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Socioeconomic Status, Obesity, Breast Cancer, and 5-Year Survival Among Men

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
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Abstract

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Taye O Olabode

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Public Health Epidemiology

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Abstract

Although male breast cancer (MBC) is rare, affecting 2,000 men in the United States each year and comprising approximately 1% of all breast cancer diagnoses, mortality for those diagnosed with MBC is significantly higher than for women diagnosed with breast cancer. Recent research on the disparities in mortality rates between men and women revealed that there may be unexplained factors for the diagnostic disparities between men and women. Bandura's (1986) SCT was used as the theoretical framework for this quantitative study.The purpose of this quantitative cross-sectional study was to determine whether there was an association between socioeconomic status, obesity, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. Social cognitive theory was used as the theoretical framework. Secondary data were gathered from the National Cancer Database. The sample size was 14,341. Statistical analysis techniques included descriptive analysis, ordinal logistic regression, proportional hazard regression, and a Bonferroni test. Body mass index categories and education were not significantly associated with 5-year survival of patients ($p > .05$). Furthermore, age at diagnosis, family history of cancer, and stage at diagnosis did not significantly predict the 5-year survival of patients ($p > .05$). The research question considering income as a covariate was not addressed because income was not collected and included in the database. Results may be used to inform an early-detection advocacy-awareness program about the risk and prevalence of MBC, which may foster proper education about MBC and effect positive social change among men.

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DEDICATION

This work is dedicated to my wife Oluchi, for her love, care and support through this journey. To my children, Adewale and Grace, thank you for loving me.

To all my families, I say a big thank you.

Lastly, to my Parents who stood by me in prayers and support, I am forever grateful.

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Chapter 1: Introduction to the Study

Male breast cancer (MBC) is relatively rare, affecting 2,000 men in the United States each year and comprising approximately 1% of all breast cancer diagnoses (Siegel et al., 2016). MBC is far rarer than breast cancer in women; however, mortality for those diagnosed with MBC is significantly higher than women diagnosed with breast cancer (Lautrup et al., 2018). Researchers have estimated that men with breast cancer are more than 40% more likely than women to die of breast cancer (Abreu et al., 2016; Lautrup et al., 2018). Men also have lower survival odds at every stage of cancer, with higher overall mortality rates (Lautrup et al., 2018; Sung et al., 2020). For men compared to women, the 5-year survival rates for Stage I cancer was 88% versus 93%, Stage II was 80% versus 86%, Stage III was 63% versus 70%, and Stage IV was 21% versus 25% (Sung et al., 2020).

The differences in mortality rate between men and women with breast cancer may be partly attributed to the differences in diagnosis patterns between MBC and female breast cancer (FBC; Cutrone et al., 2018; Lautrup et al., 2018). MBC is often diagnosed after the age of 70, while the average age of diagnosis for FBC is 61 (Lautrup et al., 2018). Age decreases the survival rate of breast cancer at every stage, so an older man is more likely to die at Stage I than a younger man also diagnosed at Stage I (Lautrup et al., 2018). However, MBC is more likely to be diagnosed at later stages than FBC, further contributing to the lower breast cancer survival rates experienced by men (Keinan-Boker et al., 2018; Lautrup et al., 2018).

Researchers have argued that the breast cancer screening routinely offered to women aged 50–69 may explain why MBC is diagnosed at a later stage and why men are older when diagnosed (Lautrup et al., 2018). However, this argument does not entirely explain why men are more likely to die of breast cancer at every stage of diagnosis, or why they are considerably older when diagnosed (Keinan-Boker et al., 2018; Lautrup et al., 2018; Sung et al., 2020). Although the more consistent breast cancer screening women receive may increase the likelihood of detecting breast cancer at an earlier stage when the patient is young, it is debated in the literature (Coleman, 2017) and cannot fully explain the 9-year gap in average breast cancer diagnosis rates between men and women (Lautrup et al., 2018).

Age is just one of many factors that contribute to a woman's risk of developing breast cancer (Sung et al., 2020). Lifestyle factors, such as body mass index (BMI), smoking, drinking alcohol, and exposure to chemicals can affect a woman's risk of developing breast cancer (Sung et al., 2020). Physiological and social factors, such as race/ethnicity, genetics, pregnancy history, education, and socioeconomic status (SES) may affect breast cancer risk (Sung et al., 2020). However, it is not well understood how these factors affect a man's risk of developing breast cancer (Cutrone et al., 2018; Keinan-Boker et al., 2018).

With so many differences in prognoses and diagnoses between MBC and FBC, some risk factors commonly understood in FBC should be explored with MBC patients (Cutrone et al., 2018; Keinan-Boker et al., 2018). Risk factors for MBC, such as education, BMI, and SES, have been underexplored despite these factors being

significant in considering women's risks of developing breast cancer (Cutrone et al., 2018; Keinan-Boker et al., 2018). I attempted to identify the roles of education, SES, and BMI on men's risk of developing, being diagnosed with, and surviving breast cancer.

In one of the few examples of studies examining risk factors associated with MBC, Keinan-Boker et al. (2018) established a correlation between obesity and MBC. Keinan-Boker et al. followed a cohort of over a million Israeli males for 21.3 years on average and found that overweight and obese adolescents were significantly associated with increased risks for adult MBC. However, Keinan-Boker et al.'s study is the only one of its kind, and a similar study had not been replicated on men in the United States.

Establishing the relationship between BMI and MBC is important because obesity (defined as having a BMI greater than 30) is an increasing phenomenon on a worldwide scale. This issue evidenced as a risk-factor in breast cancer development within women (Gershuni et al., 2016) and in Keinan-Boker et al.'s (2018) study on men. Overweight or obese women have increased breast cancer incidences, worse prognoses, and higher mortality rates from breast cancer than other women not considered overweight or obese (Gershuni et al., 2016).

Obesity is also important given how it relates to breast cancer screening (Gershuni et al. 2016). When demographic factors are controlled, obese women are screened less often than thinner women, which may contribute to the higher mortality rates of obese women (Gershuni et al., 2016). This lack of screening may be further exacerbated by lower SES. Lower SES is related to decreased access to health care and quality food

choices, contributing to obesity and reducing the likelihood of screening (Silber et al., 2018).

Researchers have linked MBC to obesity in countries outside of the United States and indirectly to SES (Keinan-Boker et al., 2018; Lautrup et al., 2018). However, despite Keinan-Boker et al. (2018) identifying a need to research education levels in those diagnosed with MBC, education had not been examined as it related to MBC. In the current study, Bandura's (1986) social cognitive theory (SCT) was used to show the importance of education and the environment on individual outcomes. The tenets of SCT were used to better understand the relationship between obesity, SES, education, and MBC. I addressed the roles of education, SES, and BMI on men's risk of developing, being diagnosed with, and surviving breast cancer.

Problem Statement

The problem addressed in this study was the high death rate and delay in diagnoses associated with MBC compared to FBC. MBC affects about 2,000 men in the United States each year; researchers have estimated that men who develop breast cancer are 40% more likely than women to die of breast cancer (Abreu et al., 2016; Lautrup et al., 2018). Although breast cancer within women is well understood, far less is known about breast cancer in men (Abreu et al., 2016; Cutrone et al., 2018; Ferzoco & Ruddy, 2016). Researchers have linked MBC to obesity in countries outside of the United States and indirectly to SES (Keinan-Boker et al., 2018; Lautrup et al., 2018). However, despite Keinan-Boker et al. (2018) identifying a need to research education level in those diagnosed with MBC, education had not been examined as related to MBC. This issue is

a significant problem because without a clear understanding of the risk factors associated with MBC, timely diagnosis and screening are difficult (Keinan-Boker et al., 2018).

Purpose of the Study

The purpose of this quantitative cross-sectional study was to determine whether there was an association between BMI, educational status, income level, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. Many epidemiological studies reported conflicting findings about this subject, leading to a lack of understanding about how these factors relate to MBC (Keinan-Boker et al., 2018; Lautrup et al., 2018). I attempted to improve the understanding of how excess body fat could alter the chances of developing breast cancer in men by examining men's rates of obesity with breast cancer compared to the general public. I also examined how low SES might contribute to the stage at which breast cancer is diagnosed and breast cancer survival rates due to SES's effect on an individual's ability to access medical care.

I aimed to examine the relationship between education, obesity, and SES on MBC; therefore, secondary data on breast cancer epidemiology that included information on a patient's educational status, SES, and BMI were used. Data were collected from the National Cancer Database (NCDB). The NCDB is a clinical oncology database sourced from hospital registry data collected in more than 1,500 facilities (American College of Surgeons, 2020). NCDB data can be used to analyze and track patients with malignant cancer, providing information related to their treatments, outcomes, and demographics (American College of Surgeons, 2020). The data available in the NCDB represent more

than 70% of newly diagnosed cancer cases in the United States; these data show more than 34 million historical records on file (American College of Surgeons, 2020). For the current study, the last 5 years of data (2015 to 2019) were used.

Research Questions and Hypotheses

The following research questions and hypotheses were used to guide the study:

RQ1: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate?

H_o1: There is no association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for educational status.

H_a1: There is an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for educational status.

RQ2: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income?

H_o2: There is no association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income.

H_a2: There is an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income.

RQ3: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status?

H_o3: There is no association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status.

H_a3: There is an association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status.

RQ4: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for income?

H_o4: There is no association between stage of MBC diagnosis and 5-year survival rate, controlling for income.

H_a4: There is an association between stage of MBC diagnosis and 5-year survival rate, controlling for income.

Theoretical Framework

Bandura's (1986) SCT was used as the theoretical framework for this quantitative study. According to Bandura (1986), individuals learn behaviors or attitudes from one another via observation, imitation, and modeling. With repeated exposure, behaviors or attitudes are likely to be integrated into an individual's personality (Bandura, 1989; Stacey et al., 2015). Bandura (1986) posited that behavior and knowledge are influenced by environment, cognitive ability, and human agency.

As examined in the current study, SCT asserts that an individual's behavior, such as nutritional and health care choices, is influenced by their environment. In this study, the environment was represented by the individual's SES and levels of education. These behaviors may also influence an individual's likelihood of developing and surviving MBC (Keinan-Boker et al., 2018; Lautrup et al., 2018). Therefore, I examined how environmental factors (e.g., education, SES), behavioral factors, and BMI contributed to

breast cancer development, diagnoses, severity of the disease, and morbidity and mortality rates.

SCT has been used in a wide variety of research contexts because it is a loosely connected theory (LaMorte, 2019). However, there were some drawbacks to SCT related to the current study. SCT focuses on learning; therefore, it does not account for biological and hormonal predispositions that influence individuals (LaMorte, 2019). This aspect was relevant to the current study because SCT could not explain a biological basis for behavior that might affect cancer diagnosis, such as a genetic disposition toward obesity. Although the SCT could not account for other biological basis for cancer, such as genetics (LaMorte, 2019), the issue was irrelevant because I adjusted the results for a family history of cancer. SCT also did not account for an individual's ability to perform a behavior, rather their likelihood of attempting to do so based on the desire, perceived importance, and individual self-efficacy (LaMorte, 2019). As perceived through the lens of SCT, an individual's SES could affect their health-care-seeking behaviors but could not account for other factors that might have influenced those behaviors, such as a lack of health insurance. Although SCT was an appropriate framework for the current study, these limitations are considered in the interpretation of the results in Chapter 5.

SCT was used to underpin this study, including the development of the research questions, conduct of data analyses, and interpretation of results. With the incorporation of SCT into the study, the results might have theoretical, empirical, and practical implications for the understanding of SCT by bolstering the applicability of SCT in MBC research. This study may have practical implications for practitioners' understanding of

how the environment and behavior affect breast cancer development, as well as implications for further research in this field of study.

Nature of the Study

I used a quantitative cross-sectional design. The goal of quantitative research is to examine the relationship between an independent variable and a dependent variable (Brannen, 2017). In the current study, the independent variables were SES, represented by education (ordinal) and income (numerical), and BMI (numerical). The dependent variables were stage of cancer diagnosis (categorical) and 5-year survival (binary). A quantitative approach was appropriate because the goal of the study was to examine the relationship between quantifiable variables rather than explore the lived experiences or observations of participants (see Brannen, 2017). Unlike qualitative researchers, quantitative researchers rely on convergent reasoning rather than divergent reasoning. I analyzed the observed data and discussed the demonstrated results rather than observing data and extrapolating to create new meaning, as in qualitative research (see University of Southern California, 2019). Cross-sectional designs are useful when examining a phenomenon that has already happened, as opposed to a phenomenon in progress (Gigi et al., 2014). I used a cross-sectional design by examining each new case of cancer emergence in patients from the last 5 years, as recorded in the NCDB.

Definitions

Socioeconomic status (SES): The social standing or class of an individual or group. SES is often measured as a combination of education, income, and occupation (Cutrone et al., 2018).

Stage 0 cancer: Cancer that have remained in the location of their origins and have not spread to nearby tissues. This stage of cancer is often highly curable and treated with surgery (American College of Surgeons, 2020).

Stage I cancer: A small cancer or tumor that has not grown deeply into nearby tissues. Also, Stage I cancer has not spread to the lymph nodes or other parts of the body. Stage I cancer may also be called early-stage cancer. This cancer is usually less curable than Stage 0 (American College of Surgeons, 2020).

Stage II cancer: Larger cancers or tumors that have grown more deeply into nearby tissue. This cancer may spread to lymph nodes but not to other parts of the body. This cancer is usually less curable than Stage I (American College of Surgeons, 2020).

Stage III cancer: Cancers or tumors larger than Stage II that have grown more deeply into nearby tissue. This cancer may spread to lymph nodes but not to other parts of the body. This cancer is usually less curable than Stage II (American College of Surgeons, 2020).

Stage IV cancer: A cancer that has spread to other organs or parts of the body. Stage IV cancer is also called advanced or metastatic cancer. This cancer is usually less curable than Stage III (American College of Surgeons, 2020).

Significance

The results of this study may provide a more definitive link between SES represented by education and income, obesity, and MBC. MBC has become an increased public health issue, especially as obesity rates among males in the United States continue to rise (Keinan-Boker et al., 2018). Insights from the current study may guide health

practitioners, breast cancer organizations, and men toward developing plans for weight loss and maintaining BMIs lower than 30, according to individual SES and education levels.

Results of this study may also have significance to the individuals possibly at-risk for MBC, especially because increased mortality is associated with MBC (Lautrup et al., 2018). Because obesity is the second leading preventable cause of disease, understanding the relationship between education, obesity, and MBC may decrease the prevalence of onset, mitigating the contributing factors from SES. For low SES, preventive measures may benefit men possibly at risk of breast cancer due to education, obesity, or family history. Results may also be used to create novel initiatives for prevention of MBC, possibly increasing patient outcomes and lowering the mortality rate associated with MBC.

This study may also have theoretical implications. This study may bolster the applicability of SCT in MBC research. The study may also have practical implications for practitioners wishing to understand how the environment and behavior affect breast cancer development. The study may have implications for future researchers continuing inquiry into this field of study.

Summary

I examined the high mortality rates and delays in diagnoses associated with MBC compared to FBC. MBC affects about 2,000 men in the United States each year; researchers have estimated that men who develop breast cancer are 40% more likely than women to die of breast cancer (Abreu et al., 2016; Lautrup et al., 2018). The purpose of

the current quantitative cross-sectional study was to determine whether there was an association between BMI, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. The study's research design was a quantitative cross-sectional design guided by Bandura's (1986) SCT with data from the NCDB.

Chapter 2: Literature Review

Overview

Though MBC is rare, affecting 2,000 men in the United States each year and comprising approximately 1% of all breast cancer diagnoses (Siegel et al., 2016), mortality for those diagnosed with MBC is significantly higher than women diagnosed with breast cancer (Lautrup et al., 2018). Though there was a gap in research regarding the differences in mortality rates between men and women with breast cancer, recent research suggested that the diagnostic differences between men and women may be partially attributable to later breast cancer detection and undertreatment in men (Cutrone et al., 2018; Lautrup et al., 2018). The average age of women diagnosed with breast cancer is approximately 10 years younger than the average age of men diagnosed, meaning that the survival rates for men are lower (Lautrup et al., 2018). However, granular research on breast cancer survival rates between men and women suggested that men experience poorer outcomes at every cancer stage than women (Keinan-Boker et al., 2018; Lautrup et al., 2018).

Though age is an important factor in understanding cancer survival rates, the rates of breast cancer survivorship among women is influenced by socioeconomic factors, health factors, and education levels (Cutrone et al., 2018; Keinan-Boker et al., 2018). Though education, SES, and obesity as outcome mediators for women have been well explored, these same indicators were underexplored in men diagnosed with breast cancer (Keinan-Boker et al., 2018). The goal of the current study was to examine the relationship between education, obesity, and SES on MBC.

To justify the need for the current study, I reviewed recent literature related to breast cancer survivorship in men and women; such research highlighted gaps in understanding MBC treatment and mortality rates. Additionally, I considered gaps in research regarding MBC diagnoses, treatments, prevention, and cultural perceptions. Relevant studies for the literature review were gathered through electronic journal databases. At least 85% of the included studies were published between 2016 and 2020. A small number of older studies were included for seminal contributions to academic understanding. The following search terms were used jointly and singularly to yield relevant results: *breast cancer*, *male*, *female*, *survivorship*, *mortality rate*, *obesity*, *SES*, *obesity*, *education level*, and *treatment*.

Theoretical Framework

Bandura's (1986) SCT was used as the theoretical framework for this quantitative study. According to Bandura (1986), individuals learn behaviors or attitudes from one another via observation, imitation, and modeling. With repeated exposure, behaviors or attitudes are likely to be integrated into personality (Bandura, 1989; Stacey et al., 2015). Bandura (1986) posited that behavior and knowledge are influenced by environment and cognitive ability, as well as human agency. The theory models human behavior using a reciprocal model in which personal factors, environmental factors, and behavioral factors interact to explain human reactions and experiences.

SCT has been used as a theoretical framework for several study types including sociological, educational, and behavioral studies. More recently, researchers have used SCT to explain disease prevention and understand how individuals make choices that

impact their health (Oyibo et al., 2018). Disease preventions studies using an SCT framework have indicated that SCT is useful in explaining that individuals make choices and adopt behaviors not only based on their experiences but also because they observe the actions of others; therefore, individuals draw conclusions and develop biases unrelated to the information directly presented to them (Oyibo et al., 2018). SCT was used to underpin the current study, including the development of research questions, conduct of data analyses, and interpretation of results. The tenets of SCT, including cognitive ability and environmental factors, were used in developing the research questions.

Literature Review

Characteristics of Male Breast Cancer

This section discusses characteristics related to MBC. Covered topics include pathological characteristics in the disease (Vermeulen et al., 2017), specifically how these characteristics compare to breast cancer in women. Additional topics include rates of MBC (Yalaza et al., 2016), screening and delayed treatments (Woods et al., 2019), and increased rates of mortality in men (Reiner et al., 2017).

Pathological Characteristics

Researchers have documented the pathological and histological features of FBC, leading to robust treatment protocols and improving patient outcomes (Vermeulen et al., 2017). However, researchers had not examined whether the same characteristics apply to MBC and whether the same treatment protocols apply. Increasing academic understanding of the disease characteristics of MBC may inform the medical community

about treatments for MBC patients and whether separate gendered protocols are desirable or warranted (Vermeulen et al., 2017). In an early exploration of the carcinogenesis of MBC and FBC, Anderson et al. (2004) used breast cancer records from the Surveillance, Epidemiology, and End Results (SEER) database. A major finding of the study was that the age incidence in women was bimodal, meaning there were two incident peaks at age 52 and 71. However, men experienced a single incidence peak at 71.

Anderson et al. (2004) also found similarities between breast cancer pathology in men and postmenopausal women, while premenopausal women showed different characteristics. For example, men and postmenopausal women had higher rates of low nuclear grade, estrogen, and progesterone receptor-positive expression. Anderson et al. determined that this presentation was associated with favorable prognosis outcomes, differing from much of subsequent research showing that men's survival odds were worse than women. The similarities between MBC and breast cancer in postmenopausal women suggest an avenue of research and medical treatment that may allow men with breast cancer to benefit from the research and treatment done on postmenopausal women (Anderson et al., 2004).

Like Anderson et al. (2004), other studies revealed similarities and differences in the epidemiology of breast cancer in men and women (Weiss et al., 2005). Weiss et al. (2005) concluded that the diseases presented similarly, with the BRCA2 genetic mutation as a common indicator for both genders. Weiss et al. further concluded that an outsized portion of MBC might occur due to hormone imbalances associated with obesity, testicular disorders, or radiation exposure. Unlike FBC, Weiss et al. believed that risks of

MBC included prostate cancer. Despite differences in the causes of the disease, Weiss et al. concluded that MBC and FBC had sufficient similarities that research for either gender could produce useful findings for both.

Years later, addressing the gap still present in literature, Vermeulen et al. (2017) studied 1,483 MBC patients recruited from the European Organization for Research and Treatment of Cancer International Breast Cancer Program. Vermeulen et al. aimed to assess the characteristics of breast cancer in men by considering histological subtype, grade, mitotic activity index, and fibrotic focus and density of lymphocytes. Vermeulen et al. correlated the previously mentioned features with breast cancer outcomes among the male patients. Vermeulen et al. found that histological grade was not associated with patient overall survival. The presence of fibrotic focus and low lymphocyte density was associated with poorer survival odds. Vermeulen et al. noted that these findings deviated from literature on FBC, which showed an association between survival odds and histological grade in women. These findings contributed to literature by emphasizing that MBC and FBC presented with different disease characteristics and associated outcomes, suggesting the need for male-specific disease research.

Other characteristics of MBC include the presence of precursor lesions near the invasive cancer indigence (Doebar et al., 2017). In a study of 1,328 breast cancer patients, Doebar et al. (2017) found that ductal carcinoma in situ was associated with better overall survival odds for MBC patients. The most commonly seen precursor legion in MBC patients was ductal carcinoma. Meanwhile, the rate of lobular carcinomas was much lower. However, columnar cell-like legions were seen as a precursor to MBC.

Doebar et al. argued that these findings presented important disease characteristics useful in designing screening and treatment protocols for MBC patients, in addition to providing important information about patient survival outcomes.

Rates of Male Breast Cancer

MBC is rare, and only 1% of all breast cancer diagnoses worldwide relate to men (Yalaza et al., 2016). Carcinomas in men and women are different but share similarities. Due to a lack of data on MBC and the similarities in carcinomas, most academic understandings of MBC come from FBC (Yalaza et al., 2016). Yalaza et al. (2016) noted a gap in the literature relating to MBC, stating that studies that made up the body of literature related to men were small in scope and lacking the level of academic rigor present in the studies of FBC. Lopez (2019) echoed the need for a better understanding of population level data and treatment protocols for MBC. Due to incomplete diagnostic information, the rarity of the disease, and the less prevalent screening for men, 40% of breast cancer diagnoses for men occur when the disease is in Stage III or IV (Yalaza et al., 2016). According to Yalaza et al., 2016, the 5-year survival rate for breast cancer in men is 40% compared to 65% in women. This overall survival rate is lower for men than women, but some literature suggested that the survival rate is equal for both genders when pairing patients' ages and cancer stages (Yalaza et al., 2016).

In a widespread study of the population characteristics of men diagnosed with breast cancer, Elimimian et al. (2020) found that diagnoses for MBC have increased faster than diagnoses for FBC. Between 2004 and 2016, the rate of diagnoses in men increased by 48%, while the rate of diagnoses for women during the same period

increased by 42%. The characteristics differences between men and women related to ethnicity and other factors remained relatively insignificant, except men tended to be diagnosed at older ages. Additionally, men had higher rates of comorbidities than women. Finally, men tended to receive later stage diagnoses than women. Elimimian et al. concluded that these statistics suggested a need for more education and screening of breast cancer in men to drive earlier detections and reduce mortality rates.

Other studies suggested that the percentage of breast cancer cases associated with male patients may increase at faster rates in specific geographic regions (Isah et al., 2019). Some regions have shown a higher increase in total cases, as well as a greater proportion of male patients compared to total patients (Isah et al., 2019). In a review of literature on MBC in Africa, Isah et al. (2019) found that the cases of MBC in Africa increased at a rate between 5% and 15% higher than the global averages. In Nigeria, Isah et al. found that MBC cases made up 3.7% and 9% of total breast cancer cases. Globally, MBC makes up 1% of total breast cancer cases (Siegel et al., 2016).

There is a gap in literature related to breast cancer detection in men (Leone et al., 2019; Yalaza et al., 2016). The literature that exists suggested that men are diagnosed at an older age with a later stage of the disease than women. Advanced ages and cancer stage are universally connected to a poorer prognosis when treating cancer, but less information is known about treating early-stage breast cancer in men (Leone et al., 2019). Addressing a lack of information about the survivability of early-stage breast cancer in men, Leone et al. (2019) studied 1,263 patients. Leone et al. found that prognoses for

early-stage detection in men were favorable, but other indicators, such as marital status, decreased survivability. Unmarried men had poorer cancer outcomes than married men.

Screening and Delayed Treatment

Outcomes for MBC are worse than outcomes for FBC, but the discrepancy is largely due to later detection and delayed treatment (Woods et al., 2019). This discrepancy may be driven by a lack of guidelines related to breast cancer screenings for men (Woods et al., 2019). Unlike for women, there are no universal recommendations for image-based screening for men; however, image-based screening is generally considered a reliable testing procedure. Though Woods et al. (2019) argued the merits for screening men for breast cancer through imaging, there were drawbacks such as increased costs with comparatively fewer benefits. The rates of MBC remain low, particularly when compared to the rates of testicular cancer or cancers not traditionally associated with a particular gender. However, as noted by Elimimian et al. (2020), the rate of detection of MBC has increased.

In addition to a general lack of screening protocols, there is a lack of awareness of MBC (Patel et al., 2020). Awareness campaigns for FBC have been successful, leading to a significant increase in cancer-specific research performed independently by female individuals and patients (Patel et al., 2020). Some researchers aimed to assess the general awareness of men compared to women; for example, Patel et al. (2020) analyzed internet-relative search volumes or the number of internet searches performed relating to MBC and FBC. October of every year is breast cancer awareness month, and the searches related to breast cancer increase by 180%. Breast cancer awareness month targets

women, and no similar efforts targeting breast cancer awareness in men have led to a significant increase. Men's cancer awareness campaigns are less successful, even when considering awareness of more common cancers in men such as testicular cancer (Patel et al., 2020).

Research on treatment protocols for MBC is less developed than treatment protocols for FBC (Venigalla et al., 2018). Therapies commonly used for women with breast cancer are underused among men, even when the treatment demonstrates positive impacts on patients. For example, adjuvant endocrine therapy is a common treatment in women, but there is underuse in the male population with breast cancer (Venigalla et al., 2018). Adjuvant endocrine therapy is available to patients with hormone receptor-positive breast cancer. In a cohort study with 10,173 male patients and a comparison group of 961,676 women, Venigalla et al. (2018) found that men more frequently presented with HR-positive breast cancer (94% compared to 84.3%). Despite a larger percentage of men presenting with the HR-positive disease, men were less likely than women to be treated with adjuvant endocrine therapy than women. These treatments were associated with improved overall breast cancer survival in women, and Venigalla et al. argued that use of adjuvant endocrine therapy should be further researched in men.

Increased Risks and Mortality

Though studies have been somewhat contradictory, the consensus in the literature is that men face higher mortality rates from breast cancer when comparing total cases to 5-year life survivorship (Reiner et al., 2017). Additionally, men with breast cancer experience several other higher risks, including complications, comorbidities, depression,

and stigma (Astani, 2019). There are also greater risks and complications associated with specific tumor types associated with the sex of the cancer patient (Leone et al., 2019; Venigalla et al., 2018).

There is evidence to suggest that comorbidity may be twice as high for men with breast cancer as for women with breast cancer (Zoorob et al., 2019). In a serial cross-sectional analysis of the 2002 to 2014 National Inpatient Sample, Zoorob et al. (2019) found that the comorbidity burden in men was twice as high as the comorbidity burden in women, suggesting a significant difference based on patient gender. The overall rate of comorbidity for both genders doubled between 2002 and 2014. Therefore, not only were men experiencing a higher number of comorbidities along with a breast cancer diagnosis, but the overall rate of comorbidity detection had also increased between 2002 and 2014. Zoorob et al. found that comorbidity, whether physical or psychological, resulted in poorer patient mortality outcomes.

On average, men with breast cancer are of more advanced age than FBC patients. The cancer risk, combined with risks associated with advanced years, results in higher risks for men with breast cancer (Reiner et al., 2017). An example of a dangerous comorbidity associated with MBC is arterial thromboembolic events. The risk of arterial thromboembolic events increases with age, and study results have shown that the risk increases further in men with breast cancer (Reiner et al., 2017). In a study of men with breast cancer between 2002 and 2011, Reiner et al. (2017) considered a matched cohort of 881 men. The results suggested that men with breast cancer were at higher risks for

arterial thromboembolic events than men without breast cancer or women with breast cancer.

Other researchers have conducted similar analyses by comparing mortality and health outcomes of men and women after controlling for mediating variables (Wang et al., 2019). Comparing outcomes of 16,000 men and 1.8 million women with breast cancer over the course of 10 years, Wang et al. (2019) confirmed the findings of numerous other researchers that men were diagnosed with breast cancer at later ages. Many characteristics could be explained by the higher ages at the time of diagnosis, but Wang et al. found that after controlling for all other factors, the male sex remained associated with poorer overall outcomes.

In addition to poorer outcomes associated with MBC as breast cancer in females, some evidence has shown that prognoses improvements in men are not similar to prognosis improvements in women. In a longitudinal study of breast cancer prognoses in both men and women, Astani (2019) found that prognoses for women have steadily increased over the past decade. However, when considering the prognosis improvement in men, there has been relatively little change. Though there are several unanswered questions in literature related to MBC, Astani argued the need for literature to establish a greater understanding of the pathology differences between men and women and effective treatment protocols. Astani found that earlier detection could be a primary driver of prognosis improvement.

Some discrepancies in the study findings may have resulted from granularities in the breast cancer diagnoses compared to studies focusing on breast cancer more

generally. For example, more men contract HR-positive breast cancer, and the type of tumor impacts detection, treatment, and prognosis (Leone et al., 2019; Venigalla et al., 2018). In a study of men and women with HR positive breast cancer, Leone et al. (2019) found that men with HR-positive tumor types had twice the risk of death as women with the HR-positive tumor types. This specificity in terms of diagnosis adds significant granularity to the comparison of men and women with breast cancer. Leone et al. found men and women had similar outcomes overall in Stages III and IV, but men had significantly worse outcomes than women in Stages I and II.

Though most studies, including those mentioned above, suggest that men face worse outcomes related to breast cancer, some researchers present conflicting evidence (Bender et al., 2017; Reiner et al., 2017). Comparing both disease-free survival and overall survival, Bender et al. (2017) conducted a cohort-study with Brazilian breast cancer patients. Comparing male patients to female patients, Bender et al. matched male patients to female patients and utilized patient records to analyze the differences. The final population included 98 men and 294 women. Bender et al. determined that several factors, such as marital statuses, comorbidities, smoking, alcohol consumption, and tumor types, impacted patient survivability, but sex alone did not significantly impact survivability or mortality. Bender et al. and Wang et al. (2019) produced directly contradictory findings using a similar analytical technique. The discrepancies between these two findings may warrant further exploration and have not been thoroughly addressed in literature at present.

Though most reviewed studies showed a difference in outcomes for men and women with breast cancer (Leone et al., 2019; Venigalla et al., 2018), Bender et al. (2017) was not the only research group to determine that no significant differences existed between men and women (Wu et al., 2017). Like Bender et al. (2017), Wu et al. (2017) found no significant differences between the survivability of men and women with breast cancer when controlling for mediating variables. To support Bender et al. (2017)'s findings further, Wu et al. (2017) found that disease characteristics did differ between men and women. Unmarried men had higher rates of breast cancer and poorer outcomes than married men. Additionally, men had higher rates of estrogen receptor-positive, progesterone receptor-positive, and a lower overall frequency of liver metastases. Wu et al. found that the overall survivability factors were higher for patients with estrogen receptor-positive disease.

Risk Factors Among Women

As mentioned, there is a significant gap in literature regarding screening, treatments, and prognoses for MBC (Yalaza et al., 2016). However, there is a significant body of literature on the risk factors for women related to breast cancer. Due to the substantial gap in data related to men, considering the risk factors for women and how they may relate to risk factors for men is a useful starting place for further research into MBC. This section reviews risk factors of breast cancer for women, such as SES, obesity, education levels, and ages. The following section also covers the impact of marital status on breast cancer diagnosis and prognosis, as marital status in men is one of the few characteristics well established as a risk factor for men (Wu et al., 2017).

Socioeconomic Status

There is a substantial body of evidence showing socioeconomic disparities related to FBC (Dreyer et al., 2018). In general, women of lower economic status have higher rates of contracting breast cancer and worse prognoses when they do contract it. Specifically related to survival, Dreyer et al. (2018) found that poor and nearly poor women were less likely to survive a breast cancer diagnosis than women of a higher SES for at least 5 years. Some differences in outcomes for poor and higher income may relate to the differences in treatments for poor and higher income women. Dreyer et al. found that higher SES women were more likely to receive treatments and tests, such as sentinel lymph node biopsies and radiation, after breast conserving surgeries. Additionally, poorer women were less likely to receive therapies, such as axillary surgery or adjuvant chemotherapy (Dreyer et al., 2018). These results relate to Venigalla et al.'s (2018) findings that men are less likely to receive adjuvant chemotherapy, influencing the survivability of men and lower-income women.

Dreyer et al.'s (2018) findings correlate with other studies on the impact of SES and the survivability of breast cancer (Silber et al., 2018). Adding additional granularity to the findings, Silber et al. (2018) found that the main difference in survival was a result of breast cancer diagnoses occurring at later stages in low-income women than higher income women. The poorer health of lower income women also resulted in a higher degree of comorbidity and overall health-related weaknesses. Additionally, Silber et al. argued that most of the income disparities in cancer survivability among women related to the above-mentioned factors rather than to differences in treatments referenced by

Dreyer et al. (2018). These findings relate to numerous studies of MBC that have found that men have poorer survivability of breast cancer due to the more advanced stage of common diagnosis (Bender et al., 2017; Wu et al., 2017).

Obesity

In addition to socioeconomics, obesity impacts breast cancer rates and survivability (Picon-Ruiz et al., 2017). Picon-Ruiz et al. (2017) argued that the increasing rates of obesity presented serious health concerns at the population level, specifically regarding breast cancer rates. Utilizing a systematic review format, Picon-Ruiz et al. found that obese women were more likely to contract breast cancer and less likely to survive the disease. In a population level study of women over the age of 60 with breast cancer, almost 40% were obese (Picon-Ruiz et al., 2017). Overall, studies on breast cancer estimated that obese women were nearly 30% more likely to contract breast cancer than nonobese women (Picon-Ruiz et al., 2017). Additionally, obesity was associated with higher rates of contracting more aggressive disease types, such as ER-positive and PR-positive breast cancer.

In addition to a higher association of contracting breast cancer (Picon-Ruiz et al., 2017), obesity is associated with poorer outcomes surviving the disease and greater incidences of recurrence (Balaban et al., 2017; Lee et al., 2019). Using a literature review format, Lee et al. (2019) found that obese women had lower disease-free survival rates than nonobese women and greater chances of disease recurrence. Additionally, obese women experience higher numbers of negative or fatal complications during surgery, radiation, and chemotherapy compared with nonobese women. Furthermore, endocrine

therapy is less impactful in women who are obese compared to those who are not, suggesting that treatment protocols are less effective.

Education Level

Like socioeconomic levels, there are disparities in breast cancer contraction and mortality rates among women with lower education levels (Trewin et al., 2017). According to Trewin et al. (2017), lower education women pre-2000 had far higher breast cancer incidence and mortality rates than women with higher education levels. Advancements in breast cancer research and treatments improved outcomes for women after 2000. Trewin et al. conducted a linked pairs study using Poisson models to calculate absolute and relative educational differences in breast cancer outcomes standardized by ages. The researchers used data from 1971 to 2009 and found the pre-2000 rates and mortality were significantly higher for lower income women. However, after 2000 the mortality rates were not significantly higher for lower education level women. However, incidence rates remained 38% higher among women of lower education levels. These results suggest that while treatment is more equitable between higher and lower education levels of women, women of lower education level are still much more likely to contract breast cancer than women with more education. Despite improvements, breast cancer mortality rates are highest among lower education levels for women under the ages of 50 (Trewin et al., 2017).

Though Trewin et al. (2017) found that progress had been made in reducing outcome disparities between women with low and high education levels, Hwang et al. (2017) found that disparities still existed. Hwang et al. conducted a widespread study to

determine the role of education level in breast cancer patient prognosis. Hwang et al. used data from 64,129 breast cancer patients cataloged in the Korean Breast Cancer Registry. Hwang et al. categorized women with under 12 years of education as belonging to the low education level group, while women with 12 years of education or more were considered as the high education level group. Hwang et al. performed a survival analysis on the two groups to determine the impact of education on breast cancer prognosis. The researchers found that women in the high education level group older than 50 had a better breast cancer prognosis than women belonging to the low education level group. However, Hwang et al. found that the prognosis was not significantly different for women who were under 50. For all molecular types of breast cancer, educational level was an important indicator of breast cancer prognosis. Hwang et al. found that women in the higher education level group were more likely to be treated with chemotherapy when considered optional, which could impact breast cancer prognosis.

Other Contributory Factors

Other factors influence breast cancer incidences and prognoses, such as the age at diagnosis, marital status, and occupation (Partridge et al., 2016; Sritharan et al., 2019). For example, researchers found the type of occupation as having a contributory risk to breast cancer (Sritharan et al., 2019). The type of activities and exposures found on a jobsite influenced breast cancer rates in both men and women. Such activities resulted in higher breast cancer rates and included sedentary behaviors, shift work, radiation, and exposure to chemicals. Regarding overall riskier professions, Sritharan et al. (2019)

found that individuals who worked in the nursing and healthcare industry, social sciences, and janitorial professions were more likely to develop breast cancer, regardless of gender.

Another important factor in the diagnosis of breast cancer is age (Partridge et al., 2016). Though studies suggest that men being diagnosed at older ages than women contribute to poorer prognoses, research on breast cancer in women present complicated findings regarding age (Elimimian et al., 2020; Partridge et al., 2016). Studies comparing MBC and FBC suggest that men being diagnosed at older ages result in poorer prognoses, and earlier detection at younger ages in women leads to higher survival odds and better outcomes. However, Partridge et al. (2016) found that women diagnosed with Stage I or II breast cancer under certain ages experience worse outcomes than older women diagnosed with similar breast cancer presentations. Partridge et al. found that women diagnosed with breast cancer under the age of 40 were 90% more likely to die from breast cancer than women diagnosed between the ages of 51 and 60. However, the results relating to FBC and age are more reflective of the findings related to men when considering an older group of women. Furthermore, the study found that when adjusting for mediating variables, there was no difference in prognosis for women diagnosed in all the age groups over 40. The finding that the age of women over 40 does not impact prognosis after controlling for tumor type suggests possibly contradictory evidence with studies of breast cancer in men.

In addition to profession, and age, marital status can impact breast cancer incidences and prognoses. The literature suggests that married patients have lower mortality rates than unmarried breast cancer patients (Martínez et al., 2017). Disparities

between prognoses for married and unmarried women were different based on mediating variables, such as SES, neighborhood, and race. Overall, unmarried women experienced poorer prognosis than married women. These results support Leone et al. (2019)'s finding that unmarried men experienced poorer prognosis than married men when diagnosed with breast cancer.

Further extrapolating on the finding that married women experienced better breast cancer prognosis and lower mortality rates than unmarried women, Hinyard et al. (2017) found that married women were diagnosed, on average, at earlier stages than unmarried women. Hinyard et al. further confirmed that consensus in literature that unmarried women experienced poorer breast cancer outcomes but explained that the literature was not yet sure why the association between marital status and survival presented so strongly. Using the SEER database and evaluating data from women ages 25 to 64, Hinyard et al. found that unmarried women were 1.18 times more likely to receive later stage diagnoses than married women. In addition to the confirmation of disparity, Hinyard et al. recommended that younger unmarried women might benefit from additional counseling and support services to help close the prognosis and survival gap.

Risk Factors Among Men

As discussed, there is a wide body of literature on risk factors for women related to breast cancer incidences and mortality rates (Partridge et al., 2016). However, due to the comparative rarity of breast cancer in men, there is less information about risk factors associated with higher mortality, higher incidence, or poorer outcomes in men (Gucalp, et al., 2019). As mentioned, breast cancer research in women is considered when

formulating hypotheses regarding men due to the limited nature of male-specific research (Gucalp et al., 2019). However, there are some important differences between MBC and FBC diagnoses that warrant additional male specific research. Some differences include the finding that male specific breast cancer almost exclusively presents as hormone receptor positive. Additionally, breast cancer in men presents a stronger association between the BRCA2 germline mutation. This section addresses male-specific risk factors, including race, hereditary factors, occupations, ages, presence of childhood cancers, socioeconomic factors, obesity, and education levels.

Race

Race was selected as an important factor in modeling incidence and outcomes of breast cancer in men due to established research on the impact of race on women (Sung et al., 2020). Literature established Black women had higher incidences of triple-negative breast cancer but lower rates for hormone receptor positive cancers (Sung et al., 2020). However, there is less established research on how race impacts breast cancer in men. To address the gap, Sung et al. (2020) used nationwide breast cancer data from 2010 to 2016 from men and women to establish the impact of race. Among men, Sung et al. found that rates were higher in Black men than in White men for all cancer-subtypes. The incidence ratio among Black and White men was 1.41. Interestingly, Sung et al. found that Black women had lower rates of cancer than White women.

Adding further confirmation for racial disparities in breast cancer outcomes by race, Parise and Caggiano (2019) explored the rates of breast cancer in White, Black, Hispanic, and Asian/Pacific Islander men. Before undertaking the study, Parise and

Caggiano noted that prior literature found that Black men had higher rates and higher mortality associated with breast cancer than White men. However, fewer studies have explored the rates of breast cancer in Hispanic men and Asian/Pacific Islander men. To address the gap in literature, Parise and Caggiano utilized the California Cancer Registry from the year 2000 to 2015 to gather data on 1,497 MBC patients. The registry data included a Comorbidity Index. Without adjusting the data, Parise and Caggiano found that Black men had higher comorbidities and worse survival rates than White men. However, when black men and white men both had low comorbidity scores, their survival odds were the same. Compared to White men, Hispanics and Asian/Pacific Islanders had higher odds of survival. These results suggest that the racial disparities in breast cancer survival among men relate to comorbidity rather than disease presentation stemming from racial differences.

Though adjusted breast cancer mortality rates reflect a lack of racial difference in some studies (Parise & Caggiano, 2019), there is evidence to suggest differences in tumor presentation among men of different races. However, the cause for the different tumor presentation is largely unknown, and controlling for all possible contributory variables is a challenge (Sighoko et al., 2017). Using the SEEP database for 1973 to 2012, Sighoko et al. (2017) found that breast cancer incidence rates were 51% higher for black men than for white men. However, black men on average were diagnosed 4 years earlier than white men and 1 year later than women. Compared to white men, black men had higher rates of ER-negative tumors. This finding relates to the findings from Sung et al. Additionally, Parise and Caggiano (2019) found that though black men were diagnosed at a younger

age on average than white men, they were more likely to be diagnosed with more advanced disease stages. The results of Parise and Caggiano's study correlate with results about the racial disparities in tumor presentations between black women and white women.

Hereditary Risks

Genetic risks are discussed as contributory factors to a female's risk of breast cancer, and women with family histories of breast cancer are often encouraged to seek additional screening (Godet & Gilkes, 2017; Postula et al., 2018). Though hereditary risk is established as a contributory factor to women's breast cancer, less information is known about hereditary risk and MBC (Postula et al., 2018). Some researchers aimed to increase academic information about hereditary risk and men's breast cancer; for example, Postula et al. (2018) explored genetic contributors to incidence rates, beyond the better established BRCA1 and BRCA2 markers. Postula et al. studied clinical histories and test results for men with breast cancer who underwent a panel test, including eight breast cancer susceptibility genes that were well established among women. The genetic markers included ATM, BRCA1, BRCA2, CDH1, CHEK2, PALB2, PTEN, and TP53. Postula et al. performed an analysis using *t* test and two-tailed Fisher's exact test. In a study of 381 men, Postula et al. found that 13 exhibited at least one of the genetic markers associated with a higher risk of breast cancer in women. Postula et al. recommended that more research be conducted on the association between breast cancer and male genetics to understand the role genetics could play in screening.

Deviating from the commonly utilized quantitative large-sample study, Krajewski et al. (2018) conducted a case study on a MBC patient to assess the role of genetics in cancer screening in men. The case study focused on a 71-year-old patient diagnosed with breast cancer after a prophylactic screening. The patient had the BRCA marker and underwent breast cancer screening using imaging due to the presumption of increased risks. After undergoing a screening, the researchers determined that the patient was positive for breast cancer. The patient was treated and the disease caught at an early stage. Three years after the treatment concluded, the patient had still not exhibited any signs of recurrence. The researchers used the case study to discuss the benefits associated with understanding the role of genetics in breast cancer occurrence in men. Many men do not start treatment for breast cancer until the disease is in the late stages; therefore, they face worse prognoses than women who undergo screening more regularly. Krajewski et al. (2018) argued that more research remained necessary to understand appropriate screening protocols for men with high genetic breast cancer risks.

Occupational Risks

Due to the rarity of breast cancer in men, researchers have explored the role of occupational hazards in influencing male susceptibility to breast cancer incidence (Grundy et al., 2016). Though initial research on occupational associations with breast cancer risks demonstrated possible impacts for men and women, the rarity of the disease in men made large sample size studies challenging to conduct for a wide range of professions (Grundy et al., 2016). Through seeking to address the gap in literature, Grundy et al. (2016) could obtain only 115 cases from the Canadian National Enhanced

Cancer Surveillance System and 570 controls. The researchers obtained lifetime employment histories for patients and a control group. The lifetime job histories were sorted into three categories based on the degree of occupational magnetic field exposure. The results showed that individuals with breast cancer were more likely to work in high exposure fields than the control group. The group of men who worked in medium exposure professions also experienced all elevated risk of breast cancer. Among men who belonged to the high exposure category for over 30 years, their risks of breast cancer were three times higher than the control group. This evidence suggests elevated risks for breast cancer associated with occupation; thus, additional research is necessary to understand appropriate protections for men in high exposure jobs.

In addition to risks associated with high levels of magnetic exposure, there are increased breast cancer risks associated with exposure to organic solvents (Laouali et al., 2018). Laouali et al. (2018) argued that studies focusing on occupational risks and breast cancer for women might be less relevant to men as gender divides in professions remain. For example, more men remain involved in work with organic solvents than women (Laouali et al., 2018). The researchers determined the relationship between work with organic solvents and breast cancer by studying 104 men with breast cancer and 1,901 control individuals. Similar to the method used by Grundy et al. (2016), Laouali et al. (2018) took a detailed work history from all of the participants and control group. The researchers found that lifetime cumulative exposure to trichloroethylene, which was greater than 23.9 ppm years, was associated with an elevated risk for breast cancer compared to the control group. A more granular review of the study found that the

statistical difference was only present if the high exposure levels continued for at least 10 years before a diagnosis. The researchers also showed possible associations between benzene and ethylene glycol but recommended that more studies be undertaken. Both studies on occupational hazards included in this review noted the data collection challenges necessitated comparatively small sample sizes.

As suggested by the previously mentioned studies, occupational risks associated with breast cancer derive from a variety of factors, including exposure to magnetism, radiation, or chemicals (Fenga, 2016). Though there was substantial research on breast cancer, especially concerning women, Fenga (2016) argued that the occupational breast cancer risks were minimally explored. The researcher tried to understand the occupational components, which could lead to an increased breast cancer risk by undertaking a widespread systematic review of literature of the occupational risks of breast cancer for men and women. The results of Fenga's analysis showed inconsistent literature findings related to occupational risks and breast cancer. There were no consistent findings related to biomarkers that could be used to identify higher than average occupational risks. Additionally, the exposures associated with any workplace were strongly mediated by the lifestyle factors of employees. Some factors related to the workplace but not specific to any particular environmental factor or sector, such as night shift work, were associated with higher risk of breast cancer in both men and women (Fenga, 2016). Regarding further research, Fenga (2016) recommended that further studies should develop models to consider workplace environmental factors (e.g., heavy

metals and employee personal lifestyle choices, such as diet) and job-related factors (e.g., management responsibilities or night shift work).

Socioeconomic Status

Prognosis and incidence inequalities exist between low SES women and higher SES women, possibly stemming from differences in lifestyle and treatment options (Akinyemiju et al., 2018; Newman, 2017; Singh & Jemal, 2018). Some researchers tried to understand if a similar phenomenon exists in men; for instance, Akinyemiju et al. (2018) conducted a systematic review of literature on SES and breast cancer in men to expand on existing literature. Akinyemiju et al. focused on the association between breast cancer risk in men and early life SES. Including studies conducted between 1990 and 2016 collected from online journal databases, Akinyemiju et al. identified only nine possible studies. The low incidence of qualified studies further supports the existence of a gap in many aspects of literature regarding MBC. Contrary to the findings of FBC, early life low SES was associated with a reduced breast cancer risk in men. However, it was associated with higher rates of mortality, confirming many studies related to SES and mortality in women's breast cancer. Studies conducted exclusively in Europe found no relationship between SES and elevated breast cancer incidence or mortality, possibly suggesting health care system differences (Akinyemiju et al., 2018).

Obesity

Just as economic status early in life can shape health-related outcomes (Akinyemiju et al., 2018), early life obesity can impact later incidences of breast cancer in men. Keinan-Boker et al. (2018) utilized a Cox proportional hazard model to assess the

relationship between adolescent obesity and incidence of MBC later in life. The researchers gathered data using examinations from between 1967 and 2011. The examinations were then followed by an analysis in 2012 for breast cancer incidence. Out of the 1,382,093 males included in the initial examination, 100 had breast cancer, and 97 were included in the study. The analysis demonstrated that males obese as adolescents exhibited a higher likelihood of presenting with breast cancer. Keinan-Boker et al. argued that the study results indicated that early obesity intervention could lower the risk of breast cancer later in life and might have other notable health benefits associated with physical fitness in adolescences.

One hypothesis related to the relationship between breast cancer and obesity in males is that breast cancer may be developed in men traditionally considered too young for incidence of obese (Obata et al., 2017). Obata et al. (2017) noted that because breast cancer in men was so rare and typically contracted at advanced ages, screening and prevention efforts were relatively minimal. However, a case study of a relatively young man with breast cancer and obesity as a comorbidity demonstrated the possibility of a more complicated relationship between obesity and breast cancer risk in men than first believed. The man was extremely obese and presented with Type 2 diabetes, which could have resulted in higher risk factors than generally seen in the population (Obata et al., 2017). Though not representing a statistically significant sample or a sample that could be generalized to the larger population, Obata et al. (2017) developed similar recommendations for additional screening and weight intervention as recommended by Keinan-Boker et al. (2018).

Some researchers explored the connection between obesity and breast cancer in men; for example, Freedman and Partridge (2017) argued that further collaboration was necessary at an international level. The relatively small sample sizes belonging to each region and the lack of complete information about prior health and future breast cancer incidence makes widespread quantitative analysis of the association between breast cancer and obesity challenging (Freedman & Partridge, 2017). Freedman and Partridge (2017) further stated that a comprehensive understanding of breast cancer screening, treatment, and prevention in men was lacking, thereby requiring more research.

Education

Similar to women, education level is predictive of breast cancer incidence in men (Restrepo et al., 2019). In a widespread study of various demographic factors which influence breast cancer incidence in men, Restrepo et al. (2019) found that education level was predictive of higher incidence and mortality, in addition to the following factors: race, government insurance, income, and treatment program type. In further corroboration of the influence of educational level on breast cancer incidence and mortality, Trewin et al. (2017) found that educational levels correlated with increased incidences and risks for men and women. However, there is still relatively little research into the relationship between educational level, incidence, and mortality of breast cancer (Restrepo et al., 2019).

Other studies on the impact of sociodemographic features on breast cancer survival have included MBC and FBC patients (Menvielle et al., 2018; Monfared et al., 2017). The utilization of this methodology suggests a perceived usefulness of information

regarding breast cancer in women in treating breast cancer in men. However, other studies have shown gendered differences that have warranted further male-specific information (Partridge et al., 2016). However, in a combined study by Monfared et al. (2017), a log-rank test showed a significant relationship between the 3-year survival rate of breast cancer patients and their ages, educations, childhood residences, siblings, and treatment types. The characteristics of patients' childhoods had an outsized impact on their survival rates, encompassing educational and socioeconomic features. Additionally, family characteristics impacted survival rates for both men and women. Individuals with higher education levels were found to have better odds of 3-year breast cancer survival regardless of gender (Monfared et al., 2017).

Unmet Needs for Breast Cancer Among Men

Due to the rare nature of breast cancer in men compared to women, most literature on breast cancer is either directed exclusively at women or utilizes information gathered through female-dominated literature (Bootsma et al., 2020). Although, the focus on women was likely appropriate due to their statuses as majority patients, Bootsma et al. (2020) argued that male patients should have access to information and treatments supported by research utilizing male participants. Though MBC has some similar indicators and characteristics to FBC, there are sufficient differences in presentation and entomology to justify further research (Bootsma et al., 2019).

Patient Care

Part of the difficulty is a lack of understanding regarding the unmet needs and information needed for male patients (Bootsma et al., 2020). Some researchers addressed

the gap in literature related to unmet needs for male; for instance, Bootsma et al. (2020) used focus groups and paper-based questionnaires. The researchers utilized three focus groups, including 12 patients and two partners. Participants were asked to discuss patient experiences, symptoms, diagnoses, treatments, side effects, follow-up care, psychological impacts, and the coping strategies used. Additionally, patients were asked to discuss their genetic and medical histories in relation to breast cancer. The major findings entailed most patients stating that they lacked information about disease side effects, particularly regarding sexual side effects. Among the health professionals included in the study, an overwhelming 79% needed to search for information regarding breast cancer care in men. These results suggest that patients and professionals both lack information about male-specific breast cancer, especially regarding the side effects (Bootsma et al., 2020).

Taken collectively, this evidence suggests that the structures of care for breast cancer patients are designed to serve women (Ernstmann et al., 2019). The idea that the focus of women might lead to a decreased standard of care of male patients was implied by studies such as Bootsma et al. (2020), but Ernstmann et al. (2019) stated that there was a lack of academic information confirming a detrimental impact. The researchers attempted to address the gap in information regarding men's perspectives on the impact of the focus on FBC patients using semi-structured interviews with 23 MBC patients. The researchers conducted two focus groups with seven and nine participants. Among other findings, the study revealed that men perceived the impact to be a lack of services designed for men, particularly regarding male follow-up care. According to the participants, rehabilitation centers and services were designed for women, and they were

sometimes incapable of accommodating male patients. Furthermore, the channels of interdisciplinary cooperation were less developed for men than women, from the perspectives of the male patients (Ernstmann et al., 2019). Though these disparities, Ernstmann et al. (2019) further argued that MBC patients experienced benefits from the large care structures designed for women. Ernstmann et al. argued that if MBC were a wholly separate disease without female counterparts, there would be substantially fewer patients to motivate research and care structure improvements.

In addition to the direct healthcare impacts of men being treated for a disease primarily seen in women, some researchers argue that the psychological impact, described in greater detail in the following subsection, can result in a delay in treatment (Fentiman, 2018). In a literature review format, Fentiman (2018) discussed evidence that the presentation of breast cancer as a woman's disease contributed to a lack of awareness on the incidence of breast cancer in men. Doubt about its likelihood and a lack of education regarding the possibility can slow the diagnostic process. In some instances, men may be aware of abnormalities in breast tissue but be embarrassed or reluctant to seek medical help (Fentiman, 2018). These types of delays can have dangerous consequences, possibly contributing to higher probability of men being diagnosed with breast cancer at more advanced disease stages.

Psychological

In addition to the practical necessity of acquiring more information for men to provide them with high quality care, some researchers argue that there remain unmet psychological and social needs for men with breast cancer (Quincey, Williamson, et al.,

2016). For example, Quincey, Williamson, et al. (2016) argued that due to the small proportion of male patients, breast cancer had been feminized to the point where care for men with breast cancer was underprioritized. Furthermore, Quincey, Williamson, et al. argued that the feminization of breast cancer had created social stigma for men suffering from breast cancer. Utilizing a systematic review, Quincey, Williamson, et al. considered existing literature on MBC and utilized the principles of critical health psychology. The study findings indicated that men diagnosed with breast cancer often experienced identity crises, issues with masculinity, and unhealthy coping responses. A major study finding was that they perceived the diagnosis to impact their relationships with friends and partners. Quincey, Williamson, et al. argued that the findings indicated that the handling and presentation of breast cancer in academia, medical systems, and the media served to isolate and stigmatize MBC patients.

Men with breast cancer also express a need to cover up their pain and present a face of masculinity and resiliency (Nemchek, 2019). In a phenomenological study utilizing 10 international patients, Nemchek (2019) explored the experiences of men with breast cancer. The major study findings included information on resilience, advocacy, pain, and masculinity. Nemchek noted that many of the men included in the study reported challenges with feeling masculine after receiving a breast cancer diagnosis. This finding supports Quincey, Williamson, et al. (2016) who found that men with breast cancer believed that the diagnosis was a threat to their masculinity and that society stigmatized men who had a disease perceived to exist in females. Multiple participants noted that themselves, their friends, or their families were uncomfortable with language

that they felt was gendered, and calling the disease “breast cancer” (Nemchek, 2019, p. 20) felt feminine. Rather than referring to it as breast cancer, multiple participants said that they referred to it as “chest cancer” (Nemchek, 2019, p. 20).

Using words and terms with a gender-neutral connotation may benefit men who feel stigmatized because of their breast cancer diagnoses (Francis, 2018; Midding et al., 2018; Nemchek, 2019). The idea that breast cancer is a “woman’s disease,” often discussed in terms relatable primarily to women, can result in men believing that they are not receiving a high standard of care or that their experiences and challenges are less legitimate than those experienced by women with breast cancer (Midding et al., 2018). In a mixed-methods study utilizing interviews and survey data, Midding et al. (2018) found that the levels and type of stigmatization differed based on patient characteristics. The treatment methodologies used also impacted those characteristics.

Other studies focus on how the healthcare system and workers have inadvertently marginalized MBC patients due, in part, to a lack of employee training or facilities designed to accommodate MBC patients. In a combined systematic review and phenomenological examination, Quincey, Shokuhi, et al. (2016) discussed the experiences of men within the healthcare system while undergoing breast cancer treatment and screening. The phenomenological examination included 31 men who underwent interviews to describe their experiences. Patients described experiences within the healthcare system that clearly communicated that breast cancer was a female disease. Examples included male patients not being allowed in waiting rooms for FBC patients. Other participants described experiences where the healthcare practitioners referred to

them as “Mrs.” as a default, as if all the patients in the waiting room were female. In a third example, healthcare workers questioned the patient when he shared his diagnosis (Quincey, Shokuhi, et al., 2016).

Informational

In addition to care systems set up to treat women and the psychological impact of men experiencing the perception of a largely female disease, men experience challenges related to a lack of education on their risks of breast cancer (Bolton et al., 2019). Though still insufficient, more information is known about the unmet information needs of men regarding breast cancer (Bolton et al., 2019). Regardless of academic education levels, literature has shown a benefit in providing individuals with screening and prevention information about cancers and other diseases. This information is regularly provided to women, and educational campaigns focus on ensuring that women remain aware of effective home examination procedures and warning signs. The same information is not as available to men, representing an unmet educational need (Faller et al., 2016). This subsection addresses unmet needs regarding MBC, including unmet educational needs.

With breast cancer being the second leading cause of death for women of all ethnicities (Bolton et al., 2019), a large number of resources are invested in ensuring that women have adequate information about breast cancer risks and indicators. The same informational campaigns are not present for men, resulting in potentially later detection among MBC patients. Some demographic groups display particular information gaps regarding breast cancer screening in men. For example, in a study of 2,812 Hispanic men and women, Bolton et al. (2019) found that women held more favorable beliefs about

breast cancer early detection and viewed themselves as much more susceptible to the development of breast cancer than men. Although it makes sense that women would view themselves as more susceptible to breast cancer than men based on incidence rates, males displayed less interest and more reluctance to engage in self screening activities and less understanding about the possibility of incidence in men (Bolton et al., 2019).

Individuals of both genders perceive various levels of information requirements, with some individuals requiring more information about their disease than others (Faller et al., 2016). Studies on unmet needs of cancer patients often focus on determining the education levels of patients, querying the degree to which patients are satisfied with their information levels, and exploring other unmet needs beyond information. This framework was echoed by Faller et al.'s (2016) quantitative study utilizing 4,020 patients. A rare feature of Faller et al.'s sample compared with other researchers is that Faller et al.'s sample is consistent of approximately 50% women and 50% men. Most studies have a population sample imbalance, with most participants being female. Faller et al. used the Patient Health Questionnaire as the data collection instrument. The study results indicated that a large portion of both men and women believed that they had sufficient information. However, there was an imbalance in perceptions of information obtained between men and women. Women believed that they had more information about breast cancer than men. However, Faller et al. noted that men perceived themselves as needing less information. Additionally, Faller et al. found a significant unmet need related to psychological support. This finding was consistent with the findings of Quincey, Shokuhi, et al. (2016) and other researchers described above.

Summary

Though MBC is rare, comprising approximately 1% of all breast cancer diagnoses (Siegel et al., 2016), mortality among MBC patients is comparatively high (Lautrup et al., 2018). There is a substantial body of literature on breast cancer in women, but research on breast cancer in men remains comparatively limited (Cutrone et al., 2018; Lautrup et al., 2018). The present literature review discussed recent literature on the characteristics of breast cancer research, including pathology, screening, delayed treatment, and higher rates of mortality. Additionally, the present literature review discussed research on the indicators of breast cancer in women, with a thought to how that research might provide future avenues of study on the indicators of MBC. Though breast cancer in women and breast cancer in men present with some differences, there is enough similarity between the diseases that the wide body of research on women should be used to inform treatment in men (Anderson et al., 2004).

Next, the literature review discusses recent literature on the risk factors in men. According to recent literature, risk factors for breast cancer in men include race (Sung et al., 2020), with Black men experiencing higher rates of breast cancer than White men. Similar to women, hereditary risks of breast cancer in men include the presence of the BRCA1 and BRCA2 mutation (Postula et al., 2018). Men with certain occupational roles and exposure factors have higher rates of breast cancer than the general population (Grundy et al., 2016). Grundy et al. (2016) argued that the occupational risks of breast cancer might be particularly relevant to MBC incidence because men often work in positions with higher exposure to magnetism and carcinogenic compounds. Other job

characteristics, such as working night shifts, were associated with an increased risk of breast cancer in men (Fenga, 2016). Men of higher SES experienced lower rates of breast cancer than men of low SES (Akinyemiju et al., 2018). In addition to SES, obese men faced a significantly higher risk of breast cancer than nonobese men, especially if the men were obese in adolescence (Akinyemiju et al., 2018). Men of higher education levels experienced lower incidences of breast cancer and better prognoses than men of lower education levels (Monfared et al., 2017).

In addition to risk factors for MBC, this literature review discussed the unmet needs for men with breast cancer. These unmet needs were related to patient care, psychological needs, and informational needs. Studies on patient care revealed that the healthcare systems for breast cancer patients were largely set up to accommodate women, sometimes to the exclusion of men (Ernstmann et al., 2019). Men's psychological needs included more support for MBC patients and less feminization of breast cancer as a woman's disease (Quincey, Williamson, et al., 2016). Finally, men were generally less informed about breast cancer treatments and outcomes than women (Bolton et al., 2019).

This section reviewed recent literature on breast cancer. Topics included characteristics of MBC, risk factors for women's breast cancer as they informed research on men, risk factors for MBC, and unmet needs of men with breast cancer. The next section presents the study methodology.

Chapter 3: Research Method

The purpose of this quantitative cross-sectional study was to determine whether there was an association between BMI, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. To address this purpose, the following four research questions were asked:

RQ1: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate?

RQ2: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income?

RQ3: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status?

RQ4: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for income?

In this chapter, the research design used in the study and the rationale for the design are discussed. The chapter also contains a description of the methodology of the study, as well as threats to the validity of the study and how those threats were minimized or considered. The chapter ends with a summary.

Research Design and Rationale

I used a quantitative cross-sectional design to answer the research questions and address the purpose of the research. A quantitative approach was appropriate because the goal of the study was to examine the relationship between quantifiable variables rather than the lived experiences or observations of participants (see Brannen, 2017). Unlike

qualitative researchers, quantitative researchers rely on convergent reasoning rather than divergent reasoning. I analyzed the observed data and discussed the demonstrated results rather than observing data and extrapolating to create new meaning as in qualitative research (see University of Southern California, 2019).

Quantitative methodology was appropriate for the current study because I sought to examine the relationship between several independent and dependent variables as described in the research questions. A cross-sectional design was used in this study. Cross-sectional designs are useful when examining a phenomenon that has already happened as opposed to a phenomenon in progress (Gigi et al., 2014). A quantitative cross-sectional design was consistent with research designs needed to advance knowledge related to the relationship between education, obesity, and SES on MBC. At the time of the current study, there were insufficient data to determine the relationship between these three variables (Keinan-Boker et al., 2018). I used this methodology and design to contribute to the body of literature by examining the relationship between these quantifiable variables (see Brannen, 2017) captured and recorded in the NCDB (see Gigi et al., 2014).

There were three independent variables and two dependent variables examined in this study. The independent variables consisted of education status (ordinal), income (numerical), and BMI (numerical). The dependent variables included 5-year survival (binary) and stage of cancer diagnosis (ordinal). The study accounted for several covariates, including age at diagnosis (numerical) and family history of cancer (binary).

Methodology

Population

The population used in this study were men aged 18 and older who had been diagnosed with breast cancer and had been recorded in the NCDB person-level data files in the last 5 years (2014 to 2019) or the most recent 5 years of data available if there was a delay between data collection and data availability. Participants must have survived for at least 5 years or were included if they had died less than 5 years after being diagnosed. Boys under 18 were not included in the study because they had not reached maturity, and pediatric breast cancer might be significantly different than breast cancer in adults.

Sampling and Sampling Procedures

The sample used in this study consisted of individuals who fit the selection criteria and were recorded in the NCDB. Sampling procedures were not used in the study. However, the total population of the NCDB was a sample of the total population with breast cancer in the United States. The study population was estimated at 14,341 individuals. A total of 1,434,130 individuals were diagnosed with breast cancer and recorded in the NCDB between 2013 and 2015 (the most recent 5 years of data available to browse online). Because 1% of all breast cancer diagnoses were MBC (Siegel et al., 2016), I estimated that 1% or 14,341 of the 1,434,130 individuals would be men. However, there were several factors that would likely reduce the total study population. The first was that it was likely that some of these individuals would choose not to share their individual-level information with the NCDB, meaning their information was not included in the person-level data files and could not be included in the study. It was also

possible that some individuals might be under 18 years of age. If that was the case, I excluded these individuals from the sample. There were some individuals diagnosed less than 5 years ago but who had not died. These individuals were not included in the current study because the outcome of their cancer (whether they would survive at least 5 years) had not been determined. There are about 3,250 men diagnosed with breast cancer each year in the United States, equaling about 16,250 men in the last 5 years (Siegel et al., 2016). With an estimated total population of 16,250 and an anticipated study population of 14,341, the confidence interval for the study was 6.14, using a 50% percentage and calculated to 95% confidence (see Brant, n.d.).

Data Collection

Data were collected by first applying for access to the NCDB Participant Use Data File (PUF), the database containing person-level data. The PUF contained deidentified patient-level data that did not identify hospitals and health care providers but did include cancer diagnosis, gender, age, education status, income, family history of cancer, stage of cancer diagnosis, and year of diagnosis. Access to the PUF was granted because the study did not pose any risk of revealing personal identifying information. Once data access was granted, I accessed the data through an online portal, CD-ROM, or federal data center. I selected the most convenient option available, and data analysis began.

Operationalization of Measures

The following independent variables were used in this study:

Education Status

Education status was an ordinal variable that described the highest level of education achieved by the participant. Response options included no high school diploma through postgraduate degree.

Income

Income was a numerical variable that described each participant's yearly income. This variable was a continuous variable or a categorical variable in the NCDB, which categorizes income information into bucket categories rather than recording them as a continuous variable. I adjusted the statistical tests as appropriate to measure this variable.

SES

SES was operationalized by combining the education and income variables. Education and income were organized into buckets with assigned points. The lowest income bucket and the lowest education bucket were assigned 1 point each. The highest levels of income and education were assigned points based on the number of buckets for each category. The number on income buckets was determined by the range of incomes in the study sample. For example, there were seven recipients of a doctoral degree. The income and education buckets were summed for each participant to create an SES variable.

BMI

BMI was a numerical variable recorded either as a continuous variable or a categorical variable if the NCDB categorized BMI information into bucket categories

rather than recording them as continuous variables. I adjusted the statistical tests, as appropriate, to measure this variable.

The dependent variables used in this study were as follows:

5-Year Survival

Five-year survival was a binary (yes/no) variable that described whether the participant in the data file had survived at least 5 years since their diagnoses. Researchers hypothesized that education status, income, and BMI would affect a patient's likelihood of surviving 5 years after a cancer diagnosis (Keinan-Boker et al., 2018; Lautrup et al., 2018). I tested that hypothesis.

Stage of Cancer Diagnosis

The stage of cancer diagnosis was an ordinal variable that indicated the stage at which a patient's cancer was diagnosed. The options ranged between Stage 0 and Stage IV. Researchers hypothesized that education status, income, and BMI would affect the stage of a patient's cancer diagnosis based on studies showing that individuals with less education, less income, and higher BMIs experienced delays in gaining a diagnosis (Keinan-Boker et al., 2018; Lautrup et al., 2018). I tested that hypothesis.

The study accounted for two covariates:

Age at Diagnosis

Age of diagnosis was a numerical variable that described the age at which a patient was diagnosed with breast cancer. Because age at diagnosis could influence an individual's chance of surviving 5 years after a diagnosis (Lautrup et al., 2018), it was important to adjust for this variable.

Family History of Cancer

Family history of cancer was a yes/no binary variable that described whether there was a history of cancer in the immediate family of a patient. A family history of cancer could influence the chances of a person surviving 5 years after a diagnosis (Lautrup et al., 2018). A family history of cancer might also affect the stage at which cancer was diagnosed because someone with a history of cancer in their family might more actively seek cancer screening (Lautrup et al., 2018). Therefore, it was important to adjust for this variable.

Data Analysis Plan

Descriptive Analyses

This study included an analysis of descriptive statistics, such as the means, medians, and rates. These descriptive analyses showed the involvement of SES (operationalized as a combination of education and income) and MBC. I considered individuals who survived 5 years after being diagnosed with breast cancer. I examined the SES of those individuals descriptively, using a pie chart of 5-year survivors by SES. Descriptive statistics were performed related to other study variables (education, income, and BMI). These analyses were decided based on what was appropriate for the data.

Multivariate Logistic Regression

Once the data were collected, I performed an ordinal logistic regression to test the relationship between education status, income, and BMI as the independent variables on stage of cancer diagnosis, and the dependent variable. This test was adjusted for age at diagnosis and family history of cancer. Another proportional hazards regression was

performed to test the relationship between education status, income, and BMI (independent variables) on 5-year survival (the dependent variable). This test was adjusted for age at diagnosis and family history of cancer. I ran these tests separately to meet the assumptions of each statistical test (see Christensen, 1997). For example, ordinal logistic regressions assumed that the dependent variable was ordinal, such as stage of cancer diagnosis, while the proportional hazard regression assumed each covariate had a compounding effect that was constant over time (see Xue et al., 2013).

Before running either regression, I checked the other assumptions of ordinal and proportional hazard regression to ensure the criterias were met. I used Statistical Package for Social Sciences (SPSS) to ensure that there was no multicollinearity in the data using dummy variables for the categorical independent variables (see Christensen, 1997), which might constitute one or all of the independent variables depending on the form of the data in the NCDB. Multicollinearity occurs when two or more of the independent variables in the regression are strongly correlated with each other (Christensen, 1997). If this occurred, I could not determine which variable was contributing to the relationship with the dependent variable (see Christensen, 1997).

I also checked that there were proportional odds in the data (see Christensen, 1997). This process involved using a full likelihood ratio test (see Christensen, 1997). However, this test might raise violations in the data that do not exist (Christensen, 1997). If the test determined that there was a violation in the data, I used separate binomial logistic regressions on the dependent variables to verify that the data did not have proportional odds (see Christensen, 1997). If either of the assumptions of binomial or

ordinal logistic regression were not met, I restructured the data or, if appropriate, found a more fitting test. Finally, I checked the proportional hazards assumption for the proportional hazard's regression by graphically plotting the scaled Schoenfeld residuals with time in SPSS. A nonsignificant relationship between the residuals and time supported the proportional hazard assumption, while a significant relationship refuted it (see Xue et al., 2013).

I accounted for the multiple statistical tests used in this study by employing the Bonferroni correction. The Bonferroni correction worked by dividing the desired significance level ($p < .05$) by the number of statistical tests, two in the case of this study (see Goldman, 2008). This correction meant that the data were only accepted as significant if the *p* value was less than .025 (see Goldman, 2008). This process was necessary to ensure that tests were not found statistically significant by chance due to the number of tests run rather than true significance (see Goldman, 2008). Although the Bonferroni correction was overly conservative in the case of many statistical tests being run, this process was less of a danger with only two statistical tests (see Goldman, 2008). Once the regressions had been run, I reviewed the results to consider the significance of the tests. Significance was measured as a *p* value less than .025. Finally, I interpreted and wrote up the results of the study.

Threats to Validity

There were several external threats to validity in the study. It was possible that the data in the NCDB represented a biased sample of individuals with MBC. Although the NCDB is the most comprehensive cancer database in the United States, they might draw

more heavily from some hospitals than others. I reviewed the notifications provided by the NCDB relating to the years of data I could access. I discussed any effect data collection biases may have had in Chapter 5. The NCDB also relies, in part, on self-reported data. Information collected from participants about their education statuses, incomes, and histories of cancer were self-reported. This threat was partly countered by the large sample size used in the study. A large sample size should reduce the impact of some instances of inaccurate self-reports (Goldman, 2008).

There were several threats to the internal validity of the study, including the chance of multicollinearity in the data or lack of proportional odds. I accounted for these threats by checking the assumptions of the logistic regressions before running them and transforming the data as appropriate (Christensen, 1997) or selecting a new test if transformation of the data could not account for these issues in the data. The use of multiple statistical tests was also a threat to the data. However, this threat was accounted for by using the Bonferroni correction to ensure any statistically significant results were a function of true significance rather than multiple tests (see Goldman, 2008). It was also possible that due to the sensitivity of the Bonferroni correction, statistically significant results could be found insignificant (see Goldman, 2008). If results were close to significant but rendered insignificant due to the heightened standards of the Bonferroni correction, I used a control as the false discovery rate to see if the results remained the same (see Goldman, 2008). The significance of the results is discussed at length in Chapters 4 and 5, including potential threats to significance or doubts relating to the significance or insignificance of the results.

Ethical Procedures

I followed several ethical procedures to ensure the study was operated in an ethical manner. This process entailed seeking institutional review board approval from the Walden University Institutional Review Board before beginning data collection. I provided a full and accurate summary of the study's goals, purpose, questions, and methods when applying for access to the NCDB person-level data files. Finally, I reported all findings of the study accurately and clearly to ensure that results were factually represented and could not be misinterpreted. Because all data used were already deidentified, there was no need to ensure further confidentiality of participants. However, I discussed all findings in aggregate, so individual participants were not unduly singled out.

Summary

The purpose of this quantitative cross-sectional study was to determine whether there was an association between BMI, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. A quantitative methodology was appropriate for the current study, as I sought to determine the relationship between several independent and dependent variables, as described in the research questions. A cross-sectional design was used in this study. Cross-sectional designs were useful when examining a phenomenon that had already happened, as opposed to a phenomenon in progress. To address the purpose of the study, I used deidentified person-level data from the NCDB. Data analysis involved performing an ordinal logistic regression to test the relationship between education status, income, and

BMI (the independent variables) on stage of cancer diagnosis (the dependent variable). Another proportional hazards regression was performed to test the relationship between education status, income, and BMI (independent variables) on 5-year survival (the dependent variable). The Bonferroni correction was used to account for multiple statistical tests. In this chapter, Chapter 3, the research method used in the current study was described. The results of the study are discussed in the next chapter, Chapter 4.

Chapter 4: Results

The purpose of this quantitative cross-sectional study was to determine whether there was an association between BMI, educational status, income level, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. To address this purpose, four research questions were asked:

RQ1: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate?

RQ2: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income?

RQ3: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status?

RQ4: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for income?

In this chapter, the data collection procedures used in the study and the results of the study are presented. The chapter also contains a discussion of how the variables were measured given the data set collected in the study. The chapter ends with a summary.

Data Collection

Permission was obtained from the NCDB PUF, the database containing person-level data. An online portal was used to access the data. The PUF contained deidentified patient-level data that did not identify hospitals or health care providers. The database showed the cancer diagnosis, BMI, age, education status, family history of cancer, stage

of cancer diagnosis, and year of diagnosis. Data necessary for the study were gathered in a separate SPSS file to prepare for data analyses.

Results

Table 1 presents the demographic characteristics of participants using frequencies and percentages. The demographic characteristics included education, marital status, occupation, and BMI of patients. All of the patients in the study were men. A total of 73,642 patients responded to the item on education and marital status. Based on the data, 16,037 patients were postgraduates (20.9%), 15,067 patients completed some college (19.6%), 13,912 patients were college graduates, 13,484 patients were high school graduates, and 9,047 patients had post high school training. Regarding marital status, 60,923 patients were married (79.5%). For occupation, 36,649 patients were retired (47.8%), and 32,467 were working (42.3%). The BMIs of patients were also presented using categories. There were 36,564 patients (47.7%) who had a BMI of 25 to 30 lb/in^2, 19,340 patients (25.2%) had a BMI of 18.5 to 25 lb/in^2, and 16,470 patients (21.5%) had a BMI of 30+ lb/in^2.

Table 1

Frequencies and Percentages of Demographic Characteristics

Demographic characteristic		Frequency	Percentage
Education	Less than 8 years	923	1.2
	8 to 11 years	5,172	6.7
	12 years or completed high school	13,484	17.6
	Post high school training	9,047	11.8
	Some college	15,067	19.6
	College graduate	13,912	18.1
	Postgraduate	16,037	20.9
	Total	73,642	96.0

Missing	System	3,036	4.0
Total		76,678	100.0
Marital status	Married or living as married	60,923	79.5
	Widowed	2,671	3.5
	Divorced	6,688	8.7
	Separated	823	1.1
	never married	2,537	3.3
	Total	73,642	96.0
Missing	System	3,036	4.0
Total		76,678	100.0
Occupation	Homemaker	58	0.1
	Working	32,467	42.3
	Unemployed	856	1.1
	Retired	36,649	47.8
	extended sick leave	128	0.2
	Disabled	1,789	2.3
	Other	1,545	2.0
	Total	73,492	95.8
Missing	System	3,186	4.2
Total		76,678	100.0
BMI at baseline (In lb/in2)	0–18.5	262	0.3
	18.5–25	19,340	25.2
	25–30	36,564	47.7
	30+	16,470	21.5
	Total	72,636	94.7
Missing	System	4,042	5.3
Total		76,678	100.0

The MBC grade was considered as the stage of the cancer at diagnosis variable. Patients were also asked whether they had family histories of any kind of cancer. The 5-year survival of patients was computed based on the difference of the age at mortality and the age at diagnosis. Table 2 shows the frequencies and percentages of the cancer-related variables. There were only 38 responses for the grade of the breast cancer. A total of 20 patients were diagnosed with Grade II breast cancer, eight patients were diagnosed with Grade I, and four patients were diagnosed with Grade III. For a family history of cancer, 38,152 patients had family histories of cancer (49.8%), while 35,464 had no family histories of cancer (46.3%). Conversely, for the 5-year survival of patients, 45,283 patients survived for 5 years or more (59.1%), while 31,395 patients survived for less than 5 years (40.9%).

Table 2

Frequencies and Percentages of Cancer-Related Variables

Variable		Frequency	Percent
Male Breast Cancer Grade (ICD-O-2)	Well differentiated, Grade I	8	0.0
	Moderately differentiated, Grade II	20	0.0
	Poorly differentiated, Grade III	4	0.0
	Not determined/stated/applicable	6	0.0
	Total	38	0.0
Missing	System	76,640	100.0
Total		76,678	100.0
Has Family History of Any Cancer?	No	35,464	46.3
	Yes	38,152	49.8
	Total	73,616	96.0
Missing	System	3,062	4.0
Total		76,678	100.0
5-Year Survival	Less than 5 years	31,395	40.9
	5 years or more	45,283	59.1

	Total	76,678	100.0

The age of patients was analyzed using descriptive statistics. The 76,678 patients had a mean age of 74.08 years (*SD* = 6.307), with a range of 55 to 90 years old. The median age of patients was 74 years.

Research Question 1

The first research question addressed the association between BMI, grade of cancer at diagnosis, and survival rate. Table 3 shows the result of the binary logistic regression. The results of the analysis indicated that the cancer grade at diagnosis categories did not significantly predict the 5-year survival of patients ($p > .05$). The BMI categories also did not significantly relate to the 5-year survival of patients ($p > .05$). Therefore, there was insufficient evidence to reject the null hypothesis that stated that there is no association between BMI, stage of MBC diagnosis, and 5-year survival rate. The model explained 12.7% of the variance in the 5-year survival of patients. The model was also determined to be insignificant in predicting the 5-year survival rate variable; chi-square (6) = 3.156, $p = .789$.

Table 3

Binary Logistic Regression for the 5-Year Survival Using Cancer Grade and Body Mass Index as Predictors

Category		*B*	*SE*	Wald	*df*	Sig.	Exp(B)
Step 1[a]	Grade I			0.960	3	0.811	
	Grade II	0.967	1.427	0.459	1	0.498	2.631
	Grade III	-0.152	1.068	0.020	1	0.887	0.859
	Not determined	0.480	1.463	0.108	1	0.743	1.616

0-18.5 lb/in2			1.233	3	0.745	
18.5-25 lb/in2	19.785	40192.969	0.000	1	1.000	391405072.135
25-30 lb/in2	-0.293	1.387	0.044	1	0.833	0.746
30+ lb/in2	-1.127	1.269	0.788	1	0.375	0.324
Constant	1.570	1.512	1.077	1	0.299	4.806

Note. Chi-square (6) = 3.156, $p = .789$.

Research Question 2

The second research question addressed the association between BMI, stage of MBC diagnosis, and 5-year survival rate while controlling for interaction effects with educational status and income. However, because there were no data for income, the interaction of education and income could not be calculated. Education variable was added as a covariate in the analysis.

Table 4 shows the results of the binary logistic regression. The results indicated that the cancer grade at diagnosis categories did not significantly predict the 5-year survival of patients ($p > .05$). The BMI categories also did not significantly relate to the 5-year survival of patients ($p > .05$). Moreover, the education categories did not significantly predict the 5-year survival of patients ($p > .05$). Therefore, there was insufficient evidence to reject the null hypothesis that stated that there is no association between BMI, stage of MBC diagnosis, and 5-year survival rate while controlling for interaction effects with educational status. The model explained 31.4% of the variance in the 5-year survival of patients. The model was also determined to be insignificant in predicting the 5-year survival rate variable; chi-square (11) = 8.402, $p = .677$.

Table 4

Binary Logistic Regression for the 5-Year Survival Using Cancer Grade and Body Mass Index as Predictors and Education as Covariate

Category		*B*	*SE*	Wald	*df*	Sig.	Exp(B)
Step 1[a]	Grade I			1.872	3	0.599	
	Grade II	1.905	1.773	1.154	1	0.283	6.718
	Grade III	0.390	1.436	0.074	1	0.786	1.477
	Not Determined	1.559	1.669	0.873	1	0.350	4.756
	0-18.5 lb/in2			1.219	3	0.748	
	18.5-25 lb/in2	19.221	40192.969	0.000	1	1.000	222606913.897
	25-30 lb/in2	0.283	1.922	0.022	1	0.883	1.327
	30+ lb/in2	-0.868	1.563	0.309	1	0.579	0.420
	8-11 years			2.226	5	0.817	
	12 years or completed high school	-0.993	1.881	0.279	1	0.598	0.371
	Post high school training	21.034	28420.721	0.000	1	0.999	1364817749.312
	Some college	-1.313	1.636	0.644	1	0.422	0.269
	College graduate	0.555	1.636	0.115	1	0.734	1.742
	Postgraduate	-1.149	1.343	0.732	1	0.392	0.317
	Constant	1.037	2.486	0.174	1	0.677	2.820

Note. Chi-square (11) = 8.402, $p = .677$.

Research Question 3

To address the research questions for the study, binary logistic regression analyses were conducted. Binary logistic regression was deemed appropriate because the dependent variable was binary in nature. A value of 1 was used to represent a survival rate of 5 years or more, and a value of 0 was used to represent a survival rate of less than 5 years. The assumptions of the binary logistic regression were satisfied because the dependent variable was binary in nature and the predictors were declared as categorical

variables. The third research question addressed the association of grade of cancer at diagnosis and survival rate while controlling for education status.

Table 5 shows the results of the binary logistic regression. The results indicated that the cancer grade at diagnosis categories did not significantly predict the 5-year survival of patients ($p > .05$). The education categories also did not significantly relate to the 5-year survival of patients. Therefore, there was insufficient evidence to reject the null hypothesis for the study that stated that there is no association between the stage of MBC diagnosis and 5-year survival rate while controlling for educational status. The model explained 26.1% of the variance in the 5-year survival of patients. The model was also determined to be insignificant in predicting the 5-year survival rate variable; chi-square (8) = 6.827, $p = .555$.

Table 5

Binary Logistic Regression for the 5-Year Survival Using Cancer Grade as Predictor and Education as Covariate

	Category	*B*	*SE*	Wald	*df*	Sig.	Exp(B)
Step 1[a]	Grade I			1.837	3	0.607	
	Grade II	1.794	1.602	1.255	1	0.263	6.014
	Grade III	0.344	1.399	0.060	1	0.806	1.411
	Not determined	1.249	1.633	0.586	1	0.444	3.488
	8-11 years			3.020	5	0.697	
	12 years or completed high school	-0.954	1.653	0.333	1	0.564	0.385
	Post high school training	20.593	28420.721	0.000	1	0.999	877790158.505
	Some college	-1.453	1.480	0.964	1	0.326	0.234
	College graduate	0.997	1.373	0.528	1	0.467	2.711
	Postgraduate	-0.879	1.285	0.469	1	0.494	0.415

Constant	0.610	1.570	0.151	1	0.698	1.840

Note. Chi-square (8) = 6.827, $p = .555$.

Research Question 4

The fourth research question addressed the association between grade of cancer at diagnosis and survival rate while controlling for income. However, there were no data on income available from the PUF database. Therefore, there were insufficient data to address the research question.

Summary

The purpose of this quantitative cross-sectional study was to determine whether there was an association between BMI, stage at diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. Permission was obtained from the NCDB PUF. The database showed the cancer diagnosis, BMI, age, education status, family history of cancer, stage of cancer diagnosis, and year of diagnosis. The results of the analysis indicated that the cancer grade at diagnosis categories did not significantly predict the 5-year survival of patients ($p > .05$). The BMI categories also did not significantly relate to the 5-year survival of patients ($p > .05$). Moreover, the education categories did not significantly predict the 5-year survival of patients ($p > .05$). The research question considering income as a covariate was not addressed in the study because income was not included in the database. A significance level of .05 was used for all analyses.

Chapter 5: Discussion, Conclusions, and Recommendations

MBC is relatively rare; however, mortality rates for those diagnosed with MBC are significantly higher than for women diagnosed with breast cancer (Lautrup et al., 2018). Overall, researchers have estimated that men with breast cancer are more than 40% more likely than women to die of breast cancer (Abreu et al., 2016; Lautrup et al., 2018). Men have lower survival odds at every stage of cancer, as well as a higher overall mortality rates (Lautrup et al., 2018; Sung et al., 2020).

The factors that contribute to a woman's risk of developing breast cancer are well understood (Sung et al., 2020). However, researchers had not addressed how those factors affect a man's risk of developing breast cancer (Cutrone et al., 2018; Keinan-Boker et al., 2018). There are also many differences in prognoses and diagnoses between MBC and FBC. Some risk factors commonly understood in FBC need to be examined in MBC patients (Cutrone et al., 2018; Keinan-Boker et al., 2018).

Keinan-Boker et al. (2018) identified a need to research the education level of those diagnosed with MBC. However, education had not been examined as it relates to MBC. Researchers also suggested that socioeconomic factors, such as education, influence breast cancer survivorship among women (Cutrone et al., 2018; Keinan-Boker et al., 2018). Though education, socioeconomic factors, and obesity were well explored as outcome mediators for women , these same indicators were underexplored in men diagnosed with breast cancer (Keinan-Boker et al., 2018).

The purpose of this quantitative cross-sectional study was to determine whether there was an association between BMI, educational status, income level, stage at

diagnosis of breast cancer, and 5-year survival rate among men, controlling for education and income. The MBC grade was considered as the stage of cancer at the diagnosis variable. I used a quantitative cross-sectional design guided by Bandura's (1986) SCT with data from the NCDB. The NCDB is a clinical oncology database sourced from hospital registry data collected in more than 1,500 facilities (American College of Surgeons, 2020). These data include information related to patient treatments, outcomes, and demographic information (American College of Surgeons, 2020). For the current study, the last 5 years of data (2015 to 2019) were used.

Bandura's (1986) SCT emphasizes the importance of education and the environment on individual outcomes. The SCT asserts that an individual's behavior, such as nutritional and health care choices, is influenced by their environments. There is reason to believe that these behaviors may also influence an individual's likelihood of developing MBC and the likelihood of surviving MBC (Keinan-Boker et al., 2018; Lautrup et al., 2018).

To address the purpose of this study, four research questions were asked. The research questions and hypotheses included the following:

RQ1: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate?

H_o1: There is no association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for educational status.

H_a1: There is an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for educational status.

RQ2: Is there an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income?

H_o2: There is no association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income.

H_a2: There is an association between BMI, stage of MBC diagnosis, and 5-year survival rate, controlling for interaction effects with educational status and income.

RQ3: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status?

H_o3: There is no association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status.

H_a3: There is an association between stage of MBC diagnosis and 5-year survival rate, controlling for educational status.

RQ4: Is there an association between stage of MBC diagnosis and 5-year survival rate, controlling for income?

H_o4: There is no association between stage of MBC diagnosis and 5-year survival rate, controlling for income.

H_a4: There is an association between stage of MBC diagnosis and 5-year survival rate, controlling for income.

The results of the analysis showed that BMI did not significantly relate to the 5-year survival rate of patients. The research question considering income as a covariate was unaddressed in the study because income was not included in the database. The result of the analysis indicated that the cancer grade at diagnosis did not significantly

predict the 5-year survival of patients. Moreover, education did not significantly predict the 5-year survival of patients.

In this chapter, study findings are discussed and compared to existing peer-reviewed literature. Next, the limitations of the study are identified and discussed. Recommendations for further research are then made. Suggestions on how future research may build on the findings of this study are also made. The implications of this study are explored, and recommendations for practices are made. Finally, this chapter provides a conclusion to this study.

Interpretation of the Findings

There was a significant gap in literature regarding screening, treatment, and prognosis for MBC (Yalaza et al., 2016). However, there was a significant body of literature on the risk factors for women related to breast cancer. Bootsma et al. (2020) pointed out that most literature on breast cancer was either directed exclusively at women or included information gathered through female-dominated literature. Due to the substantial gap in data related to men, considering the risk factors for women and how they might relate to risk factors for men was a useful starting place for further research into MBC. There was a perceived usefulness of information regarding breast cancer in women in the treatment of breast cancer in men. However, gender differences exist that warrant further male-specific research (Partridge et al., 2016).

The first research question focused on investigating the association between BMI, grade of cancer at diagnosis, and survival rate. The results of the analysis indicated that the cancer grade at diagnosis did not significantly predict the 5-year survival of patients.

BMI also did not significantly relate to the 5-year survival of patients. Therefore, there was insufficient evidence to reject the null hypothesis for the study that stated that there is no association between BMI, stage of MBC diagnosis, and 5-year survival rate.

The results from this study indicating that the BMI did not significantly relate to the 5-year survival of patients are incongruent with other studies that showed a connection. Keinan-Boker et al. (2018) established a correlation between obesity and MBC. Establishing the relationship between BMI and MBC is important because obesity (defined as having a BMI greater than 30) is an increasing phenomenon on a worldwide scale and has been evidenced as a risk factor in breast cancer development within women (Gershuni et al., 2016) and men (Keinan-Boker et al., 2018). Keinan-Boker et al. also found that early life obesity could impact later incidences of breast cancer in men. Their analysis demonstrated that males obese as adolescents exhibited a higher likelihood of presenting with breast cancer. One hypothesis related to the relationship between breast cancer and obesity in males was that breast cancer might be developed in men traditionally considered too young for incidence if they were obese (Obata et al., 2017).

Women who are overweight or obese have increase breast cancer incidences, worse prognoses, and higher mortality rates from breast cancer than other women not considered overweight or obese (Gershuni et al., 2016). Obesity is also important to show how it relates to breast cancer screening (Gershuni et al., 2016). When demographic factors are controlled, obese women are screened less often than thinner women, which may contribute to the higher mortality rates of obese women (Gershuni et al., 2016). Silber et al. (2018) suggested that a lack of screening might be exacerbated by lower SES

because lower SES was related to decreased access to health care and quality food choices, contributing to obesity and reducing the likelihood of screening.

Picon-Ruiz et al. (2017) also found obesity to impact breast cancer rates and survivability in women. Picon-Ruiz et al. found that obese women were more likely to contract breast cancer and less likely to survive the disease. Other studies indicated that obesity was associated with poorer outcomes surviving the disease and greater incidences of reoccurrence (Balaban et al., 2017; Lee et al., 2019).

The second research question focused on investigating the association between BMI, stage of MBC diagnosis, and 5-year survival rate while controlling for interaction effects with educational status and income. However, because there were no data for income, the interactions between education and income could not be calculated. The results of the analysis indicated that the cancer grade at diagnosis did not significantly predict the 5-year survival of patients. The BMI categories also did not significantly relate to the 5-year survival of patients. Moreover, the education categories did not significantly predict the 5-year survival of patients. Therefore, there was insufficient evidence to reject the null hypothesis that stated that there is no association between BMI, stage of MBC diagnosis, and 5-year survival rate while controlling for interaction effects with educational status. The factors regarding the stage of cancer at diagnosis, education, and BMI were examined individually earlier in this section.

The third research question addressed the association between grade of cancer at diagnosis and survival rate while controlling for education status. The results of the analysis indicated that the cancer grade at diagnosis did not significantly predict the 5-

year survival of patients. Education also did not significantly relate to the 5-year survival of patients. Therefore, there was insufficient evidence to reject the null hypothesis for the study that stated that there is no association between the stage of MBC diagnosis and 5-year survival rate while controlling for educational status.

Although the results of the analysis indicated that the cancer grade at diagnosis did not significantly predict the 5-year survival of patients, this finding is incongruent with existing literature. The American College of Surgeons (2020) stated that lower-stage cancer had a higher probability of being cured while more advanced stages were usually less curable. Leone et al. (2019) also stated that advanced age and cancer stage were universally connected to a poorer prognosis when treating cancer but added that less information was known about treating early-stage breast cancer in men. Other studies found that MBC was more likely to be diagnosed at later stages than FBC (Keinan-Boker et al., 2018; Lautrup et al., 2018).

Being diagnosed at a later stage contributes to the lower breast cancer survival rates experienced by men (Keinan-Boker et al., 2018; Lautrup et al., 2018). Researchers have estimated that men with breast cancer are more than 40% more likely than women to die of breast cancer (Abreu et al., 2016; Lautrup et al., 2018). The differences in mortality rates between men and women with breast cancer may be attributed to the differences in diagnostic patterns between MBCs and FBCs (Cutrone et al., 2018; Lautrup et al., 2018). MBC is often diagnosed after the age of 70, while the average age of diagnosis for FBC is 61 (Lautrup et al., 2018). Granular research on breast cancer survival rates between men and women suggested that men experience poorer outcomes

at every cancer stage than women (Keinan-Boker et al., 2018; Lautrup et al., 2018). However, older age and later stage diagnoses do not entirely explain why men are more likely to die of breast cancer at every stage of diagnoses, or why they are considerably older when diagnosed (Keinan-Boker et al., 2018; Lautrup et al., 2018; Sung et al., 2020).

The results from the current study also indicated that education did not significantly predict the 5-year survival of patients. This finding is incongruent with other literature. A prior study suggested that education level is predictive of breast cancer incidence in men (Restrepo et al., 2019). Restrepo et al. (2019) found that education level was predictive of higher incidence and mortality. However, there was little research into the relationship between education level, incidence, and mortality of breast cancer in men (Restrepo et al., 2019).

Trewin et al. (2017) also found that educational level correlated with increased incidence and risk for breast cancer in men and women. According to Trewin et al., lower educated women prior to 2000 had far higher breast cancer incidence and mortality rates than women with higher education levels. Advancements in breast cancer research and treatment improved outcomes for women generally after 2000. After 2000, the mortality rates were not significantly higher for lower education level women, but incidence rates remained 38% higher among women of lower education levels. These results suggest that although treatment is more equitable between higher and lower education levels of women, women of lower education levels are much more likely to contract breast cancer than women with more education. Despite improvements, breast cancer mortality rates

are highest among women with lower education levels under the age of 50 (Trewin et al., 2017).

Hwang et al. (2017) found that women in the high education level group who were older than 50 had better breast cancer prognoses than women belonging to the low education level group. However, Hwang et al. found that the prognosis was not significantly different for women under 50. For all molecular types of breast cancer, education level was an important indicator of breast cancer prognosis. Hwang et al. found that women in the higher education level group were more likely to be treated with chemotherapy when considered optional, which could impact breast cancer prognoses. Another study found that individuals with higher education levels had better odds of 3-year breast cancer survival regardless of gender (Monfared et al., 2017).

The fourth research question addressed the association between grade of cancer at diagnosis and survival rate while controlling for income. This research question was not addressed in the study because there were no data on income in the database. Even though income remained unaddressed as a covariate, prior studies had suggested that income might influence the diagnosis and 5-year survival rate of cancer patients, specifically relating to women. Dreyer et al. (2018) found that poor and nearly poor women were less likely than women of a higher SES to survive a breast cancer diagnosis for at least 5 years. Some differences in outcomes for poor and higher-income women might relate to the differences in treatment. Dreyer et al. found that higher SES women were more likely to receive certain treatments and tests. Poorer women were less likely to receive certain therapies such as axillary surgery or adjuvant chemotherapy. These results

relate to findings from Venigalla et al. (2018) that poorer income women and men were less likely to receive adjuvant chemotherapy, which impacted the survivability of both men and lower-income women.

Silber et al. (2018) found that the main difference in survival was a result of breast cancer diagnoses occurring at a later stage in low-income women. The poorer health of lower-income women also resulted in a higher degree of comorbidity and overall health-related weaknesses. Silber et al. argued that most income disparities in cancer survivability among women were related to the above-mentioned factors rather than to differences in treatments referenced by Dreyer et al. (2018). These findings related to other studies of MBC that found that men had poorer survivability of breast cancer due to the more advanced stage of common diagnoses (Bender et al., 2017; Wu et al., 2017).

Limitations of the Study

One limitation of the study was that it relied on secondary data from the NCDB. The NCDB was a clinical oncology database sourced from hospital registry data collected in more than 1,500 facilities (American College of Surgeons, 2020). Although the NCDB was the most comprehensive cancer database in the United States (American College of Surgeons, 2020), it did not contain sufficient data to answer all the research questions from the current study satisfactorily.

Although data from 76,678 patients were used for this study, there were only 38 responses for the grade of breast cancer. This small percentage of responses presented as a major limiting factor because the cancer grade at diagnosis was part of all four research

questions. The data also did not contain any information on income; hence, Research Question 4 could not be answered. The model was also determined as insignificant in predicting the 5-year survival rate variable.

Because the NCDB partially relied on self-reported data, not all data were captured to the same extent. Data specifically related to a participant's education status and income were largely self-reported. A large sample size should reduce the impact of some instances of inaccurate self-report (Goldman, 2008). Using a larger sample size did not reduce the impact of the limited data on income and cancer grade at diagnosis, with no income being included in the data, and only data from 38 patients providing cancer grade at diagnosis.

Recommendations

Several recommendations for further research have emerged from an analysis of the study findings and the literature that was reviewed for this study. The information gathered from the literature review suggests that BMI, income, educational status, and grade of cancer at diagnosis are associated with the 5-year survival rate of cancer patients. The results from the data analysis do not mirror those findings, so further research may be necessary to achieve a more definitive result relating to the mentioned factors.

The analysis of the results of this study indicated insufficient evidence to reject the null hypothesis for Research Question 1, which showed no association between BMI, stage of MBC diagnosis, and 5-year survival rate. It also found insufficient evidence to reject the null hypothesis for Research Question 2, which showed no association between

BMI, stage of MBC diagnosis, and 5-year survival rate while controlling for interaction effects with educational status. It also found insufficient evidence to reject the null hypothesis for Research Question 3, which stated that there was no association between the stage of MBC diagnosis and 5-year survival rate while controlling for educational status. The outcome of not being able to reject the null hypothesis suggested that the data used for the study did not provide sufficient evidence to prove the association between the stage of MBC diagnosis, 5-year survival rate, educational status, and BMI. The insufficiency of the evidence of this study presents an opportunity for future research to examine these factors and their associations further.

The data from the NCDB did not contain any information on the income of patients; thus, income could not be examined as a covariant to MBC. This finding presents an opportunity for future research to explore further the impact of income on MBC. Future researchers will need to either acquire a data source that includes information on patient income or will need to develop such a source.

Even though the NCDB was the most comprehensive cancer database in the United States (American College of Surgeons, 2020), the data contained therein on the stage of cancer at diagnosis relating to MBC were limited. Several studies had indicated that diagnosis at a later stage would contribute to a lower breast cancer survival rate (Keinan-Boker et al., 2018; Lautrup et al., 2018). This shortage of information regarding the stage of cancer at diagnosis presents an opportunity for further research into how the stage at diagnosis influences the 5-year survival rate for MBC.

Implications

Healthcare organization leaders and workers can use the findings from this study to drive positive change relating to MBC. The findings of this research suggest several implications for social change. These implications include better recordkeeping, raising general awareness of MBC and available treatments, and creating ways for the healthcare system and healthcare workers to accommodate MBC patients better.

The data on MBC from the NCDB were limited, especially regarding the information on the stage of cancer at detection and the income of the patients. The NCDB partially relied on self-reported data, specifically related to a participant's education status and income. The findings from this study indicated a lack of data on the stage of cancer at diagnosis of MBC. There were only 38 responses for the stage of cancer. A recommendation for practice is that healthcare workers should populate all the information that they have available and also encourage patients to populate as much of their information as possible. This process may provide a better source of information for future research.

I examined data from 76,678 patients. The mean age of these patients was calculated as 74.08, with a range of 55 to 90 years old. The median age of patients was 74 years old. This finding corresponded with existing literature that found the age of diagnosis of MBC to be after the age of 70, while the average age of diagnosis for FBC was 61 years of age (Lautrup et al., 2018). Utilizing breast cancer records from the SEER database, Anderson et al. (2004) found that the age incidence in men was at age 71. This finding, along with the supporting literature, points to the need for better screening for

MBC. Better screening may lead to detection at an earlier stage, which is generally favorable (Leone et al., 2019). Healthcare providers should provide men with more information as to risk factors and encourage men to be screened if they are at increased risk of breast cancer.

The late ages of the participants of this study, along with the shortcomings of screening for MBC, highlight the need to develop better treatment protocols for MBC. Treatment providers need to develop and implement better treatment protocols to inform men better on the available treatments and outcomes. Prior studies have indicated that men are generally less informed about breast cancer treatment and outcomes than women (Bolton et al., 2019). Therapies commonly utilized for women with breast cancer are underutilized among men, even when the treatment demonstrates positive impacts in patients (Venigalla et al., 2018). These treatments should be further researched and be included in treatment protocols for men.

The late ages of the participants of this study could also indicate a lack of awareness of MBC. Prior literature found a general lack of awareness of MBC (Patel et al., 2020). Breast cancer awareness month is an annual campaign that occurs in October to raise awareness of breast cancer, specifically targeting women. Men's cancer awareness campaigns have proven less successful, even when considering awareness of more common cancers in men, such as testicular cancer (Patel et al., 2020). A considerable effort needs to be made to spread awareness of MBC. Because November is considered men's health awareness month, it is recommended that health care providers use this time to make men more aware of MBC than before.

Quincey, Shokuhi, et al. (2016) suggested that the healthcare system and healthcare workers inadvertently marginalized MBC patients due to a lack of employee training or a lack of facilities designed to accommodate MBC patients. Patients from their study described experiences within the healthcare system that communicated that breast cancer was a female disease. Even though MBC only comprises approximately 1% of all breast cancer diagnoses (Siegel et al., 2016), it is not only a female disease. Healthcare workers need to remain aware of how men with breast cancer are being marginalized so that they can correct those actions.

Conclusion

I aimed to bring a better understanding of the association between education, income, obesity, stage at diagnosis, and 5-year survival rate of breast cancer among men. Even though MBC is relatively rare, mortality for those diagnosed with MBC is significantly higher than for women diagnosed with breast cancer (Lautrup et al., 2018). This quantitative study examined data from the NCDB to establish the association between education, income, obesity, stage at diagnosis, and 5-year survival rate of breast cancer among men.

The results of the analysis suggest that neither the BMI, the cancer grade at diagnosis, nor the education categories significantly predict the 5-year survival of patients. These findings are contradicted by several other studies examining the factors of cancer grade at diagnosis, BMI, and education. The research question considering income as a covariate was not addressed in the study because there were no data on income from

the database. These findings suggest shortcomings in the NCDB, especially related to the factors of income and grade of breast cancer at diagnosis.

The findings from the current study suggest shortcomings in the data contained in the NCDB relating to MBC. Because the NCDB is considered the most comprehensive cancer database in the United States, this shortage of data suggests a general shortage of data relating to MBC. This finding should encourage more research to be conducted on this subject matter and more thorough data to be collected than before.

The results from this study highlight the shortage of information on MBC and the importance of further research on this subject. I utilized a lot of information regarding breast cancer in women, and there was a perceived usefulness to this information in the treatment of breast cancer in men. However, as previously mentioned, gendered differences did exist, warranting further male-specific information (Partridge et al., 2016).

An advocacy awareness that will foster proper education about male breast cancer will definitely bring a positive social change. There must also be a strong coalition group that will focus on male breast cancer education and support to achieve a positive social change among men.

References

Abreu, M. H., Afonso, N., Abreu, P. H., Menezes, F., Lopes, P., Henrique, R., Pereira, D., & Lopes, C. (2016). Male breast cancer: Looking for better prognostic subgroups. *The Breast*, *26*, 18–24. https://doi.org/10.1016/j.breast.2015.12.001

Akinyemiju, T. F., Demb, J., Izano, M. A., Rehkopf, D. H., Fang, M. L., Hiatt, R. A., & Braithwaite, D. (2018). The association of early life socioeconomic position on breast cancer incidence and mortality: A systematic review. *International Journal of Public Health*, *63*(7), 787–797. https://doi.org/10.1007/s00038-017-1060-8

American College of Surgeons. (2020). *National cancer database*. https://www.facs.org/quality-programs/cancer/ncdb

Anderson, W. F., Althuis, M. D., Brinton, L. A., & Devesa, S. S. (2004). Is male breast cancer similar or different than female breast cancer? *Breast Cancer Research and Treatment*, *83*(1), 77–86. https://doi.org/10.1023/B:BREA.0000010701.08825.2d

Astani, A. (2019, March). Breast cancer in men. *Iranian Congress of Radiology*, *35*(1), 7–7. http://www.icrjournal.ir/article_95669.html

Balaban, S., Shearer, R. F., Lee, L. S., van Geldermalsen, M., Schreuder, M., Shtein, H. C., Cairns, R., Thomas, K. C., Fazakerley, D. J., Grewal, T., & Holst, J. (2017). Adipocyte lipolysis links obesity to breast cancer growth: Adipocyte-derived fatty acids drive breast cancer cell proliferation and migration. *Cancer & Metabolism*, *5*(1), Article 1. https://doi.org/10.1016/j.ejca.2016.10.023

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*.

Prentice-Hall.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, *44*(9), Article 1175. https://doi.org/10.1037/0003-066X.44.9.1175

Bender, P. F. M., de Oliveira, L. L., Costa, C. R., de Aguiar, S. S., Bergmann, A., & Thuler, L. C. S. (2017). Men and women show similar survival rates after breast cancer. *Journal of Cancer Research and Clinical Oncology*, *143*(4), 563–571. https://doi.org/10.1007/s00432-017-2443-1

Bolton, C. D., Sunil, T. S., Hurd, T., & Guerra, H. (2019). Hispanic men and women's knowledge, beliefs, perceived susceptibility, and barriers to clinical breast examination and mammography practices in South Texas Colonias. *Journal of Community Health*, *44*(6), 1069–1075. https://doi.org/10.1007/s10900-019-00682-1

Bootsma, T. I., Duijveman, P., Pijpe, A., Scheelings, P. C., Witkamp, A. J., & Bleiker, E. M. (2020). Unmet information needs of men with breast cancer and health professionals. *Psycho-Oncology*. Advanced online publication. https://doi.org/10.1002/pon.5356

Brannen, J. (2017). *Mixing methods: Qualitative and quantitative research*. Routledge.

Brant, R. (n.d.). *Inference for means: Comparing two independent samples*. https://www.stat.ubc.ca/~rollin/stats/ssize/n2.html

Christensen, R. (1997). *Log-linear models and logistic regressions* (2nd ed.). Springer.

Coleman, C. (2017). Early detection and screening for breast cancer. *Seminars in Oncology Nursing*, *33*(2), 141–155. https://doi.org/10.1016/j.soncn.2017.02.009

Cutrone, J. N., Segna, A. N., & Baron, R. H. (2018). Male patients with breast cancer: Addressing needs using an educational task force. *Clinical Journal of Oncology Nursing*, *22*(4), 415–420. https://doi.org/10.1188/18

Doebar, S. C., Slaets, L., Cardoso, F., Giordano, S. H., Bartlett, J. M., Tryfonidis, K., Dijkstra, N. H., Schröder, C. P., Van Asperen, C. J., Linderholm, B., & Benstead, K. (2017). Male breast cancer precursor lesions: Analysis of the EORTC 10085/TBCRC/BIG/NABCG International Male Breast Cancer Program. *Modern Pathology*, *30*(4), 509–518. https://doi.org/10.1038/modpathol.2016.229

Dreyer, M. S., Nattinger, A. B., McGinley, E. L., & Pezzin, L. E. (2018). Socioeconomic status and breast cancer treatment. *Breast Cancer Research and Treatment*, *167*(1), 1–8. doi.org/10.1007/s10549-017-4490-3

Elimimian, E. B., Elson, L., Liang, H., & Nahleh, Z. (2020). Abstract P4-17-04: Male breast cancer: Clinico-pathological characteristics from the national cancer database (NCDB). *Cancer Research*, *80*(4_Supplement), 4–17. https://doi.org/10.1158/1538-7445.SABCS19-P4-17-04

Ernstmann, N., Midding, E., Halbach, S., Würstlein, R., Weber, R., Christmann, S., & Kowalski, C. (2019). *Breast cancer in men-health care professionals' perspectives on the multidisciplinary care of a rare disease*. Gesundheitswesen (Bundesverband der Arzte des Offentlichen Gesundheitsdienstes; Germany). https://doi.org/10.1055/a-1005-6978

Faller, H., Koch, U., Brähler, E., Härter, M., Keller, M., Schulz, H., Wegscheider, K., Weis, J., Boehncke, A., Hund, B., & Reuter, K. (2016). Satisfaction with

information and unmet information needs in men and women with cancer. *Journal of Cancer Survivorship*, *10*(1), 62–70. https://doi.org/10.1007/s11764-015-0451-1

Fenga, C. (2016). Occupational exposure and risk of breast cancer. *Biomedical Reports*, *4*(3), 282–292. https://doi.org/10.3892/br.2016.575

Fentiman, I. S. (2018). Unmet needs of men with breast cancer. *European Journal of Surgical Oncology*, *44*(8), 1123–1126. https://doi.org/10.1016/j.ejso.2018.05.004

Ferzoco, R. M., & Ruddy, K. J. (2016). The epidemiology of male breast cancer. *Current Oncology Reports*, *18*(1), Art. 1. doi.org/10.1007/s11912-015-0487-4

Francis, P. A. (2018). Male breast cancer: Pink ribbon blues. *Annals of Oncology*, *29*(2), 292–293. https://doi.org/10.1093/annonc/mdx752

Freedman, R. A., & Partridge, A. H. (2017). Emerging data and current challenges for young, old, obese, or male patients with breast cancer. *Clinical Cancer Research*, *23*(11), 2647–2654. https://doi.org/10.1158/1078-0432.CCR-16-2552

Gershuni, V., Ahima, R., & Tchou, J. (2016). Obesity and breast cancer: A complex relationship. *Current Surgery Reports*, *4*(4), 1–9. https://doi.org/10.1007/s40137-016-0134-5

Gigi, K., Werbeloff, N., Goldberg, S., Portuguese, S., Reichenberg, A., Fruchter, E., & Weiser, M. (2014). Borderline intellectual functioning is associated with poor social functioning, increased rates of psychiatric diagnosis and drug use–A cross sectional population based study. *European Neuropsychopharmacology*, *24*(11), 1793–1797. https://doi.org/10.1016/j.euroneuro.2014.07.016

Godet, I., & Gilkes, D. M. (2017). BRCA1 and BRCA2 mutations and treatment strategies for breast cancer. *Integrative Cancer Science and Therapeutics*, *4*(1). https://doi.org/10.15761/ICST.1000228

Goldman, M. (2008). *Statistics for bioinformatics*. https://www.stat.berkeley.edu/~mgoldman/Section0402.pdf

Grundy, A., Harris, S. A., Demers, P. A., Johnson, K. C., Agnew, D. A., & Villeneuve, P. J. (2016). Occupational exposure to magnetic fields and breast cancer among Canadian men. *Cancer Medicine*, *5*(3), 586–596. https://doi.org/10.1002/cam4.581

Gucalp, A., Traina, T. A., Eisner, J. R., Parker, J. S., Selitsky, S. R., Park, B. H., Elias, A. D., Baskin-Bey, E. S., & Cardoso, F. (2019). Male breast cancer: A disease distinct from female breast cancer. *Breast Cancer Research and Treatment*, *173*(1), 37–48. https://doi.org/10.1007/s10549-018-4921-9

Hwang, K. T., Noh, W., Cho, S. H., Yu, J., Park, M. H., Jeong, J., Lee, H. J., Kim, J., Oh, S., & Society, K. B. C. (2017). Education level is a strong prognosticator in the subgroup aged more than 50 years regardless of the molecular subtype of breast cancer: A study based on the nationwide Korean Breast Cancer Registry Database. *Cancer research and treatment: official journal of Korean Cancer Association*, *49*(4), Art. 1114. https://doi.org/10.4143/crt.2016.528

Hinyard, L., Wirth, L. S., Clancy, J. M., & Schwartz, T. (2017). The effect of marital status on breast cancer-related outcomes in women under 65: A SEER database analysis. *The Breast*, *32*, 13–17. https://doi.org/10.1016/j.breast.2016.12.008

Isah, R. T., Mohammed, I., Avwioro, O. G., Abdullahi, K., & Bello, M. B. (2019). Breast cancer in men: A review of epidemiology, risk factors, diagnosis and prevention in Africa. *Nigerian Biomedical Science Journal* [*Online*], *2*(2015). https://www.nbsj.org.ng/2015/11/13/breast-cancer-in-men-a-review-of-epidemiology-risk-factors-diagnosis-and-prevention-in-africa/

Keinan-Boker, L., Levine, H., Leiba, A., Derazne, E., & Kark, J. D. (2018). Adolescent obesity and adult male breast cancer in a cohort of 1,382,093 men. *International Journal of Cancer*, *142*(5), 910–918. https://doi.org/10.1002/ijc.31121

Krajewski, P., Krajewska, A., & Żukowska, M. (2018). Breast cancer in a male patient with a BRCA1 mutation-A case report. *Journal of Education, Health and Sport*, *8*(9), 658–661. https://doi.org/10.5281/zenodo.1412464

LaMorte, W. (2019). *The social cognitive theory*. http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories5.html

Laouali, N., Pilorget, C., Cyr, D., Neri, M., Kaerlev, L., Sabroe, S., Gorini, G., Richiardi, L., Morales-Suarez-Varela, M., Llopis-Gonzalez, A., & Ahrens, W. (2018). Occupational exposure to organic solvents and risk of male breast cancer: a European multicenter case-control study. *Scandinavian Journal of Work Environment Health* , *44*(3), 312–322. https://doi.org/10.5271/sjweh.3717

Lautrup, M. D., Thorup, S. S., Jensen, V., Bokmand, S., Haugaard, K., Hoejris, I., Jylling, A. M. B., Joernsgaard, H., Lelkaitis, G., Oldenburg, M. H., & Qvamme, G. M. (2018). Male breast cancer: a nation-wide population-based comparison with female breast cancer. *Acta Oncologica*, *57*(5), 613–621.

https://doi.org/10.1080/0284186X.2017.1418088

Lee, K., Kruper, L., Dieli-Conwright, C. M., & Mortimer, J. E. (2019). The impact of obesity on breast cancer diagnosis and treatment. *Current Oncology Reports*, *21*(5), 1–6. https://doi.org/10.1007/s11912-019-0787-1

Leone, J., Zwenger, A. O., Leone, B. A., Vallejo, C. T., & Leone, J. P. (2019). Overall survival of men and women with breast cancer according to tumor subtype. *American Journal of Clinical Oncology*, *42*(2), 215–220. https://doi.org/10.1016/j.ejca.2016.10.038

Lopez, A. P. (2019). Delayed progress in detection and treatment of male breast cancer. *Journal of Clinical Oncology*, *1*, Art. 1. https://www.scholarsliterature.com/

Martínez, M. E., Unkart, J. T., Tao, L., Kroenke, C. H., Schwab, R., Komenaka, I., & Gomez, S. L. (2017). Prognostic significance of marital status in breast cancer survival: A population-based study. *PloS One*, *12*(5), Art. e0175515. https://doi.org/10.1371/journal.pone.0175515

Menvielle, G., Dugas, J., Richard, J. B., & Luce, D. (2018). Socioeconomic and healthcare use-related determinants of cervical, breast and colorectal cancer screening practice in the French West Indies. *European Journal of Cancer Prevention*, *27*(3), 269–273. https://doi.org/10.22034/APJCP.2017.18.4.1121

Midding, E., Halbach, S. M., Kowalski, C., Weber, R., Würstlein, R., & Ernstmann, N. (2018). Men with a “woman’s disease”: Stigmatization of male breast cancer patients—A mixed methods analysis. *American Journal of Men’s Health*, *12*(6), 2194–2207. https://doi.org/10.1177/1557988318799025

Monfared, E. D., Mohseni, M., Amanpour, F., Jarrahi, A. M., Joo, M. M., & Heidarnia, M. A. (2017). Relationship of social determinants of health with the three-year survival rate of breast cancer. *Asian Pacific journal of cancer prevention: APJCP*, *18*(4), Art. 1121. https://doi.org/10.22034/APJCP.2017.18.4.1121

Nemchek, L. (2019). *Phenomenological approach toward understanding the experience of men living with breast cancer* [Doctoral dissertation, University of Connecticut]. OpenCommons@UConn. https://opencommons.uconn.edu/dissertations/2408

Newman, L. A. (2017). Breast cancer disparities: Socioeconomic factors versus biology. *Annals of Surgical Oncology*, *24*(10), 2869–2875. https://doi.org/10.1245/s10434-017-5977-1

Obata, A., Okauchi, S., Kimura, T., Hirukawa, H., Tanabe, A., Kinoshita, T., Kohara, K., Tatsumi, F., Shimoda, M., Kamei, S., & Nakanishi, S. (2017). Advanced breast cancer in a relatively young man with severe obesity and Type 2 diabetes mellitus. *Journal of Diabetes Investigation*, *8*(3), 395–396. https://doi.org/10.1111/jdi.12570

Oyibo, K., Orji, R., & Vassileva, J. (2018). Developing culturally relevant design guidelines for encouraging physical activity: A social cognitive theory perspective. *Journal of Healthcare Informatics Research*, *2*(4), 319–352. https://doi.org/10.1007/s41666-018-0026-9

Parise, C., & Caggiano, V. (2019). Comorbidity and racial differences in risk of mortality of men with breast cancer. *Journal of Clinical Oncology*, *15*(37), 1554–1555.

https://ascopubs.org/

Partridge, A. H., Hughes, M. E., Warner, E. T., Ottesen, R. A., Wong, Y. N., Edge, S. B., Theriault, R. L., Blayney, D. W., Niland, J. C., Winer, E. P., & Weeks, J. C. (2016). Subtype-dependent relationship between young age at diagnosis and breast cancer survival. *Journal of Clinical Oncology*, *34*(27), 3308–3314. https://doi.org/10.1200/JCO.2015.65.8013

Patel, M. S., Halpern, J. A., Desai, A. S., Keeter, M. K., Bennett, N. E., & Brannigan, R. E. (2020). Success of prostate and testicular cancer awareness campaigns compared to breast cancer awareness month according to Internet search volumes: A Google trends analysis. *Urology*, *138*(1), 64–70. https://doi.org/10.1016/j.urology.2019.11.062

Picon-Ruiz, M., Morata-Tarifa, C., Valle-Goffin, J. J., Friedman, E. R., & Slingerland, J. M. (2017). Obesity and adverse breast cancer risk and outcome: Mechanistic insights and strategies for intervention. *CA: A Cancer Journal for Clinicians*, *67*(5), 378–397. https://doi.org/10.3322/caac.21405

Postula, K. V., Andolina, L. M., Theobald, K., McGill, A. K., Sutcliffe, E., Arvai, K. J., Murphy, P. D., Klein, R. T., & Hruska, K. S. (2018). Abstract PD7-11: The role of multi-gene hereditary cancer panels in male patients with breast cancer. *Cancer Research*, *78*(4_Supplement), PD7–11. https://doi.org/10.1158/1538-7445.SABCS17-PD7-11

Quincey, K., Shokuhi, S., Williamson, I. R., Appleton, D., & Wildbur, D. J. (2016). *Men and breast cancer: What do we know and what do we need to do differently?*

https://dora.dmu.ac.uk/

Quincey, K., Williamson, I., & Winstanley, S. (2016). 'Marginalised malignancies': A qualitative synthesis of men's accounts of living with breast cancer. *Social Science & Medicine*, *149*, 17–25. https://doi.org/10.1016/j.socscimed.2015.11.032

Reiner, A. S., Navi, B. B., DeAngelis, L. M., & Panageas, K. S. (2017). Increased risk of arterial thromboembolism in older men with breast cancer. *Breast Cancer Research and Treatment*, *166*(3), 903–910. https://doi.org/10.1007/s10549-017-4433-z

Restrepo, D. J., Boczar, D., Huayllani, M. T., Sisti, A., McLaughlin, S. A., Spaulding, A., Parker, A. S., Carter, R. E., Leppin, A. L., & Forte, A. J. (2019). Survival disparities in male patients with breast cancer. *Anticancer Research*, *39*(10), 5669–5674. http://ar.iiarjournals.org/content/39/10/5669.short

Siegel, R. L., Miller, K. D., & Jemal, A. (2016). Cancer statistics, 2016. *CA: A Cancer Journal for Clinicians*, *66*(1), 7–30. https://doi.org/10.3322/caac.21332

Sighoko, D., Rauscher, G., & Murphy, A. M. (2017). Male breast cancer: Are there racial disparities in incidence and tumor characteristics? *Medical Research Archives*, *5*(4). https://journals.ke-i.org/mra

Silber, J. H., Rosenbaum, P. R., Ross, R. N., Reiter, J. G., Niknam, B. A., Hill, A. S., Bongiorno, D. M., Shah, S. A., Hochman, L. L., Even-Shoshan, O. R. I. T., & Fox, K. R. (2018). Disparities in breast cancer survival by socioeconomic status despite Medicare and Medicaid insurance. *The Milbank Quarterly*, *96*(4), 706–754. https://doi.org/10.1111/1468-0009.12355

Singh, G. K., & Jemal, A. (2018). Socioeconomic inequalities in cancer incidence and mortality. In The American Cancer Society (Ed.), *principles of oncology: Prevention to survivorship* (pp. 23–32). American Cancer Society.

Sritharan, J., MacLeod, J. S., Dakouo, M., Qadri, M., McLeod, C. B., Peter, A., & Demers, P. A. (2019). Breast cancer risk by occupation and industry in women and men: Results from the Occupational Disease Surveillance System (ODSS). *American Journal of Industrial Medicine*, *62*(3), 205–211. https://doi.org/10.1002/ajim.22942

Stacey, F. G., James, E. L., Chapman, K., Courneya, K. S., & Lubans, D. R. (2015). A systematic review and meta-analysis of social cognitive theory-based physical activity and/or nutrition behavior change interventions for cancer survivors. *Journal of Cancer Survivorship*, *9*(2), 305–338. https://doi.org/10.1007/s11764-014-0413-z

Stacey, F. G., James, E. L., Chapman, K., & Lubans, D. R. (2016). Social cognitive theory mediators of physical activity in a lifestyle program for cancer survivors and carers: Findings from the ENRICH randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, *13*(1), Art. 49. https://doi.org/10.1186/s12966-016-0372-z

Sung, H., DeSantis, C., & Jemal, A. (2020). Subtype-specific breast cancer incidence rates in Black versus White men in the United States. *JNCI Cancer Spectrum*, *4*(1), Art. pkz091. https://doi.org/10.1093/jncics/pkz091

Trewin, C. B., Strand, B. H., Weedon-Fekjær, H., & Ursin, G. (2017). Changing patterns

of breast cancer incidence and mortality by education level over four decades in Norway, 1971–2009. *The European Journal of Public Health*, *27*(1), 160–166. https://doi.org/10.1093/eurpub/ckw148

University of Southern California. (2019). *Organizing your social sciences research paper: Quantitative methods*. https://libguides.usc.edu/writingguide/quantitative

Venigalla, S., Carmona, R., Guttmann, D. M., Jain, V., Freedman, G. M., Clark, A. S., & Shabason, J. E. (2018). Use and effectiveness of adjuvant endocrine therapy for hormone receptor–positive breast cancer in men. *JAMA Oncology*, *4*(10), e181114–e181114. https://doi.org/10.1001/jamaoncol.2018.1114

Vermeulen, M. A., Slaets, L., Cardoso, F., Giordano, S. H., Tryfonidis, K., van Diest, P. J., Dijkstra, N. H., Schröder, C. P., van Asperen, C. J., Linderholm, B., & Benstead, K. (2017). Pathological characterization of male breast cancer: Results of the EORTC 10085/TBCRC/BIG/NABCG International Male Breast Cancer Program. *European Journal of Cancer*, *82*, 219–227. https://doi.org/10.1016/j.ejca.2017.01.034

Wang, F., Shu, X., Meszoely, I., Pal, T., Mayer, I. A., Yu, Z., Zheng, W., Bailey, C. E., & Shu, X. O. (2019). Overall mortality after diagnosis of breast cancer in men vs women. *JAMA Oncology*, *5*(11), 1589–1596. https://doi.org/10.1001/jamaoncol.2019.2803

Weiss, J. R., Moysich, K. B., & Swede, H. (2005). Epidemiology of male breast cancer. *Cancer Epidemiology and Prevention Biomarkers*, *14*(1), 20–26. https://cebp.aacrjournals.org/content/cebp/14/1/20.full.pdf

Woods, R. W., Salkowski, L. R., Elezaby, M., Burnside, E. S., Strigel, R. M., & Fowler, A. M. (2019). Image-based screening for men at high risk for breast cancer: Benefits and drawbacks. *Clinical Imaging*, *60*(1), 84–89. https://doi.org/10.1016/j.clinimag.2019.11.005

Wu, S. G., Zhang, W. W., Liao, X. L., Sun, J. Y., Li, F. Y., Su, J. J., & He, Z. Y. (2017). Men and women show similar survival outcome in Stage IV breast cancer. *The Breast*, *34*, 115–121. https://doi.org/10.1016/j.breast.2017.05.012

Xue, X., Xie, X., Gunter, M., Rohan, T., Smoller, S., Ho, G., Cirllo, D., Yu, H., & Strickler, H., (2013). Testing the proportional hazards assumption in case-cohort analysis. *BioMedical Center Medical Research Methodology*, *13*(88). http://doi.org/10.1186/1471-2288-13-88

Yalaza, M., İnan, A., & Bozer, M. (2016). Male breast cancer. *The Journal of Breast Health*, *12*(1), Art. 1. https://doi.org/10.5152/tjbh.2015.2711

Zoorob, R. J., Salemi, J. L., de Grubb, M. C. M., Modak, S., & Levine, R. S. (2019). A nationwide study of breast cancer, depression, and multimorbidity among hospitalized women and men in the United States. *Breast Cancer Research and Treatment*, *174*(1), 237–248. https://doi.org/10.1007/s10549-018-5059-5

Appendix

Permission was obtained and granted from National Cancer Database Participant Use Data File to access the database containing person level data.