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Health Behaviors of Fruit and Vegetable Consumption, Physical Activity, and Breast Cancer among African American Women

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January, 2020

Abstract

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BA, University of North Carolina at Charlotte, 2006

Doctoral Dissertation Submitted in Partial Fulfillment

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Abstract

Breast cancer incidence is suddenly increasing among African American women. Recent studies indicate that health behaviors are thought to confer important health benefits and have the potential to lowering breast cancer incidence. Guided by the social ecological model, the purpose of this quantitative, cross-sectional study was to investigate the association between health behaviors of fruit consumption, vegetable consumption, and physical activity and breast cancer after adjusting for age, body mass index, and smoker status. Social support and income level were assessed as modifiers. Using the 2012 to 2017 Health Information and National Trends Survey data, this study was conducted with 10,592 participants using logistic regression. No statistically significant association was observed between fruit and vegetable consumption and breast cancer; however, there was a statistically significant association between physical activity and breast cancer (p = .018, odds ratio =. 435, CI 95%= [.218-.867]). These findings are consistent with studies indicating that physical activity was a potential factor in reducing breast cancer risk, and consistent with studies indicating inconsistency on the association between fruit and vegetable intake and breast cancer. A positive social change implication might be the possibility to tailor inexpensive interventions to motivate and sustain physical activity such as voucher to empower women to be active. Future studies with precise measures of dietary intake of fruits and vegetables after adjusting genetic factors are recommended.

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BA Africana Studies and Biology, University of North Carolina, 2006

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Dedication

This achievement is dedicated to God who gave me the strength and the wisdom. Dedicated to my father, Jean Ekoue, who taught me hard work, perseverance, love, and tenacity; he nurtured me to be a strong women. This work is also dedicated to the 20th-year anniversary of his death. Dedicated to my mothers, indeed I was lucky to have many mothers in my life. “It takes a village to raise a child,” Mama Rachel, Mama Catherine, Mama Jeanne, and Mama Adal. Each of you gave me love and nurtured me with wisdom; I have always cherished your combined contribution in my life. This achievement is also dedicated to my brothers, sisters, nieces and nephews, and especially to Pr Tetanye Ekoe the leader of the family.

Dedicated to a special loving brother, and my angel Gabriel Mbeng, who gave me the opportunity to come to the US, who mentored, equipped and supported me all the way, I love you, Gabriel. To my husband Paul Epee Njoh, thank you for coping with me through the emotional journey of the dissertation. Also I dedicated this to my church family, my pastors Jean Bruno Nzey and Jean Claude Kabamba, and my prayer group, “the hedgebuilders,” who supported me with prayer. Finally, to all breast cancer survivors, I was inspired to work on breast cancer during a prayer meeting in my house in 2016. We were praying to the Lord for sister Chantal Kabamba, who had just been diagnosed with breast cancer at 38 years old. That day was the “Aha” moment.

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This dissertation process started after a painful disappointment in life, when I was mainly coping with infertility. From a sad, hopeless, and helpless situation, God gave me the peace and the strength. To God be the glory. I started the PhD journey with hope, confidence, determination, and faith, yet the journey was not an easy journey. Along the journey, many talented and selfless individuals made a positive impact.

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Chapter 1: Introduction to the Study

Breast cancer is an urgent public health issue facing African American women. Breast cancer is the second common cause of mortality among women (American Cancer Society, 2017), and African American women experienced more disparities in breast cancer (DeSantis, Ma, Goding Sauer, Newman, & Jemal, 2016; DeSantis et al., 2017; Siegel, Miller, & Jemal, 2018). In this study, I investigated the association between health-related behaviors of fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women and whether or not the association was modified by social support and stratified by income levels. In Chapter 1, I discuss the background, the problem statement, and the nature of the study, the research questions and hypotheses, the research objectives, the purpose, the framework of the study, the definitions, and the assumptions. I conclude with a discussion on the scope and delimitations and limitations of the study. Overall, study findings will provide a better understanding of health behavior as risk factors, to better understand the impact of lifestyle on breast cancer development, interventions, and strategies to motivate behavior change at multiple levels

Background of the Study

A disturbing trend of breast cancer is emerging among African American women. Recent studies have reported an increased incidence of breast cancer in African American women; the incidence rates of breast cancer in African American women now equal Caucasian women (DeSantis et al., 2016; DeSantis et al., 2017; Singh & Jamel, 2017). Researchers have examined extensively the mortality rate of breast cancer, and African

American women have a higher death rate than Caucasian women (Hunt, Whitman, & Hulbert, 2014; Samson, Porter, Hurley, Adams, & Eberth, 2016). Recent studies have shown new trends in breast cancer in young African American women, which indicated widening disparities (Davis, Darby, Moore, Cadet, & Brown, 2017; DeSantis et al., 2016; Rojas & Stuckey, 2016; Singh & Jamel, 2017). In America, the incidence of breast cancer was historically lower in African American women (Richardson, Henley, Miller, Massetti, & Thomas, 2016). Today, according to the Centers for Disease Control and Prevention (CDC), 11% of new breast cancer cases are diagnosed in women ages 44 or younger. The disease is more challenging in younger African American women because of disparities (i.e., racial differences in screening practices, diagnosis, and treatment) in breast cancer (Ademuyiwa et al., 2011; Samson et al., 2016). For instance, when data were stratified by race and ethnicity, a study conducted by Samson et al. (2016) showed that adherence to breast cancer treatment-quality measures is limited. The increased incidence rate of breast cancer in African American women could be due to changes in health behaviors or changes in lifestyle

Researchers suggested that about 20% of all cancers are associated with inadequate nutrition, body fat, physical inactivity, and excess alcohol consumption (Ferlay et al., 2019; McGuire, 2016; Tarone, 2018). Multiple studies (Arem & Loftfield, 2018; Farvid et al., 2019; Norat et al., 2014) and the American Cancer Society (2017) have suggested that health behavior of fruit, vegetable, whole grains, and beans intake has the potential to lower the risk of breast cancer (Bodai & Tuso, 2015; Demark-Wahnefried et al., 2014; Hashemi, Karimi, & Mahboobi, 2014). In other studies, the

effect of fruit and vegetable intake on breast cancer prognosis was controversial (Li et al., 2018; Norat et al., 2014; Peng, Luo, & Zhang, 2017). Emerging studies and global evidence are suggesting that health behavior of fruits and vegetable consumption and physical activity may shield women from breast cancer (Arem & Loftfield, 2018; Farvid et al., 2019), yet the evidence is limited on African American women. Given the burden of breast cancer among African American women, success in breast cancer prevention may be dependent, in part, on healthy behaviors. A health behavior change could be the inexpensive approach in the prevention of breast cancer. I was prompted to conduct this study for the hope to the potential benefit of lifestyle modification in breast cancer prevention and to tailor inexpensive preventive measures against breast cancer.

Problem Statement

The research problem that I addressed in this study was the predictive association between health behaviors of fruit and vegetable consumption, physical activity on the development of breast cancer among African American women, and whether income level and social support are modifiers. African American women bear a disproportionate burden for BC, and the adverse effects of breast cancer on African American women are multidimensional. Evidence concerning disparities in breast cancer exists (Williams & Thompson, 2017). Between 2010 and 2014, African American women aged 50 years and older have had an increased breast cancer incidence (American Cancer Society, 2017). African American women are 42% more likely to die from breast cancer (DeSantis et al., 2017). In 2016, there were 31,000 breast cancer cases among African American women, and more than 6,000 died from the disease (Richardson et al., 2016). Problems caused by

breast cancer ranged from proper care to financial distress, family life, and uncertainties. Financial trouble is a part of breast cancer burdens, characterized by stress, anxiety, fear, and depression (Jafari et al., 2013), including poor quality of care and quality of life (Meeker et al., 2016). A breast cancer diagnosis alters family with a negative life-changing experience. African American women experienced more delays in diagnosis and treatment for breast cancer (George et al., 2015). Researches have shown that health behaviors (e.g. physical activity, eating a healthy diet of fruit and vegetable, grains, not smoking) have important health benefits (Peng et al., 2017; Thomson & Thompson, 2013). Evidence-based dietary recommendations from the American Cancer Society (2017) have established that physical activity is associated with a lower risk of breast cancer in women. However, there has been inconsistency on the association between fruit and vegetable intake, physical activity, and risk of breast cancer (Bradbury, Appleby, & Key, 2014; Ferrini, Ghelfi, Mannucci, & Titta, 2015; Norat et al., 2014; Peng et al., 2017; Thomson & Thompson, 2013). Studies assessing the relationships between lifestyle (i.e., diet, nutrition, physical activity) and breast cancer have mostly focused on Caucasian women (Chen et al., 2016; Kojima et al., 2017; McKenzie et al., 2016). For instance, Chen and colleagues (2016) conducted a systematic review and meta-analysis of epidemiological studies to examine the association between dietary fiber intake and breast cancer risk. Among the 24 studies Chen et al. selected, participants were all Caucasian women.

African American women are often underrepresented in studies promoting positive behaviors or lifestyle change (Paxton, Garner, Logan, Dean, & Allen-Watts,

2019). There is sparse information about the reason why African American women do not change risk behavior to reduce the incidence of breast cancer. Limited published studies have examined the relationship between health behaviors of fruits and vegetable consumption and physical activity and the development of breast cancer among African American women and the modification effect of income level and social support. This study was an opportunity to extend this understanding and fill in the gap.

Purpose of the Study

I conducted a quantitative cross-sectional study to assess the predictive association between health behavior of fruit and vegetable consumption and physical activity and the development of breast cancer, including the modifier effect of income level and social support on the presumed association. I used secondary data from the Health Information National Trends Survey (National Cancer Institute, 2018; Volkman et al., 2014). The dependent (i.e., outcome) variable was breast cancer diagnosis or the development of breast cancer (i.e., yes or no).

According the CDC (2017), an adult should eat at least 1.5 cups of fruit a day and at least 2 cups of vegetables a day to meet guideline recommendations. The CDC (2014) recommends physical activity engagement in moderate-intensity three times per week (i.e., moderate exercise or physical activity). Health behaviors were operationally defined as (a) recommended fruit consumption measured as "eats at least 1.5 cups of fruit a day (meets recommendation)" versus "does not eat at least 1.5 cups of fruit a day (does not meet the recommendation);" (b) recommended vegetable consumption as "eats at least 2 cups of vegetable a day (meets the recommendation)" versus "does not eat at least 2 cups

of vegetable a day (does not meet the recommendation);" and (c) recommended physical activity as "does moderate exercise at least 3 days a week (meets recommendation)" versus "does no moderate exercise at least 3 days a week (does not meet the recommendation)." Other independent variables were income level and social support. Social support was defined as having anyone one can count on to provide one with emotional support when one needs it, such as talking over problems or helping a person make difficult decisions (National Cancer Institute, 2018; Volkman et al., 2014).

Research Question(s) and Hypotheses

I designed this retrospective cross-sectional study to investigate whether social support and income level are modifiers in the predictive association between health behavior of recommended fruit/vegetable consumption, recommended physical activity, and the development of breast cancer. The following 12 research questions and corresponding hypotheses guided this study:

Research Question 1(RQ1): Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$1): There is no statistically significant association between recommended fruit consumption, and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a1): There is a statistically significant association between recommended fruit consumption and the development of breast cancer

among African American women after adjusting for age, body mass index, and smoker status.

Research Question 2(RQ2**):** Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$2): There is no statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a2): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support.

Research Question 3(RQ3): Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$3) There is no statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a3): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level.

Research Question 4(RQ4): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$4) There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a4): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 5(RQ5): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$5): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a5): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support.

Research Question 6(RQ6): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$6): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a6): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level.

Research Question 7(RQ7): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$7): There is no statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a7): There is a statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 8 (RQ8): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$8): There is no statistically significant association recommended physical activity and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a8): There is a statistically significant association between health behaviors of recommended physical activity and the development of breast cancer among African American women when modified by social support.

Research Question 9(RQ9): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$9): There is no statistically significant association recommended physical activity and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a9): There is a statistically significant association recommended physical activity and the development of breast cancer among African American women when stratified by income level.

Each hypothesis will be analyzed separately using logistic regressions

Research Question 10(RQ10): Is there a statistically significant association between recommended fruit/vegetable consumption, recommended physical activity and

the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

Null Hypothesis ($H_0$10): There is no statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women, after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a10): There is a statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women, after adjusting for age, body mass index, and smoker status.

Research Question 11(RQ11): Is there a statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$11): There is no statistically significant association between recommended fruit/ vegetable consumption, physical activity, and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a11): There is a statistically significant association between recommended fruit/ vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when modified by social support.

Research Question 12(RQ12): Is there a statistically significant association between recommended fruit/vegetable consumption, recommended physical activity, and the development of breast cancer among African American women, when stratified by income level?

Null Hypothesis ($H_0$12): There is no statistically significant association between recommended fruit, vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a12): There is a statistically significant association between recommended fruit/ vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when stratified by income level.

I used binomial logistic regression to test the research questions.

Research Objectives

Of the 252,710 new cases of invasive breast cancer diagnosed in 2017, about 40,610 died from breast cancer, and most deaths were African American women (Sighoko et al., 2018). African American women have a younger median age of developing breast cancer; they have higher mortality and shorter survival rates (American Cancer Society, 2017; DeSantis et al., 2016; Singh & Jemal, 2017). In this study, I investigated whether social support and income level are modifiers in predictive association between health behaviors of recommended fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women.

The dependent variable in this study was breast cancer. In the hypotheses 1, 2, and 3, health behavior of fruit consumption was the independent variable. In the hypotheses 4, 5, and 6, health behavior of vegetable consumption was the independent variable. In the hypotheses 7, 8 and 9, health behavior of physical activity was the independent variable. Lastly, in hypothesis 10, 11, and 12, the independent variables were fruit and vegetable consumption and physical activity. Social support and income level were the effect modifier variables. The results of this study may assist in developing an intervention to support lifestyle change at multiple levels, to educate African American women and to equip them with a support system for a lifestyle change. Given that breast cancer is associated with some environmental, reproductive, and modifiable lifestyle factors, some of which are potentially modifiable (Rojas & Stuckey, 2016), breast cancer risk factors can be decreased with proper education on lifestyle modification and social support.

Conceptual Framework

The socioecological model (SEM; CDC, 2019b) was the underlying theoretical model behind this study, the predictive association between health behaviors of fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women, including whether or not income level and social support are potential effect modifiers. The SEM is broadly defined as the impact of multilevel systems (individual, interpersonal, organizational, community, and policy) being fundamental to advancing disease prevention (CDC, 2019b). According to Healthy People 2020 (Office of Disease Prevention and Health Promotion, 2019), the SEM

framework identifies risk factors at multiple levels. Kelly and Barker (2016) found that changing health behaviors must be a multilevel approach, composed of social context and the political and economic forces, regardless of any individual choices. Multiple researchers have indicated that a complex web of factors contribute to the higher incidence of breast cancer. For instance, neighborhoods are critical determinants of health (Thompson et al., 2016). Gomez et al. (2015) found that neighborhood characteristics are the crucial determinant of health, and they influence individual health behaviors (e.g., physical activity, diet); therefore, they also influence cancer across the continuum, including cancer risk, diagnosis, treatment, survivorship, and mortality.

Both social support and income levels appear to be of vital importance to sustain health behaviors. Researchers found that social support influences physical and emotional health (Latkin & Knowlton, 2015; Soylar & Genç, 2016). Social support is a significant help for the person when coping with difficulties in life; therefore, it can play an essential role in protecting African American women from the burden of breast cancer. As noted by Thompson et al. (2016), low social support was associated with adverse health outcomes in breast cancer patients.

Nature of the Study

I conducted a cross-sectional study utilized secondary data from the Health Information National Trends Survey (HINTS) (National Cancer Institute, 2018; Volkman et al., 2014). I used a quantitative cross-sectional approach to assess the predictive association between health behavior of fruit/vegetable consumption, physical activity, and the development of breast cancer, including whether sociodemographic factors (i.e.,

income level, social support) moderate the association. No final evidence has been found to support the role of dietary factors in breast cancer causation; however, there is compelling evidence that a diet rich in fruits and vegetables can lower the risk of breast cancer.

According to the CDC (2017), an adult should eat at least 1.5 cups of fruit a day and at least 2 cups of vegetables a day to meet guideline recommendations. The CDC (2014) recommends physical activity engagement in moderate-intensity three times per week (i.e., moderate exercise or physical activity). The dependent (i.e., outcome) variable was breast cancer diagnosis or the development of breast cancer (i.e., yes or no). The independent (i.e., predictors) variables or health behaviors were operationally defined as (a) recommended fruit consumption as "eats at least 1.5 cups of fruit a day (meet recommendation)" versus "does not eat least 1.5 cups of fruit a day (not meet the recommendation);" (b) recommended vegetable consumption as "eats at least 2 cups of vegetable a day(meet the recommendation)" versus "does not eats at least 2 cups of vegetable a day(not meet the recommendation);" and (c) recommended physical activity as "does moderate exercise at least 3 day a week(meets recommendation)" versus "does not moderate exercise at least 3 day a week (not meet the recommendation)." Other independent variables were income level and social support. Social support was defined as having anyone one can count on to provide one with emotional support when one needs it, such as talking over problems or helping a person make difficult decisions (National Cancer Institute, 2018; Volkman et al., 2014).

Definitions

Fruit and vegetable consumption: The daily intake of fruits and vegetables measured in number of cups (HINTS, 2018a)

Fruit and vegetable consumption are measured in number of cups of fruit and vegetable per day (National Cancer Institute, 2018). Fruit was measured as "eats at least 1.5 cups fruit per day" (meets recommendation/ does not meet guidance); "eats at least 2 cups of vegetable per day" (meets recommendation/ does not meet recommendation).

Health behavior: Any activity undertaken for the purpose of preventing or improving health and well-being.

Health Information National Trends Survey (HINTS): A part of the National Cancer Institute's Division of Cancer Control and Population Sciences (HINTS 2018a).

Income level: Any total, pretax, combined annual income from all sources earned within the previous year (HINTS, 2018a)

Physical activity: Number of days in a week of any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, swimming at a consistent pace, and heavy gardening (HINTS, 2018a).

Social Support: Any support from family, friends, religious, or spiritual sources to assist individuals who are dealing with some type of illness or emotional struggles (American Cancer Society, 2017).

Assumptions

Established breast cancer risk factors among African American women are not well documented. The American Cancer Society, the National Cancer Institute, and the

CDC have differentiated risk factors into non-modifiable risk and modifiable risk factors. The non-modifiable risk factors include age, sex, genetic factors, and family history of breast cancer. I assumed some of these factors were not taken into account and may not be measured. For example, genetic factors, family history of breast cancer, age at first period, not having children or having your first child after age 30, and late age at menopause were not measured. Many factors interact with one another to contribute to the disease (CDC, 2019a). There is potential confounding and effect modification to be considered; therefore, alcohol and tobacco will be confounders. Using data from HINTS, I assumed that sampling was extensive, and consequently, no random errors existed; it was assumed that the database was representative of national patterns regarding breast cancer diagnosis, physical activity, and fruit and vegetable consumption.

Scope and Delimitations

The objective of the study was to assess the predictive association between health behaviors of fruit and vegetable consumption and physical activity and the development of breast cancer among African American women. One focus was to determine whether income level and social support modified the predictive association. This study was limited to African American women or Black women living in the US; therefore, findings of this study might not be generalized to others. This study was cross-sectional; therefore, no causal relationships could be established. The scope of the study incorporated African American women who responded to the survey questionnaire about of breast cancer diagnosis, collected from HINTS

Limitations

The primary limitation of this study was the population sample size. Few participants responded "yes" to the diagnosis of breast cancer. Also, the cross-sectional nature of this study and the use of self-report measures are also among the limitations of this analysis. Other limitations could be linked to the variation in measurement of fruit and vegetable intake and sample size. The strengths of the study are the large sample size, national representative sample, and the validity and reliability of HINTS surveys (Finney Rutten et al., 2019); the survey was a nationally representative survey.

Significance

The intent of this study was to fill the gap in the literature on the effect of behaviors of fruits and vegetables consumption, physical activity as potential risk factors to the development of breast cancer among African American women. The aim was to investigate the predictive association between health behaviors of fruits and vegetables consumption, physical activity and the development of breast cancer, and to whether social support and income level were modifiers among African American women. Breast cancer is a significant burden for African American families and the community (DeSantis et al., 2016; Rojas & Stuckey, 2016; Singh & Jamel, 2017). Some evidence showed that interventions through health behavior modification improve health outcomes, which can lower the risk factor for chronic diseases (Farvid et al., 2019). The significance of this study fills the gap in the literature by quantitatively investigating the association between health behaviors of fruits and vegetables consumption, physical activity and breast cancer among African American women, and determining whether

social support and income level were modifiers. Also, this study adds into the knowledge that changing health behavior with healthy diet of consumption of fruit and vegetable and physical activity has the potential to shield African American women from breast cancer. The findings can be used to design and tailor inexpensive interventions for breast cancer prevention. The results will contribute to enhancing nutritional education in multiple settings, and awareness of health behavior as risk factors among African American women. The significance of this study is also expended to the theory, practical and social change

Significance to Theory

Reshaping health-related behavior is a complex problem; the desire to change does not translate in action change because health behaviors, such as fruit and vegetable consumption and physical activity, are directly linked to the physical and social environment. For a sustainable lifestyle change at multiple levels, to ensure data quality before data collection the foundation for a future prevention approach could be accomplished through health behavior modification by education and a supportive environment.

Significance to Practice

At the community level, a program for a supportive environment to motivate lifestyle change could include education and support to the most vulnerable communities. Policies to build culturally aware environments could include activities such as a walk tract in the black neighborhood and nutritional counseling by a health professional.

Significance to Social Change

These findings contribute to Walden University's mission of promoting positive social change because health professionals will tailor inexpensive interventions for sustainable health behavior change; such as a nutritional counselling focusing on healthy eating. They are a crucial element to bridging the gap by increasing the number of people receiving lifestyle advice and coaching (Williams, Beeken, Fisher, & Wardle, 2015).

Summary and Transition

The purpose of this study was to investigate a predictive association between health behaviors of fruits and vegetables consumption and physical activity and the development of breast cancer among African American women and whether income level and social support have an interaction effect on the presumed association. In Chapter 1, I provided the background of what is known about breast cancer and African American women, the problem statement, the purpose of the study, the different research questions and hypotheses, the theoretical framework of the study, the nature of the study, the definitions, the assumptions, the scope and delimitations, the limitations, the significance. In Chapter 2, I focus on the overview of the precedent studies addressing breast cancer and African American women in association with their health behavior of fruit and vegetable consumption and physical activity. I addressed the interaction effect of income level and social support, because multiple factors impact health behavior change, such as personal, interpersonal, and environmental factors.

Chapter 2: Literature Review

Breast cancer is an issue of growing concern for African American women. It is the second common cause of mortality (American Cancer Society, 2017), and African American women experienced more disparities in breast cancer than Caucasian women (DeSantis et al., 2016; Siegel et al., 2018). Breast cancer is a heterogeneous disease; although determined in part by genetics, overwhelming evidence has shown that breast cancer development is influenced by environmental factors (National Institute of Environmental Health Sciences, 2018). A higher incidence rate of breast cancer and mortality among African American women compared to other races (DeSantis et al., 2016; Singh & Jemal, 2017) might be due to health behaviors such as fruit and vegetable consumption (Farvid et al., 2018) and physical activity (Rosenberg et al., 2014), but evidence for African Americans is limited.

I addressed the predictive association between health behaviors of fruits and vegetables consumption and physical activity and the development of breast cancer among African Americans and whether the presumed association is stratified by income level and modified by social support. In the chapter, I emphasize that setting healthy lifestyle patterns for African American women that can be maintained throughout their lives is needed. The primary objective of this study was to assess if there is an association between fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women while controlling for age, body mass index (BMI), and smoker status. The second objective of this study was to assess income level and social support interaction with the association. Chapter 2 includes a detailed

literature review and the background of the study, the SEM framework, breast cancer epidemiology, breast cancer epidemiology and African American women, and African American women and breast cancer disparities. I also investigated health-related behaviors and modifiable risk factors, such as fruit and vegetable consumption and physical activity, and sociodemographic factors, such income level and social support.

Literature Search Strategy

I identified relevant studies, reviews, and peer-reviewed articles. The keywords I used to search the literature included: *breast cancer, breast cancer AND African American women, breast cancer AND black women, breast cancer AND demographic factors,* and *breast cancer AND social support*. Additionally, I used the key terms were *cancer, black women, modifiable risk factors, non-modifiable risk factors, fruits and vegetables, diet, physical activity, lifestyle and social ecological model framework, age,* and *risk factors*. I also searched the literature in databases such as MEDLINE, PUBMED, EBSCOhost databases, and other search engines such as Academic Search Premier, and CINAHL Plus with Full Text, ERIC, and Google Scholar were used. I limited the search to scholarly, peer-reviewed articles that were published between 2013 and 2019.

Theoretical Foundation

The SEM has been defined as a dynamic relationship between personal and environmental factors contributing to human development (Bronfenbrenner, 1997). The SEM emphasizes the combination of individual-level physical and social environments and policies to achieve positive changes in health behavior that are then maintained (Sallis, Owen, & Fisher, 2015). The social ecological model explains the multifaceted

and interactive effects of individual-level and environmental factors that influence health-related behaviors. The CDC has recognized SEM as one successful approach to breast and cervical cancer prevention (CDC, 2019b). Reshaping health-related behavior is a complex problem; most importantly, however, health behaviors are not determined by any single factor. Freedman, Bell, and Collins (2011) found that the desire to change and awareness do not translate into behavior change because health-related behaviors, such as fruit and vegetable consumption and physical activity, are directly linked to physical and social environment. African American adults do not meet the national guidelines for engaging in regular physical activity (Coughlin & Smith, 2016).

Coughlin and Smith (2016) conducted a systematic review of the community-based participatory research (CBPR) approaches to promote physical activity among African Americans. They found that the CBPR approach and faith-based interventions have utility for shaping and promoting physical activity in African American communities. Their research is important for this study because SEM and CBPR approaches have utility for shaping socio-environmental intervention, with the potential to change health behaviors like physical activity and healthy diet, nutrition, and weight management among African American adults.

Scarinci et al. (2014) conducted a study with African American women aged 45 to 65. The purpose of the study was to examine the efficacy of a community-based, culturally relevant intervention when promoting healthy eating and physical activity. They found a lifestyle change characterized by increased fruit/vegetable intake, decreased fried food consumption, and increased physical activity. These findings indicated that

lifestyle change is possible if interventions shift the issue from an individual level to the community level. A SEM approach shifts this complex issue from individual (i.e., intrapersonal) attribution and responsibility to community (i.e., interpersonal) processes. The potential to apply SEM to health behavior and lifestyle intervention for breast cancer prevention offers some advantages, such as the opportunity for individual tailoring and elimination of barriers (Paxton et al., 2019). A depiction of SEM is presented in Figure 1.

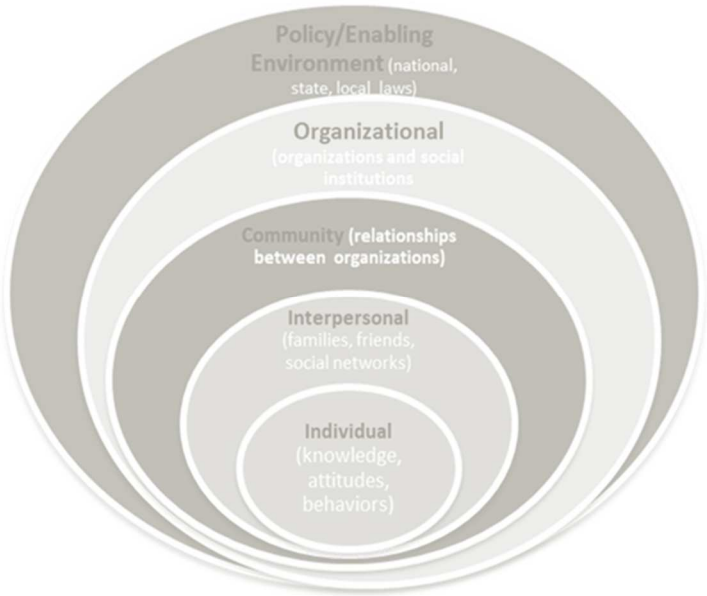


Figure 1. The social ecological model.

From McLeroy, Bibeau, Steckler, & Glanz (1988, pp. 351-377).

Breast Cancer Epidemiology

Breast cancer is caused by gene mutations that progress in a malignant tumor in a ductal cell or lobular cell of the breast cell. Genetic factors play an important role in breast cancer development according to the National Institute of Environmental Health Sciences (2018); therefore, understanding the etiology of breast cancer through the

classification of breast cancer into different subtypes is important for this study because breast cancer in the United States vary by race and ethnicity, subtypes, and outcomes. More importantly, breast cancer mortality is linked to the form of breast cancer known as triple negative and human epidermal growth factor receptors (American Cancer Society, 2017; Kohler et al., 2015). Researchers showed that the adenocarcinomas are cancerous cells developing in the glandular tissues of the body; they constitute more than 95% of breast cancers (Hennigs et al., 2016; Makki, 2015).

A new understanding of breast cancer and the clinical classification identified two types at diagnosis: (a) the invasive and (b) the noninvasive, with the main difference being the identification of metastasized cells. The invasive carcinoma is the abnormal proliferation of neoplastic cells in the breast tissue, with penetration through the duct wall into surrounding breast tissue (Thomson & Thompson, 2013). Researchers have determined that the invasive ductal carcinoma is the most common form of invasive breast cancer, representing 55% of breast cancer incidence upon diagnosis (Makki, 2015). In the noninvasive malignant type, also known as ductal carcinoma situ, the proliferation of epithelial cells is confined to the ducts and lobules (Hennigs et al., 2016; Makki, 2015).

The expressions of estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2) have revealed the heterogeneous nature of breast cancer. Based on molecular biomarkers, researchers have identified 21 distinct breast cancer histological subtypes and four different molecular subtypes (American Cancer Society, 2017). The four molecular subtypes are classified according

to hormone receptor expression (HR±) and/or epithelial cell of origin (luminal or basal) (American Cancer Society, 2017).

- Luminal A (HR+/HER2-) represents 71% of all breast cancer
- Triple negative (HR-/HER2-) represents 12%; they are negative for estrogen receptor (ER), progesterone receptor (PR), and HER2. This subtype is the aggressive type
- Luminal B (HR+/HER2+) also represents 12% luminal B cancers are ER+ and/or PR+ and/or HER2, associated with poorer survival than luminal a cancer
- HER2-enriched (HR-/HER2+) represents 5%; this subtype is very aggressive with poorer short-term prognosis.

According to the Surveillance, Epidemiology, and End Results (SEER), triple negative breast cancer (TNBC) is an aggressive form of breast cancer that tends to be more common in younger women, African Americans, and those with the BRCA 1 gene mutation. In addition, evidence has shown that breast cancer outcome and therapeutic response are associated with breast cancer subtype. Hennigs et al. (2016) conducted a cohort prospective study of 4,102 female cases with non-metastatic breast cancer and evaluated the outcome of breast cancer based on the subtype. Their findings confirmed that breast cancer was heterogeneous, meaning breast cancer has different subtypes, different clinical and pathological features, different therapeutic response patterns, and different outcomes. Hennigs et al. also found that patients with Luminal A (HR+/HER2-)

were expected to have an overall survival (OS) above 95 %, but the outcome of patients with TNBC subtypes was poor.

Breast Cancer Epidemiology and African American Women

Despite progress made in breast cancer prevention, breast cancer incidences have increased in African American women. The incidence rates of breast cancer in African American women now equal Caucasian women (Williams & Thompson, 2017). Evidence from a 2006 landmark study showed basal-like and triple-negative breast cancer (TNBC) is more common among young African American women compared with Caucasian women (Carey et al., 2006); therefore, breast cancer incidence may be due to variation in estrogen and progesterone receptor status and TNBC (Howlader et al., 2014). Multiple studies have found that the diagnosis of TNBC influences the higher breast cancer incidence rate and mortality in African American women (DeSantis et al., 2016; Howlader et al., 2014; Williams, Mohammed, & Shields, 2016). Researchers have classified TNBCs to be more aggressive, associated with poorer prognoses (DeSantis et al., 2016).

Churpek et al. (2015) conducted a cohort prospective study to assess inherited predisposition to breast cancer among African American women. They conducted the study with 289 African American women with primary invasive breast cancer and a family cancer history or tumor characteristics associated with a high genetic risk for mutation detection. Proportions of mutation were estimated using the binominal distribution; the Fisher's exact test was conducted to examine mutation proportions across age. They found that BRCA1 and BRCA2 mutation were frequent among African

American patients with breast cancer. The study confirmed other studies' findings about TNBC.

Howlader et al. (2014) conducted a study to examine breast cancer subtypes defined by ER, PR, and HER2 status across the 28% of the U.S. population listed on SEER registries. They found that young women and African American women were at increased risk for TNBC. Their findings were consistent with a study by DeSantis et al. (2016), which indicated that African American women have the largest proportion of TNBCs compared with women of other races.

Gonçalves, Correa, Nahsan, Soares, and Moraes (2018) examined the survival of triple-negative and non-TNBC in a Brazilian cohort that included 447 women with breast cancer. They analyzed the clinical, pathological, and sociodemographic of patient and their potential prognostic factors. They found that 19.5% of breast cancer diagnosis was TNBC. Gonçalves et al.'s study was important because breast cancer in Brazil showed ethnic variation in mortality as in the United Ststes. Evidences from studies across different settings have suggested that the high mortality of breast cancer is linked to TNBC. One potential explanation is that the traditional prevention of mammogram screening is not reliable; therefore, prevention must be the first line of defense. Dogan and Turnbull (2012) indicated that TNBCs do not have typical features detectable during mammogram screening. They found that a TNBC has irregular shape, speculate margins, and calcification.

Moreover, TNBCs represent 10-15% of all breast cancer and are predominant for African American and in younger women (under 40 years old). According to the CDC

(2018) mammography is less likely to reveal breast tumors in women younger than in older women of 50 years of age or more. Also, there is growing evidence linking the incidence of TNBC to diet and lifestyle. Siddharth and Sharma (2018) found that lifestyle factors such as obesity increase the development of TNBC among African American women. Given the role of obesity in breast cancer, researchers have suggested that sedentary behavior was prevalent among African American women, increasing breast cancer risk (Nomura, Dash, Rosenberg, Palmer, & Adams-Campbell, 2016)

Breast Cancer Incidence and African American women

According to the American Cancer Society (2017), the breast cancer incidence rate continues to rise. Studies have indicated that breast cancer incidence rates among African American women are now the same as among Caucasian American women (Nomura et al., 2016). Newly available data from National Cancer Institute (2018) showed a sudden shift in the breast cancer incidence; African American women and White women have the same incidence rate, but the breast cancer death rate is 40% higher for African American. It should be noted that African American women under 45 are frequently diagnosed with breast cancer (CDC, 2016.)

In a population-based study, Clarke et al. (2012) determined that the rates of invasive breast cancer were higher among African American women than among non-Hispanic White women, whereas, the incidence rate was higher among Caucasian women aged 40 years or older. Evidence available now shows that African American women (under the age of 45 year) have a greater incidence of breast cancer than Caucasian-American women (National Cancer Institute, 2018).

Studies found that the prevalence and strength of breast cancer risk factors among African American are linked to disparities, such as barriers to high-quality cancer prevention and early detection. The variation in incidence rate and death rate between African American and Caucasian women may be due gene mutations (BRCA) and TNBC (Chen & Li, 2015; Clarke et al., 2012).

Breast Cancer Mortality and African American Women

African American women have had higher breast cancer mortality for decades. Kinney, Varghese, Anandakrishnan, and Garner (2017) found that the mortality rate is getting worse; in 2009, the difference in the racially specific breast cancer mortality was 39.7%, and in 2014, the difference was 43%. Findings from the American Cancer Society (2017) indicate that African American women are 42% more likely to die from breast cancer, yet white women and African American women have similar incidence rates. In addition, in 2016, more than 31,000 African American women were estimated to be diagnosed with breast cancer, and more than 6,000 were predicted to die from the disease (Richardson et al., 2016).

DeSantis et al. (2016) conducted a study to understand the disproportionate burden of breast cancer for blacks in the United States by assessing the statistics on breast cancer. Their findings indicated an increase in breast cancer incidence, mortality, and risk factors for cancers among African American women. Singh and Jemal (2017) conducted a study to understand the racial/ethnic disparities in the United States

from 1950 to 2014 for mortality, incidence, and survival rates from all cancers. They found that socioeconomic inequalities play a pivotal role in cancer mortality. In

addition, Singh and Jemal illustrated that cancer mortality and incidence disparities replicate inequalities in smoking, obesity, physical inactivity, diet, alcohol use, screening, and treatment.

Tao, Gomez, Keegan, Kurian, and Clarke (2015) conducted a study to assess whether mortality differences persisted across molecular subtype and stage at diagnosis. Participants were White and African American women diagnosed with invasive breast cancer during the period 2005–2012. Also, they assessed the contributions of clinical and demographic characteristics, such as treatment, neighborhood socioeconomic status (SES), and health insurance status compared to racial/ethnic mortality differences. They found a higher hazard of breast cancer death among African American women with stage II/III HR+/HER2 and stage III TNBCs relative to Whites.

Given the breast cancer burden among African American women (see Figure 2), it is important to identify modifiable risk factors. There is a critical need for lifestyle change education about health behavior decision-making in breast cancer prevention. Investigating the association of fruit and vegetable consumption and physical activity and whether income level and social support modified such association is much needed for the most effective interventions to reduce the development of breast cancer

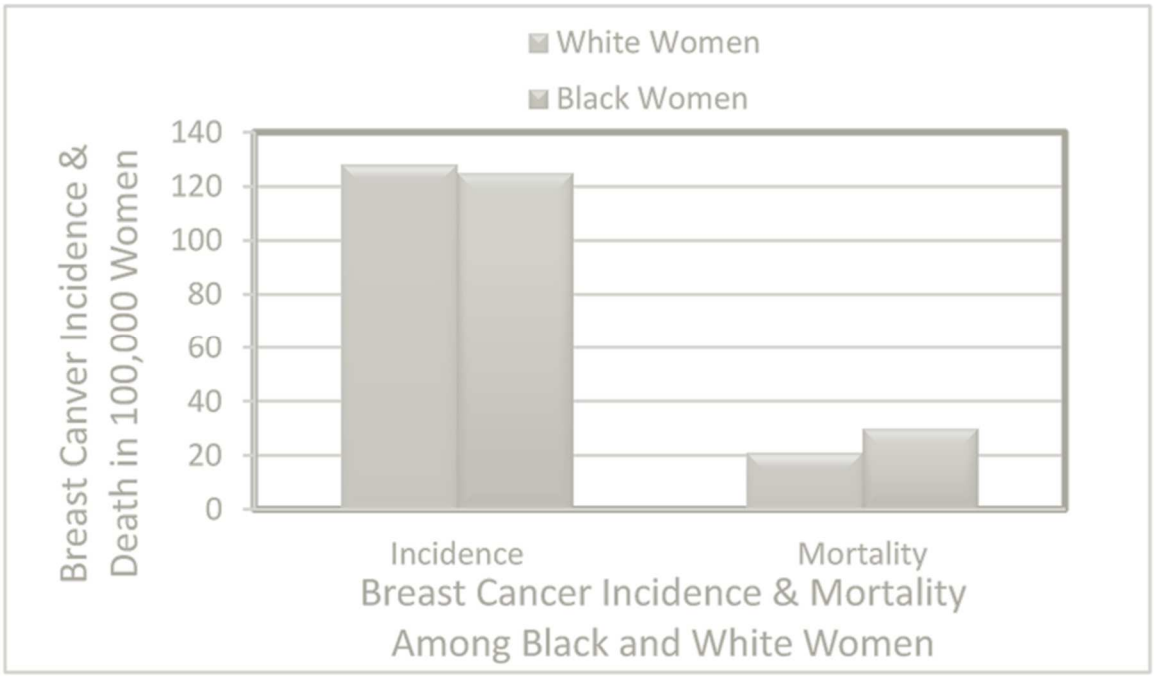


Figure 2. Number of breast cancer incidences and mortality among Black women and White women

African American Women and Breast Cancer Disparities

The compounding effect of breast cancer diagnosis is huge; breast cancer is the second leading cause of cancer death among African American women. Black women are 20% to 40% more likely to die from breast cancer (Tao et al., 2015). Studies showed that disparities in sociocultural factors may contribute to increase breast cancer mortality among African Americans women. Disparities in breast cancer have been well established (Samson et al., 2016; Siegel et al., 2018; Singh & Jemal, 2017; Williams & Thompson, 2017).

Reeder-Hayes, Wheeler, and Mayer (2015) conducted a study to assess whether disparities may be contributing to higher incidence and higher mortality. Their findings

showed multiple factors contributed to these disparities, such as advanced stage at diagnosis and higher rates of TNBC, and they identified that disparities exist in treatment. Studies showed that African Americans do not benefit from medical advances. Tao and colleagues (2015) posited that there are deficiencies in treatment for African American women, which could be attributed to a barrier from health insurance and financial hardship.

Researchers have found that the diagnosis of breast cancer dramatically affects the family; it is a life-changing experience for families, bringing stress and challenging situations. Family must adjust to psychological distress from physical changes, anxiety, fear, depression, and impaired physical functioning (Jafari et al., 2013). Woźniak and Iżycki (2014) found that breast cancer diagnosis increases financial problems and significant emotional and physical distress. Aparicio and Caldas (2016) conducted a systematic review about health-related quality of life in young Black breast cancer survivors. They compare the incidence rate of breast cancer and mortality rate between Black and White women. The findings indicated that young Black survivors reported greater fear of dying, unmet supportive care needs, financial distress, and lower physical/functional well-being.

Many socio-economic and environmental factors have contributed to the burden of breast cancer in African American women. While mammogram screening has been central to the prevention of breast cancer, the prevention model must change to include potential modifiable risk factors such as change in health behavior. Therefore, breast cancer prevention must address multilevel intervention at the socio-ecological model.

Health-related behaviors. Health-related behavior is any activity undertaken for the purpose of preventing or improving health and well-being. In this study health related behaviors of interest are fruit and vegetable consumption and physical activity factors as predictors of breast cancer. Many risk factors play a role in breast cancer, and a large number are related to lifestyle. Lifestyle factors like diet, physical activity, sedentary time, and alcohol consumption are suggested to be risk factors for breast cancer (American Cancer Society, 2017). Numerous studies found that major lifestyle-related risk factors contributed for one-third of breast cancer cases, and women can change those factors (Lammert, Grill, & Kiechle, 2018). A healthy lifestyle has positive impacts on a person's life (Weigl, Hauner, & Hauner, 2018).

Observational prospective studies have shown that diet, nutrition, physical activity, and weight management are associated with a lower risk of developing most types of cancer, including breast cancer (Ferrini et al., 2015). Thus, a healthy lifestyle may decrease the probability of developing cancer. Paxton and colleagues (2019) evaluated multiple studies (e.g., cohort, cross-sectional, and randomized trials studies) to examine the efficacy or effectiveness of intervention based on healthy behavior for African American women breast cancer survivors. They found that the lifestyle factors such as obesity and weight gain were associated with breast cancer among African American women. Specifically, the findings indicated that patients adhering to the American Cancer Society (2012) dietary guidelines observed a 15–43% reduction in all-cause mortality and a 29% reduction in cancer recurrence. While these findings were

important, the study limitations were that the adherence to the American Cancer Society (2012) dietary guidelines has not been studied extensively in African American women.

A healthy lifestyle may decrease the probability of developing cancer, and implementing health-related behavior and lifestyle change strategies in breast cancer prevention provides the opportunity to engage African American women in sustainable change in lifestyle choices. Dieterich, Stubert, Toralf Reimer, Erickson, and Berling (2014) suggested that when developing strategies for breast cancer prevention, it is important that health-related behavior (i.e., modifiable risk) and lifestyle factors be considered. In review of breast cancer and lifestyle, studies showed that healthy behaviors are more effectively enacted in a social environment. Janni (2018) indicated that lifestyle factors contribute substantially to the risk of developing breast cancer in tumor progression and relapse. Given that diet and lifestyle are major factors influencing many diseases, continued efforts are needed to focus on modifiable risk factors as prevention strategies at multiple levels, both at individual and policy levels.

Modifiable risk factors for breast cancer. Researches have indicated that health and health outcomes are linked with nonmedical factors such as nutrition and diet (Daniel, Bornstein, & Kane, 2018). Recent studies have estimated that up to 50% of all new breast cancer cases could be prevented through healthy behaviors: specifically, body weight, physical activity, alcohol intake, and smoking (Colditz & Sutcliffe, 2016; Song & Giovannucci, 2016). The association between breast cancer and modifiable risk factors such as fruit and vegetable consumption and physical activity will be discussed in this section. Healthy eating and regular physical activity are both modifiable risk factors in

prevention and management of chronic disease, including breast cancer. Hashemi et al. (2014) posited that diet, physical activity, smoking, alcohol use, and vitamin and mineral use are key factors influencing the risk of breast cancer among women; therefore, they hypothesized that lifestyle changes were the easy, effective, and economical way to help prevention breast cancer.

In the "Fourth Edition of the European Code against Cancer," Norat and colleagues (2014) recommended that people should have a healthy diet to reduce their risk of cancer, which would include eating whole grains, vegetables, and fruits and limiting high-calorie foods. According to Kooshki, Moghaddam, and Akbarzadeh (2016), diet is one of the most important modifiable risk factors for prevention and control of chronic diseases, including breast cancer. They conducted a cross-sectional study in Sabzevar on 125 women with breast cancer to determine their fruit and vegetable intake. The study supported evidence that high vegetable and fruit intake is associated with lower breast cancer risk. Other studies have been consistent about the beneficial effect of vegetable and fruit intake in lowering the risk of breast cancer in women, or some patterns in the dietary intake were associated with the risk of breast cancer (Dandamudi, Tommie, Nommsen-Rivers, & Couch, 2018; Van Ryswyk, Villeneuve, Johnson, & Epidemiology Research Group, 2016).

Dandamudi and colleagues (2018) conducted a systematic review of the association between dietary patterns and breast cancer risk. They analyzed articles published between January 2013 and May 2017. The findings suggested that dietary patterns that include vegetables and limit saturated fat and red and processed meats may

lower breast cancer risk. However, other studies provided inconsistent results in the role of nutrition and breast cancer association. Mayne, Playdon, and Rock (2016) conducted a review of cancer-diet research comprised of epidemiological studies. They found inconsistency in the association and stated that foods, eating patterns, and assessment of dietary patterns were complex

Ferrini and colleagues (2015) conducted a review of studies related to lifestyle, nutrition, and breast cancer. They stated that prospective epidemiological studies on diet and breast cancer incidence and recurrence suggested no association; moreover, they suggested a randomized controlled trial was best to provide direct evidence of a causal relationship. These findings are important because nutrition, physical activity, or lifestyle modification are complex issues. Therefore, confounders and effect modification may have accounted for the inconsistency. In fact, Janni (2018) stated that healthy lifestyle depends on different factors, such as the influence of one's social environment (i.e., role models in family and peers), level of education, occupational status, and income. Although robust evidence has shown that healthy diet and lifestyle are important tools for the prevention of cancer, those studies conducted with Caucasian women and African American are underrepresented (Boggs et al., 2010).

Fruit and vegetable intake and breast cancer. Lifestyle characteristics and environmental factors such as diet, obesity, physical activity, smoking, and alcohol consumption have a profound influence on cancer development (Yedjou et al., 2017). Healthy eating provides nutrients vital for health and maintenance of the body. According to the U.S. Department of Health and Human Services and the U.S. Department of

Agriculture's (2015) *Dietary Guidelines for Americans 2015–2020*, adults should eat 1.5–2 cups of fruits and 2–3 cups of vegetables everyday (p. 18). Recent data demonstrated that few people consume the recommended amount of fruits and vegetables (Lee-Kwan, Moore, Blanck, Harris, & Galuska, 2017; Moore, Thompson, & Demissie, 2017). A recent study conducted by Lee-Kwan and colleagues (2017) indicated that fewer people consume the recommended amount of fruits and vegetables, and they found that only one tenth of US adults consume the recommended quantity of fruits and vegetables daily. Paxton et al. (2019) conducted a study on health behavior and lifestyle intervention in African American breast cancer survivors. They found that adherence to the American Cancer Society's (2012) dietary guidelines has not been studied extensively in breast cancer survivors in the African American population.

Furthermore, recent studies have indicated that the increased consumption of fruits and vegetables was associated with reduced risk of breast cancer (Bradbury et al., 2014; Farvid et al., 2019), but other studies found that the effect of fruit and vegetable intake on breast cancer prognosis is still controversial (Ferrini et al., 2015; Peng et al., 2017). More importantly the impact of fruit and vegetable intake on breast cancer development among African American women is unclear; evidences on the association in African Americans are limited because African American women are underrepresented, except in a study done by Boggs et al. (2010).

Boggs and colleagues (2010) conducted a prospective study using data from a previous Black Women's Health Study to investigate the relationship of fruit and vegetable intake to breast cancer risk among 51,928 women aged 21 to 69 years. They

used cox proportional hazard regression models to estimate incidence rate ratios and 95% confidence intervals after adjusting for breast cancer risk factors. They found that total fruit, total vegetable, and total fruit and vegetable intakes were not significantly associated with overall risk of breast cancer, but total vegetable consumption was associated with a decreased risk of estrogen receptor-negative/progesterone receptor-negative breast cancer

A recent study conducted by Farvid and colleagues (2019) is considered to be a landmark study on the association between fruit and vegetable consumption and breast cancer incidence, but not a cause-and-affect. They conducted a large study of more than 182,000 women participants of a nurses' health study over a long-term period of 30 years. They investigated the association of breast cancer incidence (menopausal status, hormone receptor status, and molecular subtypes) and fruit and vegetable consumption. They used cox proportional hazard regression to evaluate the effect of risk factors. The findings indicated that among the subtypes of breast cancer, an association was found between higher consumption of fruits and vegetables and estrogen-receptor (ER)-negative tumors compared to ER-positive, aggressive HER2-enriched, and basal-like tumors.

It is important to note that the *Breast Cancer 2010 Report* (World Cancer Research Fund & American Institute for Cancer Research, 2010) and multiple studies have found inconclusive evidence of fruits and vegetables consumption and breast cancer incidence. A landmark study on fruit and vegetable consumption and cancer risk was the "European Prospective Investigation into Cancer and Nutrition (EPIC)" (Bradbury et al.,

2014). The EPIC reported on a large cohort of 500,000 participants and a multi-national of 10 European countries, which evaluated the relation of fruit, vegetable, and fiber and 14 different cancer sites. The findings indicated a borderline inverse association of fiber intake with breast cancer risk (Bradbury et al., 2014).

Choi and colleagues (2015) conducted a prospective study in an Asian population to evaluate the associations between total fruit, vegetable intake, and total fruit and vegetable intake and total cancer incidence and mortality. They used cox proportional hazard regression models to compute RR ratios and 95% CIs. They found an association between total vegetable intake and no associations between total fruit intake and total cancer incidence and mortality. Peng and colleagues (2017) conducted meta-analysis of studies; they found no significant associations between fruit and vegetable intake and breast cancer prognosis.

Zhang and colleagues (2009) conducted a study with Chinese women and stated that vegetable and fruit intake is associated with a lower risk of breast cancer. Multiple studies, including the CDC studies, have stated that individuals who eat a lot of fruits and vegetables have higher chances to diminish risk of some chronic diseases such as diabetes and cancers. The exact amounts that represent a cup of fruits and vegetables in a daily recommended consumption from common fruits as well as an extensive list of fruits and vegetables from ChooseMyPlate (2018) are displayed in Appendix A.

Breast Cancer and Physical Activity

Physical activity has been associated with several benefits for disease prevention and, in some cases, for cancer survivors across the cancer continuum. The World Health

Organization, the CDC, and public health advocates have recommended physical activity as a primary intervention in disease prevention. Moderate to vigorous physical activities are recommended for health benefits (CDC, 2019a; ChooseMyPlate, 2018). Moderate physical activity is any physical movement that causes a noticeable increase in heart rate, breathing depth and frequency, and sweating (brisk walking, bicycling, general gardening, dancing, and water aerobics).

According to the World Cancer Research Fund and American Institute for Cancer Research (2010), regular vigorous and moderate physical activity reduces the risk of both post- and pre-menopausal breast cancers. Studies showed that physical activity may reduce the risk of several types of cancer, including cancers of the breast (Kushi et al., 2012). Studies found that regular physical activity, with a frequency of 3-5 times a week, reduces the risk of breast cancer occurrence by 20-40% (Kamińska, Ciszewski, Łopacka-Szatan, Miotła, & Starosławska, 2015). Years of researches have revealed that physical activity may decrease breast cancer recurrence and can extend overall breast cancer survival and quality of life in disease-free breast cancer survival (Borch, Braaten, Lund & Weiderpass, 2015). Colditz and Bohlke (2014) stated that regular physical activity and a healthy body weight are key components of cancer prevention efforts.

Many studies in the United States and around the world have consistently found that physically active women have a lower risk of developing breast cancer compared to inactive (de Boer, et al., 2017, Lynch, Neilson, and Friedenreich (2011) conducted a systematic review of 62 studies; they concluded that increased physical activity resulted in greater reduction of breast cancer risk. Physical activity may have an independent

protective effect by assisting with weight control (Lee et al., 2010). Wirtz and Baumann (2018) reported that physical, psychological, and social impairments are reduced with regular exercise or aerobic training. They also reported that breast cancer survivors involved in group or community-based activities with approaches to behavioral change experienced the biggest effect. Above all, physical activity influences health and quality of life; low-to-moderate intensity as well as high-intensity interval training can have the same positive influence on fatigue, quality of life, and physical factors in female cancer survivors (Wirtz & Baumann, 2018).

According to the American Cancer Society (2017), African American women are less likely to adhere to physical activity guidelines than women of other races. African American women, compared to Caucasian woman, are significantly less likely to meet national physical activity guidelines after diagnosis; the lack of or limited physical exercise have some implications for breast cancer care (Hair, Hayes, Tse, Bell, & Olshan, 2014). Most studies on physical activity and risk of breast cancer focused on White women, and evidences on the association in African Americans women are limited. Rosenberg and colleagues (2014) conducted a prospective study with data from the Black Women's Health Study; they assessed the association between physical activity and incidence of invasive breast cancer overall; estrogen receptor–negative and receptor positive. They used cox proportional hazard regression models to estimate incidence rate ratios (IRR) and 95% confidence intervals (CI). They found that physical activity was associated with a reduction in incidence of breast cancer in African American women.

The results are consistent to the evidence that health behaviors such physical activity can shield African American women from breast cancer

Age and Breast Cancer

Among non-modifiable breast cancer factors, age is well-established breast cancer risk factor. The risk of breast cancer increases as women age (American Cancer Society, 2017; CDC, 2018). Age and breast cancer have been intensively investigated and it appears that age influence breast cancer development, and breast cancer outcomes (American Cancer Society, 2017; CDC, 2018). The likelihood of having breast cancer varies with the age of women. Breast cancer incidence rates have increased slightly among women over the age of 50 during the most recent time period (2005-2014). Multiple studies showed age-specific differences in breast cancer subtype distribution. Carey et al. (2006) posited that breast tumors arising in younger women may be more enriched for aggressive subtypes. It appears that age can positively influence certain cancer preventions, quality of life, recurrence, and survival. There are differences in breast cancer development, outcome, and prognosis when stratified by age. Studies have determined that the biology of breast cancer arising in younger women indicates that younger women's breast tumors are enriched for more aggressive intrinsic subtypes, namely, basal-like. Breast tumors arising in younger women (≤ 45 years) were basal-like tumors and HER2-enriched breast tumors (Anders et al., 2011). Female breast cancer mortality has a bimodal age distribution, the SEER reports trends in age-standardized cancer incidence and death rates (Kohler et al., 2015).

Age and breast cancer among African American women. Breast cancer is the most commonly diagnosed cancer, and the second most common cause of cancer death. The most studied risk factor to breast cancer is age. Breast cancer risk factors also

differed according to age, meaning the contributor factors to breast cancer risk are different between younger women and older women. Studies have established that age is the most influential risk factor for breast cancer diagnosis and breast cancer mortality (DeSantis et al., 2016; Partridge et al., 2016). Researchers have revealed that diagnosis at a young age is a risk factor for breast cancer recurrence and death (Partridge et al., 2016). DeSantis et al. (2016) highlighted that the median age at diagnosis for female breast cancer is 61 years, and the median age at diagnosis is younger for black women at 58 years. The high incidence of breast cancer correlates to the predominance of triple-negative subtype because African American women have a higher incidence of TNBC than White Americans (American Cancer Society, 2017). Young women are at increased risk for developing more aggressive subtypes of breast cancer (Partridge et al., 2016). Moreover, a triple-negative status is likely a large contributor to the incidence of breast cancer.

Researches have indicated that aggressive breast tumors are more common in younger African American (National Cancer Institute, 2018). African American women developed breast cancer at a young age and are more likely to have the aggressive and triple-negative breast cancers. Mutations in BRCA1 and BRCA2 affect one in four African American breast cancer patients (Churpek et al., 2015). Age-targeted prevention may be effective policy mechanism to breast cancer prevention

Socioeconomic factors

This study evaluated the predictive association between health-related behavior of fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women and the effect modification of income level and social support. Socioeconomic status and unhealthy behaviors, such as tobacco use, physical inactivity, and poor nutrition, have been well demonstrated. Nandi, Glymour, and Subramanian (2014) conducted a study to investigate the extent to which smoking, alcohol consumption, and physical inactivity mediated the association between adult socioeconomic status and all-cause mortality in a sample of 8,037 US Health and Retirement Study participants. The findings suggested that reducing social disparities in unhealthy behaviors may mitigate socioeconomic disparities in mortality. Smoking, alcohol consumption, and physical inactivity have mediated the association between socioeconomic status and all-cause mortality in a representative sample of US adults. Socioeconomic status (i.e., education level) and access to care are well-established factors associated with breast cancer disparity (Wheeler, Reeder-Hayes, & Carey, 2013). Socioeconomic status is associated with age.

Income level and breast cancer risk. The influence of socioeconomic status such as income level has been associated with breast cancer disparities. Income level is an important component of the socioeconomic status. According to American Cancer Society (2017), statistic show that African American women are disproportionally affected by breast cancer with a higher mortality and shorter 5-year survival rate; socioeconomic status such as income level influence both mortality and survival rate.

Income level and access to service influence the opportunity for early detection of breast cancer. Chowdhury and colleagues (2016) suggested that obstacles to screening include individual characteristics such as low income and lower educational attainment. They conducted a study to determine whether observed disparities related to breast cancer can be predicted with the socioeconomic and other demographic attributes. They examined the association of breast cancer screening rates and breast self-exam with income, the level of education, family doctor, and type of health insurance, obesity, and age. The findings showed that income, education, family doctor, age, and health insurance were independent predictors for the low utilization rate of mammography and breast self-exam, recognizing that low income is a financial barrier to achieve optimal health. Advani and colleagues (2014) found that financial strain is associated with an elevated unmet health need; therefore, financial strain may be reflected by increased mortality among older African Americans.

Social support and breast cancer. Health-promoting lifestyle is linked to social support. Social support might contribute to health prevention, health outcome, or changing risk behavior. Social support is the emotional or financial assistance provided by family, friends, and community when someone is dealing with a negative event. More importantly, social support might contribute to health prevention, health outcome, or changing risk behavior. The interaction between health behavior, personal, and environmental factors plays a role in the development of disease, including breast cancer. According to the CDC, a range of factors or social determinants contribute to health differences. Multiple researchers have estimated that half of all new breast cancer cases

are preventable through health-promoting behaviors and lifestyle change (Colditz & Bohlke, 2014). A person's social environment greatly affects the likelihood of lifestyle modification, and social support quality is an important predictor of risky behaviors (Spohr, Suzuki, Marshall, Taxman, & Walters, 2016).

Evidence has shown that to reduce the risk factor of chronic diseases, such as diabetes, heart disease, and even breast cancer, people have a wide variety of choices for achieving healthy lifestyle. One such choice includes social support. Studies have shown that a decreased likelihood of developing breast cancer is related to modification of risk factors, such as smoking, excessive consumption of foods high in cholesterol, saturated fat, and sodium, and lack of exercise (CDC, 2018). In this study, social/emotional support is defined as having friends or family members that one talk to about one's health or close friends and family members who provide hope and a listening ear (National Cancer Institute, 2018). Epidemiological studies have found that social support influences health (Casale et al, 2015); social support influences morbidity, mortality, and quality of life in chronic disease populations. Social support is beneficial to the health of individuals in a variety of ways and has been linked to healthy behaviors and better health outcomes (Spohr et al., 2016).

Sarkar, Taylor, Lai, Shegog, and Paxton (2016) conducted a cross-sectional study with 144 participants from four worksites in a large to examine the associations among family, friend, and coworker social support for physical activity. After controlling for all the covariates (i.e., age, sex, marital status, BMI, education, and income), the findings indicated social support was associated with physical activity among participants in the

workplace study. The findings are important to this study in proving that lifestyle modification may also depend on social support (Jensen, Ejlertsen, Mouridsen, Christiansen, & Danish Breast Cancer Cooperative Group, 2015; Sarkar et al., 2016).

Social support can have positive and negative influences on diet, physical activity, and weight status. Wang, Pbert, and Lemon (2014) conducted a study among adult employees to examine the relationships between sources of social support and lifestyle modification, for healthy eating and physical activity, and weight change. The study found that social support for healthy eating from friend and coworker and family support for physical activity predicted improved weight management. Empirical evidence suggested that social support influences cancer outcomes, screening, and treatment (Smalls et al., 2018). Health education studies suggested that social support is associated with breast cancer screening compliance (Documet et al., 2015). Social support prevents negative impact on breast cancer screening, lack of knowledge, and fear of positive diagnosis.

According to the CDC (2019b), social support impacts the physical activity levels via community-based intervention, through building, strengthening, and maintaining social networks that provide supportive relationships for behavior change (e.g., setting up a buddy system or a walking group). Social support for physical activity increases physical activity among older adults, especially when interventions include family support (Smith, 2017a) to provide friendship and support. Calamidas and Crowell (2018) posited that healthy behaviors such as exercise and better eating habits would be supported by help from friends and family, internal motivation, and goal-setting. Lack of

social support can also result in barriers to lifestyle change, as efforts to initiate and sustain health behavior change are notoriously difficult.

The Covariates

Socioeconomic status, lifestyle, and obesity have been proposed to explain the incidence of breast cancer among African American women (Bandera et al., 2013). Observational studies have shown that smoking status (Jones, Schoemaker, Wright, Ashworth, & Swerdlow, 2017), BMI (Dietze, Sistrunk, Miranda-Carboni, O'Regan, & Seewaldt, 2015), and income have the potential to distort the relationship between fruit and vegetable consumption, physical activity, and the development of breast cancer. Smoking, BMI, income, and the development of breast cancer among African American are addressed in this section. The purpose of this study was to assess the predictive association between fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women and whether the strength of the association differs according to age, education, and social support. The goal is to assess the association with validity meaning without influence of other factors known as confounders

Smoking and breast cancer risk. Several factors known as modifiable risk factors increase a woman's risk for breast cancer. For instance, there is an increased risk of breast cancer among women who smoke. Review of literature showed that active and passive smoking have been associated with increased risk of breast cancer. Rosenberg and colleagues (2014) examined the association between smoking and breast cancer among African American women. They used data from the Black Women's Health Study

to evaluate active and passive smoking in relation to breast cancer incidence by menopausal status, estrogen receptor status, and other factors. The findings indicated that both active and passive smoking increase the incidence of premenopausal breast cancer. Smoking risk is greater at a young age and in younger woman (Jones et al., 2017). Jones and colleagues (2017) conducted a cohort study to examine the risk of invasive breast cancer in relation to smoking. The result indicated that smoking was associated with a modest, but significantly increased risk of breast cancer. Using the "European Prospective Investigation into Cancer and Nutrition (EPIC)," Dossus et al. (2014) investigated the association between passive and active smoking and the risk of invasive breast cancer, including possible effect modification by known breast cancer risk factors. The results indicated that smoking, either passively or actively, increases breast cancer risk and that at menarche, smoking was particularly deleterious. Considering the smoking factor as a confounder was important for this study to reduce random error related to confounding

BMI and breast cancer. Findings of studies about the association between a higher BMI and breast cancer are still controversial. Liu, Zhang, and Du (2016) conducted dose-response meta-analysis on 12 prospective cohort studies to evaluate the association between BMI and breast cancer risk. The results showed a weak positive association. The association between body weight and breast cancer risk is controversial. Obesity has been shown to be inversely associated with breast cancer, meaning before menopause, being overweight or obese modestly decreases breast cancer risk, and after menopause, being overweight or obese increases breast cancer risk among White women.

Bandera et al. (2013) conducted a multi-site case-control study to evaluate the impact of BMI, body fat distribution, and body composition on breast cancer risk among pre- and post-menopausal African American women, using data from the Women's Circle of Health Study. The result indicated that BMI was unrelated to breast cancer, but higher waist and hip circumferences were associated with increased pre-menopausal breast cancer risk. Carey et al. (2006) reviewed the Carolina Breast Study, which suggested an association between obesity, as measured by increased waist/hip ratio, and an increased incidence of TNBC in pre- and post-menopausal African American women. Given the lack of consistency in results for analysis of BMI in relation to breast cancer, controlling BMI as a confounding was a necessary step for this study validity.

Summary and Conclusions

Health-related behaviors of fruit and vegetable consumption and physical activity are among the leading preventable risk factors for a variety of diseases. With the increasing incidence of breast cancer among African American and younger women, a call of action is to educate the women about lifestyle intervention to reduce their breast cancer risk. A better understanding of how health behavior, a mechanism of interaction with social support, and demographic factors (e.g., age, education) may influence the development of breast cancer is a priority for prevention effort.

Chapter 3: Research Method

The objective in this study was to investigate the association between fruit and vegetable consumption, physical activity and the development of breast cancer among African American women, and I assessed whether income level and social support were modifiers the interaction. I utilized data from the Health Information Trends Analysis Survey (HINTS; National Cancer Institute, 2018). The HINTS is a cross-sectional survey tool that has been used by the National Cancer Institute to study multiple aspects of health behavior and cancer. In this chapter, I present the research design, methods and procedure, the research questions and the hypotheses, and data collection. In addition, I describe health behaviors as independent variables (i.e., fruit consumption, vegetable consumption, and physical activity), the dependent variable (i.e., development of breast cancer), and covariates (i.e., income level and social support), and the instrument used to measure each variable. Also, in this chapter I outline the variables dictionary, data analysis, statistical analysis, and IRB approval and the protection of human participants.

Research Design and Rationale

The purpose of this study was to assess the predictive association between health-related behaviors of fruit and vegetable consumption, and physical activity and the development of breast cancer among African American women, and whether income level, social support modified the predictive association after controlling for smoking habits, BMI, and age. The research design was a cross-sectional quantitative study using secondary data from the HINTS (National Cancer Institute, 2018). Mainly, HINTS4 Cycle 2, 4 and HINTS5 Cycle 1 were the source of data. I conducted an observational

quantitative design, and I used HINTS data that provided strength given the dataset has a large sample size and reproducibility. The HINTS is a cross-sectional survey tool that has been used by NCI to study multiple aspects of health behavior and cancer. By understanding African American women health-related behavior and associated factors, a community education program targeting cancer risk factors would be crucial to reduce the overall incidence of cancer among African American

Methodology

For this study, I used a cross-sectional design using data from three cycles (National Cancer Institute, 2012, 2014, 2017) of the Health Information National Trends Survey, which included the 2014 HINTS 4, Cycle 4 and HINTS 4, Cycle 2 plus the 2017 HINTS 5. The HINTS 4, Cycle 2 was conducted between October 2012 and January 2013, and Cycle 4 was conducted between August and November 2014. The HINTS 5, Cycle 1 was conducted from January 25 through May 5, 2017. The HINTS survey has been used over several cycles and has included nationally representative samples utilizing both mail in surveys and telephone-based surveys (National Cancer Institute, 2018). Data from three Health Information National Trends Surveys came from database managed by Marketing Systems Group. The database consisted of random samples, representative of African American women who responded to the relevant information questionnaires about being diagnosed with breast cancer, about fruit and vegetable consumption, about physical activity, social support, income level, smoking, and BMI. In this study, I examined health behaviors (e.g., fruits and vegetables consumption and physical activity) and breast cancer among African American women and whether or not the association

interacted with social support and income level. I used Statistical Package for the Social Sciences (SPSS) for statistical analysis. The dependent variable breast cancer is measured on a nominal scale (*yes* = 1 /*no* = 0), and the independent variables health behaviors fruits consumption, vegetable consumption and exercise are measured on a continuous scale. The effect modifier variables were income level measured as nominal, imputed categorical, and social support was measured on a nominal scale (*yes* = 1/*no* = 0).

Population

The study population included all African American women who responded to questionnaire about who responded to the relevant information questionnaires about being diagnosed with breast cancer. The other inclusion criteria required that HINTS participants in this study had completed data information regarding fruit and vegetable consumption, about physical activity, and social support, income level, smoke, and BMI.

Sampling and Sampling Procedures

Through its HINTS survey, the National Cancer Institute (2018) collects data about the use of cancer-related information by adults in the United States aged 18 years and older. The Health Information National Trends Survey (National Cancer Institute, n.d., 2018) is a nationally representative cross-sectional survey that collects data in two-stage sampling design. The first sampling method is stratification of addresses selected from a file of residential addresses. The second sampling method involves one adult selected within each sampled household using the Next Birthday Method.

The HINTS 4 (Cycle 2) was conducted from October 2012 to January 2013. The method for data collection was mailing, and the sampling method was a random sample

of address and next birthday method. A total of $N = 3,630$ responded to the questionnaires.

The HINTS 4 (Cycle 4) was conducted August 2014 to November 2014. The data collection method was mailing, and the sampling method was stratified sample of address and next birthday method. A total of $N = 3,677$ responded to the questionnaires.

The HINTS 5 (Cycle 1) was conducted from January 25 through May 5, 2017, with 3,500 participants. The data collection method was mailing, and the sampling method was a stratified sample of address and next birthday method. A total of $N = 3,191$ responded to the questionnaires.

The Health Information National Trends Survey has the stratification done by grouping the sampling frame into three sampling strata: First sampling was related to areas with high concentrations of minority population, the second addresses in areas with low concentration of minority population, and the third strata was in counties comprising Central Appalachia, regardless of minority population. Weighted survey responses from Cycle 2 and Cycle 4 of the HINTS 4 survey and Cycle 1 of HINTS 4 were used for multivariable logistic regression. HINTS data collection is presented in Table 1.

Table 1

How HINTS Data Were Collected

	HINTS 4, Cycle 2	HINTS 4, Cycle 4	HINTS 5, Cycle 1
Data collection period	Oct. 2012 – Jan. 2013	Aug. 2014- Nov. 2014	Jan 25- May 5, 2017
Mode of data collection	Mailing	Mailing	Mailing
Sampling method	Random sample of address; Next birthday method	Stratified sample of address; Next birthday method	Stratified sample of address; Next birthday method
Number of respondents	Total respondents: 3,630	Total respondents: 3,677	Total respondents: 3,285
	Complete responses: 3,529	Complete responses: 3,529	Complete responses: 3,191
		Partial responses**: 148	Partial responses**: 94

Inclusion and Exclusion Criteria

This study included HINTS participants who identified themselves as African American women and responded to questionnaire regarding fruit and vegetable consumption, physical activity, income level, social support, gender, smoking status, BMI, and diagnosed with breast cancer. I excluded the participants who responded to HINTS questionnaires by identifying their ethnicity as other than African American

Data Analysis Plan

I used binomial logistic regressions to test the hypotheses: of the association between health behaviors of fruit consumption, vegetable consumption, physical activity and developing breast cancer (the dependent variable breast cancer is dichotomous). The purpose of the analysis was to identify whether these independent variables are significantly related with to the development of breast cancer among African American

women. I analyzed data using SPSS version 25, and I used two-tail tests with significance level of alpha = 0.05 *(p* < .05 threshold for statistical significance).

Data Collection

Data sources were secondary data from the HINTS the primary methodological advantage of choosing HINTS was the availability of data from the National Cancer Institute (2018), which included information on multiple aspects of health behavior and cancer. The date collection process was described in Chapter 3. After Walden University Institutional Review Board (IRB) approval, I used the SPSS version 25 to download data from 2012–2017 Health Information and National Trends Survey, which included HINTS 4 (Cycle 2 and Cycle 4) and HINTS 5 (Cycle 1). I merged data extracted to one file. I conducted data cleaning and pre-analysis screening procedures to ensure that the study variables adequately met the required statistical assumptions. The data set included the population of African American women aged 18 to 99 after filtering out all male respondents, and non-African American women respondents. The eligible population thus included 1,205 African American women 18 yrs. and older.

Power Analysis

To test the hypotheses in this study, I conducted binomial logistic regressions. The tested predictors were health behaviors of fruit and vegetable consumption and physical activity. Additional predictors included income level and social support. The outcome variable was the development of breast cancer.

Prior to the statistical analysis, I conducted an estimate sample size using G*Power 3.1.9.2. By convention, the statistical power level set at 0.8, a conventional

probability *p*-value level set at 0.05, and one-tail or two-tails, and effect size of 30% (Cohen, 2013). The effect size is the likelihood of the outcome of interest given exposure (i.e., health behaviors of fruit and vegetable consumption and physical activity) as recommended versus those who do not are 30% more likely to develop breast cancer versus those who eat at least two to four servings per day and engage in physical activity. A power analysis was completed, suggesting that the total sample size was a minimum of 568 (one-tail) or 721 (two-tails) participants. HINTS from 2012, 2014, and 2017 were aggregated to ensure sufficient power to enable analysis

I used binomial logistic regression to examine effect modification by social support and income level. Additionally, confounders such as age and smoking status (measured as smoked at least 100 cigarettes during their lifetime versus never smoked) were controlled for using hierarchical binary logistic regression

Assessment of Variables

In this study, I assessed the predictive association of health behaviors of fruit consumption, vegetable consumption, and physical activity on the development of breast cancer and whether the association is modified by social support and stratified by income level. It involved one dependent variable (breast cancer) and three independent variables (fruit consumption, vegetable consumption, and physical activity).

Dependent variable. The dependent variable was determined when participants were asked, “Have you ever been diagnosed as having cancer?” with the follow-up question “What type of cancer did you have?” Breast cancer was coded 1 for yes or 0 for no

Independent variables. The independent variables were health behavior of recommended fruit consumption, recommended vegetable consumption, and recommended physical activity.

In addressing RQ1, RQ2, and RQ3, health behaviors of recommended fruit consumption were measured as consuming at least 1.5 cups servings of fruit per day. Participants were asked, "About how many cups of fruit (including 100% pure fruit juice) do you eat or drink each day?" Participants had multiple response options, and the answer choices were coded as 0 = *None,* 1 = *1/2 cup or less,* 2 = *1/2 to 1 cup,* 3 = *1 to 2 cups,* 4 = *2 to 3 cups,* 5 = *3 to 4 cups,* and 6 = *4 or more cups* (National Cancer Institute, 2018). I categorized the scaled response to be binary response in such that the following responses 0 = *none,* 1 = *1/2 cup or less,* 2 = *1/2-1 cup* were classified as "does not meet recommendation = 0, versus 3 = *1 to 2 cups*, 4 = *2 to 3 cups*, 5 = *3 to 4 cups*, and 6 = *4 or more cups* were classified as *meets recommendation* = 1." In summary, recommended fruit consumption was recoded binary as meets the recommendation of consuming at least 1.5 cup of fruit a day: *meets recommendation* = 1" versus *does not meet the recommendation* = 0."

In addressing RQ4, RQ5, and RQ6, health behavior of recommended vegetable consumption was measured as consuming at least 2 cups of vegetables per day: Participants were asked, "About how many cups of vegetables (including 100% pure vegetable juice) do you eat or drink each day?" Multiple response options were provided, and the answer choices were coded as *0 = none, 1 = 1/2 cup or less, 2 = 1/2 to 1 cup, 3 = 1 to 2 cups, 4 = 2 to 3 cups, 5 = 3 to 4 cups,* and *6 = 4 or more cups* (National Cancer

Institute, 2018). I categorized the scaled response to be binary response, such that the following responses *0 = none, 1 = 1/2 cup or less, 2 = 1/2 to 1 cup, or 3 = 1 to 2* cups were classified as "does not meet the recommendation *= 0" versus 4 = 2 to 3 cups, 5 = 3 to 4 cups,* and *6 = 4* or more cups classified as "meets the recommendation = 1." In summary, recommended vegetable consumption was recoded binary as meets the recommendation of consuming at least 2 cups of vegetable a day: "Meets recommendation = 1" versus "Does not meet the recommendation = 0."

In addressing RQ7, RQ8, and RQ9, the independent variable was health behaviors of recommended physical activity defined as engagement three times a week in moderate-intensity. National Cancer Institute (2018) formulated the HINTS question as: "In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, swimming at a regular pace, and heavy gardening. Participants had multiple response options. The physical activity variable was recoded binary as meets recommended (1) and does not meet recommendation (0). I categorized the scaled response to be binary response, such that the following responses were coded *0 = none, 1 = 1 day per week, 2 = 2 days per* week were classified as "does not meet the recommendation = 0" versus *3 = 3 days per week, 4 = 4 days per week, 5 = 5 days per week, 6 = 6 days per week, 7 = 7 days per* week classified as "meets recommendation = 1." In summary, recommended physical activity was measured as moderate exercising at least 3 days a week for "Meets recommendation = 1" versus "Does not meet recommendation = 0."

In addressing RQ10, RQ11, and RQ12, the independent variables were health behaviors of recommended fruit consumption, recommended vegetable consumption, and recommended physical activity. The modifier variables were income level and social support. The presumed association was stratified by income level and modified by social support.

The National Cancer Institute (2018) defined social support as: "Talk Health Friend2/Do you have friend or family that you talk to about your health?" Participants had only two response options: yes/no (Binomial variable) in the HINTS questionnaire

Income level measurement was defined as: "What is your combined annual income, meaning the total pre-tax income from all sources earned in the past year?" Participants had multiple response options recorded as: Less than $*25,000, $25,000 to < $35, 000; $35,000 to < $50, 000; $50,000 to < $75, 000; $75, 000 or More; Less than $20,000; $20,000 to < $35,000; Refused, Don't know. The income level was imputed as "less than $20,000, $20,000 to 34,999, $35,000 to $49,999, $50,000 to $74,999, $75,000* or more." (HINTS questionnaires and responses are indicated on Table 2: Data Dictionary.)

Multiple studies have established factors such as age, BMI, and smoker status as risk factor for breast cancer (Dieterich et al., 2014; Kluttig & Schmidt-Pokrzywniak, 2009). In fact, smoking tobacco is well known to be carcinogenic; therefore, in this study age, BMI, and smoking are confounders and were adjusted using binary logistic regressions for controlling the confounding variables. Race and ethnicity were not identified as potential confounding variables, and they are excluded in this study.

Covariates such as age were categorized as less than 45 years of age or 45 years of age and older. Smoking status was measured in dichotomous categories of "smoked at least 100 cigarettes in life, with 1 = yes, 0 = no. BMI is one way of defining obesity, which is equal to (Weight*703)/ (Height in inches**2).

The binomial logistic regressions were conducted with the dependent variable being breast cancer and coded (1 = yes/, 0 = no) and three independent variables. Effect modification occurs when the observe effect is influenced positively or negatively. The binomial logistic regressions were conducted with the dependent variable being breast cancer and coded (1 = yes/, 0 = no) and three independent variables.

Table 2

Data Dictionary

Variables	Variable Type	Values Options for this Variable
Dependent variable (DV)		
• Breast cancer • Question what type of cancer	Nominal, categorical	Yes = 1, No = 0
Independent variables (IV)		
• Fruit consumption About how many cups of fruit (including 100% pure fruit juice) do you eat or drink each day	Ratio, categorical	0 = None, 1/2 cup or less, 1/2 to 1 cup, 1 to 2 cups 1 = 2 to 3 cups, 3 to 4 cups, 4 or more cups
• Vegetable consumption About how many cups of vegetables (including 100% pure vegetable juice) do you eat or drink each day	Ratio, categorical	0 = None, 1/2 cup or less, 1/2 to 1 cup, 1 to 2 cups 1 = 2 to 3 cups, 3 to 4 cups, 4 or more cups
• Physical activity In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, swimming at a regular pace, and heavy gardening	Ratio, categorical	0 = None, 1 day per week, 2 days per week 1 = 3 days per week, 4 days per week, 5 days per week, 6 days per week, 7 days per week
Effect modifier variables		
• Income level what is your combined annual income, meaning the total pre-tax income from all sources earned in the past year?	Nominal, categorical	Less than $25,000, $25,000 to < $35, 000, $35,000 to < $50, 000, $50,000 to < $75, 000, $75, 000 or More, Less than $20,000, $20,000 to < $35,000, Refused, Don't know
• Social support Do you have friend or family that you talk to about your health	Ratio, categorical	Yes = 1 No = 0
Confounder variables		
• Age	Integral, continuous	18-99 years
• BMI	Ratio, continuous	13%-92%
• Smoke status	Nominal, categorical	Every day, somedays, not at all

Research Questions and Hypothesis

Operationally, I defined health-related behavior of recommended fruit consumption as "eats at least 1.5 cups of fruit a day (meets recommendation)" versus "does not eat least 1.5 cups of fruit a day (does not meet the recommendation)." Each hypothesis will be analyzed separately using binary logistic regressions.

Research Question 1 (RQ1): Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$1): There is no statistically significant association between recommended fruit consumption, and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a1): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 2 (RQ2**):** Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$2): There is no statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a2): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support.

Research Question 3 (RQ3)**:** Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0 3$): There is no statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a3): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level.

Research Question 4 (RQ4): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0 4$): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a4): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index,

and smoker status.

Research Question 5 (RQ5)**:** Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$5): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a5): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support.

Research Question 6 (RQ6**)**: Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$6): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a6): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level.

Research Question 7 (RQ7): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$7): There is no statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a7): There is a statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 8 (RQ8**)**: Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$8): There is no statistically significant association recommended physical activity and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a8): There is a statistically significant association between health behaviors of recommended physical activity and the development of breast cancer among African American women when modified by social support.

Research Question 9 (RQ9)**:** Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$9): There is no statistically significant association

recommended physical activity and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a9): There is a statistically significant association recommended physical activity and the development of breast cancer among African American women when stratified by income level.

Each hypothesis will be analyzed separately using logistic regressions

Research Question 10 (RQ10): Is there a statistically significant association between recommended fruit/vegetable consumption, recommended physical activity and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

Null Hypothesis ($H_0$10): There is no statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women, after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a10): There is a statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women, after adjusting for age, body mass index, and smoker status.

Research Question 11 (RQ11**)**: Is there a statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$11): There is no statistically significant association between recommended fruit/ vegetable consumption, physical activity, and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a11): There is a statistically significant association between recommended fruit/ vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when modified by social support.

Research Question 12 (RQ12)**:** Is there a statistically significant association between recommended fruit/vegetable consumption, recommended physical activity, and the development of breast cancer among African American women, when stratified by income level?

Null Hypothesis ($H_0$12): There is no statistically significant association between recommended fruit, vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a12) There is a statistically significant association between recommended fruit/ vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when stratified by income level.

Multivariable logistic regression was used to test research question 10, 11, 12. Additionally, confounders such as age and smoking status (measured as every smoked at least 100 cigarettes during their life time versus never smoked) were controlled for using hierarchical logistic regression.

In addressing RQ1, RQ 4, and RQ 7, I conducted binary logistic regression after controlling for age, BMI, and smoker status for statistical analyses. For RQ2, RQ3, RQ5, RQ6, RQ8, and RQ9, I conducted binary logistic regression with modifier variables (social support and income level). For RQ10, RQ11, RQ12, I conducted binomial regressions for statistical analyses. These statistics are presented in Table 3.

Table 3

Description of Variables/Research Questions

Research Questions	Independent Variables (IV) and Measurement	Dependent Variables (DV) and Measurement	Effect Modifier and Controlling and Measurement	Statistical Analysis
RQ1	• Fruit consumption • Continuous scaled	• Breast cancer • Binary	• Controlling for age, BMI, smoker status	• Binomial Logistic regression
RQ2	• Fruit consumption • Continuous scaled	• Breast cancer • Binary	• Income level	• Binomial • Logistic regression
RQ3	• Fruit consumption • Continuous scaled	• Breast cancer • Binary	• Social support	• Binomial • Logistic regression
RQ4	• Vegetables consumption • Continuous scaled	• Breast cancer • Binary	• Controlling for age, BMI, smoker status	• Binomial • Logistic regression
RQ5	• Vegetables consumption • Continuous scaled	• Breast cancer • Binary	• Social support	• Binomial • Logistic regression

Research Questions	Independent Variables (IV) and Measurement	Dependent Variables (DV) and Measurement	Effect Modifier and Controlling and Measurement	Statistical Analysis
				Table 3 continued
RQ6	• Vegetables consumption • Continuous scaled	• Breast cancer • Binary	• Income level	• Binomial • Logistic regression
RQ7	• Physical activity • Continuous scaled	• Breast cancer • Binary	• Controlling for age, BMI, smoker status	• Binomial Logistic regression
RQ8	• Physical activity • Continuous scaled	• Breast cancer • Binary	• Social support • Nominal, categorical	• Binomial • Logistic regression
RQ9	• Physical activity • Continuous scaled	• Breast cancer • Binary	• Income level	• Binomial • Logistic regression
RQ10	• Fruit, Vegetables consumption, Physical activity • Continuous scaled	• Breast cancer • Binary	• Controlling for age, BMI, smoker status	• Binomial Logistic regression
RQ11	• Fruit, Vegetables consumption, Physical activity • Continuous scaled	• Breast cancer • Binary	• Social support • Nominal, categorical	• Binomial • Logistic regression
RQ12	• Fruit, Vegetables consumption, Physical activity • Continuous scaled	• Breast cancer • Binary	• Income level	• Binomial • Logistic regression

Threats to Validity

External Validity

Threats to validity mean consideration internal or external or factors outside of independent variables could account for the results obtained. Quantitative study in social

sciences deals with numerical data to answer research questions and to test theories. The tentative answers to the research question or hypothesis must be free from threats to validity. Creswell (2009) posited that it was crucial to identify potential threats to the interval: meaning factors or other eventual confounders within the study design, participants' answers, or procedures that could provide plausible rival hypotheses. For instance, using the SEM theory to predict the relationship between health behaviors (fruit and vegetable consumption, physical activity) and the development of breast cancer among African American women must be free from threats to internal and external validity for findings to be translated into policy and intervention.

This study used data from National Cancer Institute's (2018) Health Information National Trends Survey, which included HINTS 5 (Cycle 1) and HINTS 4 (Cycles 4 and 2). The National Cancer Institute has developed this nationally representative survey to provide baseline data about cancer communication practices, information preferences, risk behaviors, attitudes, and cancer knowledge across the country, with data collection repeated routinely to monitor trends. Multiple studies have used the HINTS survey because of its strength from a reliance on multiple methods in order to reduce non-response, selected sample (Volkman et al., 2014). Silverman, Ohman-Strickland, and Christian (2017) also used the HINTS results to determine the weight status and personal cancer risk perceptions.

Internal Validity

According to Creswell (2009), history, maturation, experimental mortality, subject selection, and testing are threats to internal validity. The current study was cross-

sectional in nature and utilized data from HINTS survey; history and maturation are not threats to internal validity. In addition, the study was not experimental, bias and measurement bias are not potential threats either, but the reliability of the survey instrument was established prior to its use based on the best practices in survey research methodology, sampling, and procedures. The methodological of HINTS surveys were valid and reliable because information obtained from the three cycles used in this study (HINTS 5, cycle 1, HINTS 4 cycle 4 and 2) came from nationally representative samples utilizing both mail in surveys.

Ethical Procedures

Researchers face ethical challenges at multiple stages of the study. Ethical procedures are important aspect of research from designing to reporting. Ethical guideline regulates anonymity, confidentiality, informed consent, researchers' potential impact on the participants and vice versa. In considering HINTS data (National Cancer Institute, 2018), I understood that HINTS data were collected with the strictest standards of ethical conduct for research. For instance, the protection the identity of the participants was achieved by using a random identification. Personal information such as name, social security number, and date of birth, phone number, or address was retracted for confidentiality. Although this study used secondary data, all necessary Institutional Review Board (IRB) approvals were received from Walden University (IRB approval number is 07-30-19-0584473).

Summary

The main purpose of this study was to identify if there is an association between fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women. To accomplish this, it was necessary to ensure data quality; therefore, my data were retrieved from HINTS surveys. The data collection, the methodology, and the research questions and hypotheses were addressed. I also described the method and statistical analyses used to accept or reject the hypotheses. The significance of this study is that breast cancer can be prevented, if there is a predictive association between fruit and vegetable consumption and physical activity and the development of breast cancer. A potential positive social change is to promote healthy diet, nutrition, and physical activity in African American communities at multiple levels. Given the multifactorial nature of breast cancer and that breast cancer arises as a consequence of modifiable lifestyle risk factors, community education programs targeting cancer risk factors and modifiable lifestyle risk factors awareness at a multilevel approach may help in launching new initiatives to reduce the incidence of breast cancer.

Chapter 4: Results

The purpose of this research study was to quantitatively examine the predictive association between health behaviors of recommended fruits and vegetables consumption, physical activity, and the development of breast cancer among African American women. I examined whether social support and income level were modifiers in the association. In this chapter, I will present the research questions and hypotheses, data collection, descriptive statistics, and the inferential statistics, findings and summary.

Research Question(s) and Hypotheses

Research Question 1(RQ1): Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$1): There is no statistically significant association between recommended fruit consumption, and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a1): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 2(RQ2**):** Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$2): There is no statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a2): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when modified by social support.

Research Question 3(RQ3): Is there a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$3) There is no statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a3): There is a statistically significant association between recommended fruit consumption and the development of breast cancer among African American women when stratified by income level.

Research Question 4(RQ4): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$4): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a4): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 5(RQ5): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0 5$): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a5): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support.

Research Question 6(RQ6): Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0 6$): There is no statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a6): There is a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when stratified by income level.

Research Question 7(RQ7): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status?

Null Hypothesis ($H_0$7): There is no statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a7): There is a statistically significant association between recommended physical activity and the development of breast cancer among African American women after adjusting for age, body mass index, and smoker status.

Research Question 8 (RQ8): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$8): There is no statistically significant association recommended physical activity and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a8): There is a statistically significant association between health behaviors of recommended physical activity and the development of breast cancer among African American women when modified by social support.

Research Question 9(RQ9): Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when stratified by income level?

Null Hypothesis ($H_0$9): There is no statistically significant association recommended physical activity and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a9): There is a statistically significant association recommended physical activity and the development of breast cancer among African American women when stratified by income level.

Each hypothesis will be analyzed separately using logistic regressions

Research Question 10(RQ10): Is there a statistically significant association between recommended fruit/vegetable consumption, recommended physical activity and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

Null Hypothesis ($H_0$10): There is no statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women, after adjusting for age, body mass index, and smoker status.

Alternative Hypothesis (H_a10): There is a statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women, after adjusting for age, body mass index, and smoker status.

Research Question 11(RQ11): Is there a statistically significant association between recommended fruit/vegetable consumption, physical activity, and the development of breast cancer among African American women when modified by social support?

Null Hypothesis ($H_0$11): There is no statistically significant association between recommended fruit/ vegetable consumption, physical activity, and the development of breast cancer among African American women when modified by social support.

Alternative Hypothesis (H_a11): There is a statistically significant association between recommended fruit/ vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when modified by social support.

Research Question 12(RQ12): Is there a statistically significant association between recommended fruit/vegetable consumption, recommended physical activity, and the development of breast cancer among African American women, when stratified by income level?

Null Hypothesis ($H_0$12): There is no statistically significant association between recommended fruit, vegetable consumption, recommended physical activity, and the development of breast cancer among African American women when stratified by income level.

Alternative Hypothesis (H_a12): There is a statistically significant association between recommended fruit/ vegetable consumption, recommended physical

activity, and the development of breast cancer among African American women when stratified by income level.

Data collection

Upon Walden University IRB approval, I retrieved secondary data from three cycles of the Health Information National Trends Survey from the National Cancer Institute (2012, 2014, 2017). Mainly, HINTS 4, Cycle 2 and Cycle 4 and HINTS 5, Cycle 1 were accessed for a total participant sample of 10,249. In Chapter 3, I have described the study design, data collection, variables, and the method of analysis.

The dependent variable was determined when participants were asked, "Have you ever been diagnosed as having cancer," with the follow-up question "What type of cancer did you have?" Never had any breast cancer = 0; has had breast cancer = 1; all others who reported a type of cancer other than breast cancer are excluded from the sample

For hypothesis 1, 2, and 3, health behaviors of recommended fruit consumption were measured as consuming at least 1.5 cups servings of fruit per day. Participants were asked, "About how many cups of fruit (including 100% pure fruit juice) do you eat or drink each day?" Participants had multiple response options, and the answer choices were coded as *0 = None, 1 = 1/2 cup or less, 2 = 1/2 to 1 cup, 3 = 1 to 2 cups, 4 = 2 to 3 cups, 5 = 3 to 4 cups,* and *6 = 4 or more cups* (National Cancer Institute, 2018)

Does not meet recommendation (eats 1.5 cup or less) = 0

Meets recommendation (eats over 1.5 cup) = 1

For hypothesis 4, 5, and 6, health behavior of recommended vegetable consumption was measured as consuming at least 2 cups of vegetables per day: Participants were asked, "About how many cups of vegetables (including 100% pure vegetable juice) do you eat or drink each day?" Multiple response options were provided, and the answer choices were coded as 0 = *none, 1 = 1/2 cup or less, 2 = 1/2 to 1 cup, 3 = 1 to 2 cups, 4 = 2 to 3 cups, 5 = 3 to 4 cups,* and *6 = 4 or more cups* (National Cancer Institute, 2018). I categorized the scaled response to be binary response, such that the following responses *0 = none, 1 = 1/2 cup or less, 2 = 1/2 to 1 cup, 3 = 1 to 2* cups were classified as "does not meet the recommendation *= 0" versus 4 = 2 to 3 cups, 5 = 3 to 4 cups,* and *6 = 4* or more cups classified as "meets the recommendation = 1."

Does not meet recommendation (eats 2 cups or less) = 0

Meets recommendation (eats over 2 cups) = 1

The independent variable for hypothesis 7, 8, and 9 was health behaviors of recommended physical activity defined as engagement three times a week in moderate-intensity. National Cancer Institute (2018) formulated the HINTS question as: "In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, swimming at a regular pace, and heavy gardening. Participants had multiple response options. The physical activity variable was recoded binary as meets recommended (1) and does not meet recommendation (0). I categorized the scaled response to be binary response, such that the following responses were coded *0 = none, 1 = 1 day per week, 2 = 2 days per week* were classified as *"*does not meet the recommendation *= 0"* versus *3 = 3 days per*

week, 4 = 4 days per week, 5 = 5 days per week, 6 = 6 days per week, and *7 = 7 days per* week classified as "meets recommendation = 1:

Does not meet recommendation (exercises less than 3 days a week) = 0

Meets recommendation (exercises 3 days a week or more) = 1

The independent variables for hypothesis 10, 11, and 12 were health behaviors of recommended fruit consumption, recommended vegetable consumption, and recommended physical activity

Effect modifier variables were income level and social support. The presumed association was stratified by income level and modified by social support.

Covariates such as age were categorized as less than 45 years of age or 45 years of age and older

Under 45 years of age = 0

45 years of age and older = 1

BMI is one way of defining obesity, which is equal to (Weight*703)/ (Height in inches**2); Recoded BMI:

Underweight: less than 19 = 1

Healthy: 19-24 = 2

Overweight: 25-29 = 3

Obese: more than 29 = 4

Smoker status was measured in dichotomous categories of "smoked at least 100 cigarettes in life. Smoker status: (HINTS, 2018a)

Smoked less than 100 cigarettes in lifetime = 0

Smoked at least 100 cigarettes in lifetime = 1

Income: The data set did not code the household income, and instead used the categories below. Fewer categories help preserve statistical power, and so I recommend using the following categories, as provided by the dataset (HINTS, 2018a)

Less than $20,000 = 1

$20,000 to 34,999 = 2

$35,000 to $49,999 = 3

$50,000 to $74,999 = 4

$75,000 or more = 5

The National Cancer Institute (HINTS, 2018a,) defined social support as: "Talk Health Friend2/Do you have friend or family that you talk to about your health?" Participants had only two response options: yes/no (Binomial variable) as a choice for social support:

Does not have someone to talk to about health = 0

Has someone to talk to about health = 1

Study Results

The objective of this study was to assess the predictive association between the health behaviors of recommended fruits, vegetable consumption, recommended physical activity and development of breast cancer among African American women after controlling for age, BMI, smoking status, and whether the association is modified by social support and income level.

The effect modification occurs when, in the presence of recommended fruit consumption and social support or income level, the breast cancer occurs more frequently than would be expected based on the independent effects of each factor. Data were analyzed using SPSS version 25. The significance level of $\alpha = 0.05$ was established. The statistical significance was based on the hypothesis test (null hypothesis H_0 and alternative hypothesis H_a). If the observed *p*-value is less than $\alpha = 0.05$, then the results were statistically significant at level α, and the alternative hypothesis was true. Therefore, the null hypothesis was rejected (not due to chance). If the observed *p*-value is more than $\alpha = 0.05$, then the results are not statistically significant, data do not provide sufficient evidence to reject the null hypothesis H_0, so it was not rejected or could be due to chance (Leech, Barrett, & Morgan, 2011). It is important to understand that statistical significance is not the same as practical significance. In multiple settings, practical significance is based on the effect size; it looks at whether the difference is large enough to be of value in a practical sense. A *p* value of less than 0.05 provided a significant improvement to the block 0 model.

The inferential goodness-of-fit test is the Hosmer-Lemeshow (HL), and two additional descriptive measures of goodness-of-fit were presented Cox and Snell and Nagelkerke (Hosmer, Lemeshow, & Sturdivant, 2013). In presenting the results, I have included an overall evaluation of the logistic model, statistical tests of individual predictors, goodness-of-fit statistics, and the exp(β) column, which represents the odds ratio for the individual variable. A descriptive statistical analysis was conducted to describe the variable frequency, variable percentage and missing value. Frequency

analysis was conducted to determine the distribution of the variables and graphs (see Appendix B). Bivariate associations between the dependent variable of breast cancer status and all independent and control variables were assessed with Pearson's correlations. The model has large number of covariates; therefore, multicollinearity between predictors was conducted. It was helpful to examine the correlation matrix to detect multicollinearity (Midi Sarkar & Rana, 2010), to ensure there were no strong correlations between independent variables. Univariate and multivariate associations were assessed using binomial logistic regressions.

Descriptive Statistics

Data from this study showed that 1,205 African American women participants responded to HINTS questionnaire about breast cancer diagnosis, but 21 were excluded because of missing data, yielding a sample of 1,184 participants (N = 1,184). Descriptive statistics analysis was conducted to show the frequency distribution of each variable.

Descriptive statistics of the sample for all variables included in the study are presented in Tables 4 and 5. The amount and percentage of missing data were also reported for all variables. The descriptive statistic showed that the amount of missing data was under 5% with a sample size large ($n \geq 1{,}000$), therefore the lack of statistical power was not an issue as clearly demonstrated (Cheema, 2014). The only exception to this was the variable of income level, for which nearly 11% of the sample was missing. To compensate for this large amount of missing data, missing values were imputed using the Expectation Maximization algorithm in SPSS.

Table 4

Characteristics of the Sample (N = 1,205)

Variable	*N*	%	Missing *n* (%)
Breast Cancer (*N*)	1,184		21 (1.7)
Has breast cancer (*n*)	51	4.2	
Does not have breast cancer (*n*)	1,133	94.0	
Recommended Fruit Consumption (*N*)	1,171		34 (2.8)
Meets recommendation (*n*)	579	48.0	
Does not meet recommendation (*n*)	592	49.1	
Recommended Vegetable Consumption (*N*)	1,173		32 (2.7)
Meets recommendation (*n*)	335	27.8	
Does not meet recommendation (*n*)	838	69.5	
Recommended Physical Activity (*N*)	1,186		19 (1.6)
Meets recommendation (*n*)	541	44.9	
Does not meet recommendation (*n*)	649	53.5	
Has someone to talk to about health (*N*)	1,177		28 (2.3)
Yes (*n*)	1,036	86.0	
No (*n*)	141	11.7	
Income Level (*N*)	1,076		129 (10.7)
Less than $20,000 (*n*)	408	33.9	
$20,000 to 34,999 (*n*)	192	15.9	
$35,000 to $49,999 (*n*)	161	13.4	
$50,000 to $74,999 (*n*)	148	12.3	
$75,000 or more (*n*)	167	13.9	
Smoking Status (*N*)	1,202		3 (0.2)
Smoked at least 100 cigarettes in lifetime (*n*)	404	33.5	
Has not smoked at least 100 cigarettes (*n*)	798	66.2	
Age (*N*)	1,166		39 (3.2)
Under 45 (*n*)	358	29.7	
45 and older (*n*)	808	67.1	
BMI (*N*)	1,152		53 (4.4)
Underweight (*n*)	22	1.8	
Healthy (*n*)	219	18.2	
Overweight (*n*)	353	29.3	
Obese (*n*)	558	46.3	

Table 5

Income Level (Imputed)

Income Level Variable	*N* = 1,205	%	Missing *n* (%)
Less than $20,000	473	39.3	
$20,000 to 34,999	234	19.4	
$35,000 to $49,999	183	15.2	
$50,000 to $74,999	148	12.3	
$75,000 or more	167	13.9	

Inferential Statistics

To test the predictive association between health behaviors of fruit consumption, vegetable consumption, physical activity and the development of breast cancer after controlling for age, BMI, and smoker status, binomial logistic regressions were conducted. A p-value < 0.05 was considered statistically significant. Binomial logistic regression was chosen because the outcome variable (breast cancer status) was binary and the independent variable (IVs) or predictor variables were dichotomous. I screened data for any issues of multicollinearity by testing the correlations of all study variables to ensure there were no strong correlations between independent variables. No correlation coefficient rose above 0.38, indicating there would be no collinearity issues within the sample. Furthermore, tolerance and VIF statistics were examined for all independent variables (Table 6). Once again, no issues of multicollinearity were detected, with tolerance statistics all considerably above 0.1 and VIF values all considerably below 10. Therefore, all variables were included in the analyses.

Table 6

Collinearity Statistics for All Predictor Variables (N = 1,205)

Variable	Tolerance	VIF
Recommended Fruit Consumption	.797	1.255
Recommended Vegetable Consumption	.824	1.214
Recommended Physical Activity	.884	1.131
Smoking Status	.939	1.065
Age: 45 and Older	.952	1.051
BMI		
Underweight	.912	1.096
Overweight	.539	1.854
Obese	.519	1.927
Has someone to talk to about health	.967	1.034
Income Level		
$20,000 to 34,999	.806	1.240
$35,000 to $49,999	.817	1.224
$50,000 to $74,999	.831	1.203
$75,000 or more	.795	1.259

Note: Household income level has been imputed

Bivariate Analyses

I conducted bivariate analyses to examine the relationship (independency) between the dependent variable of breast cancer status and all independent and control variables, using Chi-square tests followed with the Cramer's *V* as the strength statistic. The results of the Pearson Chi-Square tests revealed that only recommended activity level and age were significantly associated with breast cancer, with individuals who have had breast cancer more likely to report that they exercise less than 3 days per week and more likely to be over the age of 45. However, the relationship between social support—having

a friend or family to discuss health with—and breast cancer status approached statistical significance ($p < .1$), with individuals reporting having had breast cancer were more likely to have this social support.

Table 7

Categorical Descriptive Characteristics by Breast Cancer Status (N = 1,205)

	No Breast Cancer		Breast Cancer		
Variable	*n*	%	*n*	%	χ^2
Recommended Fruit					0.04
Meets recommendation	546	49.5%	24	49.0%	
Does not meet recommendation	557	50.5%	25	51.0%	
Recommended Vegetables					0.45
Meets recommendation	320	28.9%	12	24.5%	
Does not meet recommendation	786	71.1%	37	75.5%	
Recommended Activity					8.18**
Meets recommendation	520	46.6%	13	26.0%	
Does not meet recommendation	596	53.4%	37	74.0%	
Smoking Status					0.47
Smoked at least 100 cigarettes in lifetime	377	33.3%	19	38.0%	
Has not smoked at least 100 cigarettes	754	66.7%	31	62.0%	
Age					
Under 45	350	31.9%	2	4.0%	17.51***
45 and Older	747	68.1%	48	96.0%	
Has someone to talk to about health					2.92†
Yes	972	87.6%	46	95.8%	
No	137	12.4%	2	4.2%	
Income Level					2.78
Less than $20,000	444	39.2%	20	39.2%	
$20,000 to 34,999	215	19.0%	12	23.5%	
$35,000 to $49,999	170	15.0%	10	19.6%	
$50,000 to $74,999	142	12.5%	4	7.8%	
$75,000 or more	162	14.3%	5	9.8%	

Note: Household income level has been imputed, †$p < .1$. *$p < .05$. **$p < .01$. ***$p < .001$.

Multivariable Results

I conducted binomial logistic regression to examine the association between recommended fruit consumption, recommended vegetable consumption, and recommended physical activity and breast cancer when controlling for age, BMI, and smoker status. Additionally, I assessed if social support and income level were modifiers. I assessed for significance using a *p*-value of 0.05 and confidence interval (CI) of 0.95.

Research Questions Findings

Research question 1*:* Is there a statistically significant association between health behavior of recommended fruit consumption, and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

A binomial regression was conducted to investigate if there was an association between recommended fruit consumption and the development of breast cancer, controlling for age, BMI, and smoker status. The outcome variable of interest was breast cancer. The Hosmer and Lemeshow (HL) test was used to test the goodness of fit (Hosmer, Lemeshow, & Sturdivant, 2013), and the Omnibus Tests of Model Coefficients tested the significance. Also, the odds ratio was used to determine whether not meeting fruit consumption was risk factor for the development of breast cancer. I compared the magnitude of the risk base ($OR = 1$): (a) exposure does not affect odds of outcome, $OR > 1$; (b) exposure associated with higher odds of outcome and $OR < 1$; and (c) exposure associated with lower odds of outcome (Szumilas, 2015).The HL goodness-of-fit was significant ($p = .980 > 0.05$) indicating that the model was correctly specified. Based on The Omnibus Tests of Model Coefficients, the full model was statistically

significant, $\chi 2$ (6, n = 1080) = 23.868, $p < .001$, but the model was able to explain only 2.2% (Cox & Snell R^2) to 7.6% (Nagelkerke R^2) of the variance in breast cancer status. Recommended fruit was not a significant predictor, $p = .844 > .05$, the unadjusted odd ratio (*OR* = .941, 95% CI = [.531-1.668], and the adjusted odd ratio was (*OR* = 1.063, 95% CI = [.577-1.958]). This result was not statistically significant. Age was the only significant predictor of breast cancer $p = .002$, and the *OR* = 10.184, indicating that women 45 and older were 10 times were more likely to be diagnosed with breast cancer. The summary of logistic regression analysis of recommended fruit consumption on having breast cancer when adjusted for age, smoke status and BMI are presented in Table 8.

Table 8

Summary of Logistic Regression Analysis of Recommended Fruit Consumption on Having Breast Cancer when Adjusted for Age, Smoker Status, and BMI

	Unadjusted (n = 1,152)			Adjusted for covariate (n = 1,080)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit in take						
Not Met(ref)						
Met	.941	(.531–1.668)	.835	.577	(.577–1.958)	.844
Age						
Less 45(ref)						
45 older				10.184	(2.413–42.992)	.002
Smoke Status						
No(ref)						
Yes				1.058	(.562–1.990)	.862
BMI						
Healthy(ref)						
Underweight				4.897	(.477–50.277)	.181
Overweight				2.330	(.763–7.115)	.138
Obese				2.054	(.697–6.053)	.192

Note.* = adjusting for gender; OR = odds ratio; CI = confidence interval; ref = reference,
χ^2 (6, n = 1152) =, 23.869 p < .001,
Cox & Snell R^2 = .022,
Nagelkerke R^2 = .077

Research Question 2: Is there a statistically significant association between recommended fruit consumption, and the development of breast cancer among African American women when modified by social support?

A binomial logistic regression was conducted to investigate whether social support might modify the association of recommended fruit consumption on the

development of breast cancer, testing the hypothesis that the association between recommended fruit consumption on the development of breast cancer could improve the predictive power. The HL test was used to test the goodness of fit (Hosmer et al., 2013).and the Omnibus Tests of Model Coefficients tested the significance. I compared the magnitude of the risk based on the following assumptions: *OR* = 1, exposure does not affect odds of outcome; *OR*>1, exposure associated with higher odds of outcome, and *OR* < 1, exposure associated with lower odds of outcome (Szumilas, 2015). The HL goodness-of-fit was significant ($p = .570 > 0.05$), indicating that the model was correctly specified. Based on the Omnibus Tests of Model Coefficients, the full model was statistically significant, $\chi 2$ (2, $n = 1141$) = 3.689, $p = .0158 > 0.05$. Also, the odds ratio was used to measure association between recommended fruit consumption and the development of breast cancer in association with social support. Recommended fruit consumption was not a significant predictor ($p = .978$). The unadjusted odd ratio (*OR* = .941, 95% CI = [.531-1.668], $p = .835$) and the adjusted odd ratio was (*OR* = 1.008, 95% CI = [.561-1.812], $p = .978$). Social support was not a modifier ($p = .110$), and the adjusted *OR* = 3.271, 95% CI = [.2.413-42.992]. There was no statistically significant association between recommended fruit consumption and the development of breast cancer when modified by social support. The summary of logistic regression analysis of recommended fruit consumption on having breast cancer when modified by social support is presented in Table 9.

Table 9

Summary of Logistic Regression Analysis of Recommended Fruit Consumption on Having Breast Cancer when Modified by Social Support

	Unadjusted (n = 1,152)			Adjusted for covariate (n = 1,141)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit in take						
Not Met(ref)						
Met	.941	(.531–1.668)	.835	1.008	(.561–1.812)	.978
Social support						
No(ref)						
Yes				3.217	(2.413–42.992)	.110

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (2, n = 1141) = 3.689 p = .0158
Cox & Snell R^2 = .003
Nagelkerke R^2 = .011

Research Question 3: Is there a statistically significant association between health behavior of recommended fruit, and the development of breast cancer among African American women when stratified by income level?

A binomial logistic regression was conducted to investigate whether income level might modify the effect of recommended fruit consumption on the development of breast cancer and whether adding income variable in the model would provide an improvement in predictive power. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al., 2013), and the Omnibus Tests of Model Coefficients tested the significance. I compared the magnitude of the risk based on the following assumptions: (a) *OR* = 1, exposure does not

affect odds of outcome; (b) *OR* > 1, exposure associated with higher odds of outcome; and (c) *OR* < 1, exposure associated with lower odds of outcome (Szumilas, 2015).The HL goodness-of-fit was significant ($p = .995 > 0.05$), indicating that the model was correctly specified. Based on the Omnibus Tests of Model Coefficients, the full model was not statistically significant, $\chi 2$ (2, n = 1,152) = 3.493, $p = .0624 > 0.05$. The unadjusted *OR* = .941, 95% CI = [.531-1.668] and the adjusted *OR* = 1.089, 95% CI = [.613-1.934], $p = .771$ were stratified by imputed income the $p = .540 > .05$. There was no statistically significant association between recommended fruit consumption and the development of breast cancer when stratified by income indicting no effect modification by income at $p = .540 > .05$. The summary of logistic regression analysis of recommended fruit consumption on having breast cancer when modified by social support is presented in Table 10.

Table 10

Summary of Logistic Regression Analysis of Recommended Fruit Consumption on Having Breast Cancer when Modified by Income Level Imputed

	Unadjusted (n = 1,152)			Adjusted for Covariate (n = 1,152)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit in take						
Not Met(ref)						
Met	.941	(531−1.66)	.835	1.089	(.613−1.934)	.771
Income						.
Less than $20,000						.540
= $20,000 to < $35,000				1.114	(.524−2.386)	.779
35,000 to < $50,000				1.276	(.585−2.784)	.541
= $50,000 to < $75,000				.616	(.207−1.836)	.385
$75,000 or More				.534	(.179−1.589)	.259

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (6, n = 1152) = 3.493 p = .06
Cox & Snell $R2$ = .003
Nagelkerke R^2 = .010

Research Question 4: Is there a statistically significant association between recommended vegetable consumption, and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

A binomial regression was conducted to investigate if there is an association between recommended vegetable consumption and the development of breast cancer after adjusting for age, BMI, and smoker status. The outcome variable of interest was breast cancer. The HL test was used to test the goodness of fit (Hosmer et al., 2013), and the Omnibus Tests of Model Coefficients tested the significance. Based on The Omnibus Tests of Model Coefficients, I compared the magnitude of the risk based on the following assumptions: (a) $OR = 1$, exposure does not affect odds of outcome; (b) $OR > 1$, exposure associated with higher odds of outcome; and (c) $OR < 1$, exposure associated with lower

odds of outcome (Szumilas, 2015). The HL goodness-of-fit was significant (p = .973 > .05), indicating that the model was correctly specified. The full model was significant, $\chi 2(6, n = 1{,}084) = 24.371$, $p < .001$, but the model was able to explain only 2.2% (Cox & Snell R^2) to 7.7% (Nagelkerke R) of the variance in breast cancer status. Recommended vegetable consumption was not a significant predictor, p value = .844>.05. The unadjusted odd ratio was (OR = .797, 95% CI = [.410-1.547]), and the adjusted odd ratio was (OR = .867, 95% CI = [.429-1.752]). There was no statistically significant association between recommended vegetable consumption and the development of breast cancer p value = .692>.005. Again, age was the only significant predictor of breast cancer, with p = .002 and the OR = 10.184, indicating that women aged of 45 and older were 10 times were more likely to be diagnosed with breast cancer. The summary of logistic regression analysis of recommended vegetable consumption on having breast cancer when adjusted for age, BMI, and smoker status are presented in Table 11.

Table 11

Summary of Logistic Regression Analysis of Recommended Fruit Consumption on Having Breast Cancer when Adjusted for Age, Smoke Status, and BMI

	Unadjusted (n = 1,155)			Adjusted for covariate (n = 1,084)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Vegetable						
Not Met(ref)						
Met	.797	(.410-1.547)	.502	.867	(.429-1.752	.692
Age						
Less 45(ref)						
45 older				10.239	(2.424-43.246)	.002
Smoke Status						
No(ref)						
Yes				1.036	.(.551-1.947	.914
BMI						
Healthy(ref)						.348
Underweight				5.053	(.493-51.810}	.172
Overweight				2.476	(.826-7.513)	.109
Obese				1.980	(.670-5.855)	.217

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (6, n = 1,152) = 24.371, $p < .001$
Cox & Snell R^2 = .022
Nagelkerke R^2 = .077

Research Question 5: Is there a statistically significant association between recommended vegetable consumption and the development of breast cancer among African American women when modified by social support?

A binomial logistic regression was conducted to investigate whether social support might modify effect of recommended vegetable consumption on the development of breast cancer, testing the hypothesis that the effect of social support on the association between recommended vegetable consumption on the development of breast cancer could improve the predictive power. The outcome variable of interest was breast cancer. The

HL test was used to test the goodness of fit (Hosmer et al., 2013), and the Omnibus Tests of Model Coefficients tested the significance.

The HL goodness-of-fit was significant ($p = .928 > 0.05$), indicating that the model was correctly specified. Based on the Omnibus Tests of Model Coefficients, the full model was not statistically significant: $\chi 2$ (2, $n = 1144$) = 4.084, $p = .0130 > 0.05$.

There was no statistically significant association between recommended fruit consumption and the development of breast cancer when modified by social support.

The unadjusted odd ratio was (*OR* = .797, 95% CI = [.410-1.547], $p = .792$), and the adjusted odd ratio was (*OR* = .792, 95% CI = [.405-1.548], $p = .492$). The summary of logistic regression analysis of recommended fruit consumption on breast cancer when modified by social support is reported in Table 12.

Table 12

Summary of Logistic Regression Analysis of Recommended Fruit Consumption on Having Breast Cancer when Modified by Social Support

	Unadjusted (n = 1152)			Adjusted for covariate (n = 1144)		
Covariates	Odd Ratio	95% CI	*p*-value	Odd Ratio	95% CI	*p*-value
Vegetable						.
Not Met(ref)						
Met	797	(.410-1.547)	502	.792	(.405-1.548	.495
Social support						
No(ref)						
Yes				3.289	(.787-13.752)	.103

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (2, n = 1144) = 4.084, $p = .0130$
Cox & Snell $R^2 = .004$
Nagelkerke $R^2 = .012$

Research Question 6: Is there a statistically significant association between recommended vegetable consumption, and the development of breast cancer among African American women when stratified by income level?

A binomial logistic regression was conducted to investigate whether income level might modify the effect of recommended vegetable consumption on the development of breast cancer. The hypothesis tested whether adding income variable in the model will provide an improvement in predictive power. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al., 2013), and the Omnibus Tests of Model Coefficients tested the significance. The HL goodness-of-fit was significant ($p = .998 > 0.05$), indicating that the model was correctly specified. Based on the Omnibus Tests of Model Coefficients, the full model was not statistically significant: $\chi 2$ (5, n = 1,155) = 2.938, p = .710 > 0.05. There was not statistically significant association between recommended vegetable consumption and the development of breast cancer when stratified by income, resulting in an unadjusted odd ratio (*OR* = .797, 95% CI = [.410-1.547], p = .502) and the adjusted odd ratio was (*OR* = .813, 95% *CI* = [.405-1.548], p = .545. Imputed income level was not statistically significant p = .540

The summary of logistic regression analysis of recommended fruit consumption on having breast cancer when modified by income is presented in Table 13.

Table 13

Summary of Logistic Regression Analysis of Recommended Vegetable Consumption on Having Breast Cancer when Modified by Income Level Imputed

	Unadjusted (n = 1,152)			Adjusted for covariate (n = 1,155)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit in take						
Not Met(ref)						
Met	797	(.410-1.547)	502	813	(.417-1.587)	.545
Income						
Less than $20,000						.540
= $20,000 to < $35,000				1.172	(.547-2.509)	683
35,000 to < $50,000				1.356	.616-2.982	449
= $50,000 to < $75,000				.647	.216-1.938	.437
$75,000 or More				.720	.263-1.970	523

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (5, n = 1144) = 2.938, p = .710
Cox & Snell R^2 = .003
Nagelkerke R^2 = .009

Research Question 7: Is there a statistically significant association between recommended physical activity, and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

A binomial regression was conducted to investigate if there is an association between recommended exercise (i.e., physical activity) and the development of breast cancer after adjusting for age, BMI, and smoker status. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al., 2013), and the Omnibus Tests of Model Coefficients tested the significance. The HL goodness-of-fit was significant (p = .851 > .05), indicating that the model was correctly specified. The full model was significant: χ2 (6, n

= 1044) = 29.983, $p < .001$, but the model was able to explain only 2.7% (Cox & Snell R^2) to 9.5% (Nagelkerke R^2) of the variance in breast cancer status. There was a statistically significant association between recommended exercise (physical activity) and the development of breast cancer for both models: (a) unadjusted $OR = 2.483$, 95% CI = [1.306-4.722], $p = .006 < 0.05$); and (b) adjusted $OR = .435$, 95% CI [.218-.867], $p = 018 < 0.05$). Age was also a significant predictor of breast cancer $p = .002$ and the $OR = 10.184$, indicating that women aged 45 and older were 10 times were more likely to be diagnosed with breast cancer. The summary of logistic regression analysis of recommended exercise on having breast cancer when adjusted for age, smoker status, and BMI is presented in Table 14.

Table 14

Summary of Logistic Regression Analysis of Recommended Exercise on Having Breast Cancer when Adjusted for Age, Smoker Status and BMI

	Unadjusted (n = 1,166)			Adjusted for covariate (n = 1,084)		
Covariates	Odd Ratio	95% CI	P-value	Odd Ratio	95% CI	P-value
Exercise (PA)						
Not Met(ref)						
Met	2.483	1.306-4.722	006	435	.218-.867	018
Age						
Less 45(ref)						
45 older				10.585	2.496-44.892	.001
Smoker Status						
No(ref)						
Yes				. 990	.526-1.864	.976
BMI						
Healthy(ref)						.416
Underweight				4.740	.457-49.137	.192
Overweight				2.259	.738-6.919	.154
Obese				1.772	.596-5.264	.303

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (6, n = 1,144) = 29.983, p < 001
Cox & Snell R^2 = .027
Nagelkerke R^2 = .095

Research Question 8: Is there a statistically significant association between recommended physical activity, and the development of breast cancer among African American women when modified by social support?

A binomial regression was conducted to investigate the association between recommended exercise (i.e., physical activity) and the development of breast cancer when modified by social support. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al.,

2013), and the Omnibus Tests of Model Coefficients tested the significance. The HL goodness-of-fit was significant ($p = .699 > .05$), indicating the model was correctly specified. The full model was statistically significant $\chi 2$ (6, n = 1,080) = 11.960, $p < .003$; however, the model was able to explain only 10% (Cox & Snell R^2) to 36% (Nagelkerke R^2) of the variance in breast cancer status. There was a statistically significant association between recommended exercise (i.e., physical activity) and the development of breast cancer in both models: (a) unadjusted OR = 2.483, 95% CI = [1.306-4.722], p = .006 < 0.05), and (b) adjusted OR = .393, 95% CI [.202-.766], p = 018 < 0.05. Social support was not a predictor: p = .105(OR = 3.265.95% CI [781-13.644]. The summary of logistic regression analysis of recommended exercise (i.e., physical activity) on having breast cancer when modified by social support is presented in Table 15.

Table 15

Summary of Logistic Regression Analysis of Recommended Exercise (Physical activity) on Having Breast Cancer when Modified by Social Support

	Unadjusted (n = 1,166)			Adjusted for covariate (n = 1,040)		
Covariates	Odd Ratio	95% CI	*P*-value	Odd Ratio	95% CI	*P*-value
Vegetable						.
Not Met(ref)						
Met	2.483	1.306-4.722	.006	.393	.202-.766	.006
Social support						
No(ref)						
Yes				3.265	.781-13.644	.105

Note.* = adjusting for gender; OR = odds ratio; CI = confidence interval; ref = reference
χ^2 (6, n = 1,144) = 11.930, $p < 003$
Cox & Snell R^2 = .010
Nagelkerke R^2 = .036

Research Question 9: Is there a statistically significant association between recommended physical activity and the development of breast cancer among African American women when stratified by income level?

A binomial regression was conducted to investigate the association between recommended exercise (i.e., physical activity) and the development of breast cancer, when stratified by income. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al., 2013), and the Omnibus Tests of Model Coefficients tested the significance. The HL goodness-of-fit was significant ($p = .993$; $p > .05$), indicating the model was correctly specified. The full model was statistically significant: $\chi 2$ (5, $n = 1{,}081$) = 11.413, $p = .044$; however, the model was able to explain only 1% (Cox & Snell R^2) to 33 % (Nagelkerke R^2) of the variance in breast cancer status. There was a statistically significant association between recommended exercise (physical activity) and the development of breast cancer in both models: (a) unadjusted $OR = 2.483$, 95% CI = [1.306-4.722], $p = .006 < 0.05$); and (b) adjusted $OR =. 404$, 95% CI = [.212-.770], $p = 0.06$), when I included income variables in the logistic.

Table 16

Summary of Logistic Regression Analysis of Recommended Vegetable Consumption on Having Breast Cancer when Modified by Income Level Imputed

	Unadjusted (n = 1,152)			Adjusted for covariate (n = 1,166)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit in take						
Not Met(ref)						
Met	2.483	1.306-4.722	006	404	.212-.770	006
Income						
Less than $20,000						.598
= $20,000 to < $35,000				1.386	.658-2.919	.390
= $35,000 to < $50,000				1.477	.670-3.257	.333
= $50,000 to < $75,000				713	.238-2.140	.546
$75,000 or More				.806	.295-2.207	.675

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (6, n = 1,144) = 11.413, p < 044
Cox & Snell R^2 = .010
Nagelkerke R^2 = .033

Research Question 10: Is there a statistically significant association between recommended fruit, vegetable consumption, recommended physical activity and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status?

A binomial logistic regression was conducted to investigate the association between recommended fruit, vegetable consumption, recommended physical activity and the development of breast cancer after controlling for age, BMI, and smoker status. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to report the goodness of fit (Hosmer et al., 2013). Also, the significance was reported based on the Omnibus Tests of Model Coefficients. Finally, the

magnitude of the risk reported was based on the following assumptions: (a) $OR = 1$, exposure does not affect odds of outcome; (b) $OR > 1$, exposure associated with higher odds of outcome; and (c) $OR < 1$, exposure associated with lower odds of outcome (Szumilas, 2015).The full model was statistically significant: $\chi 2$ (6, n = 1,061) = 28.19, $p < .001$ and explained between 2.6% (Cox & Snell vegetable consumption, recommended physical activity) and 9.2% (Nagelkerke R^2) of the variance in breast cancer status.. Only recommended exercise or physical activity was a statistically significant predictor for both models: (a) unadjusted OR = .368, 95% CI = [.182-.722.], p = .004 < 0.05; and (b) adjusted OR = .379, 95% CI [.181-.793.], p = .010 < .05. Once again, age was a statistically significant predictor: OR = 9.863, 95% CI = [2.325-41.836], p = .002. Women aged 45 or older were 9.8 times more likely to indicate they have had breast cancer (see Table 17).

Table 17

Summary of Multiple Regression Analysis of Recommended Fruit and Vegetable Consumption, Physical Activity on Having Breast Cancer

	Unadjusted (n = 1,127)			Adjusted for covariate (n = 1,061)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit						
Not Met(ref)						
Met	1.648	(.868-3.130)	.127	1.605	(.803-3.209)	.181
Vegetable						
Not Met						
Met	.727	(.347-1.524)	.399	.788	(.355-1.750)	.558
Exercise(PA)						
Not Met						
Met	.363	(.182-.722)	.004	.379	.181-.793	.010
Age						
Less 45						
45 and more				9.863	2.325-41.836	.002
Smoke Status						
No						
Yes				1.112	.584-2.118	.747
BMI						
Healthy						
Underweight				4.440	.428-46.022	212
Overweight				2.136	.690-6.611	.188
Obese				1.679	.562-5.014	.353

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (8, n = 1,061) = 30.707, $p < .001$
Cox & Snell R^2 = .029
Nagelkerke R^2 =. 101

Research Question 11 is there a statistically significant association between recommended fruit consumption, recommended vegetable consumption, and recommended physical activity and the development of breast cancer among African American women when modified by social support?

A binomial logistic regression was conducted to investigate the association between recommended fruit, vegetable consumption, recommended physical activity, and whether social support modified the association. The outcome of interest was the development of breast cancer (i.e., had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al., 2013). Also, the significance was reported based on the Omnibus Tests of Model Coefficients. Finally, the magnitude of the risk reported was based on the following assumptions: (a) $OR = 1$, exposure does not affect odds of outcome; (b) $OR > 1$, exposure associated with higher odds of outcome; and (c) $OR < 1$, exposure associated with lower odds of outcome (Szumilas, 2015).The HL goodness-of-fit was significant ($p = .699$, $p > .05$), indicating the model was correctly specified. While the full model was statistically significant: $\chi 2$ (10, $n = 1{,}061$) = 32.44, $p < .01$, the model was able to explain only 3% (Cox & Snell R^2) to 10% (Nagelkerke R^2) of the variance in breast cancer status. When social support was added to the model, there was no statistical significance ($OR = 3.021$, 95% CI = [.717-12.731], $p = .132 > .05$), indicating no evidence of effect modification .The association between recommended fruit consumption, vegetable consumption, and recommended physical activity when modified by social support was not statistically significant (see Table 18).

Table 18

Summary of Multiple Logistic Regression Analysis of Recommended Fruit, Vegetable Consumption and Physical Activity on Having Breast Cancer when Modified by Social Support

	Unadjusted (n = 1,127)			Adjusted for covariate (n = 1,117)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit						
Not Met(ref)						
Met	1.648	.868-3.130	.127	1.569	.814-3.023	.179
Vegetable						
Not Met						
Met	.727	.347-1.524	.399	.744	.353-1.568	.437
Exercise(PA)						
Not Met						
Met	363	.182-.722	.004	.345	.169-.704	.003
Social support						
No						
Yes				3.021	.717-12.731	.132

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (4, n = 1,117) = 14.148, $p < .007$
Cox & Snell R^2 = .013
Nagelkerke R^2 =. 044

Research Question 12: Is there a statistically significant association between recommended fruit consumption, recommended vegetable consumption, recommended physical activity and the development of breast cancer among African American women when stratified by income level?

A binomial logistic regression was conducted to investigate the association between recommended fruit, vegetable consumption, and recommended physical activity, when stratified by income level. The outcome of interest was the development of breast

cancer (had breast cancer). The HL test was used to test the goodness of fit (Hosmer et al., 2013). Also, the significance was reported based on the Omnibus Tests of Model Coefficients. Finally, the magnitude of the risk reported was based on the following assumptions: (a) $OR = 1$, exposure does not affect odds of outcome; (b) $OR > 1$, exposure associated with higher odds of outcome; and (c) $OR < 1$, exposure associated with lower odds of outcome (Szumilas, 2015). The HL goodness-of-fit was significant ($p = .667$, $p > .05$), indicating the model was correctly specified. While the full model was statistically significant: $\chi 2$ (7, $n = 1{,}127$) = 14.027, $p = .05$, the model was able to explain only 4.2% (Cox & Snell R^2) to 12% (Nagelkerke R^2) of the variance in breast cancer status. When imputed income was added to the model, there was no statistically significant finding ($p = .529$). The association between recommended fruit consumption, vegetable consumption, and recommended physical activity when modified by income was not statistically significant (as shown on Table 19).

Table 19

Summary of Multiple Logistic Regression Analysis of Recommended Fruit, Vegetable Consumption and Physical Activity on Having Breast Cancer when Modified by Income Level Imputed

	Unadjusted (n = 1,127)			Adjusted for covariate (n = 1,127)		
Covariates	Odd Ratio	95% CI	p-value	Odd Ratio	95% CI	p-value
Fruit						
Not Met(ref)						
Met	1.648	.868-3.130	.127	1.669	.879-3.171	.118
Vegetable						
Not Met						
Met	.727	.347-1.524	.399			.422
Exercise(PA)						
Not Met						
Met	363	.182-.722	.004	.362	.181-.723	.004
Income						
Less than $20,000						.529
= $20,000 to < $35,000				1.316	.607-2.852	487
$35,000 to < $50,000				1.547	.694-3.449	.286
= $50,000 to < $75,000				728	.241-2.205	. 575
$75,000 or More				.670	.221-2.027	478

Note.* = adjusting for gender; *OR* = odds ratio; CI = confidence interval; ref = reference
χ^2 (4, n = 1117) = 14.024, $p < .05$
Cox & Snell R^2 = .012
Nagelkerke R^2 =. 042

Summary

I examined the association between health behaviors of recommended fruit, vegetable consumption, recommended physical activity (i.e., independent variables) and breast cancer (dependent variable) after controlling for covariates (i.e., age, BMI, smoker status), also I examined the effect modification of social support and income level on the association. Binomial logistic regressions were conducted after controlling for covariates

age, BMI, and smoker status. In this chapter, I presented the results of the descriptive and inferential statistics, demographic characteristics of the sample and the results of hypothesis testing. Results of the data analysis showed inconsistency on whether or not health behaviors of recommended fruit, vegetable consumption, and recommended physical activity could predict the development of breast cancer among African American women. The association between recommended physical activity and breast cancer was statistically significant, yet it cannot be determined whether increased exercise levels help to prevent the development of breast cancer, or whether developing breast cancer impacts activity levels. A summary of the results, conclusions, and implications for positive social change is presented in Chapter 5.

Chapter 5: Discussion, Conclusions, and Recommendations

My goal for this study was to investigate the association between health behaviors of fruit and vegetable consumption, physical activity, and breast cancer among African American women. Researchers have suggested increased risk of breast cancer is linked to modifiable health behavior such as fruit, vegetable consumption, and physical activity (Demark-Wahnefried et al., 2014; Hashemi et al., 2014). However, these findings are still limited due to inconsistency. The findings show that there is a lack of conclusive evidence as to whether social support and income levels modify the association between health behavior and breast cancer among African American women.

I conducted this cross-sectional study, with data from 2012 to 2017 HINTS (National Cancer Institute, 2018), I tested 12 research questions with corresponding hypotheses and the findings were presented in Chapter 4. I discuss the findings, the limitations of the study, the recommendation, the positive social change implications, and the conclusions are discussed in this chapter.

Interpretation of Findings

Health behaviors of fruit and vegetable consumption affect multiple health outcomes (Moore & Thompson, 2015); health behaviors are also linked to breast cancer risk. Studies predicted that one third to one half of cancers could be prevented by healthier lifestyle choices (Arem & Loftfield, 2018). Physical inactivity and unhealthy diet are modifiable behaviors associated with several cancers including breast cancer (Jankowska et al., 2019. Epidemiological studies indicate that unhealthy lifestyle is one important risk factor of breast cancer (Sun et al., 2017). Numerous studies (Rosenberg et

al., 2014; Farvid et al., 2019) have indicated that physical activity and vegetable and fruit consumption are associated with a lower risk of breast cancer in women. While health practitioners are still promoting mammograms, a healthy lifestyle may shield women from breast cancer (Bodai & Tuso, 2015). The overall findings of this study suggest that healthy behavior may play a role in breast cancer risk. There was no statistically significant association between recommended fruit and vegetable consumption and breast cancer, but recommended physical activity was significantly associated with the development of breast cancer. Of the 1,184 participants who were able to answer the question about breast cancer, the majority (n = 1,133) responded "does not have breast cancer (94%), and the minority (n = 51) had breast cancer (4.2%), and 1.7% were missing data. Relative to the predictor variable recommended fruit consumption, of the 1,184 participants, n = 579 (48%) meet the fruit recommendation and n = 592(49.1%) do not meet the recommendation. Relative to the predictor variable recommended vegetable consumption, of the 1,184 participants, 335(27.8%) met the vegetable recommendation and the majority, n=838(69.5%) did not meet the recommendation, and 2.7% were missing data. Relative to physical activity, n = 541(44.9%) met the recommended physical activity, and the majority, n = 649 (53.5%), did not meet the recommendation.

The findings on health behavior of fruit and vegetable consumption were contrary to my hypothesis; however, they were consistent with previous research that found mixed results and inconsistency with the association between fruit and vegetable consumption and the diagnosis of breast cancer. One explanation for the lack of association in this study may be due to the problem of sample imbalance. Of the 1,184 participants who

were able to answer the question about breast cancer, the majority (n = 1,133) responded "does not have breast cancer (94%), and the minority (n = 51) had breast cancer (4.2%), and 1.7% were missing data.

Hypothesis 1**:** There is a statistically significant association between fruit consumption and the development of breast cancer after adjusting for age, BMI, and smoker status. The findings indicated that recommended health behavior of fruit consumption was not associated with the development of breast cancer. There was no statistically significant association between recommended fruit consumption and the development of breast cancer in both models, with results showing the unadjusted *OR* = .941, 95% CI = [.531-1.668], p = .835, and the adjusted *OR* = 1.063, 95% CI = [.577-1.958], p = .844. This result was not statistically significant. Recommended fruit consumption was not a predictor of breast cancer. Therefore, I failed to reject the null hypothesis.

Hypothesis 2: There is a statistically significant association between health behavior of recommended fruit consumption and the development of breast cancer when modified by social support. The findings indicated that there was no statistical significance, providing no evidence to suggest a modifying effect. Recommended fruit consumption was not a significant predictor (p = .978). The unadjusted odd ratio was (*OR* = .941, 95% CI = [.531-1.668], p = .835) and the adjusted odd ratio was (*OR* = 1.008, 95% CI = [.561-1.812], p = .978). Social support was not a predictor (p = .110) and the adjusted *OR* = 3.271, 95% CI = [.2.413-42.992]. There was no statistically significant

association between recommended fruit consumption and the development of breast cancer when modified by social support; therefore, I failed to reject the null hypothesis.

Hypothesis 3: There is a statistically significant association between health behavior of recommended fruit consumption and the development of breast cancer when stratified by income level. The findings indicated no statistically significant data, providing no evidence to suggest a modifying effect on the association. The unadjusted *OR* = .941, 95% CI = [.531-1.668] and the adjusted *OR* = 1.089, 95% CI = [.613-1.934], *p* = .771, which were stratified by imputed income with a *p*= .540 > .05. Therefore, I failed to reject the null hypothesis.

Hypothesis 4 There is a statistically significant association between health behavior of recommended vegetable consumption and the development of breast cancer after adjusting for age, BMI, and smoker status. This hypothesis was not supported; the findings indicated not statistically significant associated with breast cancer when controlling for age, BMI, and smoker status. The unadjusted odd ratio was *OR* = .797, 95% CI = [.410-1.547] and the adjusted odd ratio was *OR* = .867, 95% CI = [.429-1.752]. There was no statistically significant association between recommended vegetable consumption and the development of breast cancer (*p* = .692 >.005). Again, age was the only significant predictor of breast cancer (*p*= .002), with those aged 45 and older more likely to report having had breast cancer compared to those under the age of 45. Therefore, this study failed to reject the Null hypothesis 4

Hypothesis 5: There is a statistically significant association between health behavior of recommended vegetable consumption and the development of breast cancer

when modified by social support. The findings in research question 5 indicated not statistically significant association between health behavior of recommended vegetable and breast cancer when modified by social support. The unadjusted odd ratio was *OR* = .797, 95% CI = [.410-1.547], *p* = .792 and the adjusted odd ratio was *OR* = .792, 95% CI = [.405-1.548], *p* = .492. Therefore, I failed to reject the null hypothesis 5

Hypothesis 6: There is a statistically significant association between health behavior of recommended vegetable consumption and the development of breast cancer when modified by income level. The result showed that the interaction term was not statistically significant, providing no evidence to suggest an effect modifying on the association. The unadjusted odd ratio was *OR* = .797, 95% CI = [.410-1.547], *p* = .502, and the adjusted odd ratio was *OR* = .813, 95% CI = [.405-1.548], *p* = .545. Imputed income level was not statistically significant (*p* = .540). I failed to reject the Null hypothesis 6.

I hypothesized that health behavior of recommended fruit and vegetable consumption would be associated with the development of breast cancer. This hypothesis failed to demonstrate a statistically significant association between health behavior of recommended fruit and vegetable consumption and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status. Consistent with the literature, these findings support previous cross-sectional studies that showed inconsistency. Peng et al. (2017) conducted meta-analysis of studies; they found no significant associations between fruit and vegetable intake and breast cancer prognosis. Boggs et al. (2010) also found that total fruit, total vegetable, and total fruit

and vegetable intakes were not significantly associated with overall risk of breast cancer, but total vegetable consumption was associated with a decreased risk of estrogen receptor-negative/progesterone receptor-negative breast cancer. Numerous studies have indicated controversial results on the impact of fruit and vegetable intake and breast cancer (Li et al., 2018; Norat et al., 2014; Peng et al., 2017). Despite this inconsistency, in a recent study, Farvid et al. (2019) suggested that women who eat a variety of colorful fruits and vegetables have higher chances to diminish risk of breast cancer. Farvid et al. (2019) conducted a prospective study to evaluate the relationship between specified fruit and vegetable consumption, and the incident of breast cancer, characterized by menopausal status, hormone receptor status, and molecular subtype. The findings indicated that greater intake of total fruits and vegetables, especially cruciferous and yellow/orange vegetables, was associated with significantly lower breast cancer risk (> 5.5 vs ≤ 2.5 servings/day, HR = 0.89, 95% CI = [0.83–0.96], $p = 0.006$). Their findings support that higher intake of fruits and vegetables may reduce the risk of breast cancer. Moreover, according to the American Institute for Cancer Research (2019), a diet rich in fruits and vegetables decreases the risk of many chronic diseases and increases longevity.

Hypothesis 7: There is a statistically significant association between recommended physical activity, and the development of breast cancer among African American women after adjusting for age, BMI, and smoker status. I hypothesized that recommended physical activity would be statistically associated with the development of breast cancer. The findings indicated that recommended physical activity was statistically significant. As predicted recommended physical activity (i.e., exercise) was statistically

significant for both models: (a) unadjusted *OR* = 2.483, 95% CI = [1.306-4.722], *p* = .006 < 0.05, and (b) adjusted *OR* = .435, 95% CI [.218-.867], *p* = .018 < 0.05. Therefore, I rejected the null hypothesis. Importantly, this analysis was not able to identify causal relationships between recommended activity levels and having had breast cancer, as time order could not be established in a cross-sectional study.

Hypothesis 8: There is a statistically significant association between health behaviors of recommended physical activity and the development of breast cancer among African-American women when modified by social support. Testing the modifying effect of social support on the relationship between recommended physical activity and breast cancer, I hypothesized that social support would be associated with the development of breast cancer. There was a statistically significant association between recommended exercise (i.e., physical activity) and the development of breast cancer in both models: (a) unadjusted *OR* = 2.483, 95% CI = [1.306-4.722], *p* = .006 < 0.05; and (b) adjusted *OR* = .393, 95% CI [.202-.766], *p* = 018 < 0.05. Social support was not a modifier: (*p* = .105, and *OR* = 3.265, 95% CI [781-13.644]).

Hypothesis 9: stated there is a statistically significant association between recommended physical activity, and the development of breast cancer among African American women when stratified by income level**.** There was a statistically significant association between recommended exercise (physical activity) and the development of breast cancer in both models: (a) unadjusted *OR* = 2.483, 95% CI = [1.306-4.722], *p* = .006 < 0.05, and (b) adjusted *OR* =. 404, 95% *CI* = [.212-.770], *p* = 0.06. When the imputed income variable was included in the logistic, there was no statistical significance

(p = .598), indicating that income does not modify the association between meeting recommendations of physical activity. Physical activity or exercise was assessed qualitatively as moderate and three times a week, and the result is consistent with numerous studies that indicated a protective effect of physical activity. Previous studies demonstrated that physical activity was associated with reduced risk of breast cancer (Kyu et al., 2016; Li et al., 2016; Rosenberg et al. 2014). A recent study by Kyu et al. (2016) indicated that a higher level of total physical activity is strongly associated with a lower risk of breast cancer, colon cancer, or diabetes; yet, physical activity patterns might vary across race, and studies in African Americans are limited. Rosenberg et al. (2014) conducted a study to investigate the association between physical activity and the incidence of invasive breast cancer using data from Black Women's Health Study. Their findings indicated that physical activity was associated with a reduction in incidence of breast cancer in African American women. The results from this study are consistent with the previous studies and the evidence that increased physical activity can shield women from breast cancer.

Binomial logistic regressions were conducted to investigate the association between health behaviors of recommended fruit and vegetable consumption, recommended physical activity, and the development of breast cancer, after adjusting for age, BMI, and smoker status, and whether the association is modified by social support or stratified by income level

Hypothesis 10: There is statistically significant association between recommended fruit, vegetable consumption, physical activity and the development of breast cancer

among African American women after adjusting for age, BMI, and smoker status. In examining the effects of recommended fruit and vegetable consumption, physical activity, and the development of breast cancer, while controlling for smoking status, age, and BMI, findings indicated that the full model was statistically significant: $\chi 2$ (6, n = 1,061) = 28.19, $p < .001$, and explained between 2.6% (Cox & Snell R^2) and 9.2% (Nagelkerke R^2) of the variance in breast cancer status. The only significant variables were recommended physical activity and age, with those aged 45 or older being 9.5 times more likely to indicate they have had breast cancer, while those who reported moderate exercise at least 3 days a week were .38 times less likely to report having ever had breast cancer.

Hypothesis 11 and 12: Findings on the moderating effect of social support on these associations were not statistically significant, indicating there was no evidence to suggest the association were modified by social support (i.e., having a friend or family member to discuss health with) and that income did not modify the association between meeting recommendations for fruit consumption, vegetable consumption, physical activity and breast cancer (see Tables 18 & 19).

As briefly discussed earlier, in this study, I failed to demonstrate a predictive association between health behavior of recommended fruit and vegetable consumption and the development of breast cancer among African American women. The findings from this study support previous cross-sectional studies that showed inconsistency. Peng et al (2017) conducted a meta-analysis of studies; they found no significant associations between fruit and vegetable intake and breast cancer prognosis. Boggs et al (2010) also

found that total fruit, total vegetable, or total fruit and vegetable intakes were not significantly associated with overall risk of breast cancer, but total vegetable consumption was associated with a decreased risk of estrogen receptor-negative/progesterone receptor-negative breast cancer. However, despite methodologic limitations and small sample sizes, evidence has suggested that individuals who eat a lot of fruits and vegetables have higher chances to diminish risk of breast cancer (Kooshki et al., 2016). In their landmark study on the association between fruit and vegetable consumption and breast cancer incidence, Farvid et al. (2019) findings supported that higher intake of fruits and vegetables may reduce the risk of breast cancer but not a cause-and-affect. The results from this study are consistent with the previous studies, and the evidence indicated that increased physical activity can shield African American women from breast cancer. Prior research also indicated that the incidence of breast risk was higher as women age (American Cancer Society, 2017; CDC, 2018). My findings confirmed that once again, the only significant variables were recommended activity and age, with those aged 45 or older being 9.5 times more likely to indicate they have had breast cancer, while those who report moderate exercise at least three days a week were .38 times less likely to report having ever had breast cancer.

Interpretation of Findings in the Context of the Theoretical Framework

This study aimed to examine the association between health behavior of recommended fruit and vegetable consumption, physical activity, and the development of breast cancer among African American women after controlling for age, BMI and smoker status and the effect modification of social support and income level. The research

objectives for this study were to determine if health behaviors of recommended fruit and vegetable consumption and recommended physical activity, through the social ecological model, were predictive of the development of breast cancer among African American women, and whether income level and social support influenced the predictive association. Statistical analyses revealed that there is no statistically significant association between breast cancer and health behaviors of recommended fruit and vegetable consumption. On the other hand, statistical analyses revealed that recommended physical activity was statistically significant. The findings from this study support previous cross-sectional studies that showed inconsistency. Despite the mixed results, to close the widening breast cancer disparities gap and to improve the health of African American women as related to breast cancer, health intervention initiatives guided by SEM are recommended. SEM identified multiples interconnected at intrapersonal, interpersonal, and community level. A combination of multiple level factors (i.e., individual-level, physical and social environments, and policies) can achieve positive change in health behavior when they are then maintained (Sallis et al., 2015).

Role of Interpersonal Factors

Although an individual interpersonal factor such as personal behavior is crucial in modifying health behavior, it is only part of the formula for a disease-prevention approach. Individual (i.e., interpersonal) factors supported with interpersonal (i.e., organizational, community, and policy) factors are fundamental to advancing disease prevention (CDC, 2017). For example, women desire to be active with moderate physical activity need a supportive environment to produce sustainably outcomes. Given that

physical activity and fruit and vegetable consumption are modifiable behaviors, to support the actions individuals take into account in the relationship between the individual and the environment in which they live. The findings of this study are consistent with the literature that identified an association between fruit and vegetable consumption and breast cancer are inconclusive (Mayne et al., 2016).

Limitations of the Study

The strengths of the study are the large sample size, national representative sample, and the validity and reliability of HINTS surveys (National Cancer Institute, 2018). However, there are still several limitations related to cross-sectional design, unmeasured confounders, and self-reported data. First, this cross-sectional design failed to imply causal inferences. Secondly, there were unmeasured confounders; the study did not control all potential confounding factors, such as genetic mutation, alcohol, reproductive history, or being a carrier of BRCA1 or BRCA2. Yedjou et al. (2017) found that about 20 to 25% of breast cancer incidences are of hereditary breast cancers from BRCA1 and BRCA2 mutations. The known unmeasured risk confounders may have influenced the results. Thirdly, there are often issues with self-reported data related to mis-reporting and non-reporting source of recall biases. In this meta-analysis study, the prevalence of breast cancer in African American women was 12%, in the US, but in this study only 4.2% responded to having had breast cancer. The unbalanced sample was observed because of the 1,184 participants who were able to answer the question about breast cancer, the majority (n = 1,133) responded “does not have breast cancer (94%), and the minority (n = 51) had breast cancer (4.2%), and 1.7% were missing data. The

non-significant *p*-value found may be a reflection of insufficient sample size or unreliable measurements (Rusticus & Lovato, 2014).

Examples of unreliable measurement are mis-reporting and non-reporting which causes recall bias. Rusticus and Lovato (2014) have indicated that the overall power of the test is strongly influenced by the size of the sample, the amount of variability in the sample, and the size of the difference in the population. The sample population used in this investigation is a subset of African American responders and may not be representative of the African American women population, and therefore, finding cannot be generalized

Recommendations

The present study investigated the predictive association between health behavior of fruits and vegetable consumption and the development of breast cancer. Self-reported data from the HINTS cross-sectional surveys available from the National Cancer Institute (2018) were used to assess the changes in exposures and outcomes in a particular population; however, this cross-sectional study may not be sufficient to understand the current incidence of breast cancer trends. Given the growing number of African American women who are diagnosed with breast cancer, both younger and TNBC, I recommend future prospective cohort studies that would control multiple confounding variables. Such studies would provide in-depth details of these associations, although according to Archer, Lavie, and Hill (2018), the diet-disease associations did not meet Bradford Hill's criteria for causation because epidemiologic methods do not measure dietary intake, such as fruits and vegetables.

Implications

In the United States, breast cancer is a significant burden for African American women and their families. Although breast cancer risk factors are complex and wide-ranging (Hennigs et al., 2016; Makki, 2015), evidence from studies have suggested that positive change in health behavior has the potential to shield African American women from developing breast cancer. The study findings are a significant step toward making lifestyle choices, such as exercising regularly, which can be the foundation for future prevention approach such as voucher initiative to motive and sustain physical activity. Possible positive social change is to increase awareness of health behavior risk factors among African American women, mainly voucher initiative to motivate and sustain physical activity. A socio-ecological model that includes interpersonal (i.e., individual behavior); interpersonal (i.e., parent, friend, and peer support); or community level, such as a community walk track. Kelly and Barker (2016) posited that changing health behaviors must be a multilevel approach regardless of any individual choice. At the individual level, an incentive to increase preparedness to change behavior could be a voucher to a fitness center. At the community level, intervention to motivate lifestyle change could include availability of a community walk track to encourage more physical activity, African programs to motivate lifestyle change, and providing education and support to the most vulnerable communities. I suggest involving health professionals because they are a crucial element to bridging the gap between individuals knowing what needs to change and actually implementing those lifestyle change (Williams, Beeken, Fisher, & Wardle, 2015

Conclusions

Breast cancer is a persistent problem among African American women and a leading cause of death; African American women in the US are about 40% more likely to die from breast cancer than White women (Hunt et al., 2014; Iqbal, Anwar, & Haider, 2015; Samson et al., 2016). In addition to high mortality, the cancer incidence rate has increased rapidly despite progress made in mammogram screening (Sun et al., .2017). The high incidence of breast cancer among African American women is a serious public health problem (DeSantis et al., 2016; Singh & Jemal, 2017). Breast cancer prevention remains challenging for African American women, and physical inactivity and unhealthy diets are modifiable behavior. Can the increased incidence rate of breast cancer in African American women be attributed to unhealthy behavior? This study aimed to investigate the predictive association between health behaviors of fruits and vegetables consumption, physical activity, and the development of breast cancer among African Americans and whether the potential association is stratified by income level and modified by social support. The second objective was to evaluate income level and social support interaction with the association while controlling the confounders of age, BMI, and smoker status.

Understanding how these health behaviors impact the development of breast cancer is required in order to develop and implement appropriate interventions that will help reverse the trend of high incidence of breast cancer among African American women. In the current study, no statistically significant associations were observed between recommended fruit and vegetable consumption and the development of breast

cancer; however, recommended physical activity was statistically significant. My findings are consistent with other studies that investigated the association between fruit and vegetable consumption and breast cancer and found the association inconclusive (Mayne et al., 2016). In addition to limitations linked to self-reporting, measuring complex behavioral constructs such as dietary consumption is often limited. Measuring fruit and vegetable consumption remains a challenge in epidemiological studies, as epidemiologic methods do not measure dietary intake (Archer et al., 2018). The results from this study did reveal a statistically significant association with age. However, a statistically significant association does not imply causal inference can be made.

References

Ademuyiwa, F. O., Groman, A., O'Connor, T., Ambrosone, C., Watroba, N., & Edge, S. B. (2011). Impact of body mass index on clinical outcomes in triple-negative breast cancer. *Cancer, 117*(18), 4132-4140. doi:10.1002/cncr.26019

Advani, P. S., Reitzel, L. R., Nguyen, N. T., Fisher, F. D., Savoy, E. J., Cuevas, A. G., ... McNeill, L. H. (2014). Financial strain and cancer risk behaviors among African Americans. *Cancer Epidemiology and Prevention Biomarkers*, *23*(6), 967-975. doi:10.1158/1055-9965.EPI-14-0016

American Cancer Society. (2012, January 11). *ACS guidelines for nutrition and physical activity*. Retrieved from https://www.cancer.org/healthy/eat-healthy-get-active/acs-guidelines-nutrition-physical-activity-cancer-prevention/guidelines.html

American Cancer Society. (2017, October 3). *Breast cancer facts & figures 2017-2018*. Retrieved from https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/breast-cancer-facts-and-figures/breast-cancer-facts-and-figures-2017-2018.pdf

Anders, C. K., Deal, A. M., Miller, C. R., Khorram, C., Meng, H., Burrows, E, . . . Carey, L. A. (2011). The prognostic contribution of clinical breast cancer subtype, age, and race among patients with breast cancer brain metastases. *Cancer, 117*(8), 1602-1611. doi:10.1002/cncr.25746

Aparicio, S., & Caldas, C. (2016, June 2). Why biology matters when it comes to conquering breast cancer. In *BC Cancer Molecular Oncology Research*. Retrieved from http://molonc.bccrc.ca/natcomm2016/

Archer, E., Lavie, C. J., & Hill, J. O. (2018). The failure to measure dietary intake engendered a fictional discourse on diet-disease relations. *Frontiers in Nutrition*, *5*, 105. doi:10.3389/fnut.2018.00105

Arem, H., & Loftfield, E. (2018). Cancer epidemiology: A survey of modifiable risk factors for prevention and survivorship. *American Journal of Lifestyle Medicine, 12*(3). https://doi.org/10.1177/1559827617700600

Aune, D., Chan, D. S. M., Vieira, A. R., Rosenblatt, D. N., Vieira, R., Greenwood, D. C., & Norat, T. (2012). Fruits, vegetables and breast cancer risk: A systematic review and meta-analysis of prospective studies. *Breast Cancer Research and Treatment*, *134*(2), 479-493.

Bandera, E. V., Chandran, U., Zirpoli, G., Gong, Z., McCann, S. E., Hong, C.-C., . . .Christine B Ambrosone, C. B. (2013). Body fatness and breast cancer risk in women of African ancestry. *BioMed Central Cancer, 13*, 475. doi:10.1186/1471-2407-13-475

Bodai, B. I., & Tuso, P. (2015). Breast cancer survivorship: a comprehensive review of long-term medical issues and lifestyle recommendations. *The Permanente Journal*, *19*(2), 48.

Boggs, D. A., Palmer, J. R., Wise, L. A., Spiegelman, D., Stampfer, M. J., Adams-Campbell, L. L., & Rosenberg, L. (2010). Fruit and vegetable intake in relation to risk of breast cancer in the Black Women's Health Study. *American Journal of Epidemiolog*y, *172*(11), 1268–1279. doi:10.1093/aje/kwq293

Borch, K. B., Braaten, T., Lund, E., &Weiderpass, E. (2015). Physical activity before and after breast cancer diagnosis and survival - the Norwegian women and cancer cohort study. *BioMed Central Cancer, 16*(15), 967. doi:10.1186/s12885-015-1971-9

Bradbury, K. E., Appleby, P. N., & Key, T. J. (2014). Fruit, vegetable, and fiber intake in relation to cancer risk: Findings from the European Prospective Investigation into Cancer and Nutrition (EPIC). *The American Journal of Clinical Nutrition*, 100(Suppl_1), 394S-398S. doi:10.3945/ajcn.113.071357

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*(7), 513-531.

Calamidas, E. G., & Crowell, T. L. (2018). A content analysis of college students' health behaviors. *American Journal of Health Education, 49*(3), 133-146. https://doi.org/10.1080/19325037.2018.1428699

Carey, L. A., Perou, C. M., Livasy, C. A., Dressler, L. G., Cowan, D., Conway, K. ... Deming, S. L. (2006). Race, breast cancer subtypes, and survival in the Carolina Breast Cancer Study. *Jama*, *295*(21), 2492-2502.

Centers for Disease Control and Prevention. (2014). *Facts about physical activity*. Retrieved from https://www.cdc.gov/physicalactivity/data/facts.htm

Centers for Disease Control and Prevention. (2016). Breast cancer rates among Black women and White women.

Centers for Disease Control and prevention. (2018). *State indicator report on fruits and vegetables, 2018*. Retrieved from https://www.cdc.gov/nutrition/data-statistics/2018-state-indicator-report-fruits-vegetables.html

Centers for Disease Control and Prevention. (2019a, July 2). *Physical activity and health*. Retrieved from https://www.cdc.gov/physicalactivity/basics/pa-health/index.htm

Centers for Disease Control and Prevention. (2019b, January 16). *Social-ecological model: A framework for prevention*. Retrieved from https://www.cdc.gov/violenceprevention/publichealthissue/social-ecologicalmodel.html

Cheema, J. R. (2014). A Review of Missing Data Handling Methods in Education Research. *Review of Educational Research, 84*(4). https://doi.org/10.3102/0034654314532697

Chen, L., &Christopher, Li. (2015). Racial disparities in breast cancer diagnosis and treatment by hormone receptor and HER2 status. *Cancer Epidemiology Biomarkers & Prevention, 24*(11), 1666-1672.

Chen, S., Chen, Y., Ma, S., Zheng, R., Zhao, P., Zhang, L., . . . Zhang, K. (2016). Dietary fibre intake and risk of breast cancer: A systematic review and meta-analysis of epidemiological studies. *Oncotarget, 7*(49), 80980-80989. doi:10.18632/oncotarget.13140

Choi, K. S., Yoon, M., Song, S. H., Suh, M., Park, B., Jung, K. W., & Jun, J. K. (2018). Effect of mammography screening on stage at breast cancer diagnosis: results from the Korea National Cancer Screening Program. *Scientific Reports*, *8*(1), 8882.

ChooseMyPlate. (2018). *Why is it important to eat fruit?* Retrieved from https://www.choosemyplate.gov/vegetables-nutrients-health

Chowdhury, R., David, N., Bogale, A., Nandy, S., Habtemariam, T., & Tameru, B. (2016). Assessing the key attributes of low utilization of mammography screening and breast-self exam among African American women. *Journal of Cancer*, *7*(5), 532.

Churpek, J. E., Walsh, T., Zheng, Y., Moton, Z., Thornton, A. M., Lee, M., . . . Olopade, O. (2015). Inherited predisposition to breast cancer among African American women. *Breast Cancer Research and Treatment, 149*(1), 31-39. doi:10.1007/s10549-014-3195-0

Clarke, C. A., Keegan, T. H., Yang, J., Press, D. J., Kurian, A. W., Patel, A. H., & Lacey, J. V., Jr. (2012). Age-specific incidence of breast cancer subtypes: Understanding the black-white crossover. *Journal of the National Cancer Institute, 104*(14), 1094-10101. doi:10.1093/jnci/djs264

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge..

Colditz, G. A., & Bohlke, K. (2014). Priorities for the primary prevention of breast cancer. *CA: A Cancer Journal for Clinicians*, *64*(3), 186-194.

Colditz, G. A., & Sutcliffe, S. (2016). The preventability of cancer: Stacking the deck. *JAMA Oncology, 2*(9), 1131-1133. doi:10.1001/jamaoncol.2016.0889

Coughlin, S. S., & Smith, S. A. (2016). A review of community-based participatory research studies to promote physical activity among African Americans. *Journal of the Georgia Public Health Association, 5*(3), 220-227.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Dandamudi, A., Tommie, J., Nommsen-Rivers, L., & Couch, S. (2018). Dietary patterns and breast cancer risk: A systematic review. *Anticancer Research, 38*(6), 3209-3222. doi:10.21873/anticanres.12586

Daniel, H., Bornstein, S. S., & Kane, G. C. (2018). Addressing social determinants to improve patient care and promote health equity: An American College of Physicians' position paper. *Annals of Internal Medicine*, *168*(8), 577-578.

Davis, C., Darby, K., Moore, M., Cadet, T., & Brown, G. (2017). Breast care screening for underserved African American women: Community-based participatory approach. *Journal of Psychosocial Oncology*, *35*(1), 90-105.

Demark-Wahnefried, W., Jones, L. W., Snyder, D. C., Sloane, R. J., Kimmick, G. G., Hughes, D. C., … Lipkus, I. M. (2014). Daughters and mothers against breast cancer (DAMES): Main outcomes of a randomized controlled trial of weight loss in overweight mothers with breast cancer and their overweight daughters. *Cance*r, *120*(16), 2522–2534. doi:10.1002/cncr.28761

DeSantis, C. E., Ma, J., Goding Sauer, A., Newman, L. A., & Jemal, A. (2017). Breast cancer statistics, 2017, racial disparity in mortality by state. *A Cancer Journal for Clinicians, 67*(6), 439-448. doi:10.3322/caac.21412

DeSantis, C. E., Siegel, R. L., Sauer, A. G., Miller, K. D., Jemal, A., Fedewa, S. A., & Alcaraz, K. I. (2016). Cancer statistics for African Americans, 2016: Progress and opportunities in reducing racial disparities. *Cancer Journal for Clinicians*, *66*(4), 290-308. doi:10.3322/caac.21340

Dieterich, M., Stubert, J., Toralf Reimer, T., Erickson, N., & Berling, A. (2014). Influence of Lifestyle Factors on Breast Cancer Risk. *Breast Care (Basel), 9*(6), 407-414. doi:10.1159/000369571

Dietze, E. C., Sistrunk, C., Miranda-Carboni, G., O'Regan, R., & Seewaldt, V. L. (2015). Triple-negative breast cancer in African American women: Disparities versus biology. *Nature Reviews. Cancer, 15*(4), 248–254. http://doi.org/10.1038/nrc3896

Documet, P., Bear, T. M., Flatt, J. D., Macia, L., Trauth, J., & Ricci, E. M. (2015). The association of social support and education with breast and cervical cancer screening. *Health Education & Behavior*, *42*(1), 55-64.

Dogan, B. E., & Turnbull, L. W. (2012). Imaging of triple-negative breast cancer. *Annals of Oncology, 23*(Suppl 6), vi23-vi29. doi:10.1093/annonc/mds191

Dossus, L., Boutron-Ruault, M. C., Kaaks, R., Vilier, A., Fervers, B., Manjer, J., . . . Clavel-Chapelon, F. (2014). Active and passive cigarette smoking and breast cancer risk: Results from the EPIC cohort. *International Journal of Cancer, 134*, 1871-1888. doi:10.1002/ijc.28508

Farvid, M. S., Chen, W. Y., Rosner, B. A., Tamimi, R. M., Willett, W. C., & Eliassen, A. H. (2019). Fruit and vegetable consumption and breast cancer incidence: Repeated measures over 30 years of follow□up. *International Journal of Cancer*, *144*(7), 1496-1510.

Ferlay, J., Colombet, M., Soerjomataram, I., Mathers, C., Parkin, D. M., Piñeros, M., ... & Bray, F. (2019). Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. *International Journal of Cancer*, *144*(8), 1941-1953.

Ferrini, K., Ghelfi, F., Mannucci, R., & Titta, L. (2015). Lifestyle, nutrition and breast cancer: Facts and presumptions for consideration. *Ecancermedicalscience*, *9*, 557. doi:10.3332/ecancer.2015.557

Finney Rutten, L. J., Blake, KI. D., Greenberg-Worisek, A. J., Allen, S. V., Moser, R. P., & Hesse, B. W. (2019). Online health information seeking among us adults: Measuring progress toward a healthy people 2020 objective. *Public Health Reports, 134*(6). https://doi.org/10.1177/0033354919874074

Freedman, D. A., Bell, B. A., & Collins, L. V. (2011). The veggie project: A case study of a multi-component farmers' market intervention. *The Journal of Primary Prevention, 32*(3-4), 213-224. doi:10.1007/s10935-011-0245-9

George, P., Chandwani, S., Gabel, M., Ambrosone, C. B., Rhoads, G., Bandera, E. V., & Demissie, K. (2015). Diagnosis and surgical delays in African American and white women with early-stage breast cancer. *Journal of Women's Health, 24*(3), 209-217. doi:10.1089/jwh.2014.4773.

Gomez, S. L., Shariff-Marco, S., DeRouen, M., Keegan, T. H., Yen, I. H., Mujahid, M. … Glaser, S. L. (2015). The impact of neighborhood social and built environment factors across the cancer continuum: Current research, methodological considerations, and future directions. *Cancer*, *121*(14), 2314–2330. doi:10.1002/cncr.29345

Gonçalves, A. P. R., Correa, M. B., Nahsan, F. P. S., Soares, C. J., & Moraes, R. R. (2018). Use of scientific evidence by dentists in Brazil: Room for improving the evidence-based practice. *PLoS ONE, 13*(9), e0203284. https://doi.org/10.1371/journal.pone.0203284

Hair, B. Y., Hayes, S., Tse, C. K., Bell, M. B., & Olshan, A. F. (2014). Racial differences in physical activity among breast cancer survivors: Implications for breast cancer care. *Cancer*, *120*(14), 2174-2182. doi:10.1002/cncr.28630

Hashemi, S. H., Karimi, S., & Mahboobi, H. (2014). Lifestyle changes for prevention of breast cancer. *Electronic Physician*, *6*(3), 894–905. doi:10.14661/2014.894-905

Hennigs, A., Riedel, F., Gondos, A., Sinn, P., Schirmacher, P., Marmé, F., . . . Schneeweiss A. (2016). Prognosis of breast cancer molecular subtypes in routine clinical care: A large prospective cohort study. *BioMed Central Cancer, 16*(1), 734. doi:10.1186/s12885-016-2766-3

Hosmer, D. W. Jr., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Howlader, N., Altekruse, S. F., Li, C. I., Chen, V. W., Clarke, C. A., Ries, L. A., & Cronin, K. A. (2014). US incidence of breast cancer subtypes defined by joint hormone receptor and HER2 status. *Journal of the National Cancer Institute*, *106*(5), pii: dju055. doi:10.1093/jnci/dju055

Hunt, B. R., Whitman, S., & Hurlbert, M. S. (2014). Increasing Black: White disparities in breast cancer mortality in the 50 largest cities in the United States. *Cancer Epidemiology*, *38*(2), 118-123.

Iqbal, N., Anwar, S., & Haider, N. (2015). Effect of Leadership Style on Employee Performance [Reprint]. Arabian Journal of Business and Management Review, 5(5), 1-6. doi:10.4172/2223-5833.1000146

Jafari, N., Farajzadegan, Z., Zamani, A., Bahrami, F., Emami, H., & Loghmani, A. (2013). Spiritual well-being and quality of life in Iranian women with breast cancer undergoing radiation therapy. *Supportive Care in Cancer, 21*(5), 1219-1225. doi:10.1007/s00520-012-1650-1

Jankowska, M. M., Sears, D. D., Natarajan, L., Martinez, E., Anderson, C. A., Sallis, J. F. ... Barrera-Ng, A. (2019). Protocol for a cross sectional study of cancer risk, environmental exposures and lifestyle behaviors in a diverse community sample: The community of mine study. *BMC Public Health, 19*(1), 186. doi:10.1186/s12889-019-6501-2

Janni, W. (2018, December 7). *Lifestyle intervention helped breast cancer survivors lose weight, and was associated with higher disease-free survival rates*. Paper presented to the San Antonio Breast Cancer Symposium, Dec. 4–8, 2018. Retrieved from https://www.sabcs.org/sabcs/2018/pressreleases/4_dqp3rb23j9z5_Lifestyle%20Intervention%20Helped%20Breast%20Cancer%20Survivors%20Lose%20Weight,%20and%20Was%20Associated%20with%20Higher%20Disease-free%20Survival%20Rates.pdf

Jensen, M.-B., Ejlertsen, B., Mouridsen, H. T., Christiansen, P., & Danish Breast Cancer Cooperative Group. (2015). Improvements in breast cancer survival between 1995 and 2012 in Denmark: The importance of earlier diagnosis and adjuvant treatment. *Acta Oncologica, 55*, 24-35. https://doi.org/10.3109/0284186X.2015.1128119

Jones, M. E., Schoemaker, M. J., Wright, L. B., Ashworth, A., & Swerdlow, A. J. (2017). Smoking and risk of breast cancer in the Generations Study cohort. *Breast Cancer Research, 19*, 118. doi:10.1186/s13058-017-0908-4

Kamińska, M., Ciszewski, T., Łopacka-Szatan, K., Miotła, P., & Starosławska, E. (2015). Breast cancer risk factors. *Menopause Review, 14*(3), 196-202. doi:10.5114/pm.2015.54346

Keegan, T. H., Shariff-Marco, S., Sangaramoorthy, M., Koo, J., Hertz, A., Schupp, C. W. ... Gomez, S. L. (2014). Neighborhood influences on recreational physical activity and survival after breast cancer. *Cancer Causes & Control*, *25*(10), 1295-1308.

Kelly, M. P., & Barker, M. (2016). Why is changing health-related behavior so difficult? *Public Health*, *136*, 109-116.

Key, T. J., & Reeves, G. K. (2016, May 11). Alcohol, diet, and risk of breast cancer. BMJ: *British Medical Journal* (Online), 353. https://doi.org/10.1136/bmj.i2503

Khazaee-Pool, M., Pashaei, T., Jahangiry, L., Ponnet, K., & Gholami, A. (2017). Exploring breast cancer preventive lifestyle and social support of Iranian women: A study protocol for a mixed-methods approach. *International Journal for Equity in Health*, 16(1), 97.

Kinney, N., Varghese, R. T., Anandakrishnan, R., & Garner, H. R. S. (2017). ZDHHC3 as a risk and mortality marker for breast cancer in African American women. *Cancer Informatics*, *16*, doi:10.1177/1176935117746644

Kluttig, A., & Schmidt-Pokrzywniak, A. (2009). Established and suspected risk factors in breast cancer aetiology. *Breast Care (Basel), 4*(2), 82-87.

Kohler, B. A., Sherman, R. L., Howlader, N., Jemal, A., Ryerson, A. B., Henry, K. A., . . . Penberthy, L. (2015). Annual report to the nation on the status of cancer, 1975-2011, Featuring incidence of breast cancer subtypes by race/ethnicity, poverty, and state. *Journal of the National Cancer Institute, 107*(6), djv048. doi:10.1093/jnci/djv048

Kojima, R., Okada, E., Ukawa, S., Mori, M., Wakai, K., Date, C.... Tamakoshi, A. (2017). Dietary patterns and breast cancer risk in a prospective Japanese study. *Breast Cancer*, *24*(1), 152-160.

Kooshki, A., Moghaddam, M. Y., & Akbarzadeh, R. (2016). Study of fruit and vegetable intake in breast cancer patients in the city of Sabzevar. *Electronic Physician, 8*(9), 3011-3014. doi:10.19082/3011

Kyu, H. H., Bachman, V. F., Alexander, L. T., Mumford, J. E., Afshin, A., Estep, K., … Forouzanfar, M. H. (2016). Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: Systematic review and dose-response meta-analysis for the Global Burden of Disease Study 2013. *British Medical Journal, 354,* i3857. https://doi.org/10.1136/bmj.i3857

Kushi, L. H., Doyle, C., McCullough, M., Rock, C. L., Demark□Wahnefried, W., Elisa V. Bandera, E. V., . . . The American Cancer Society 2010 Nutrition and Physical Activity Guidelines Advisory Committee. (2012, January). American Cancer Society guidelines on nutrition and physical activity for cancer prevention.

Lammert, J., Grill, S., & Kiechle, M. (2018). Modifiable lifestyle factors: Opportunities for (hereditary) breast cancer prevention—A narrative review. *Breast Care (Basel), 13*(2), 109-114. doi:10.1159/000488995

Leech, N. L., Barrett, K. C., & Morgan, G. A. (2011). *IBM SPSS for intermediate statistics: Use and interpretation* (4th ed.). New York, NY: Routledge/Taylor & Francis Group.

Latkin, C. A., & Knowlton, A. R. (2015). Social network assessments and interventions for health behavior change: A critical review. *Behavioral Medicine*, *41*(3), 90-97.

Lee-Kwan, S. H., Moore, L. V., Blanck, H. M., Harris, D. M., & Galuska, D. (2017). Disparities in State-Specific Adult Fruit and Vegetable Consumption—United States, 2015. *Weekly, 66*(45), 1241–1247.

Li, L., Yun, S., Tingting, L., Qin, Q., Jieyun, Y., Shuo, P., ... Sheng, W. (2016). Leisure time, physical activity and cancer risk: Evaluation of the WHO's recommendation based on 126 high-quality epidemiological studies. *British Journal of Sports Medicine*, *50*(6), 372-378.. doi:10.1136/bjsports-2015-094728

Liu, Z., Zhang, K., & Du, X. L. (2016). Risks of developing breast and colorectal cancer in association with incomes and geographic locations in Texas: A retrospective cohort study. *BMC Cancer*, *16*, 294. doi:10.1186/s12885-016-2324-z

Lynch, B. M., Neilson, H. K., & Friedenreich, C. M. (2010). Physical activity and breast cancer prevention. In *Physical activity and cancer* (pp. 13-42). Berlin, Heidelberg: Springer.

Makki, J. (2015). Diversity of breast carcinoma: Histological subtypes and clinical relevance. *Clinical Medicine Insights. Pathology, 8*, 23-31. doi:10.4137/CPath.S31563

Mayne, S. T., Playdon, M. C., & Rock, C. L. (2016). Diet, nutrition, and cancer: Past, present and future. *Nature Reviews Clinical Oncology*, *13*(8), 504.

McGuire, S. (2016). World cancer report 2014. Geneva, Switzerland: World Health Organization, international agency for research on cancer, WHO Press, 2015. *Advances in Nutrition, 7*(2), 418-419. doi:10.3945/an.116.012211

McKenzie, F., Biessy, C., Ferrari, P., Freisling, H., Rinaldi, S., Chajès, V., ... Trichopoulos, D. (2016). Healthy lifestyle and risk of cancer in the European prospective investigation into cancer and nutrition cohort study. *Medicine, 95*(16), e2850. doi:10.1097/MD.0000000000002850

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15*(4), 351-377. doi:10.1177/109019818801500401

Meeker, C. R., Geynisman, D. M., Egleston, B. L., Hall, M. J., Mechanic, K. Y., Bilusic, M. ... Wong, Y. N. (2016). Relationships among financial distress, emotional distress, and overall distress in insured patients with cancer. *Journal of Oncology Practice*, *12*(7), e755-e764.

Moore, L. V., & Thompson, F. E. (2015). Adults meeting fruit and vegetable intake recommendations - United States, 2013. *Morbidity and Mortality Weekly Report, 64*(26), 709-713. Retrieved from PubMed database. (PMID: 26158351)

Moore, L. V., Thompson, F. E., & Demissie, Z. (2017). Percentage of youth meeting federal fruit and vegetable intake recommendations: Youth risk behavior surveillance system, United States and 33 states, 2013. *Journal of the Academy of Nutrition and Dietetics*, 117(4), 545-553. doi:10.1016/j.jand.2016.10.012

Nandi, A., Glymour, M. M., & Subramanian, S. V. (2014). Association among socioeconomic status, health behaviors, and all-cause mortality in the United States. *Epidemiology, 25*(2), 170-177. doi:10.1097/EDE.0000000000000038

National Cancer Institute. (n.d.). *Health information national trends survey: All HINTS questions.* Retrieved from https://hints.cancer.gov/view-questions-topics/all-hints-questions.aspx

National Cancer Institute. (2018). *Health information national trends survey 5 (HINTS 5): Cycle 2 methodology report*. Retrieved from https://hints.cancer.gov/docs/methodologyreports/HINTS5_Cycle_2_Methodology_Report.pdf

National Institute of Environmental Health Sciences. (2018, November). *Breast cancer risk and environmental factors*. Retrieved from https://www.niehs.nih.gov/health/materials/environmental_factors_and_breast_cancer_risk_508.pdf

Nomura, S. J. O., Dash, C., Rosenberg, L., Palmer, J., & Adams-Campbell, L. L. (2016). Sedentary time and breast cancer incidence in African American women. *Cancer Causes & Control*, *27*(10), 1239–1252 doi: 10.1007/s10552-016-0803-9

Norat, T., Scoccianti, C., Boutron-Ruault, M. C., Anderson, A., Berrino, F., Cecchini, M., ... Wiseman, M. (2015). European code against cancer 4th edition: Diet and cancer. *Cancer Epidemiology, 39(*Suppl 1), S56-66. doi:10.1016/j.canep.2014.12.016

Office of Disease Prevention and Health Promotion. (2019, November). *Healthy People 2020.* Retrieved from the U.S. Department of Health and Human Services website: https://www.healthypeople.gov/

Partridge, A. H., Hughes, M. E., Warner, E. T., Ottesen, R. A., Wong, Y. N., Edge, S. B., . . . Tamimi, R. M. (2016). Subtype-dependent relationship between young age at diagnosis and breast cancer survival. *Journal of Clinical Oncology, 34*(27), 3308-3314. doi:10.1200/JCO.2015.65.8013

Paxton, R. J., Garner, W., Logan, G., Dean, L. T., & Allen-Watts, K. (2019). Health behaviors and lifestyle interventions in African American breast cancer survivors: A systematic review. *Frontiers in Oncology*, *9*, 3. doi:10.3389/fonc.2019.00003

Penniecook-Sawyers, J. A., Jaceldo-Siegl, K., Fan, J., Beeson, L., Knutsen, S., Herring, P., & Fraser, G. E. (2016). Vegetarian dietary patterns and the risk of breast cancer in a low-risk population. *British Journal of Nutrition*, *115*(10), 1790-1797.

Peng, C., Luo, W. P., & Zhang, C. X. (2017). Fruit and vegetable intake and breast cancer prognosis: A meta-analysis of prospective cohort studies. *British Journal of Nutrition, 117*(5), 737-749.

Physical Activities Guidelines Advisory Committee. (2018). *Physical Activity Guidelines Advisory Committee scientific report*. Retrieved from https://health.gov/paguidelines/second-edition/report/pdf/PAG_Advisory_Committee_Report.pdf

Reblin, M., & Uchino, B. N. (2008). Social and Emotional Support and its Implication for Health. *Current Opinion in Psychiatry, 21*(2), 201–205. doi:10.1097/YCO.0b013e3282f3ad89

Reeder-Hayes, K. E., Wheeler, S. B., & Mayer, D. K. (2015). Health disparities across the breast cancer continuum. *Seminars in Oncology Nursing, 31*(2), 170-177. doi:10.1016/j.soncn.2015.02.005

Richardson, L. C., Henley, S. J., Miller, J. W., Massetti, G., & Thomas, C. C. (2016). *Patterns and trends in age-specific black-white differences in breast cancer incidence and mortality–United States, 1999–2014. MMWR. Morbidity and mortality weekly report, 65*. Retrieved from https://www.cdc.gov/mmwr/volumes/65/wr/mm6540a1.htm

Rojas, K., & Stuckey, A. (2016). Breast cancer epidemiology and risk factors. *Clinical Obstetrics and Gynecology*, *59*(4), 651-672.

Rosenberg, L., Palmer, J. R., Bethea, T. N., Ban, Y., Kipping-Ruane, K., & Adams-Campbell, L. L. (2014). A prospective study of physical activity and breast cancer incidence in African American women. *Cancer Epidemiology and Prevention Biomarkers*, *23*(11), 2522-2531.

Rusticus, S. A., & Lovato, C. Y. (2014). Impact of sample size and variability on the power and type I error rates of equivalence tests: A simulation study. *Practical Assessment, Research & Evaluation, 19*(11), 1-10.

Sallis, J. F., Owen, N., & Fisher, E. (2015). Ecological models of health behavior. *Health Behavior: Theory, Research, and Practice*, *5*, 43-64.

Samson, M. E., Porter, N. G., Hurley, D. M., Adams, S. A., & Eberth, J. M. (2016). Disparities in breast cancer incidence, mortality, and quality of care among African American and European American women in South Carolina. *Southern Medical Journal, 109*(1), 24-30.

Sarkar, S., Taylor, W. C., Lai, D., Shegog, R., & Paxton, R. J. (2016). Social support for physical activity: Comparison of family, friends, and coworkers. *Work*, *55*(4), 893-899.

Scarinci, I. C., Moore, A., Wynn-Wallace, T., Cherrington, A., Fouad, M., & Li, Y. (2014). A community-based, culturally relevant intervention to promote healthy eating and physical activity among middle-aged African American women in rural Alabama: Findings from a group randomized controlled trial. *Preventive Medicine, 69*, 13-20.

Schoemaker, M. J., Nichols, H. B., Wright, L. B., Brook, M. N., Jones, M. E., O'brien, K. M., ... Boutron-Ruault, M. C. (2018). Association of body mass index and age with subsequent breast cancer risk in premenopausal women. *JAMA Oncology*, *4*(11), e181771-e181771.

Setia M. S. (2016). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology, 61*(3), 261–264. doi:10.4103/0019-5154.182410

Sheppard, V. B., Makambi, K., Taylor, T., Wallington, S. F., Sween, J., & Adams-Campbell, L. (2011). Physical activity reduces breast cancer risk in African American women. *Ethnicity & Disease*, *21*(4), 406–411.

Siddharth, S., & Sharma, D. (2018). Racial disparity and triple-negative breast cancer in African American women: A multifaceted affair between obesity, biology, and socioeconomic determinants. *Cancers (Basel), 10*(12), pii: E514. doi:10.3390/cancers10120514

Siegel, R. L., Miller, K. D., & Jemal, A. (2018). Cancer statistics, 2018. *CA: A Cancer Journal for Clinicians*, *68*, 7–30. doi:10.3322/caac.21442

Sighoko, D., Hunt, B. R., Irizarry, B., Watson, K., Ansell, D., & Murphy, A. M. (2018). Disparity in breast cancer mortality by age and geography in 10 racially diverse US cities. *Cancer Epidemiology, 53*, 178-183. doi:10.1016/j.canep.2018.02.003

Silverman, K. R., Ohman-Strickland, P. A., & Christian, A. H. (2017). Perceptions of cancer risk: Differences by weight status. *Journal of Cancer Education, 32*(2), 357–363. doi:10.1007/s13187-015-0942-9

Singh, G. K., & Jemal, A. (2017). Socioeconomic and racial/ethnic disparities in cancer mortality, incidence, and survival in the United States, 1950–2014: Over six decades of changing patterns and widening inequalities. *Journal of Environmental and Public Health*, Article ID 2819372. https://doi.org/10.1155/2017/2819372

Smalls, B. L., Aroh, A., McQuerry, K., Adegboyega, A., Schoenberg, N., & Hatcher, J. (2018). Social support and breast cancer screening in rural A ppalachia. *Psycho□ oncology*, *27*(9), 2281-2288.

Song, M., & Giovannucci, E. (2016). Preventable incidence and mortality of carcinoma associated with lifestyle factors among white adults in the United States. *JAMA Oncolog*y, *2*(9), 1154-1161.

Soylar, P., & Genç, M. F. (2016). The treatment approach and social support needs for patients with breast cancer. *The Journal of Breast Health*, *12*(2), 56-62. doi:10.5152/tjbh.2016.2753

Spohr, S. A., Suzuki, S., Marshall, B., Taxman, F. S., & Walters, S. T. (2016). Social support quality and availability affects risk behaviors in offenders. *Health & justice*, *4*(1), 2.

Su, J. A., Yeh, D. C., Chang, C. C., Lin, T. C., Lai, C. H., Hu, P. Y.,, … Gossop, M. (2017). Depression and family support in breast cancer patients. *Neuropsychiatric Disease and Treatment*, *13*, 2389-2396. doi:10.2147/NDT.S135624

Sun, Y. S., Zhao, Z., Yang, Z. N., Xu, F., Lu, H. J., Zhu, Z. Y. … Zhu, H. P. (2017). Risk factors and preventions of breast cancer. *International Journal of Biological Sciences*, *13*(11), 1387–1397. doi:10.7150/ijbs.21635

Szumilas M. (2010). Explaining odds ratios. *Journal of the Canadian Academy of Child and Adolescent Psychiatry = Journal de l'Academie canadienne de psychiatrie de l'enfant et de l'adolescent*, *19*(3), 227–229.

Tao, L., Gomez, S. L., Keegan, T. H. M., Kurian, A. W., & Clarke, C. A. (2015). Breast cancer mortality in African American and Non-Hispanic White women by molecular subtype and stage at diagnosis: A population-based study. *Cancer Epidemiology, Biomarkers and Prevention, 24*(7), 1039–1045. doi:10.1158/1055-9965.EPI-15-0243

Tarone, R. E. (2018). On the International Agency for Research on Cancer classification of glyphosate as a probable human carcinogen. *European Journal of Cancer Prevention*, *27*(1), 82-87.

Thompson, T., Rodebaugh, T. L., Pérez, M., Struthers, J., Sefko, J. A., Lian, M. … Jeffe, D. B. (2016). Influence of neighborhood-level factors on social support in early-stage breast cancer patients and controls. *Social Science & Medicine*, *156*, 55–63. doi:10.1016/j.socscimed.2016.03.023

Thomson, C. A. (2012). Diet and breast cancer: Understanding risks and benefits. *Nutrition in Clinical Practice*, *27*(5), 636-650.

Thomson, C. A., & Thompson, P. A. (2013). Fruit and vegetable intake and breast cancer risk: A case for subtype-specific risk? *Journal of the National Cancer Institute, 105*(3), 164–165. https://doi.org/10.1093/jnci/djs640

Turati, F., Rossi, M., Pelucchi, C., Levi, F., & La Vecchia, C. (2015). Fruit and vegetables and cancer risk: A review of southern European studies. *British Journal of Nutrition*, *113*(S2), S102-S110.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2015, December). Dietary guidelines for Americans 2015-2020 (8th ed.). Retrieved from https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf

Van Ryswyk, K., Villeneuve, P., Johnson, K. C., & Epidemiology Research Group. (2016). Dietary patterns and the risk of female breast cancer among participants of the Canadian National Enhanced Cancer Surveillance System. *Canadian Journal of Public Health, 107*(1), e49-e55. doi:10.17269/cjph.107.5230

Volkman, J. E., Luger, T. M., Harvey, K. L., Hogan, T. P., Shimada, S. L., Amante, D., … Houston, T. K. (2014). The National Cancer Institute's Health Information National Trends Survey [HINTS]: A national cross-sectional analysis of talking to your doctor and other healthcare providers for health information. *BMC Family Practice*, *15*, 111. doi:10.1186/1471-2296-15-111

Wang, M. L., Pbert, L., & Lemon, S. C. (2014). Influence of family, friend and coworker social support and social undermining on weight gain prevention among adults. *Obesity (Silver Spring), 22*(9), 1973-80. doi:10.1002/oby.20814

Weigl, J., Hauner, H., & Hauner, D. (2018). Can nutrition lower the risk of recurrence in breast cancer? *Breast Care (Basel), 13*(2), 86-91. doi:10.1159/000488718

Wheeler, S. B., Reeder-Hayes, K. E., Carey, L. A. (2013). Disparities in breast cancer treatment and outcomes: biological, social, and health system determinants and opportunities for research. *Oncologist, 18*(9), 986-993. doi:10.1634/theoncologist.2013-0243

Wheeler, S. B., Spencer, J. C., Pinheiro, L. C., Carey, L. A., Olshan, A. F., & Reeder-Hayes, K. E. (2018). Financial impact of breast cancer in black versus white women. *Journal of Clinical Oncology, 36*(17), 1695-1701. doi:10.1200/JCO.2017.77.6310

Williams, K., Beeken, R. J., Fisher, A., & Wardle, J. (2015). Health professionals' provision of lifestyle advice in the oncology context in the United Kingdom. *European journal of cancer care*, *24*(4), 522-530.

Williams, D. R., Mohammed, S. A., & Shields, A. E. (2016). Understanding and effectively addressing breast cancer in African American women: Unpacking the social context. *Cancer*, *122*(14), 2138-2149. http://doi.org/10.1002/cncr.29935

Williams, F., & Thompson, E. (2017). Disparities in breast cancer stage at diagnosis: Importance of race, poverty, and age. *Journal of Health Disparities Research and Practice, 10*(3), 34-45. Retrieved from PubMed database. (PMID: 30637180)

Wirtz, P., & Baumann, F. T. (2018). Physical Activity, Exercise and Breast Cancer—What Is the evidence for rehabilitation, aftercare, and survival? A review. *Breast Care (Basel), 13*(2), 93-101. doi:10.1159/000488717

World Cancer Research Fund & American Institute for Cancer Research. (2010). *Continuous update project report: Food, nutrition, physical activity, and the prevention of breast cancer*. Retrieved from https://www.wcrf.org/sites/default/files/Breast-Cancer-2010-Report.pdf

Woźniak, K., & Iżycki, D. (2014). Cancer: A family at risk. *Menopause Review, 13*(4), 253-261. doi:10.5114/pm.2014.45002

Yedjou, C. G., Tchounwou, P. B., Payton, M., Miele, L., Fonseca, D. D., Lowe, L., & Alo, R. A. (2017). Assessing the racial and ethnic disparities in breast cancer mortality in the United States. *International Journal of Environmental Research and Public Health*, *14*(5), pii: E486. doi:10.3390/ijerph14050486

Young S. (2014). Healthy behavior change in practical settings. *The Permanente journal*, *18*(4), 89–92. doi:10.7812/TPP/14-018

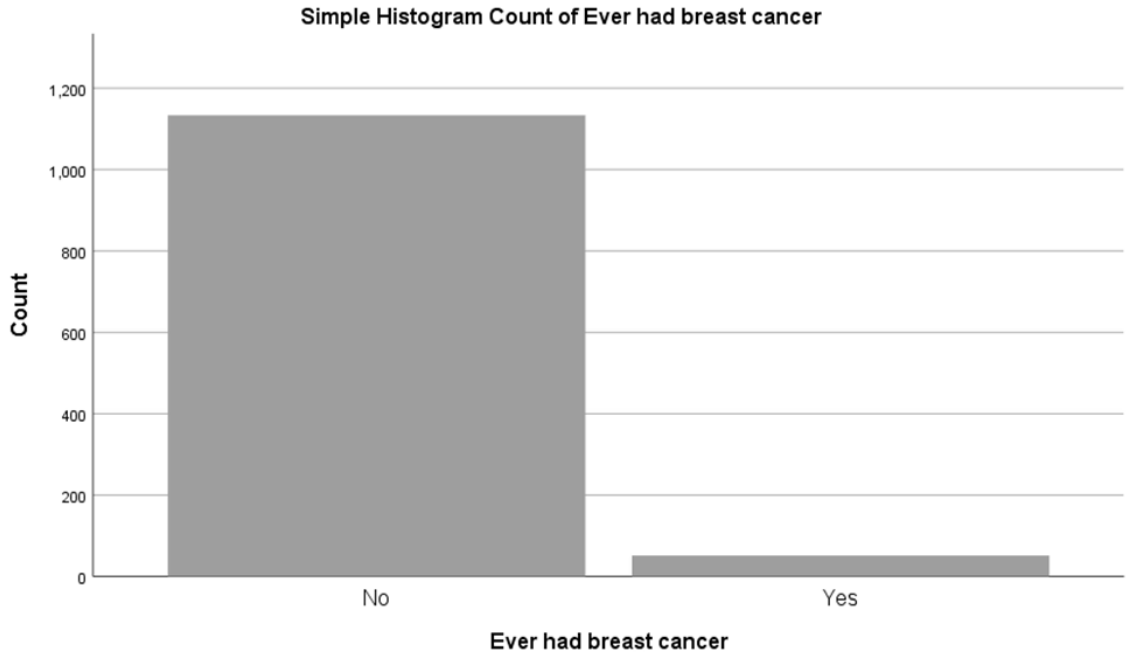
Zhang, C. X., Ho, S. C., Chen, Y. M., Fu, J. H., Cheng, S. Z., & Lin, F. Y. (2009).Greater vegetable and fruit intake is associated with a lower risk of breast cancer among Chinese women. *International Journal of Cancer*, *125*(1), 181-188.

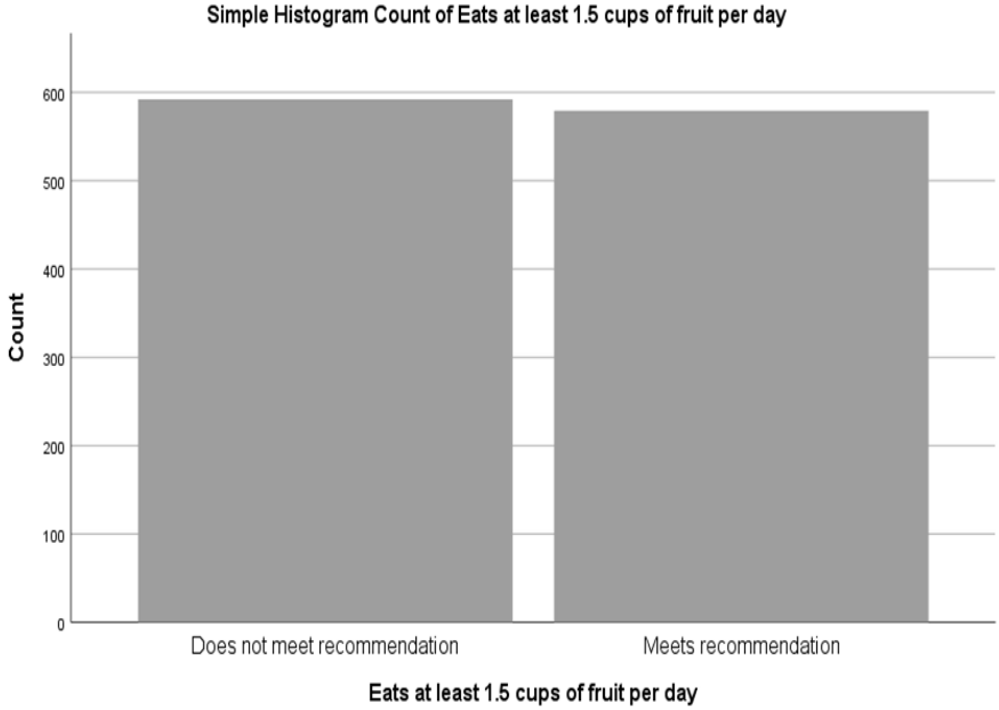
Appendix A: Cup of Fruit Table

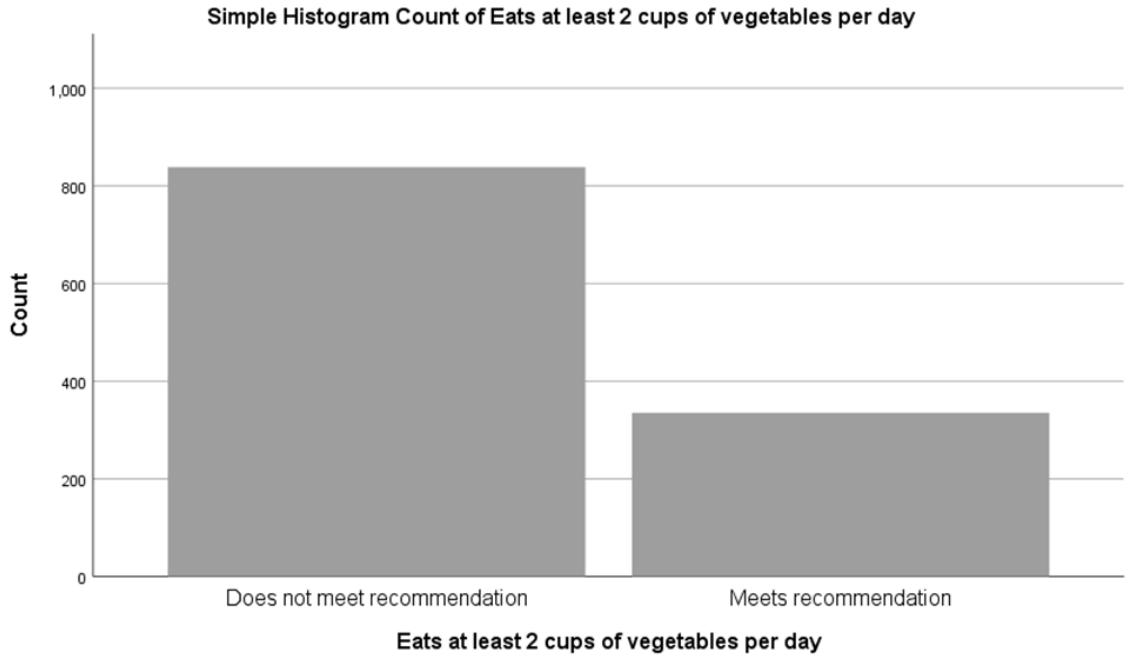
	Amount that counts as 1 cup of fruit	Other amounts (count as 1/2 cup of fruit unless noted)
Apple	½ large (3 ¼" diameter) 1 small (2 ¼" diameter) 1 cup, sliced or chopped, raw or cooked	½ cup, sliced or chopped, raw or cooked
Applesauce	1 cup	1 snack container (4 oz.)
Banana	1 cup, sliced 1 large (8" to 9" long)	1 small (less than 6" long)
Cantaloupe	1 cup, diced or melon balls	1 medium wedge (1/8 of a med. melon)
Grapes	1 cup, whole or cut-up 32 seedless grapes	16 seedless grapes
Grapefruit	1 medium (4" diameter) 1 cup, sections	½ medium (4" diameter)
Mixed fruit (fruit cocktail)	1 cup, diced or sliced, raw or canned, drained	1 snack container (4 oz.) drained = 3/8 cup
Orange	1 large (3 1/16" diameter) 1 cup, sections	1 small (2 3/8" diameter)
Orange, mandarin	1 cup, canned, drained	
Peach	1 large (2 ¾" diameter) 1 cup, sliced or diced, raw, cooked, or canned, drained 2 halves, canned	1 small (2" diameter) 1 snack container (4 oz.) drained = 3/8 cup

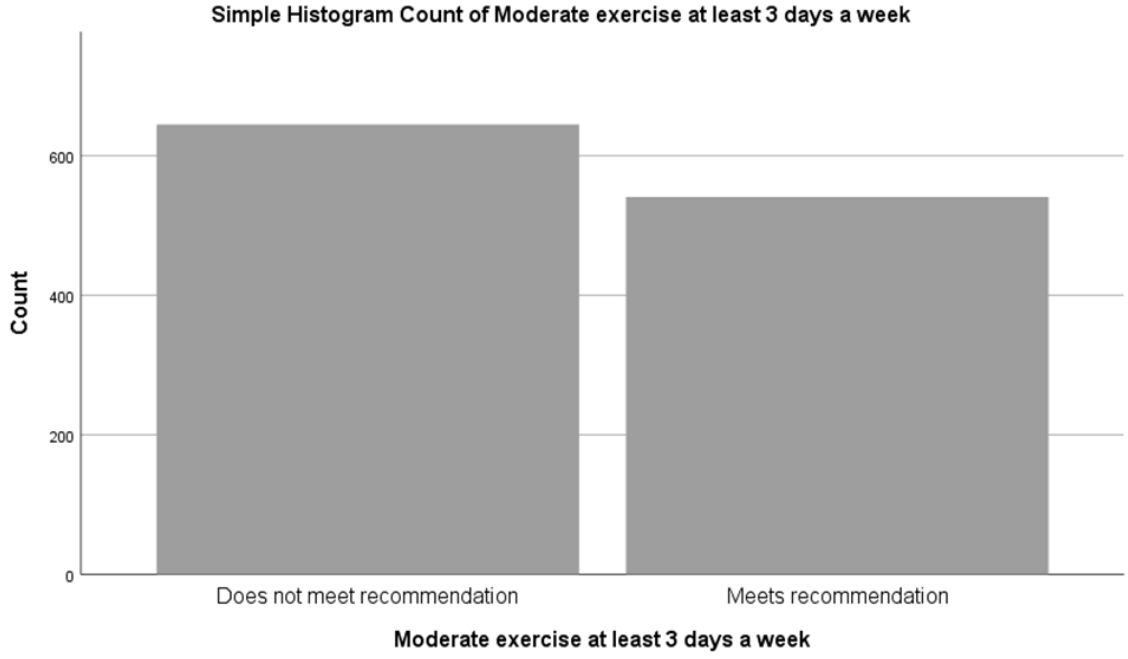
	Amount that counts as 1 cup of fruit	Other amounts (count as 1/2 cup of fruit unless noted)
Pear	1 medium pear (2 ½ per lb.) 1 cup, sliced or diced, raw cooked, or canned, drained	1 snack container (4 oz.) drained = 3/8 cup
Pineapple	1 cup, chunks, sliced or crushed, raw, cooked or canned, drained	1 snack container (4 oz.) drained = 3/8 cup
Plum	1 cup, sliced raw or cooked 3 medium or 2 large plums	1 large plum
Strawberries	About 8 large berries 1 cup, whole, halved, or sliced, fresh or frozen	½ cup whole, halved, or sliced
Watermelon	1 small (1" thick) 1 cup, diced or balls	6 melon balls
Dried fruit (raisins, prunes, apricots, etc.)	½ cup dried fruit	¼ cup dried fruit or 1 small box raisins (1 ½ oz.)
100% fruit juice (orange, apple, grape, grapefruit, etc.)	1 cup	½ cup

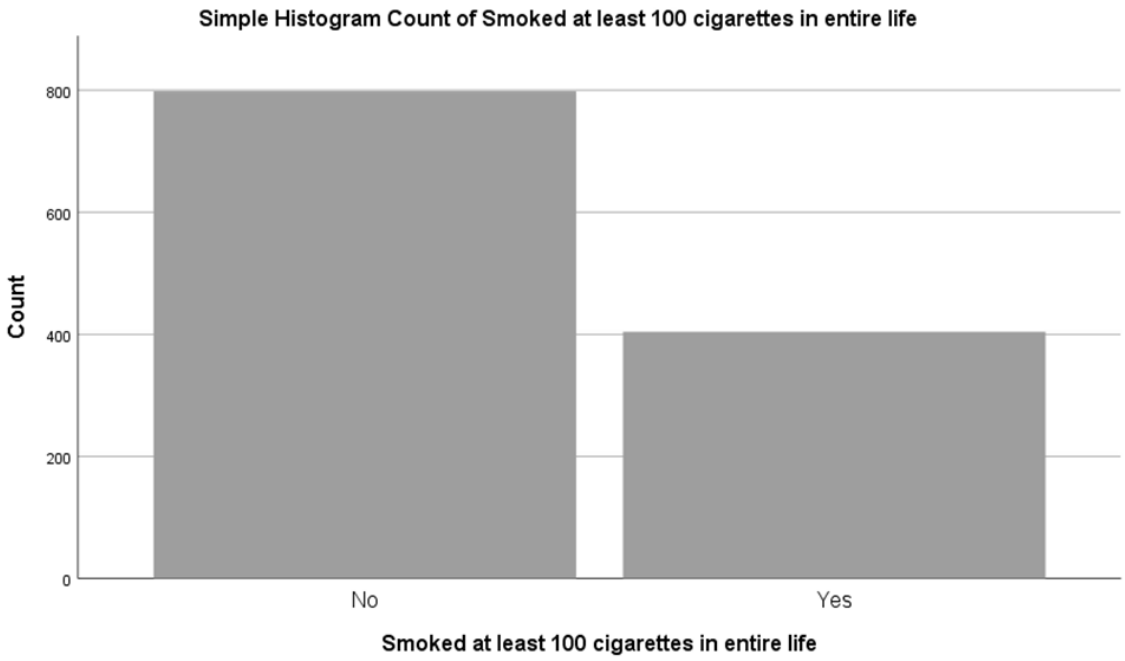
Appendix B: Graph and Histograms

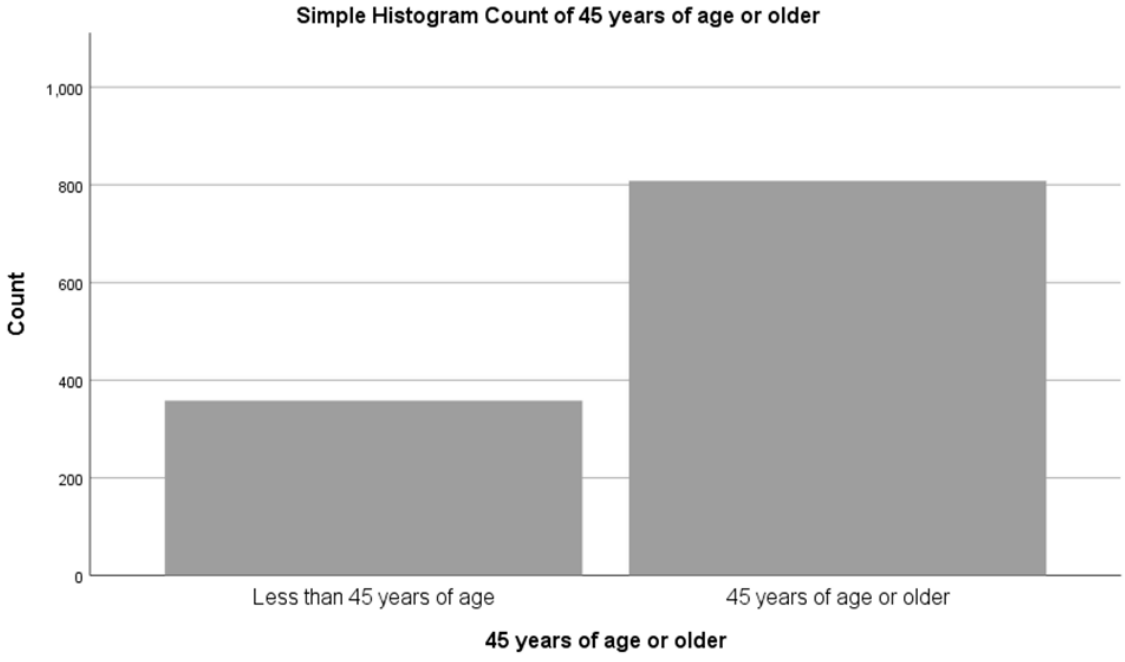


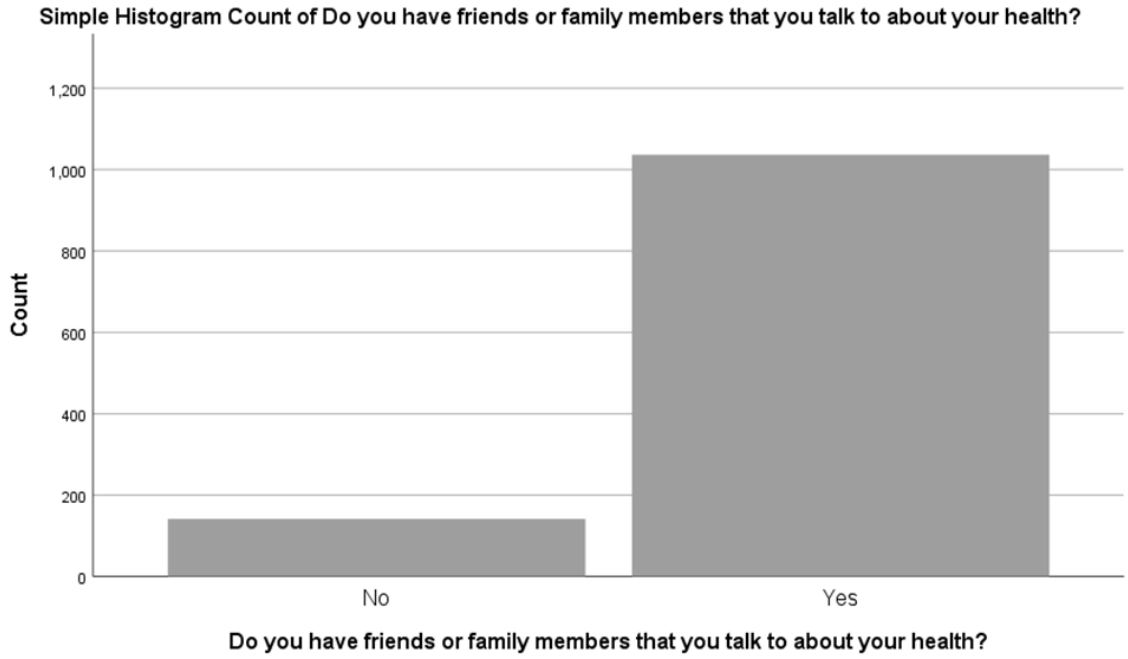


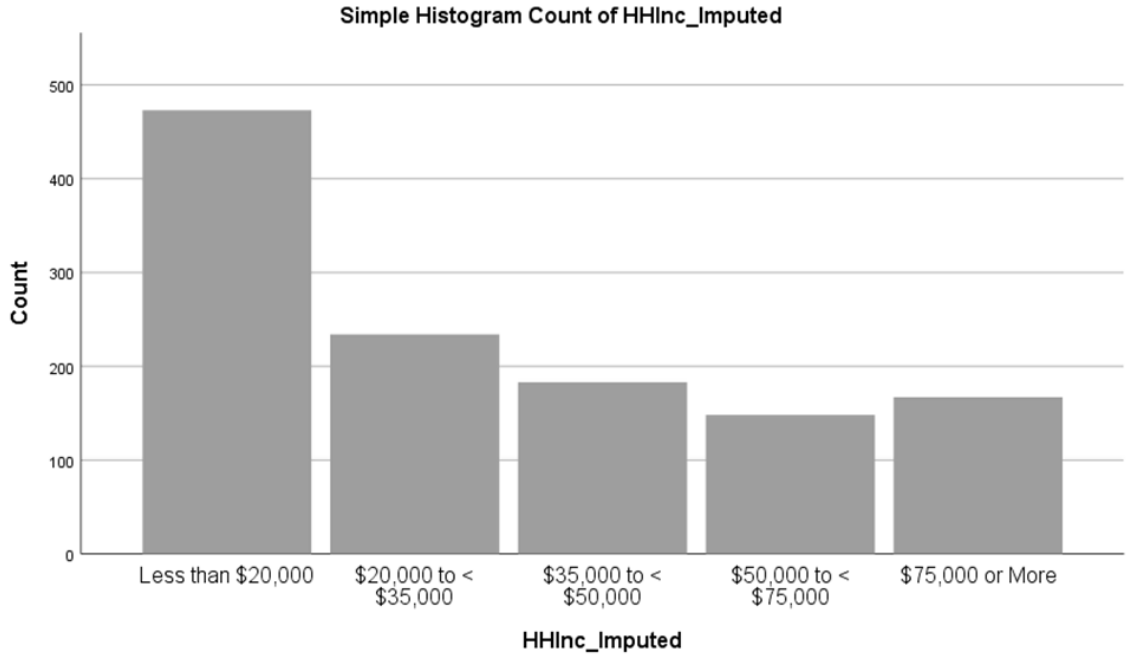

Simple Histogram Count of Eats at least 2 cups of vegetables per day
1,000
800
600
400
200
0
Count
Does not meet recommendation
Meets recommendation
Eats at least 2 cups of vegetables per day

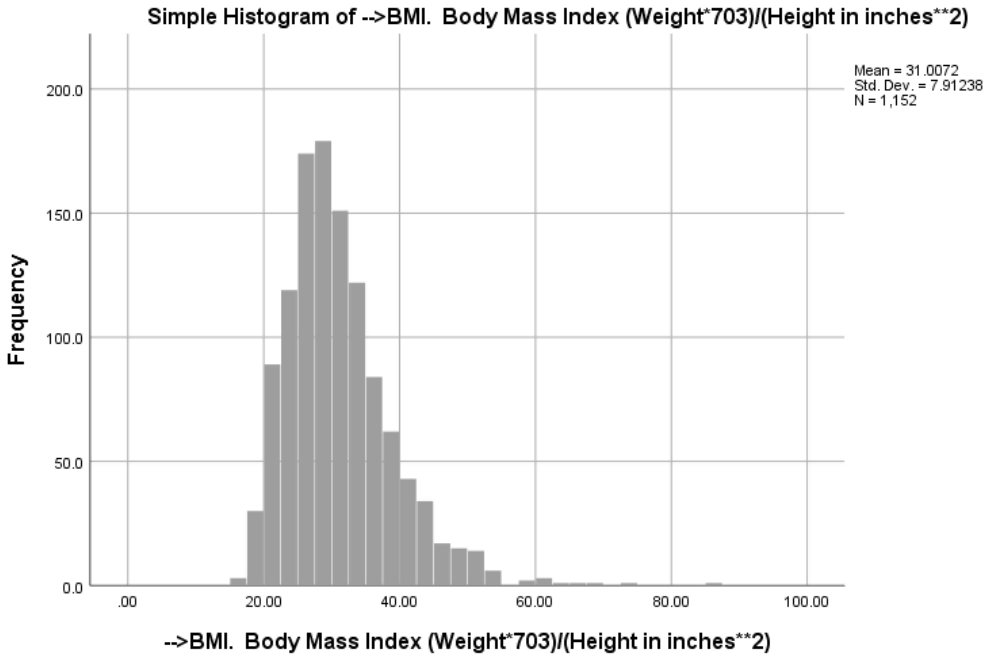

Simple Histogram Count of Moderate exercise at least 3 days a week
600
400
200
0
Count
Does not meet recommendation
Meets recommendation
Moderate exercise at least 3 days a week


Simple Histogram Count of Smoked at least 100 cigarettes in entire life
800
600
400
200
0
Count
No
Yes
Smoked at least 100 cigarettes in entire life


Simple Histogram Count of 45 years of age or older
1,000
800
600
400
200
0
Count
Less than 45 years of age
45 years of age or older
45 years of age or older


Simple Histogram Count of Do you have friends or family members that you talk to about your health?
Count
1,200
1,000
800
600
400
200
0
No
Yes
Do you have friends or family members that you talk to about your health?


Simple Histogram Count of HHInc_Imputed
Count
500
400
300
200
100
0
Less than $20,000
$20,000 to < $35,000
$35,000 to < $50,000
$50,000 to < $75,000
$75,000 or More
HHInc_Imputed


Simple Histogram of -->BMI. Body Mass Index (Weight*703)/(Height in inches**2)
Mean = 31.0072
Std. Dev. = 7.91238
N = 1,152
Frequency
200.0
150.0
100.0
50.0
0.0
.00
20.00
40.00
60.00
80.00
100.00
-->BMI. Body Mass Index (Weight*703)/(Height in inches**2)