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Meat Intake and Prostate Cancer in African American Men

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Walden University
2020

Abstract

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MPH, National University, 2015

OD, Abia State University, 1991

Dissertation Submitted in Partial Fulfillment

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Abstract

African American men have more prostate cancer and are more than twice as likely to die of the disease as Caucasian men, and the reasons for this racial disparity have not been clarified. Identifying lifestyle and dietary risk factors of prostate cancer is an important public health issue. Studies on the association between meat intake and prostate cancer risk have produced inconsistent results. The purpose of this cross-sectional quantitative study was to determine whether there is an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, educational level, physical activity, overweight status and smoking. The theoretical foundation for this study was the health belief model and the theory of planned behavior, which were used to identify the risk factors for prostate cancer for African American men. The analysis was done on 1152 participants from the 2013–2014 National Health and Nutrition Examination Survey data using binary logistic regression. The findings from this study indicated no statistically significant association between total meat intake and total prostate cancer risk among African American men with and without the covariates in the model. This study contributes to positive social change by increasing the understanding of the association between total meat intake and prostate cancer risk among African American men by providing more information to African American men, healthcare providers, and the clinical community in an effort to reduce the incidence and mortality from prostate cancer, as well as healthcare costs.

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Dedication

I dedicate this dissertation to my family and friends for encouraging me throughout his process.

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Chapter 1: Introduction to the Study

Introduction

There is a growing incidence of prostate cancer worldwide, and the years lived with disability contributes to its burden in higher sociodemographic index countries (Pishgar, Ebrahimi, Saeedi Moghaddam, Fitzmaurice & Amini, 2018). The incidence of prostate cancer is higher in North America, northwestern Europe, Australia, and Caribbean islands than in Asia, Africa, Central America, and South America, and the reasons for this disparity is unclear (American Cancer Society, 2018). The disparity in prostate cancer occurrence may be due to more screening in some developed countries and differences in lifestyle factors including diet (American Cancer Society, 2018). Prostate cancer is the second most common cancer in American men after skin cancer, and it is estimated that there will be 174,650 new cases and 31,620 deaths from prostate cancer in the United States in 2019 (American Cancer Society, 2019). Although the findings from epidemiologic, preclinical, and clinical studies have been inconsistent and inconclusive on the association between dietary factors and incidence of prostate cancer, dietary intake likely plays a role in the prevention of prostate cancer (Lin, Aronson, & Freedland, 2015). The best dietary advice may be a healthy diet that contains a mixture of all dietary factors that reduces the incidence of prostate cancer, so further carefully designed studies are needed on this topic (Lin et al., 2015). More research on the association between diet and prostate cancer is needed to target interventions that will effectively reduce the burden of prostate cancer and improve male well-being. In this

study, I used broad epidemiological data from the United States to determine whether there is an association between total meat intake and prostate cancer.

In this chapter, I address the problem of prostate cancer as it relates to the study topic and the research questions. In addition, I describe the background of the study, purpose of the study, theoretical framework, definitions, scope and delimitations, limitations, and assumptions and the significance of the study. Finally, I present a summary of the main points in this chapter and a transition into Chapter 2.

Background of the Study

Researchers in the past have focused on different diets consumed through food items or cooking preparations and their potential associations to prostate cancer in attempts to identify possible mechanisms through which diets can cause prostate cancer. Williams et al. (2018) reported on the significant racial disparities in the outcomes of prostate cancer for African American men by showing that they had high mortality from prostate cancer after controlling for clinicodemographic and potential risk factors. Gathirua-Mwangi and Zhang (2014) provided information on the association between diet and prostate cancer by showing that frequent intake of a diet high in saturated fat, well-done meats, and calcium is associated with an increased risk for advanced prostate cancer. However, the findings also show an inconsistent association between intake of total meat, fruits, and vegetables and no association between fish and zinc intake and advanced prostate cancer (Gathirua-Mwangi & Zhang, 2014). If these findings are confirmed by more epidemiologic studies, the risk of prostate cancer may be reduced by dietary modifications (Gathirua-Mwangi & Zhang, 2014). Rohrmann et al. (2015)

reported on the association between meat and prostate cancer by showing that there were positive associations between the intake of 2-amino-1-methyl-6-phenylimidaz from red meat and prostate cancer, especially high-grade and advanced prostate cancer. However, the findings of a study by Bylsma and Alexander (2015) did not support a significant association between red and processed meat, meat cooking methods, heme iron, heterocyclic amines and prostate cancer. Wilson et al. (2016) provided information on methods that aligns with some of the methodologies that was used in this study by using logistic regression to study the association between meat, fish, poultry, and egg intake and prostate cancer. Therefore, it is important to investigate diets as potential risk factors related to prostate cancer development.

Problem Statement

Prostate cancer is common among older men of African descent with a family history of prostate cancer (Surveillance, Epidemiology, and End Results Program [SEER], n.d.). In 2014, African American men had the highest incidence and mortality rates from prostate cancer, followed by Caucasian, Hispanic, American Indian/Alaska Native, and Asian/Pacific Islander men (Centers for Disease Control and Prevention [CDC], 2017b). According to Discacciati and Wolk (2014), the cause of prostate cancer is still mostly unknown and the only well-established risk factors are those that are nonmodifiable such as age, race, and family history. Therefore, identifying lifestyle and dietary factors that may prevent the development and progression of prostate cancer is a very important public health issue (Discacciati & Wolk, 2014). Evidence is still unclear for several of the modifiable prostate cancer risk factors, but lifestyle modifications such

as smoking cessation and exercise have been associated with the decreased risk of developing prostate cancer (Cuzick et al., 2014). Red meat, dairy protein, dietary fat, and coffee have been suggested to be associated to prostate cancer, but no evidence has been clearly established (Discacciati & Wolk, 2014). Gathirua-Mwangi and Zhang (2014) stated that there was an inconsistent association between intakes of total meat and the risk of prostate cancer. According to Wilson et al. (2016), lower intakes of red meat, higher intakes of poultry, and higher intakes of fish are associated with reduced risk of prostate cancer and recurrence. However, Wu et al. (2016) stated that red meat, processed meat, and seafood was not substantially associated with prostate cancer, but higher poultry intake was associated with a lower risk of prostate cancer, while higher egg intake was associated with a higher risk of prostate cancer. Evidence has shown that African American men have the highest incidence and mortality from prostate cancer compared to other races in the United States, and the association between total meat intake and the risk of prostate cancer is unclear.

Previous researchers implied that there is an inconsistency in the association between meat intake and prostate cancer (Bylsma and Alexander, 2015; Cuzick et al., 2014; Discacciati & Wolk, 2014; Gathirua-Mwangi & Zhang, 2014; Rohrmann et al., 2015; Wilson et al., 2016; Wu et al, 2016). In addition, most of the previous studies on this topic have used multiethnic case control or prospective cohort study methodology to examine this association. My research used the National Health and Nutrition Examination Survey (NHANES) dataset, which is a national representative dataset, with large sample sizes of African American men in a cross-sectional study design to examine

this association while controlling for other potential risk factors. In this study, I addressed the problem of whether there is a relationship between total meat intake and total prostate cancer among African American men when controlling for age, income, educational level, physical activity, overweight status and smoking using the 2013–2014 NHANES dataset. In this study, I focused only on the African American male population using a different methodology in an effort to clarify the association between meat and prostate cancer risk. The purpose of my focus on the African American male population was to help provide information to develop an intervention to reduce the high incidence and mortality from prostate cancer in this population. Although the most significant risk factors for prostate cancer are age, race and family history, the benefits of clarification of more risk factors will help to reduce the risk of the disease especially for African American male population.

Purpose of the Study

The purpose of this study was to examine the association between total meat intake and prostate cancer, with a focus on African American men. In this study, I addressed the gap in the investigation of this association for African American men and provided the justification for further research on this topic to reduce prostate cancer incidence and mortality in this high-risk population. I used a quantitative approach and secondary data to examine the association between total meat intake and total prostate cancer risk among African American men.

Research Questions and Hypotheses

Research Question 1 (RQ1): Is there an association between total meat intake and total prostate cancer risk among African American men?

Null Hypothesis ($H_0$1): There is no association between total meat intake and total prostate cancer risk among African American men.

Alternative Hypothesis (H_a1): There is an association between total meat intake and total prostate cancer risk among African American men.

Research Question 2 (RQ2): Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level?

Null Hypothesis ($H_0$2): There is no association between total meat intake and prostate cancer among African American men when controlling for age, income, and educational level.

Alternative Hypothesis (H_a2): There is an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level.

Research Question 3 (RQ3): Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking?

Null Hypothesis ($H_0$3): There is no association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking.

Alternative Hypothesis (H_a3): There is an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking.

Theoretical Foundation

The health belief model (HBM) and the theory of planned behavior (TPB) were the theoretical base for this study. The HBM and the TPB may be used to understand and support the process that determines health-related behaviors with African Americans (Geyen, 2012). The HBM is used to theorize that perceived susceptibility and perceived severity contribute to the perceived threat of a disease, whereas perceived benefits and perceived barriers affect the likelihood that a person will take action against the disease (Geyen, 2012). The TPB indicates factors used to determine a person's intention to perform a behavior, such as the judgment of whether the behavior is a good thing or not, the impact of social pressure on the behavior's appropriateness, and a person's expectation of success in performing the behavior (Geyen, 2012). Both theories are based on the assumption that people weigh the perceived benefits and costs, and then behave according to the outcome of their analysis (Geyen, 2012). I used the HBM and the TPB in this study to understand the eating behaviors of African American men, in order to provide information for effective dietary interventions.

Nature of the Study

The nature of the study was quantitative with cross-sectional data. Quantitative research methods are used to analyze and represent the relationship between variables mathematically through statistical analysis (Center for Innovation in Research and

Teaching [CIRT], n.d.). Cross-sectional designs are used for population-based surveys and may be used before cohort studies and for public health monitoring and planning (Setia, 2016). I used the NHANES dataset to measure the effects of meat intake on prostate cancer among African American men by finding the associations between the consumption of meat and prostate cancer risk, when controlling for the risk factors of prostate cancer in the dataset. NHANES is a secondary dataset that was collected through interviews and physical examinations, and used to assess the health and nutritional status of individuals in the United States (CDC, 2017a). My research involved the use of cross-sectional data from the 2013–2014 NHANES questionnaire that contains the variables to measure the associations between total meat intake and prostate cancer among African American men, including red meat, poultry, and fish, occurrence of prostate cancer, African American men, as well as some risk factors of the disease (CDC, n.d.).

Definitions

African American men: Men of African descent born within the United States.

Prostate cancer: Cancer that develops in tissues of the prostate in the male reproductive system, especially in older men (National Cancer Institute (NCI), n.d.).

Total meat intake: Combination of animal flesh consumed, including red meat, poultry and fish.

Assumptions

The 2013–2014 NHANES dataset has been used in many studies, so I assumed that the interviews were accurately done and that the physical examinations, laboratory tests and diagnosis were accurate. I also assumed that the variables selected were the

most appropriate for the study to determine the association between total meat intake and total prostate cancer risk among African American men when controlling for potential risk factors of the disease.

Scope and Delimitations

The scope of the study was to investigate the association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, educational level, smoking, overweight status, and physical activity in the NHANES dataset. The sample for this study was delimited to African American men who consumed red meat, poultry and fish and the occurrence of prostate cancer in the 2013–2014 NHANES dataset. I did not include men from other race/ethnicities in the United States, and the results of the study are limited to the sample and not generalizable to the entire population.

Limitations

Cross-sectional study designs are not used for causal relationships, and are prone to biases (Setia, 2016). In addition, there may be residual confounding or glitches in the secondary data collection process that can affect the interpretation of some variables in the dataset and the validity of the data (Cheng & Phillips, 2014). The outcome of this study is limited to the sample and not generalizable to the entire population. The limitations to causality, biases, secondary data, generalizability and other confounding variables not controlled for in the study may affect the validity of the study. However, the dataset has been used in many research studies and no reports of inaccurate or misleading data has been indicated.

Significance of the Study

In this study, I addressed the gap in understanding for African American men by determining the role of total meat intake in the racial/ethnic disparities in prostate cancer. This research is important because the association between total meat intake and prostate cancer is unclear, and more research is needed to investigate the association between total meat intake and prostate cancer in African American men because of their higher incidences and death rates from the disease. The results of this study may provide the much-needed information to African American men, healthcare providers, and the clinical community about the racial disparity in prostate cancer and dietary modifications for African American men. This study contributes to positive social change by clarifying the importance of total meat consumption and the risk of prostate cancer among African American male populations by identifying the risk factors of the disease. This could improve the intervention programs for African American men, and reduce the incidence, mortality and healthcare costs.

Summary and Transition

Prostate cancer is the second most common cancer in American men, and it is estimated that there will be 174,650 new cases and 31,620 deaths from prostate cancer in the United States in 2019 (American Cancer Society, 2019). Prostate cancer occurs more in African American men and Caribbean men of African ancestry and less in Asian-American and Hispanic/Latino men than in non-Hispanic Caucasians (American Cancer Society, 2018). In addition, African American men are more than twice as likely to die of the disease as Caucasian men, and the reasons for these racial and ethnic differences

have not been clarified (American Cancer Society, 2018). The cause of prostate cancer is still mostly unknown and the only well-established risk factors are those that are non-modifiable, so identifying lifestyle and dietary factors which might prevent the development of prostate cancer is a very important public health issue (Discacciati & Wolk, 2014). Gathirua-Mwangi and Zhang (2014) stated that the association between intakes of total meat and the risk of prostate cancer was inconsistent. Therefore, the purpose of this quantitative study was to determine whether there is an association between total meat intake and total prostate cancer risk among African American men using a large sample of men in the United States.

Chapter 2: Literature Review

Introduction

African American men have the highest incidence and mortality rates from prostate cancer compared to other races in the United States (CDC, 2017b). The cause of prostate cancer is still mostly unknown, but red meat, dairy protein, dietary fat, and coffee have been suggested to be associated to prostate cancer, but no evidence has been established (Discacciati & Wolk, 2014). According to Gathirua-Mwangi and Zhang (2014), there was an inconsistent association between intakes of total meat and the risk of prostate cancer. The purpose of this study was to examine the association between total meat intake and prostate cancer, with a focus on African American men in an effort to reduce prostate cancer incidence and mortality in this high-risk population. This chapter includes sections on the literature search strategy; theoretical framework; epidemiology of prostate cancer; racial disparity in prostate cancer; the role of meat intake in prostate cancer development; age, income, educational level, and prostate cancer; physical activity, smoking, overweight status, and prostate cancer; as well as NHANES and prostate cancer. This chapter concludes with a summary and an introduction to Chapter 3.

Literature Search Strategy

I researched the literature using various databases such as EBSCO through Walden University. Other search engines included CINAHL, Pub Med, ProQuest, Science Direct and Google Scholar. The keywords used for this study included: *HBM, TPB, meat, fat, NHANES, prostate cancer or prostatic neoplasm or prostate carcinoma,*

and *African American* or *Black American.* I selected articles from the databases based on their relevancy to the research hypotheses and only considered articles in English. I limited the searches to research published between 2013 and 2019, except in the case of seminal articles. I only considered peer-reviewed journals and government publications for inclusion.

Theoretical Foundation

I based the framework for this study on several studies that investigated the association between meat intake and the risk of developing prostate cancer (Bylsma and Alexander, 2015; Cuzick et al., 2014; Discacciati & Wolk, 2014; Gathirua-Mwangi & Zhang, 2014; Rohrmann et al., 2015; Wilson et al., 2016; Wu et al, 2016). I based this study on using the HBM and the TPB to focus on African American men in communities in the United States in relation to their eating behavior concerning prostate cancer. Rosenstock, Strecher, and Becker (1988) stated that the HBM was developed to examine the motivational factors associated with behavioral health. Based on the HBM, one potential factor for this study is individual perceptions of perceived susceptibility to developing prostate cancer. Geyen (2012) noted that the TPB implies that an individual's self-efficacy, such as their belief that they are capable of performing a behavior change with the proper resources, opportunity, and ability can explain their eating behavior. Participants' age, income, educational level, physical activity level, overweight status, smoking status, and diets may affect their exposure and development of prostate cancer. Perceived benefits and barriers or costs may affect dietary behavior, thus employing the

HBM and the TPB in this study provided in-depth knowledge and awareness about the factors affecting a man's dietary behaviors and their risk of prostate cancer.

Based on literature, the HBM has been used in prostate cancer studies to understand the screening behaviors of African American men (Zare et al., 2016). The HBM was developed as a cognitive model that tries to identify patterns of healthy behavior (Zare et al., 2016). Behavior can be explained by the HBM as ensuing from the combination of attitudes associated with its four main constructs including the perceived susceptibility, severity, benefits, and barriers (Zare et al., 2016). In addition, O'Neal et al. (2014) stated that the TPB can be used to explain the variation in eating behaviors of older African American men by using its broad constructs of preparing, self-monitoring, and consumption of fruits and vegetables. The HBM and the TPB have been applied in the areas of preventive health behavior and are useful theoretical frameworks to use in identifying certain dietary behaviors that are risk factors for prostate cancer for African Americans.

Literature Review Related to Key Variables and/or Concepts

Epidemiology of Prostate Cancer

According to Torre et al. (2015), the burden of cancer worldwide is enormous and expected to increase due to population growth and aging, as well as the adoption of behaviors and lifestyle factors that are known to be risk factors of cancer. Globally, prostate cancer ranks among the top five cancers for both incidence and mortality (Ferlay et al. 2015). This global burden can be substantially reduced through the use of existing

cancer control knowledge, including tobacco control, vaccination, early detection, and the promotion of physical activity, and healthy dietary patterns (Torre et al., 2015).

Globally, prostate cancer is the most commonly diagnosed cancer in men, with approximately 1.6 million incident cases and the fifth most common cause of cancer death, accounting for an estimated 366,000 deaths and 6.3 million disability-adjusted life years in 2015 (Global Burden of Disease Cancer Collaboration 2016). According to Pishgar et al. (2018), the incident cases of prostate cancer increased 3.7-fold and the age standardized incidence rate increased 1.7-fold from 1990 to 2015. In addition, the global estimates of the age standardized death rate of prostate cancer decreased slightly especially in high income countries, but the disability adjusted life years due to prostate cancer increased by 90% during this period (Pishgar et al., 2018). The prostate cancer mortality rate is decreasing in high income countries, but the incidence and burden of the disease are increasing globally, resulting in more challenges in the allocation of limited health care resources (Pishgar et al., 2018).

There is a significant global variation in the incidence of prostate cancer, which is most common in developed countries (Pernar, Ebot, Wilson & Mucci, 2018). This global variation in incidence rates which is partly due to screening emphasizes the potential role of lifestyle factors in prostate cancer risk (Pernar et al., 2018). Thus, an examination of the incidence and mortality patterns of prostate cancer across populations and over time will provide more information on the role of individual risk factors such as diet and population screening behaviors in the epidemiology of the disease (Pernar et al., 2018).

According to Howlader et al. (2016), prostate cancer is the leading cause of incident cancer in the United States, and it is estimated that 180,890 new cases were diagnosed in 2016. Howlader et al. (2016) stated that African American men have the highest age-adjusted incidence rates of prostate cancer, which is 40-fold higher than that of Asian men living in their native countries. As a result of the implementation of prostate cancer screening in the United States, the average age of prostate cancer diagnosis is currently 66 years (Howlader et al., 2016). There is a threefold difference in incidence rates of prostate cancer across the different ethnic groups in the United States, with the highest incidence among African American men (Pernar et al., 2018). In addition, deaths from prostate cancer are 2.4 times higher among African American men compared to Caucasian men, while prostate cancer incidence and mortality rates are lower among Asian/Pacific Islanders, American Indian/Alaskan Natives, and Hispanic men compared with non-Hispanic Caucasian men (Howlader et al. 2016). More studies are needed to identify the cause of these disparities (Pernar et al., 2018). Therefore, prostate cancer remains a significant public health concern among men in the United States and worldwide (Bylsma & Alexander, 2015).

Pernar et al. (2018) noted that epidemiologic studies of prostate cancer have indicated ways that individual biology and lifestyle factors can influence the risk of developing prostate cancer. Although the etiology of prostate cancer remains unclear, the current knowledge of its risk factors indicate ways to identify individuals at high risk and use behavior change to reduce the burden of the disease (Pernar et al., 2018). Many risk factors show different associations for slow growing and lethal prostate cancer (Jahn,

Giovannucci, & Stampfer, 2015). Thus, it is important to differentiate the risk factors for total prostate cancer from that of the fatal disease in prostate cancer epidemiology (Pernar et al., 2018). The few established risk factors for total prostate cancer incidence are older age, African American race, family history, and genetic predisposition to the disease (Pernar et al., 2018). Therefore, it is essential to identify further risk factors of total prostate cancer.

According to Labbé et al. (2014), diet has been hypothesized to be an important environmentally related risk factor for prostate cancer development, but the mechanisms underlying these associations remain unclear. Bylsma and Alexander (2015) noted that the findings from epidemiologic studies have mostly produced inconclusive results for dietary risk factors for prostate cancer, including intake of red and processed meats. Although, the research findings have been inconsistent, the potential role of dietary intake for the prevention of prostate cancer is promising, and a combination of all the beneficial factors in a healthy dietary pattern may reduce the risk of prostate cancer (Lin et al., 2015).

Prostate cancer epidemiology is complex partly because of the biological heterogeneity of the disease and its screening, and the prevention of prostate cancer is difficult because the established risk factors, including age, race, family history, and genetic variants are mostly nonmodifiable (Pernar et al., 2018). However, smoking cessation, regular exercise, and maintaining healthy weight are important public health targets for the intervention of prostate cancer (Pernar et al., 2018). Thus, lifestyle modifications may lower risk of developing more aggressive prostate cancer (Pernar et

al., 2018). There are few known modifiable risk factors for prostate cancer, thus future research has the potential to improve the efficacy of its prevention strategies through targeted interventions (Pernar et al., 2018). Therefore, a coordinated and intensified response from all sectors of society, including governments, civil society, the private sector, and individuals is needed to control the growing burden of prostate cancer (Torre et al., 2015).

Racial Disparity in Prostate Cancer

According to Pietro, Chornokur, Kumar, Davis, and Park (2016), the determinants of the high rate of incidence and aggressiveness of prostate cancer in African Americans is still unclear. However, this disparity can be due to socioeconomic status, detection at advanced stages of the disease, biological aggressiveness, family history, and differences in genetic susceptibility (Pietro et al., 2016). Other contributing factors could be obesity, differences in treatment, and a tendency for more African American patients to delay treatment in comparison to Caucasians (Pietro et al., 2016). Barrington et al. (2015) conducted a study to determine whether the association of obesity with prostate cancer risk is different for African American and non-Hispanic Caucasian men, and whether obesity modifies the excess risk associated with African American race. The data for the study was obtained from a prospective study of 3,398 African American and 22,673 non-Hispanic Caucasian men who participated in the Selenium and Vitamin E Cancer Prevention Trial between 2001 and 2011 with the analyses completed in 2014 (Barrington et al., 2015). Their findings showed that obesity was more strongly associated with increased prostate cancer risk among African American than non-

Hispanic Caucasian men and reducing obesity among African American men could reduce the racial disparity in prostate cancer incidence (Barrington et al., 2015). Therefore, further research is needed to determine the cause of the different effects of obesity in African American and non-Hispanic Caucasian men (Barrington et al., 2015). In addition, Bhardwaj et al. (2017) stated that the exact causes of the prevalent racial disparities in prostate cancer incidence and mortality are not fully understood.

Although these ethnic differences are partly due to socioeconomic factors, it also has a molecular basis, such as differences in genetic polymorphism, gene mutations, epigenetic modifications, and miRNAs alterations (Bhardwaj et al., 2017). Gaines et al. (2014) examined the association between race and risk of low- and high-grade prostate cancer in men undergoing initial prostate biopsy in an equal access medical center by using a retrospective record review of 887 men from the Durham Veterans Affairs Medical Center who underwent initial prostate biopsy between 2001 and 2009. Gaines et al. (2014) conducted a multivariable logistic regression analysis of race and biopsy outcome when adjusting for age, body mass index, number of cores taken, prostate-specific antigen (PSA), and digital rectal examination findings, and used multinomial logistic regression to test the association between African American race and prostate cancer grade. The findings indicated that African American race was associated with a higher risk of prostate cancer detection on initial biopsy, and of high-grade prostate cancer after adjusting for clinical characteristics in an equal access healthcare facility, so further studies of the mechanisms linking African American race and prostate cancer risk and aggressiveness is needed (Gaines et al., 2014).

In contrast, Kheirandish and Chinegwundoh (2011) stated that race and environmental factors such as diet and migration are thought to be risk factors for prostate cancer. They conducted a review that compared data from the United States which suggested that African American men have a 60% higher risk for developing prostate cancer with poorer prognosis in comparison with their Caucasian counterparts, with similar studies conducted in the United Kingdom, Africa, and the Caribbean (Kheirandish & Chinegwundoh, 2011). Their findings indicated that the studies from the United States had significantly different conclusions from the studies in the United Kingdom, which has implications for policy development and raising awareness among African American men and clinical practice (Kheirandish & Chinegwundoh, 2011). In addition, Layne, Graubard, Ma, Mayne, and Albanes (2018) examined the race-specific prostate cancer risk associations among men in the National Institutes of Health (NIH)-AARP Diet and Health Study. Layne et al. (2018) identified 1,417 prostate cancer cases among African American men, and 28,845 cases among Caucasian men, and used Cox proportional hazards regression models to estimate hazard ratios and 95% confidence intervals. The cumulative change in the hazard ratios for African American race was also evaluated when adjusting for different factors, and the findings suggest that the dietary, nutrient, and health-related factors associated with prostate cancer risk is different for non-Hispanic Caucasian men compared to African American men, and the adjustment for these factors increased the African American-Caucasian difference in risk (Layne et al., 2018). Therefore, larger prospective studies of African American men are needed to help identify risk factors relevant to their population (Layne et al., 2018). The findings from

these studies indicated that the exact causes of the significant racial disparity in prostate cancer is still unclear, which raised the question of whether meat intake is associated with the racial disparity in prostate cancer incidence and mortality.

The Role of Meat Intake in Prostate Cancer Development

Wilson et al. (2016) examined the relationship between intake of total red meat, processed and unprocessed red meat, poultry, fish, and eggs and prostate cancer. This prospective study included 971 men treated with radical prostatectomy for prostate cancer between 2003 and 2010 (Wilson et al., 2016). Food Frequency Questionnaire (FFQ) was used at diagnosis and logistic regression was used to study the association between diet and high-grade or advanced-stage disease, while Cox models were used to study the risk of progression (Wilson et al., 2016). The findings showed that total red meat and very high intake of eggs was mildly associated with risk of high-grade prostate cancer, and well-done red meat was associated with advanced disease (Wilson et al., 2016). Their findings also indicated that higher intakes of poultry and fish are associated with lower risk of high grade and advanced prostate cancer, as well as with reduced recurrence risk, independent of prostate cancer stage and grade (Wilson et al., 2016). However, Richman, Kenfield, Stampfer, Giovannucci, and Chan (2011) examined the association between intake of red meat, poultry, and eggs and the risk of lethal prostate cancer among men who were not diagnosed with the cancer in 1994 in a prospective cohort study among 27,607 men followed from 1994 to 2008. Cox proportional hazards regression was used to examine the associations between red meat, poultry, and eggs and risk of lethal prostate cancer, and the findings showed a statistically significant positive

association between intake of eggs and risk of lethal prostate cancer, and mild statistical significant positive association between total poultry and total processed red meat intake and progression to lethal prostate cancer among men initially diagnosed with clinically localized prostate cancer (Richman et al., 2011). This raised the question of whether prostate cancer is related to the intake of a combination of these meats when consumed by African American men. Rodriguez et al. (2006) examined the association between intake of red meat, processed meat, and poultry and the incidence of prostate cancer among African American and Caucasian men in the Cancer Prevention Study II Nutrition Cohort. The participants completed a questionnaire, and the initial sample included 692 African Americans and 64,856 Caucasian men, and the follow-up included 85 African Americans and 5,028 Caucasian men (Rodriguez et al., 2006). Cox proportional hazards models were used for the analysis, and the results showed that meat intake was associated with prostate cancer risk among Caucasian men, and that total red meat intake was associated with a higher prostate cancer risk for African Americans (Rodriguez et al., 2006). This stimulated the question of the possibility that total meat intake may increase prostate cancer risk in African American men.

Chavarro, Stampfer, Hall, Sesso, and Ma (2008) conducted a prospective cohort study to examine the association between fish and seafood n-3 fatty acid intakes and prostate cancer incidence and mortality, by using 20,167 men participating in the Physician's Health Study who were free of cancer in 1983. Questionnaires were used for prostate cancer incidence and mortality analyses, and the relative risks and death from prostate cancer were estimated by Cox proportional-hazards regression models, using the

lowest intake category as the reference group (Chavarro et al., 2008). The findings supported the epidemiological evidence that fish intake may not affect the risk of developing prostate cancer (Chavarro et al., 2008). Stott-Miller, Neuhouser, and Stanford (2013) investigated the association between intake of deep-fried foods and prostate cancer risk and aggressiveness by conducting a population-based case-control study using 1,549 cases and 1,492 controls from Caucasian and African American residents of King County, Washington between 1993 and 1996. Unconditional adjusted logistic regression models were used to estimate odds ratios and 95% confidence intervals for the association between intake of French fries, fried chicken, fried fish, doughnuts and snack chips and prostate cancer risk, as well as more aggressive prostate cancer, when adjusting for potential confounders (Stott-Miller et al., 2013). The findings suggested that regular consumption of some deep-fried foods is associated with increased prostate cancer risk (Stott-Miller et al., 2013). Joshi, Corral, et al. (2012) investigated the association between types of red meats, processed meats and poultry, and the risk of localized and advanced prostate cancer when controlling for other factors. This case-control study included 717 localized and 1,140 advanced prostate cancer cases, and 1,096 controls from the California Collaborative Prostate Cancer Study, which is a multiethnic, population-based study (Joshi, Corral, et al., 2012). A nutrient density-adjusted intake of red meat and poultry was examined and tested for effect modification by selected polymorphisms and copy number variants (Joshi, Corral, et al., 2012). Their findings supported the role for carcinogens that accumulate in meats cooked at high temperatures as potential prostate cancer risk factors and may support a role for heterocyclic amines in

prostate cancer etiology (Joshi, Corral, et al., 2012). In addition, Joshi, John, Koo, Ingles, and Stern (2012) investigated the relationship between fish intake and localized and advanced prostate cancer by considering fish types and cooking practices in a multiethnic, population-based case–control study using 1,096 controls and 717 localized and 1,140 advanced cases from the California Collaborative Prostate Cancer Study. A multivariate conditional logistic regression was used to estimate the odds ratios using the nutrient density converted variables of fried fish, tuna, dark fish and White fish consumption, while effect modification was tested by cooking methods and levels of doneness (Joshi, John et al., 2012). The findings suggested that the consideration of fish type, specific fish cooking practices and levels of doneness helps to clarify the association between fish intake and prostate cancer risk (Joshi, John, et al., 2012). Major et al. (2011) examined the association between type of meat intake and prostate cancer risk among African American men in a large, prospective NIH-AARP Diet and Health Study. Major et al. (2011) stated that more investigation is needed on the association between diet and prostate cancer among high-risk groups because of the large racial differences in prostate cancer risk. In the study, baseline data between1995 and 1996 from African American participants, aged 50–71 years were analyzed and1,089 incident prostate cancer cases were identified through 2006 (Major et al., 2011). Questionnaires were administered at baseline to determine the dietary and risk factor data and Cox models were used to estimate hazard ratios and 95% confidence intervals within intake quantiles (Major et al., 2011). The findings indicated that red meats cooked at high temperatures were positively associated with prostate cancer risk among African

American men (Major et al., 2011). In contrast, Sharma et al. (2010) examined the association between well-done meat and prostate cancer risk, as well as the modifying effects of *NAT1* and *NAT2* acetylator genotypes, among five ethnic groups. Sharma et al. (2010) conducted a case-control study of prostate cancer nested within the Multiethnic Cohort study of African American, Native Hawaiian, Japanese American, Latino, and Caucasian using 2,106 cases and 2,063 controls. The cases and controls were genotyped for selected polymorphisms in *NAT1* and *NAT2*, and well-done meat intake was computed with FFQ including a question on meat preference, and conditional logistic regression was used in the analysis (Sharma et al., 2010). Their findings did not support the hypothesis that exposure to heterocyclic amines is associated with prostate cancer risk (Sharma et al., 2010).

Van Blarigan et al. (2015) investigated the association between the intake of post-diagnostic saturated, monounsaturated, polyunsaturated, trans fat, animal and vegetable fat, and all-cause and prostate cancer-specific mortality. The sample consists of 926 men with non-metastatic prostate cancer in the Physicians' Health Study who completed a FFQ (Van Blarigan et al., 2015). The analysis was done with multivariate Cox Proportional Hazards regression, and the results showed that saturated fat intake may increase risk of death and vegetable fat intake may lower risk of death among men with non-metastatic prostate cancer (Van Blarigan et al., 2015). This raised the question of whether prostate cancer is related to the type of fat from meat consumed by African American men. In contrast, a study by Park, Murphy, Wilkens, Henderson, and Kolonel (2007) examined the association between dietary fat and meat intake and prostate cancer

risk in the Multiethnic Cohort Study. According to Park et al. (2007), the findings from epidemiological studies that have focused on dietary fat and meat as potential risk factors for prostate cancer have been inconsistent. The study included 82,483 men in Hawaii and Los Angeles aged 45 years and above, who completed a quantitative FFQ in 1993-1996, and 4,404 incident cases, including 1,278 nonlocalized or high-grade prostate cancer cases that were identified after 8 years during the follow-up visit (Park et al., 2007). Cox proportional hazard models were used to estimate the relative risks of prostate cancer after adjustment for time of study, ethnicity, family history of prostate cancer, education, body mass index, smoking status, and energy intake (Park et al., 2007). The findings from this ethnically diverse population revealed that intake of fat and meat did not significantly affect prostate cancer risk (Park et al., 2007). Sanderson, Coker, Logan, Zheng, and Fadden (2004) separately examined the association between lifestyle and prostate cancer risk among Caucasian and African American men. The data was collected by telephone interviews, and the sample included 416 cases and 429 controls, while the analysis was done by unconditional logistic regression when controlling for many potential confounders including race (Sanderson et al., 2004). The results showed that intake of animal fat among all men were not related to prostate cancer risk (Sanderson et al., 2004). There is a need to better understand the link between fat from meat intake and prostate cancer, especially for African American men. Hayes et al. (1999) investigated the causes of the racial disparity in prostate cancer incidence by conducting a population-based case-control study in three geographic areas of the United States. The sample consisted of 932 cases and 1,201 controls who were interviewed to examine the effect of

the intake of animal fat on the risk of prostate cancer among African Americans and Caucasians in the United States (Hayes et al., 1999). The unconditional logistic regression was used to analyze the data, with adjustment for age, study site, and race (Hayes et al., 1999). The findings showed that the intake of animal fat was associated to increased risk for prostate cancer among African Americans and to advanced prostate cancer among African Americans and Caucasians (Hayes et al., 1999). In addition, Whittemore et al. (1995) conducted a population-based case-control study of prostate cancer among African Americans, Caucasians, and Asian-Americans in Los Angeles, San Francisco, Hawaii, Vancouver, and Toronto to investigate the roles of diet, physical activity patterns, body size, and migration on the risk of prostate cancer in these ethnic groups, and to assess how much of the interethnic differences in risk might be due to differences in their lifestyle. Common protocol and questionnaire were used to administer personal interviews to 1,655 African American, Caucasian, Chinese American, and Japanese-American case patients diagnosed during 1987–1991 with prostate carcinoma and to 1,645 controls, and conditional logistic regression was used to estimate the odds ratios (Whittemore et al., 1995). The findings suggested that differences in saturated fat intake account for about 10% of African American-Caucasian differences and about 15% of Caucasian-Asian American differences in prostate cancer incidence (Whittemore et al., 1995). In addition, prostate cancer risk was not consistently associated with intake of any micronutrients, body mass, or physical activity patterns, thus these findings supported the causal role in prostate cancer for saturated fat intake but suggested that other factors are largely responsible for the differences in prostate cancer risk (Whittemore et al., 1995).

This stimulated the question of the role of fat intake in the racial disparity of prostate cancer. A study by Pelser, Mondul, Hollenbeck, and Park (2013) examined the associations between dietary fats and fatty acids and risk of prostate cancer in the NIH-American Association of Retired Persons (AARP) Diet and Health Study. Self-administered FFQ were used to examine diet at baseline and 23,281 prostate cancer cases were identified after follow-up (Pelser et al., 2013). Cox proportional hazards models was used in the analysis and the results suggested that the associations of fat and fatty acids differ by prostate cancer severity, and that saturated fat intakes were related to the risk of advanced prostate cancer but not to nonadvanced prostate cancer (Pelser et al., 2013). This raised the question of whether fat from meat intake is associated with the severity of prostate cancer among African American men.

Understanding racial disparity in prostate cancer diagnosis and survival can be beneficial to the health care professionals and the policy makers, in the absence of clear primary prevention strategies (Sakharkar & Kahaleh, 2017). Although, the evidence shows that African American men have the highest incidence and mortality from prostate cancer compared to other races in the United States, the association between total meat intake and prostate cancer is an understudied topic in this population. The studies reviewed described the associations between meat, fish, poultry, fat and prostate cancer risk among multi-ethnic population in the United States and African American men. However, few studies focused on the effect of the intake of total meat on African American men, despite their increased incidence and mortality from the disease. The findings from this review indicated that there is an inconsistent association between well-

done meat, fish and poultry, fat and prostate cancer risk. Therefore, further studies on the topic are warranted, especially for vulnerable populations such as African American men.

Age, Income, Educational Level and Prostate Cancer

Sakharkar and Kahaleh (2017) examined the association of age, racial disparities, obesity, dyslipidemia, and diabetes and the burden of prostate cancer in the United States by using the data on 5,951 participants in the 2001-2010 NHANES dataset. Chi-square test and ANOVA were used in the analysis for descriptive statistics and for differences using a p value of <0.05 for significance (Sakharkar & Kahaleh, 2017). The results showed that participants younger than 50 years had PSA ratio greater than 25% compared to the participants older than 60 years, so there was a greater chance of having increase risk of prostate cancer with advancing age (Sakharkar & Kahaleh, 2017). In addition, non-Hispanic African Americans and Caucasians had higher prostate cancer burden than Mexicans, thus it was concluded that age and race/ethnicity were significantly associated with PSA levels (Sakharkar & Kahaleh, 2017). Leal, Hamdy, and Wolstenholme (2014) conducted a literature review to estimate the histological prevalence of prostate cancer according to age and ethnicity while accounting for the uncertainty in its estimation. A total of 25 autopsy studies of men without clinical diagnosis of prostate cancer during their lifetime were identified from the review, and a Bayesian logistic meta-regression was used to examine the association between histological prevalence, age by decade and ethnic group (Leal et al., 2014). The findings indicated that the prevalence of histological prostate cancer increased on average from 1–2% in men aged 20–29 years to 59–72% in men aged 90–99 years, depending on their ethnicity, which supported previous research

on the relationship between age and the risk of histological cancer while emphasizing the need for further research on the differences in histological prevalence between ethnic groups (Leal et al., 2014). Therefore, larger studies are needed to examine other ethnic groups other than Caucasians, especially African populations (Leal et al., 2014). In addition, Zhang et al. (2013) conducted the largest population-based study focused only on PSA-detected prostate cancer in the United States to examine its risk profile and identified 70,345 men with the disease that was reported to the SEER program from 2004-2008. The analysis was done by using multivariate logistic regression to model the probability of intermediate-risk-disease and high-risk-disease relative to low-risk disease, when adjusting for age, race, marital status, median household income, and area of residence (Zhang et al., 2013). The findings showed that a significant proportion of men with PSA-detected prostate cancer that was reported to the SEER program had the high-risk-disease, and that men of older age and African American race were more likely to have the high-risk-disease than younger and Caucasian men (Zhang et al., 2013).

Clegg et al. (2008) conducted a study on cancer-related health disparities according to individual-level socioeconomic status and demographic characteristics for all cancers including prostate cancer in the SEER and the U.S. representative National Longitudinal Mortality Study data. The 26,844 matched patients from the data and unmatched patients were compared by age group, sex, race, ethnicity, residence area, year of diagnosis, and cancer anatomic site, and cohort-based age-adjusted cancer incidence rates were calculated (Clegg et al., 2008). The impact of socioeconomic status on cancer incidence and stage of diagnosis was evaluated, and the findings showed

consistent gradients in incidence rates for major cancers including prostate cancer by self-reported educational attainment, family income, and poverty status (Clegg et al., 2008). There were also substantial racial differences in incidence rates for all cancers including prostate cancer, which showed that compared to non-Hispanic Caucasians, Asian/Pacific Islanders had a lower rate for prostate cancer, and compared to non-Hispanic Caucasian men, non-Hispanic African American men had a higher rate of prostate cancer (Clegg et al., 2008). In addition, lower income was also statistically significantly associated with an increased risk of being diagnosed with a late-stage prostate cancer (Clegg et al., 2008). The odds of being diagnosed with late-stage prostate cancer for non-Hispanic African American men were 2.6 times higher than their non-Hispanic Caucasian counterparts (Clegg et al., 2008). Social disparities in cancer incidence may be related to socioeconomic and demographic differences in cancer-related risk factors and behaviors, such as cigarette smoking, poor diet, physical inactivity, and obesity (Clegg et al., 2008). The existence of an association between prostate cancer and age, income, and educational level indicated a potential confounding effect on the relationships between other factors and prostate cancer.

Physical Activity, Overweight Status, Smoking and Prostate Cancer

Smoking cessation, regular exercise, and maintaining healthy weight are important public health targets for the intervention of prostate cancer (Pernar et al., 2018). A study by Loprinzi, and Kohli (2013) examined the association between accelerometer-derived sedentary, physical activity and PSA in a nationally representative sample of men in the United States with the data collected from 1,672 male participants

in the 2003-2004 and 2005-2006 NHANES cycles. The sedentary and physical activity variable was objectively measured using an accelerometer, and covariates included many demographic, dietary, biological, and immunologic variables (Loprinzi & Kohli, 2013). The findings indicated that individuals who engage in more sedentary behavior and lower levels of light physical activity have higher PSA concentrations (Loprinzi & Kohli, 2013). Orsini et al. (2009) examined the possible benefit of lifetime physical activity in reducing prostate cancer incidence and mortality in a prospective cohort of 45,887 men aged 45–79 years. The findings suggested that not sitting for most of the time during work or occupational activity and walking or bicycling more than 30 minutes per day during adult life is associated with reduced incidence of prostate cancer (Orsini et al., 2009). In addition, Moore et al. (2009) investigated the association between physical activity, including activity during different age periods and of varying intensities and prostate cancer incidence among Caucasian and African American men. The data for the study included 160,006 Caucasian men and 3,671 African American men aged 51–72 years in the National Institutes of Health-AARP Diet and Health Study that reported the time they spent per week engaging in physical activity during ages 15–18, 19–29, 35–39 years, and the past 10 years, and Cox regression models were used to examine their intensity of physical activity in relation to prostate cancer risk (Moore et al., 2009). The findings indicated that regular physical activity may reduce the risk of prostate cancer among African American men, with activity during young adulthood possibly yielding the greatest benefit (Moore et al., 2009). According to Peisch, Van Blarigan, Chan, Stampfer, and Kenfield (2016), more evidence from prospective cohort studies of healthy

individuals suggested that vigorous activity that causes sweating, and increased heart and respiratory rate are associated with a reduced risk of lethal prostate cancer. These are usually activities with a metabolic equivalent task value greater than 6, such as jogging, biking, swimming, or bicycling (Peisch et al., 2016).

The 2014 report by the Surgeon General of the United States indicated that smoking increases risk of death from prostate cancer and the advanced-stage disease (U.S. Department of Health and Human Services, 2014). Huncharek, Haddock, Reid, and Kupelnick (2010) investigated the relationship between smoking and prostate adenocarcinoma using pooled data from 24 cohort studies enrolling 21,579 prostate cancer case participants for a general variance-based meta-analysis. The summary relative risks and 95% confidence intervals were calculated separately for mortality and incidence studies, the robustness of effect measures was tested, and the statistical heterogeneity were evaluated with sensitivity analyses (Huncharek et al., 2010). The findings indicated that observational cohort studies showed an association between smoking and prostate cancer incidence and mortality (Huncharek et al., 2010). In addition, Jones et al. (2016) conducted a study to examine state prostate cancer mortality rates in relation to changes in cigarette smoking with data obtained from the Behavioral Risk Factor Surveillance System, and the CDC's Wide-Ranging Online Data for Epidemiologic Research for men aged 35 years or older from California, Kentucky, Maryland, and Utah (Jones et al., 2016). Joinpoint analysis was used to estimate the average annual percentage change from 1999- 2010, and the findings showed that declines in prostate cancer mortality rates appear to be associated with the decrease in

smoking prevalence at the population level (Jones et al., 2016). Therefore, smoking increases risk of aggressive prostate cancer and prostate cancer-specific mortality (Peisch et al., 2016).

According to Parikesit, Mochtar, Umbas, and Hamid (2015), the evidence has supported obesity as a risk factor for prostate cancer, and there are several different mechanisms which may cause the development of the disease and high-grade prostate cancer, such as decreased serum testosterone, peripheral aromatization of androgens, insulin resistance, and altered adipokine secretion caused by inflammation. A study was conducted by Allott, Masko, and Freedland (2012) to consolidate and evaluate the evidence for an epidemiologic link between obesity and prostate cancer, as well as examine the proposed underlying molecular mechanisms. A better understanding of the role of obesity as a modifiable risk factor in prostate cancer etiology is necessary to improve the screening, treatment, and prevention of prostate cancer (Allott et al., 2012). The authors conducted a Pub Med search for relevant articles and their references published between 1991 and July 2012, and the articles were selected based on content and date of publication (Allott et al., 2012). The findings showed that more evidence suggests obesity is associated with elevated incidence of aggressive prostate cancer, increased risk of biochemical failure following radical prostatectomy and external-beam radiotherapy, higher frequency of complications following androgen-deprivation therapy, and increased prostate cancer-specific mortality, and a lower overall prostate cancer incidence (Allott et al., 2012). It was concluded that obesity appears to be linked with aggressive prostate cancer (Allott et al., 2012). In addition, Kenfield et al. (2015)

conducted a study to develop and apply a lifestyle score for prevention of lethal prostate cancer by developing a lifestyle score among 42,701 men in the Health Professionals Follow-up Study followed from 1986-2010 and applied it among 20,324 men in the Physicians' Health Study followed from 1982 to 2010. Multivariable Cox proportional hazards regression were used to estimate the risk of lethal prostate cancer when adjusting for potential risk factors of lethal prostate cancer, and the findings showed that maintaining a healthy lifestyle, defined by not smoking, normal body weight, high physical activity, and a healthy diet, may lower risk of lethal prostate cancer (Kenfield et al., 2015). Hence, physical activity, overweight status, and smoking could have an effect on the risk of prostate cancer and could also be potential confounders on the association between prostate cancer risk and other factors.

NHANES and Prostate Cancer

A study by Daniel, Cross, Koebnick and Sinha (2010) examined the trends, distribution, potential determinants, and public health implications of meat intake in the United States. They investigated the temporal trends in meat consumption in the United States by using food availability data from the Food and Agricultural Organization and United States Department of Agriculture, and also evaluated meat intake by type in the NHANES dataset that is linked to the MyPyramid Equivalents Database (Daniel et al., 2010). Their findings indicated that meat intake has continued to rise in developed countries, and despite a shift toward higher poultry consumption, red meat still represents the largest proportion of meat consumed in the United States (Daniel et al., 2010). In the NHANES 2003–2004, the total meat intake averaged 128 g/day, and the type and

quantity of meat consumed varied by education, race, age, and gender (Daniel et al., 2010). Therefore, understanding the trends and determinants of meat consumption in the United States, where meat is consumed at more than three times the global average, are essential to researchers and public health professionals that are working to reduce the global burden of chronic diseases (Daniel et al., 2010).

Kappeler, Eichholzer and Rohrmann (2013) examined the association of meat intake and the healthy eating index with total mortality, cancer, and cardiovascular disease (CVD) mortality. They used 17,611 participants from a cross-sectional data of the Third National Health and Nutrition Examination Survey (1986–2010), and Cox proportional hazards regression models were used to estimate hazard ratios and confidence intervals of mortality according to five types of meat consumption (Kappeler et al., 2013). After multivariable adjustment, the intake of red meat, processed meat, white meat, and fish was not significantly associated with total, cancer and CVD mortality (Kappeler et al., 2013). This raised the question of whether total meat intake is associated with prostate cancer mortality among African American men. Tseng, Breslow, DeVellis and Ziegler (2004) investigated the association between dietary patterns measured in individuals and prostate cancer risk by using prospective data from the NHANES Follow-up Study. The data included 3,779 men followed from 1982-84 to 1992, and 136 incident cases of prostate cancer were identified (Tseng et al., 2004). In addition, a principal component analysis was used on the responses to a 105-item dietary questionnaire to identify three distinct patterns including a vegetable-fruit pattern, a red meat-starch pattern, and a Southern pattern (Tseng et al., 2004). The adjusted

proportional hazards models used in the study revealed that prostate cancer risk was not associated with the vegetable-fruit or red meat-starch pattern, but higher intake of the Southern pattern showed a reduction in risk that approached statistical significance (Tseng et al., 2004). This inverse association of the Southern pattern was observed in African American and non-African American men and was not attributed to intake of any individual foods or nutrients (Tseng et al., 2004).

Clarke and Whittemore (2000) examined the relationship of prostate cancer to anthropometry and self-reported physical activity among 5,377 African American and Caucasian participants in the National Health and Nutrition Examination Survey I cohort. The participants were initially examined between 1971 and 1975 and then followed prospectively through the Epidemiologic Follow-up Study in 1982–1984, 1986, 1987, and 1992 (Clarke & Whittemore, 2000). The findings showed that men that had low levels of nonrecreational physical activity had increased risk of prostate cancer compared with very active men after adjustment for potential confounders, and these findings were stronger for African Americans than for Caucasians (Clarke & Whittemore, 2000). In addition, lower levels of recreational activity were weakly associated with increased prostate cancer risk among African Americans but not among Caucasians suggesting that inactive men are at increased risk of prostate cancer (Clarke & Whittemore, 2000).

Many researchers have used the NHANES dataset to examine the association between prostate cancer and its risk factors, so it was appropriate to use this dataset in this research. Despite the body of evidence that studied prostate cancer, the literature search for this review yielded no studies addressing the relationship between total meat

intake and total prostate cancer for African American men using the 2013–2014 NHANES data. Due to the lack of existing research on this topic, this study filled a gap by contributing to understanding the role of meat intake in prostate cancer development.

Summary and Conclusions

African American men have higher incidence and mortality rates of prostate cancer than any other ethnic group in the United States (Howlader et al., 2016). The theoretical framework for this study employed the use of the HBM and TPB, which are useful frameworks to use in identifying certain dietary behaviors that could be risk factors for prostate cancer for African Americans. Prostate cancer is a significant public health concern in the United States, and the literature review for this study showed a wide variety of cofounders which may explain why the incidence and mortality of prostate cancer is high, especially for African American men. The exact causes of prostate cancer are still a major research topic, and lifestyle, as well as diet has been identified in the literature as factors which have an influence on prostate cancer. Therefore, this study filled the gap that has been missing in the literature and extended the knowledge on this topic for African American men. Although, meat intake has been associated with prostate cancer (Bylsma and Alexander, 2015; Discacciati & Wolk, 2014; Gathirua-Mwangi & Zhang, 2014; Rohrmann et al., 2015; Wilson et al., 2016; Wu et al, 2016), the findings have been inconclusive regarding the association between total meat intake and prostate cancer (Gathirua-Mwangi & Zhang, 2014). Therefore, further detailed investigation was required on the link between meat intake and the risk of prostate cancer especially for African American men. If such a link is established, dietary behavior will be useful in

intervention programs for the disease. Additionally, existing studies have not used the 2013–2014 NHANES data to study the association between total meat intake and total prostate cancer for African American men. A description of the research design and methodology, including the population and sampling procedure, a description of variables and NHANES data collection process, the data analysis plan, threats to validity, protection of human participants, and a summary are reported in Chapter 3.

Chapter 3: Research Method

Introduction

The purpose of this study was to use a quantitative approach and secondary data to examine the association between total meat intake and total prostate cancer risk among African American men. I focused on African American men and provide the justification for further research on this topic to reduce prostate cancer incidence and mortality in this high-risk population. In this chapter, I present the research design and rationale, methodology, population, sampling and sampling procedures, data collection, statistical analysis, and threats to validity, ethical procedures, and a summary.

Research Design and Rationale

My research involved the use of a quantitative design and cross-sectional data from the 2013–2014 NHANES questionnaires to measure the effects of meat intake on prostate cancer in African American men. The dependent variable in this quantitative cross-sectional study was prostate cancer diagnosis or lack of diagnosis. The independent variable was total meat intake, whereas the covariate factors that have evidence of confounding in the NHANES 2013–2014 dataset are income, education level, age, and physical activity, overweight status and smoking cigarettes. I used the data for these variables collected through NHANES 2013–2014 study to examine the associations between total meat intake and prostate cancer for African American men.

Setia (2016) stated that cross-sectional designs can be used in population-based surveys to measure the outcome and the exposures in the study participants at the same time. Cross-sectional studies are usually inexpensive and faster to conduct, and the

participants are selected based on the inclusion and exclusion criteria set for the study (Setia, 2016). Cross-sectional designs can provide information on the prevalence of outcomes or exposures, and odds ratios can be estimated to study the association between exposure and the outcomes in this design (Setia, 2016). Therefore, cross-sectional study designs are very useful in epidemiology, and I did not expect time and resource constraints to be an issue in this research because of the benefits of this design. This design was appropriate for me to answer the research questions in this study because it was useful in testing the significance of lifestyle and diet as risk factors for prostate cancer in the African American male population.

Methodology

This was a secondary data study using information gathered from the NHANES 2013 to 2014 dataset, which represents the current years available in the NHANES database that includes all variables to be tested. I used the data collected from NHANES to address the research questions with the goal of reducing the incidence and mortality from prostate cancer among African American populations in the United States.

Population

The target population for this study was adult African American men living in the United States, with and without prostate cancer, who completed the NHANES survey from 2013 to 2014. The unweighted population size was 9,813 participants in the 2013 to 2014 database (CDC, 2018b), but women and other race/ethnicities were removed from the dataset, leaving African American men.

Sampling and Sampling Procedures

A representative sample is important in making inferences about the target population and ensures that the findings are credible. The NHANES survey includes a nationally representative sample of about 5,000 persons each year that are located in counties across the United States (CDC, 2017a). NHANES uses a complex, multistage, probability sampling design to select participant's representative of the civilian, non-institutionalized United States population, and oversampling of certain population subgroups is done to increase the reliability and precision of health status indicator estimates for these groups (CDC, 2013). The NHANES sample is selected by the National Center for Health Statistics (NCHS) to represent the population of all ages in the United States and to produce reliable statistics, so they over-sampled persons 60 and older, African Americans, and Hispanics (CDC, 2017a). NHANES includes information on the noninstitutionalized civilian population and excludes the information of all persons in supervised care or custody in institutional settings, all active-duty military personnel, active-duty family members living overseas, and any other United States citizen residing outside of the 50 states and District of Columbia (Johnson, Dohrmann, Burt & Mohadjer, 2014).

In this study, I performed power analysis for a logistic regression using G*Power 3.1 tool to determine a sufficient sample size. The parameters I used for the logistic regression analysis for the first research question are two tails, odds ratio of 1.72 for medium effect size, alpha of 0.05, desired power of 0.80, R2 for other controls = 0, normal distribution, X parm $\mu = 0$, and X parm $\sigma = 1$. The G*Power indicated that 177

participants were required. The parameters I specified for the second and third research questions using logistic regression analysis are also two tails, odds ratio of 1.72 for medium effect size, alpha of 0.05, desired power of 0.80, R2 for other controls = 0, normal distribution, X parm $\mu = 0$, and X parm $\sigma = 1$. The G*Power calculation indicated that 177 participants were needed for the logistic regression analysis with these specifications.

Procedures for Recruitment, Participation, and Data Collection

For this study, I used the NHANES dataset for the years 2013 to 2014. The NHANES program began in the early 1960s and became a continuous program that has a changing focus on various health and nutrition measurements to meet emerging needs in 1999 (CDC, 2017a). The survey is used to examine a nationally representative sample of about 5,000 persons every year that are located in all the counties across the United States, 15 of which are visited each year (CDC, 2017a). The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions, and the examination consists of medical, dental, and physiological measurements, as well as laboratory tests administered by highly trained medical personnel (CDC, 2017a). These health interviews are conducted in the respondent's homes and the measurements are performed in specially-designed and equipped mobile centers (CDC, 2017a). To eliminate the need for paper forms and manual coding operations, an advanced computer system that uses high-end servers, desktop PCs, and wide-area networking are used to collect and process all of the NHANES data (CDC, 2017a). NHANES is designed to encourage participation, so transportation can be provided for the participants to and from

the mobile center if necessary, and they receive compensation as well as a report of the medical findings (CDC, 2017a). All information collected in the survey is kept strictly private and confidential, and protected by public laws (CDC, 2017a).

Instrumentation and Operationalization of Constructs

The NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States through interviews and physical examinations (CDC, 2017a). NHANES is a major program of the NCHS, which is the part of the CDC that is responsible for producing vital and health statistics (CDC, 2017a). The survey findings are used to determine the prevalence of major diseases and risk factors for diseases (CDC, 2017a). The 2013–2014 NHANES dataset was appropriate for my study because it contains the necessary variables to examine the dietary and lifestyle risk factors of prostate cancer in the African American male population. The NHANES data are publicly available on the CDC website in .XPT files, thus securing permission to access the data was not necessary.

The variables I used to answer the research questions were operationalized before the analysis, and the data I used for this study was accessed after Walden Institutional Review Board (IRB) approval was secured. The dependent variable in the study was total prostate cancer, which is operationally defined as what kind of cancer (MCQ230A, MCQ230B, MCQ230C, and MCQ230D) and coded 30; while the independent variable total meat intake is operationalized as combination food type (DR1CCMTX and DR2CCMTX); and meat, poultry and fish is coded as 12. The covariates age and income were operationalized as continuous variables, defined as age in years at screening

(RIDAGEYR) and poverty-to-income ratio (INDFMPIR) respectively. Physical activity covariate was operationally defined as vigorous recreational activity (PAQ650) coded as (1 for yes) and (2 or no), smoking covariate is defined as smoked at least 100 cigarettes in life (SMQ020) and coded as (1 for yes) or (2 for no). In addition, the overweight covariate as defined as doctor ever said you were overweight (MCQ080) coded as (1 for yes) or (2 for no), and educational level covariate was operationalized as educational attainment (DMDEDUC2) and coded as (1 for less than ninth grade), (2 for ninth to eleventh grade, including twelfth grade with no diploma), (3 for high school graduate/GED or equivalent), (4 for some college or associate's degree), and (5 for college graduate or above) in the NHANES codebook.

Data Analysis Plan

I used the SPSS software version 25 to analyze the data in this study. Cleaning and recoding NHANES data is necessary before analysis if there are missing data, skip patterns, or outliers in the dataset (CDC, 2013). Thus, I performed data cleaning and screening procedures for the dataset by identifying missing values, checking for skip patterns, outliers and distributions, and recoding the variables needed with new values (CDC, 2013). I applied sampling weights to the variables for analysis to take into account differential selection probabilities, non-response to survey instruments, and differences between the sample and the United States civilian non-institutionalized male population (CDC, 2018b).

The research questions, hypotheses, and planned analysis to answer the research questions are listed below:

RQ1: Is there an association between total meat intake and total prostate cancer risk among African American men?

$H_0$1: There is no association between total meat intake and total prostate cancer risk among African American men.

H_a1: There is an association between total meat intake and total prostate cancer risk among African American men.

RQ2: Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level?

$H_0$2: There is no association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level?

H_a2: There is an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level.

RQ3: Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking?

$H_0$3: There is no association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking.

H_a3: There is an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking.

The descriptive statistical analyses for all the research questions included constructing frequency tables for all categorical variables that reported their sample sizes and percentages, and measures of central tendency and variability were used for all the continuous variables analyzed, with the mean, median, and standard deviation reported along with minimum and maximum scores. In addition, their measures of skewness and kurtosis were reported as measures of normality. The inferential analyses for the research questions were conducted to test the null hypotheses of the study and a p value of $< .05$ was considered statistically significant to indicate when the null hypotheses were rejected. For the research questions, I analyzed the relationship between total meat intake and total prostate cancer in African American men by using a logistic regression model to test the binary outcome of prostate cancer yes/no when controlling for the covariates in the study. I used a two-tailed bivariate analysis to develop the multivariable logistic regression model that included all the covariate risk factor adjusted for in the study. I used the Hosmer-Lemeshow statistic to compare the expected and observed probability to test for goodness of fit, and I interpreted the results of the research questions using odds ratios with corresponding 95% confidence interval limits, and p value of significance at $p < .05$.

Threats to Validity

According to Ahluwalia, Dwyer, Terry, Moshfegh, and Johnson (2016), the major strength of NHANES is the use of a combination of different dietary methods, along with anthropometric measures and biomarkers to examine nutritional status and to lessen bias or measurement error in estimates. In addition, NHANES planners try to always evaluate and balance its components and assessment tools to improve monitoring of nutrition and overall health (Ahluwalia et al., 2016). Thus, NHANES dataset has a flexible design that enables it to address emerging public health issues, and the methods used in the survey are evaluated and updated periodically with current market trends, scientific advances, and new tools and techniques while balancing respondent burden, feasibility, validity, and cost (Ahluwalia et al., 2016). However, Archer, Hand, and Blair (2013) noted that some of the validity of the NHANES dataset may have been affected by under-reporting and self-reporting issues. Therefore, few internal validity threats may exist with the NHANES dataset.

NHANES dietary data are essential for population-based nutrition monitoring, informing nutrition policy, and assessing associations between nutrition and health, but they are not suitable for assessment at the individual level (Ahluwalia et al., 2016). The issues related to individual-level dietary assessment are very important, and their understanding is essential to the use and correct interpretation of dietary intake findings from NHANES (Ahluwalia et al., 2016). Therefore, there may be issues with the generalization of the findings from their research-based studies and external validity threats. The NHANES dataset like other large epidemiological surveys have their

strengths and limitations, and its cross-sectional design must be kept in mind when analyzing the data, so that appropriate conclusions are reached (Ahluwalia et al., 2016).

Ethical Procedures

The approval of the collection of the data for this study was sought and obtained from the Walden IRB (IRB approval number 07-24-19-0480643). The NHANES data collection adheres to the requirements of Federal Law, which authorizes data collection and prohibits NCHS from releasing information that may identify any respondent or group of respondents, so some variables are edited to reduce the risk of disclosure (CDC, 2018b). The NHANES participant's names will not be associated with their answers, and their responses are voluntary, confidential, and will only be used to understand the nation's health (CDC, 2018a). All NHANES data are combined to protect the confidentiality of their participants and the databases are password protected and encrypted, so that they can only be accessed by appropriate personnel (CDC, 2018a). These data are used for research and statistical purposes only, without releasing any information that could identify any individual publicly (CDC, 2018a). I stored the data for my study in a laptop that is password protected and destroyed it after use.

Summary

I described the data collection and analysis methods for my research in this chapter. This quantitative cross-sectional study used the 2013–2014 NHANES dataset to examine the association between total meat intake and total prostate cancer risk in African American men when controlling for age, income, and educational level, physical activity, overweight status, and smoking as operationalized in the dataset. I screened the

data and did the descriptive, as well as inferential analyses with logistic regression to answer the research questions in my study. There are few external and internal validity threats with using the NHANES dataset that I took into consideration in the study conclusions. The privacy and confidentiality of the participants are protected by law, and I secured the data on my laptop and destroyed it after use. The results of the statistical analysis are provided in Chapter 4.

Chapter 4: Results

Introduction

The purpose of this research was to use a quantitative approach and secondary data to examine the association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level, physical activity, overweight status, and smoking. The research questions and corresponding hypotheses of this study were:

RQ1: Is there an association between total meat intake and total prostate cancer risk among African American men?

$H_0$1: There is no association between total meat intake and total prostate cancer risk among African American men.

H_a1: There is an association between total meat intake and total prostate cancer risk among African American men.

RQ2: Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level?

$H_0$2: There is no association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level.

H_a2: There is an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level.

RQ3: Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking?

$H_0$3: There is no association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking.

H_a3: There is an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking.

In this chapter, I present the data collection, the descriptive statistics for the variables and the inferential statistics with the results of my analysis of the research questions. This chapter concludes with a summary and transition to Chapter 5.

Data Collection

The NHANES uses a complex, multistage probability design to sample the civilian, noninstitutionalized population that lives in the United States (CDC, 2018c). However, its design has changed since it started to sample larger numbers of some subgroups of special public health interest to increase the reliability and precision of estimates of health status indicators for these population subgroups (CDC, 2018c). A primary sample design change was introduced in 2011 to oversample non-Hispanic Asians with the ongoing oversample of Hispanics, non-Hispanic African Americans, older adults, and low-income Caucasians/others (CDC, 2018c). 14,332 persons were selected for NHANES from 30 survey locations in 2013–2014, and 10,175 of these

persons completed the interview, while 9,813 of them were examined (CDC, 2018c). I collected the data for this study from the 2013–2014 NHANES dataset as I described in my plan in Chapter 3.

Results

I downloaded and recoded the dependent and independent variables, and covariates from their original format for analysis using SPSS 25 software and presented the findings of this study in Tables1–24. I removed from all variables the categories of other races and women, remaining 1152 participants in the sample. I recoded the variables by reducing their categories and creating dummy variables.

Descriptive Statistics

Table 1

Descriptive Statistics of Age and Income

Statistics

		Age in years at screening	Ratio of family income to poverty
N	Valid	1152	1063
Mean		29.08	1.9139
Median		20.00	1.3600
Std. Deviation		24.378	1.49804

Table 2

Educational level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Others	325	56.0	56.0	56.0
	College and above	255	44.0	44.0	100.0
	Total	580	100.0	100.0	

Table 3

Total prostate cancer

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	19	43.2	43.2	43.2
	Yes	25	56.8	56.8	100.0
	Total	44	100.0	100.0	

Table 4

Total meat

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Total meat	12	1.3	1.3	1.3
	No combinations	426	44.5	44.5	45.7
	Other combinations	520	54.3	54.3	100.0
	Total	958	100.0	100.0	

Table 5

Overweight

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	502	76.2	76.2	76.2
	Yes	157	23.8	23.8	100.0
	Total	659	100.0	100.0	

Table 6

Physical activity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	454	60.2	60.2	60.2
	Yes	300	39.8	39.8	100.0
	Total	754	100.0	100.0	

Table 7

Smoking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	300	49.2	49.2	49.2
	Yes	310	50.8	50.8	100.0
	Total	610	100.0	100.0	

Table 8

No combinations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	726	63.0	63.0	63.0
	Yes	426	37.0	37.0	100.0
	Total	1152	100.0	100.0	

Table 9

Other combinations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	632	54.9	54.9	54.9
	Yes	520	45.1	45.1	100.0
	Total	1152	100.0	100.0	

I combined the categorical variables of combination food type (DR1CCMTX and DR2CCMTX) and created dummy variables of no combinations and other combinations, which were used in the binary logistic regression. In addition, I combined the variables of what kind of cancer (MCQ230A, MCQ230B, MCQ230C, and MCQ230D) and recoded the variables of educational level, physical activity, overweight status , and smoking into 2 groups to allow for their use in the regression model. I classified theeducational level variable as 1=college and above and 0= others, and also classified the other categorical variables used in the analysis as 1=yes and 0=no. The covariates age and income were operationalized as continuous variables in the dataset. The age in years at screening (RIDAGEYR) variable was defined as 0 to 79 years and 80 years of age and over, and the

ratio of family income to poverty (INDFMPIR) was defined as 0 to 4.99 and value greater than or equal to 5 in the dataset. The continuous variable of age has a mean of 29.08, median of 20.00, standard deviation of 24.378 with minimum value of 0 and maximum value of 80.00 as shown in Table 1. The continuous variable of income has a mean of 1.9139, median of 1.3600, standard deviation of 1.49804 with minimum value of 0 and maximum value of 5.00 as also shown in Table 1. The others category of educational level have a higher percentage of participants (56.00 %, *n* = 325) compared to college and above category (44.00 %, *n* = 255) as shown in Table 2. More of the participants had prostate cancer (56.8 %, *n* = 25) compared to no prostate cancer (43.2 %, *n* = 19) as shown in Table 3, and most of the participants consumed other combinations of food (54.3 %, *n* = 520) compared to total meat (1.3 %, *n* = 12) and no combinations of food (44.5 %, *n* = 426) as shown in Table 4. In addition, more of the participants were not overweight (76.2 %, *n* = 502) compared to being overweight (23.8 %, *n* = 157) as shown in Table 5, and more of the participants were not physically active (60.2 %, *n* = 454) than physically active (39.8 %, *n* = 300) as shown in Table 6. More of the participants were smoking (50.2 %, *n* = 310) compared to those that were not smoking (49.8 %, *n* = 300) as shown in Table 7. I examined thecontinuous variables to determine whether they met the assumptions for statistical analysis including normality, and the skewness statistic for age and income were 0.570 and 0.815 respectively, suggesting normality. In addition, the kurtosis of age and income were -1.084 and -0.570 respectively. Therefore, I assumed that all the variables were normally distributed and that any missing data was missing at random.

Inferential Statistics

I examined the data to ensure that it met the assumptions of binomial logistic regression. These assumptions include dichotomous dependent variable, one or more independent variables (continuous or categorical), independence of observations, mutually exclusive and exhaustive categories of the dependent variable, as well as a linear relationship between the continuous independent variables and the logit transformation of the dependent variable (Laerd Statistics, 2018). I performed binary logistic regression analyses to examine the relationship between the dependent variable (prostate cancer status) and independent variable (total meat intake) and the covariates. The binomial logistic regression I performed was to model the relationship between the predictors and total prostate cancer yes or no, and the traditional 0.05 criterion of statistical significance was used for all tests.

The findings of the statistical analyses, organized by research questions are reported below:

Table 10

Logistic Regression of Total Meat and Total Prostate Cancer:

Omnibus Tests of Model Coefficients

		Chi-square	Df	Sig.
Step 1	Step	.448	2	.799
	Block	.448	2	.799
	Model	.448	2	.799

Table 11

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	59.728[a]	.010	.014

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Table 12

Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	.000	1	1.000

Table 13

Classification Table[a]

			Predicted		
			Total prostate cancer		Percentage
	Observed		No	Yes	Correct
Step 1	Total prostate cancer	No	0	19	.0
		Yes	0	25	100.0
	Overall Percentage				56.8

a. The cut value is .500

Table 14

Variables in the Equation

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	No combinations	.134	.876	.023	1	.879	1.143	.205	6.366
	Other combinations	.486	.838	.336	1	.562	1.625	.315	8.395
	Constant	.000	.707	.000	1	1.000	1.000		

a. Variable(s) entered on step 1: nocombinations, othercombinations.

Research Question 1

RQ1: Is there an association between total meat intake and total prostate cancer risk among African American men? I performed a binomial logistic regression to examine the effects of total meat intake on the likelihood of having prostate cancer among African American males. The Chi-square that tests for the null hypothesis was not statistically significant ($p = 0.799$) as shown in Table 10. The explained variation in the dependent variable based on the model is 1.4% (Nagelkerke R^2) as shown in Table 11, and the model is a good fit ($p = 1.000$) as shown in Table 12. The overall percentage of participants that were correctly predicted by the logistic regression model was 56.8% as shown in Table 13. The results in the dummy variable of no combinations had an odds ratio of 1.143 (95% CI: 0.205 to 6.366) when compared to the total meat group as shown in Table 14, and the odds ratio for the participants in the dummy variable of other combinations group was 1.625 (95% CI: 0.315 to 8.395) when compared to those in the total meat group. These results suggested that the overall total combination of food variable was not associated with total prostate cancer. Therefore, I failed to reject the null hypothesis, and the findings indicated that there was no statistically significant

association between total meat intake and total prostate cancer risk among African American men with a small effect size of 0.28, given an undersized sample of 44 participants.

Table 15

Logistic Regression of Total Meat and Total Prostate Cancer when controlling for Age, Income and Educational Level:

Omnibus Tests of Model Coefficients

		Chi-square	Df	Sig.
Step 1	Step	8.578	5	.127
	Block	8.578	5	.127
	Model	8.578	5	.127

Table 16

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	49.888[a]	.181	.243

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Table 17

Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	12.508	8	.130

Table 18

Classification Table[a]

			Predicted		
			Total prostate cancer		Percentage
	Observed		No	Yes	Correct
Step 1	Total prostate cancer	No	9	9	50.0
		Yes	8	17	68.0
	Overall Percentage				60.5

a. The cut value is .500

Table 19

Variables in the Equation

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	No combinations	.435	1.027	.179	1	.672	1.545	.206	11.560
	Other combinations	1.045	1.031	1.027	1	.311	2.843	.377	21.443
	Age in years at screening	.063	.042	2.245	1	.134	1.065	.981	1.157
	Ratio of family income to poverty	.086	.268	.102	1	.749	1.089	.645	1.841
	Educational level	1.503	.868	3.000	1	.083	4.495	.820	24.624
	Constant	-5.177	3.081	2.824	1	.093	.006		

a. Variable(s) entered on step 1: nocombinations, othercombinations, Age in years at screening, Ratio of family income to poverty, educationallevel.

Research Question 2

RQ2: Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level? The logistic regression model was not statistically significant (Chi-square = 8.578, $p = 0.127$) as shown in Table 15. The model explained 24.3% (Nagelkerke R^2) of the variance in total prostate cancer as shown in Table 16. The model is a good fit ($p = 0.130$) as shown in Table 17, and correctly classified 60.5% of cases as shown in Table 18. The age ($p = 0.134$), income ($p = 0.749$) and educational level ($p = 0.083$) did not add significantly to the model as shown in Table 19. Therefore, I failed to reject the null hypothesis, and the findings indicated that there was no statistically significant association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level with a small effect size of 0.28, given an undersized sample of 44 participants.

Table 20

Logistic Regression of Total Meat and Total Prostate Cancer when controlling for Overweight, Physical Activity and Smoking:

Omnibus Tests of Model Coefficients

		Chi-square	Df	Sig.
Step 1	Step	3.239	5	.663
	Block	3.239	5	.663
	Model	3.239	5	.663

Table 21

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	56.937[a]	.071	.095

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Table 22

Hosmer and Lemeshow Test

Step	Chi-square	Df	Sig.
1	5.849	6	.440

Table 23

Classification Table[a]

			Predicted		
			Total prostate cancer		Percentage
	Observed		No	Yes	Correct
Step 1	Total prostate cancer	No	9	10	47.4
		Yes	6	19	76.0
	Overall Percentage				63.6

a. The cut value is .500

Table 24

Variables in the Equation

								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	No combinations	-.034	.937	.001	1	.971	.966	.154	6.067
	Other combinations	.596	.885	.454	1	.501	1.815	.320	10.284
	Overweight	1.232	.835	2.180	1	.140	3.429	.668	17.598
	Physical activity	.004	1.108	.000	1	.997	1.004	.114	8.806
	Smoking	-.052	.763	.005	1	.945	.949	.213	4.233
	Constant	-.267	.909	.086	1	.769	.766		

a. Variable(s) entered on step 1: nocombinations, othercombinations, overweight, physicalactivity, smoking.

Research Question 3

RQ3: Is there an association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking? I performed a binary logistic regression to determine the effect of total meat intake on total prostate cancer risk among African American men when controlling for the covariates. The logistic regression model was not statistically significant (Chi-square = 3.239, $p = 0.663$) as shown in Table 20. The model explained 9.5% (Nagelkerke R^2) of the variance in total prostate cancer as shown in Table 21, and it correctly classified 63.6% of cases as shown in Table 23. In addition, the model was a good fit ($p = 0.440$) as shown in Table 22. Finally, the overweight ($p = 0.140$), physical activity ($p = 0.997$) and smoking ($p = 0.945$) did not add significantly to the model as shown in Table 24, thus I failed to reject the null hypothesis. The findings indicated that there was no statistically significant association between total meat intake and total

prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking with a small effect size of 0.28, given an undersized sample of 44 participants.

Summary

The findings of my study indicated that there was no statistically significant association between total meat intake and total prostate cancer risk among African American men. In addition, the findings indicated that there was no statistically significant association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level. There was also no statistically significant association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight status, and smoking. The achieved effect size for these findings was a small effect size of 0.28, given an alpha of 0.05, desired power of 0.80, and an undersized sample of 44 participants. However, the odds ratios were mostly greater than one in the logistic regression models suggesting a small effect of total meat intake on total prostate cancer among African American men with and without the covariates. The interpretation of these findings in the context of previous studies, limitations of the study, recommendations for further research, and social change implications of the study were discussed in Chapter 5.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this cross-sectional quantitative study was to investigate the association between total meat intake and total prostate cancer risk among African American men using the 2013–2014 NHANES dataset. I conducted this study to examine the effect of total meat consumption on prostate cancer among African American men when controlling for covariates of age, income, educational level, and physical activity, overweight status, and smoking in the dataset. The data analysis included frequencies, measures of central tendency and variability, measures of normality, and logistic regression analysis. The key findings from the analysis showed that the null hypotheses of this study could not be rejected, indicating that there were no statistically significant association between total meat intake and total prostate cancer risk when controlling for age, income, educational level, physical activity, overweight status, and smoking with a small effect size of 0.28, given an undersized sample of 44 participants among 1152 African American men who participated in the 2013–2014 NHANES.

Interpretation of the Findings

The findings from previous studies have shown that prostate cancer has affected the African American population more than other races in the United States. A study by Layne et al. (2018) found that the dietary, nutrient, and health-related factors associated with prostate cancer risk is different for non-Hispanic Caucasian men compared to African American men, and the adjustment for these factors increased the African American-Caucasian difference in risk. In addition, the findings of the study by Clegg et

al. (2008) indicated that the odds of being diagnosed with late-stage prostate cancer for non-Hispanic African American men were 2.6 times higher than their non-Hispanic Caucasian counterparts.

The HBM and the TPB were the theoretical framework I used in this study to focus on African American men in communities in the United States in relation to their eating behavior concerning prostate cancer. According to Rosenstock et al. (1988), the HBM was developed to investigate the motivational factors associated with behavioral health, and Geyen (2012) stated that the TPB implies that an individual's self-efficacy can explain their eating behavior. Zare et al. (2016) noted that the HBM has been used in prostate cancer studies to understand the screening behaviors of African American men, and O'Neal et al. (2014) stated that TPB can be used to explain the variation in eating behaviors of older African American men. The HBM and the TPB were appropriate for this study, and I used them to identify the dietary risk factors for prostate cancer for African Americans. Based on these theories, I used logistic regression analysis to examine the association between total meat intake and prostate cancer risk among African American when controlling for the covariates in the 2013–2014 NHANES dataset.

The interpretations of the results by each research question are shown below:

Research Question 1

The results of the logistic regression analysis for the first research question indicated that the dummy variable of no combinations had an odds ratio of 1.143 (95% CI: 0.205 to 6.366) when compared to total meat group, and the odds ratio for the

participants in the dummy variable of other combinations group was 1.625 (95% CI: 0.315 to 8.395) when compared to those in the total meat group, thus there was no statistically significant association between total meat intake and total prostate cancer risk among African American men with a small effect size of 0.28, given an undersized sample of 44 participants. The findings from previous research indicated that there was an inconsistent association between red meat, fish, and poultry and prostate cancer risk. The results of the study conducted by Rodriguez et al. (2006) showed that meat intake was associated with prostate cancer risk among Caucasian men, and that total red meat intake was associated with a higher prostate cancer risk for African Americans. In addition, the findings of the study by Wilson et al. (2016) indicated that higher intakes of poultry and fish are associated with lower risk of high grade and advanced prostate cancer, as well as with reduced recurrence risk, independent of prostate cancer stage and grade, and the findings by Richman et al. (2011) showed a mild statistical significant positive association between total poultry and total processed red meat intake and progression to lethal prostate cancer among men initially diagnosed with clinically localized prostate cancer. The findings of the study by Discacciati and Wolk (2014) suggested that red meat is associated with prostate cancer, and the results of the study by Gathirua-Mwangi and Zhang (2014) indicated that there was an inconsistent association between intakes of total meat and the risk of prostate cancer. Rohrmann et al. (2015) also reported an association between red meat and prostate cancer. Therefore, the findings of my research did not confirm these previous studies that found an association between red meat, poultry, and fish and prostate cancer. However, the findings of a study by Bylsma

and Alexander (2015) did not support a significant association between red and processed meat, and prostate cancer. In addition, the results of a study by Chavarro et al. (2008) supported the epidemiological evidence that fish is not associated to the risk of developing prostate cancer. Thus, my research supported the results of these studies that found no association between red meat, poultry and fish and prostate cancer. In addition, my research supported part of the study by Wu et al. (2016) that found that red meat was not substantially associated with prostate cancer but disconfirmed the part of the study that found an association between higher poultry intake and a lower risk of prostate cancer.

Research Question 2

The results of the logistic regression analysis for the second research question indicated that age ($p = 0.134$), income ($p = 0.749$) and educational level ($p = 0.083$) did not add significantly to the model, thus there was no statistically significant association between total meat intake and total prostate cancer risk among African American men when controlling for age, income, and educational level with a small effect size of 0.28, given an undersized sample of 44 participants. Sakharkar and Kahaleh (2017) concluded that age and race/ethnicity were significantly associated with PSA levels, and the findings of the study by Leal et al. (2014) indicated that the prevalence of histological prostate cancer increased with age in men depending on their ethnicity. In addition, the results of the study by Zhang et al. (2013) showed that men of older age and African American race were more likely to have high risk prostate cancer than younger and Caucasian men. The results of the study by Clegg et al. (2008) indicated that prostate cancer incidence and

stage of diagnosis were associated with self-reported educational attainment, family income, and poverty status; lower income was also statistically significantly associated with an increased risk of late-stage prostate cancer. This suggested that age, income, and educational level may have a potential confounding effect on the relationships between total and prostate cancer. However, the findings from my study disconfirmed these previous studies.

Research Question 3

The result of the logistic regression analysis for the third research question indicated that overweight ($p = 0.140$), physical activity ($p = 0.997$) and smoking ($p = 0.945$) did not add significantly to the model, thus there was no statistically significant association between total meat intake and total prostate cancer risk among African American men when controlling for physical activity, overweight, and smoking with a small effect size of 0.28, given an undersized sample of 44 participants. Cancer-related risk factors and behaviors, such as cigarette smoking, poor diet, physical inactivity, and obesity were found to be associated with prostate cancer in the study by Clegg et al. (2008), and the findings of a study by Barrington et al. (2015) indicated that obesity was more strongly associated with increased prostate cancer risk among African American than non-Hispanic Caucasians. The findings of the study by Loprinzi, and Kohli (2013) indicated that individuals who engaged in more sedentary behavior and lower levels of light physical activity have higher PSA concentrations, and the study by Orsini et al. (2009) found that not sitting for most of the time during work or occupational activity and walking or bicycling more than 30 minutes per day during adult life was associated

with reduced incidence of prostate cancer. The findings of the study by Clarke and Whittemore (2000) showed that men that had low levels of nonrecreational physical activity had increased risk of prostate cancer compared with very active men after adjustment for potential confounders, and these findings were stronger for African Americans than for Caucasians. In addition, a study by Moore et al. (2009) indicated that regular physical activity may reduce the risk of prostate cancer among African American men, with activity during young adulthood possibly yielding the greatest benefit. According to Peisch et al. (2016), more evidence suggested that vigorous activity that causes sweating, and increased heart and respiratory rate are associated with a reduced risk of lethal prostate cancer, such as jogging, biking, swimming, or bicycling. The results of the study by Huncharek et al. (2010) showed that smoking is associated with prostate cancer incidence and mortality, and the study by Jones et al. (2016) found that the decrease in prostate cancer mortality rates may be associated with the decrease in smoking prevalence at the population level. According to Parikesit et al. (2015), evidence has supported obesity as a risk factor for prostate cancer, and the findings of the study conducted by Allott et al. (2012) indicated that obesity appears to be linked with aggressive prostate cancer. In addition, the results of the study by Kenfield et al. (2015) showed that maintaining a healthy lifestyle such as not smoking, normal body weight, high physical activity, and a healthy diet, may lower the risk of lethal prostate cancer. Hence, previous studies indicated that physical activity, overweight status, and smoking could be potential confounders on the association between total meat intake and prostate

cancer risk among African American men. However, the findings from my research disconfirmed these previous studies.

Previous studies suggested that prostate cancer risk may be related to the intake of meats when consumed by African American men, and that the covariates may be confounders to the relationship. However, after collecting and analyzing the data on the variables total meat intake, total prostate cancer, age, income, educational level, physical activity, overweight status, and smoking from the 2013–2014 NHANES, my findings disconfirmed most of what has been found in previous peer-reviewed literature. Overall, the results from my study did not suggest a statistically significant association between total meat intake and total prostate cancer among African American men with or without the covariates included in the models. However, the odds ratios were mostly greater than one in the logistic regression models suggesting a small effect of total meat intake on total prostate cancer among African American men with and without the covariates.

Limitations of the Study

The limitations of cross-sectional study designs include inability to determine causal relationships and biases (Setia, 2016). In addition, the secondary data collection process may include residual confounding or glitches that can affect the interpretation of some variables in the dataset and the validity of the data (Cheng & Phillips, 2014). Therefore, any inaccuracies in the measurement, reporting, and data entry processes in the 2013–2014 NHANES dataset were limitations to this study. Other confounding variables not included in the dataset were not considered and may also affect the validity of this study. Other limitations of this study included the small percentage of participants

that had total prostate cancer, and small amount of the participants in total meat category compared to the other categories. However, a similar study with NHANES dataset conducted by Raymonvil (2016) used a sample of 1,850 participants with 3.51 percent of prostate cancer to investigate the risk factors of prostate cancer. The outcome of this study was limited to the sample and may not be generalizable to the entire population, other countries and other measures of total meat and total prostate cancer. However, randomization during the data collection process of the NHANES study may increase the validity of the statistical conclusions from this study. The dataset has been used in many research studies and no reports of inaccurate or misleading data has been indicated.

Recommendations

I did not find a statistically significant association between total meat intake and total prostate cancer risk among African American men with and without covariates in this study. However, considering the strengths and limitations of this study, I would recommend further studies with larger sample sizes, different datasets, variables or research questions to investigate this topic in the target population. In addition, the findings from this study needs to be confirmed by further studies. Considering the literature review from this study, the risk factors for total prostate cancer may be different from those of advanced prostate cancer which is common among African American men. Therefore, I would recommend further studies to consider the type and stage of the disease in the investigation of this topic in this target population of African American men.

Implications

This study contributes to positive social change by increasing the understanding of the association between total meat consumption and prostate cancer risk among African American male populations, by providing more information to African American men, healthcare providers, and the clinical community in an effort to reduce the incidence and mortality from the disease, as well as healthcare costs. This study also contributes to positive social change and public health practice by adding to the literature and providing a renewed focus for further studies on diet and prostate cancer, especially among African Americans. The findings from this study contribute to our overall understanding of the epidemiology of prostate cancer in the United States. The methodological and theoretical approach used in this study were appropriate, cost-effective, and easier to use, thus they will generate more interest in further research on this topic using similar approaches.

Conclusion

In this study, I used a cross-sectional quantitative study design and secondary data in an attempt to clarify the effect of total meat consumption on total prostate cancer risk among African American men when controlling for covariates in the dataset. The findings from this study did not indicate an association between total meat intake and prostate cancer risk with and without the covariates of age, income, and educational level, physical activity, overweight status, and smoking with a small effect size of 0.28, given an undersized sample of 44 participants. However, the odds ratios were mostly greater than one, suggesting a small effect of total meat intake on total prostate cancer among African American men with and without the covariates. Therefore, further studies are

needed with larger sample sizes, different datasets, variables or research questions to confirm these findings. In addition, researchers that will consider the type and stage of prostate cancer are needed in the investigation of this topic in this target population of African American men.

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