
17.8		Depression		
17.9		Other		Stress, sleep apnea, asthma, pain, or any other reported health condition
Program Development				
18.0	Program Development			**DOUBLE-CODE ALERT: Comments can be coded more than once.**
18.1		Things to do to become less sedentary		
18.1.1			Enlist social support	Find a support group
18.1.2			Volunteer	Get involved with community events and volunteer time or resources.
18.1.3			Build PA into daily routines	Become more active, start exercising, go to the gym, park car further away, take stairs
18.1.4			Reduce stress	Comments on reducing amount of stress in life that causes women to be

				sedentary
18.1.5			Take Breaks	Take breaks at work to stand up and move around or stretch out.
18.1.6			Change dietary habits	Comments on how diet causes sluggish behavior and SB so changes in eating will lead to increase movement.
18.1.7			Focus on psychosocial factors	Increase self-esteem, increase faith, increase self-confidence,
18.1.8			Decrease socializing or change social activities	Decrease sedentary behaviors with family/ friends (i.e. talking on the phone, eating)
18.1.9			Other	
18.2		Things to include in a program designed to decrease SB		
18.2.1			Social Support: Tangible/Instrumental	Receives handouts or materials related to ways to decrease SB.
18.2.2			Social Support: Emotional	Support of friends/family/ "buddy system"
18.2.3			Management Role Modeling	Comments that supervisors at work should set an example for work-site programs.
18.2.4		*	Verbal/Auditory Commands	A friend/supervisor/doctor tells you to sit less
18.2.5		*	Visual commands	A visual aid prompts standing(e.g. computer)
18.2.6			Health Behaviors: PA	Include components on increasing PA
18.2.7			Health Behaviors: Diet	Include components on healthy eating
18.2.8			Technology	Use cell-phone, email, online video sources
18.2.9			Other	Message framing, marketing strategies

19.0	Program Delivery			
19.1		Group-based Setting		Program delivered in a group
19.2		Home-based Setting		Program delivered at home
19.3		Work-based Setting		Program delivered at work
19.4		Text messages		Receives program via text message
19.5		Online Video Source		Listserve, youtube, work/school network
19.6		Faith-based		Multiple strategies used to deliver program
19.7		Other		Workshops and seminars
20.0	Duration of Program			
20.1		By Week		
20.1.1			Weekly	
20.1.2			Bi-weekly	
20.2		By Hours/Week		
20.2.1			<1 h/w	
20.2.2			1 to <2 h/w	
20.2.3			2 to <3 h/w	
20.2.4			3 to <4 h/w	
20.2.5			4 to <5 h/w	
20.3		Length of Entire Program		
20.3.1			≤4 Weeks	
20.3.2			5-8 Weeks	
20.3.3			9-11 Weeks	
20.3.4			≥ 12 Weeks	
21.0	Incentives to include			
21.1		Membership		Membership to gym or special

			promotions
21.2		Money	Monetary incentive for participation or mention free program
21.3		Childcare	Services provided to babysit kids while participating in the program
21.4		Food	A meal or snack provided during meeting times.
21.5		Other	Any other incentive not included previously
22.0	Physical Activity		Any time PA came up within the context of a discussion on SB
23.0	Diet		Any time eating came up within the context of a discussion on SB
24.0	Life Stressors		Comments about problems in daily lives