

2021

Disparities in the Use of Radiation Therapy for Postlumpectomy Breast Cancer

Deborah Rothley
Walden University

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Walden University

College of Health Professions

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Deborah Rothley

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Walden University
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Abstract

Disparities in the Use of Radiation Therapy for Postlumpectomy Breast Cancer

by

Deborah Rothley

MSPH, University of South Carolina, 1990

BS, University of South Carolina, 1985

Doctoral Study Submitted in Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Public Health

Walden University

August 2021

Abstract

Early-stage breast cancer can be highly curable when properly treated using national standards of care. However, disparities in treatment, including radiation therapy after lumpectomy, may result in disproportional mortality rates in African American women. The purpose of this study was to add to the body of research to help determine the reasons for an underutilization of radiation therapy among African American women and whether the disparity has continued by analyzing recent patient data. Anderson's behavioral model was used to frame the study and help determine the associations between the predisposing and enabling independent variables of race, age, health insurance status, and residential urbanicity and the dependent variable of radiation therapy use. This retrospective quantitative study used data from the National Cancer Institute Surveillance, Epidemiology, and End Results Program of women in Georgia diagnosed with early-stage breast cancer between 2012–2016. Logistic regression analysis of case files indicated that there were no statistically significant racial association, ($p = .517$), after controlling for age, in receiving radiation therapy after lumpectomy in Georgia. Furthermore, logistic regression analysis indicated that residential urbanicity and health insurance status did not significantly predict radiation therapy usage among women with early-stage breast cancer after controlling for race and age. The findings were not significant and did not show an increase in use of critical radiation treatment by African Americans. These results justify an expansion of interventions by cancer facilities to increase breast cancer treatment with radiation therapy. Appropriate treatment may improve survival rates of African Americans and those living in rural areas, which would lead to positive social change.

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Section 1: Foundation of the Study and Literature Review

In the United States, the most common cancer among women is breast cancer, with 1 in 8 women developing the disease (Siegel et al., 2018). While the death rate from female breast cancer has dropped significantly over the past few decades, in 2018 it was still the second leading cause of cancer death among women (Siegel et al., 2018). With more than 40,000 women dying across the country in 2018, efforts to improve the prevention, early detection, and treatment of breast cancer remain paramount in the medical community. While great advances have been made in these regards, survival has not been affected equally in all segments of the U.S. population (Sighoko et al., 2018). Health disparities exist in populations defined by geographic location and race, with complex and ambiguous causes.

Survivability of breast cancer, and especially early-stage breast cancer, depends on proper treatment. As part of the National Cancer Institute (NCI), the National Comprehensive Cancer Network's (NCCN) guideline for the treatment of most early-stage breast cancer recommends breast-conserving surgery with radiation therapy to follow for definitive local therapy (NCCN, 2019b). However, even though radiation therapy after breast-conserving surgery is considered the standard of care in the United States, many women do not receive this important treatment. In this study, I examined the associations between African American and White women's receipt of radiation therapy for treatment of early-stage breast cancer in Georgia. I also analyzed the patients' health insurance status and the accessibility of treatment facilities to determine if they predicted the patients' use of radiation therapy.

In this first section of the study, I provide the problem statement, the study's purpose, and the research questions and hypotheses. The theoretical foundation for the study and the nature of the study with the key variables are described next. My exhaustive search of the literature revealed many articles related to the study topic, and I highlight the ones most relevant to the research questions. Definitions of terms used in the study are listed with citations for support. My assumptions, scope, and delimitations to be used for conducting this study are described next. Finally, I conclude by identifying the significance of the study and summarizing the section.

Problem Statement

Elimination of the cancer burden caused by disparities is the goal of many health care organizations with the belief that survival rates can be improved by the identification of the root causes of disparities (NCI, n.d.b). The disparity in breast cancer mortality between African American and White women is the largest disparity among racial groups and has widened over the past 30 years (McCarthy et al., 2015). In addition to racial differences in cancer mortality, cancer patients in rural areas of the United States die of their disease at a higher rate than those who live in cities (McLafferty et al., 2011).

A factor on which survival outcome depends in all patients is that of their medical treatment, which includes surgery and radiation therapy when the NCCN guidelines are followed. There is a gap in the literature due to a lack of current studies using recent data to examine whether the trend of underutilization of radiation therapy following surgery has continued in African American women and those residing in rural areas. In this study, I addressed this gap by examining the most recent Surveillance, Epidemiology, and End

Results (SEER) data to determine the rates of proper receipt of radiation therapy in African Americans and rural populations in Georgia. The SEER (n.d.b) database contains cancer registry data from 18 geographic regions in the United States, including both the metropolitan Atlanta area and rural Georgia. To continue to provide interventions aimed at improving breast cancer care for vulnerable patients, research should remain current and at the forefront of public health investigation.

Purpose of the Study

The underutilization of radiation therapy after breast-conserving surgery signifies a severe health care concern for many women, and discovery of the reasons for this disparity is needed to improve breast cancer survival. Radiation therapy after breast-conserving surgery is the standard of care in the United States for women with early-stage breast cancer and reduces the risk of recurrence by two thirds (Early Breast Cancer Trialists' Collaborative Group (EBCTCG) et al., 2011; Fisher et al., 2002). The goal of this quantitative study was to answer several research questions to better understand some of the specific reasons for the underutilization of radiation therapy. The independent variables were race, health insurance status, and county of residence, while the dependent variable was radiation therapy use. My objective was to analyze the association between race, health insurance status, and residential urbanicity with the use of postlumpectomy radiation therapy. Because African American women experience the highest breast cancer mortality rate and White women have the lowest mortality rate due to breast cancer, only these races were examined (see Sighoko et al., 2018). Another reason for only including these two races was that the population of Georgia is comprised of about

60% Whites, 32% African Americans, and only 8% all other races (U.S. Census Bureau, n.d.).

The disparities in breast cancer treatment and mortality are well documented in the literature. Breast cancer treatment guidelines have been developed to provide the best outcomes possible, but the disparities in guideline concordance impact mortality rates of vulnerable patients (Fang et al., 2018). The findings of this study extend the knowledge gained from previous research. As cancer treatment becomes more complex and more costly, the potential for disparities may only increase. It is important to continue to analyze the available data to determine whether efforts to improve access and quality of care have resulted in the receipt of adjuvant radiation therapy by greater numbers of underserved women and whether breast cancer mortality disparities are being reduced.

Research Questions and Hypotheses

RQ1: Is there an association between patient race (i.e., African American versus White) in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia?

H₀1: There is no significant association between race in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia.

H_a1: There is a significant association between race in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia.

RQ2: Does patients' residence (i.e., rural versus urban) and health insurance status predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia?

H₀1: Patients' residence and health insurance status do not predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia.

H_a1: Patients' residence and health insurance status do significantly predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia.

Theoretical Foundation for the Study

The theoretical framework for this study was Andersen's behavioral model (ABM). This conceptual model is the most widely used for explaining variation in the use of health service (Fan et al., 2011). ABM was initially developed in 1960 and indicates that an individual's use of health care services is dependent on their predisposing factors, enabling factors, and need for care (Andersen, 1995). Predisposing factors to use health services consist of demographics, social structure, and health beliefs. Enabling resources include those obtained from personal, family, and community. The need factors comprise self-perceived reasons why an individual would or would not use health services. These

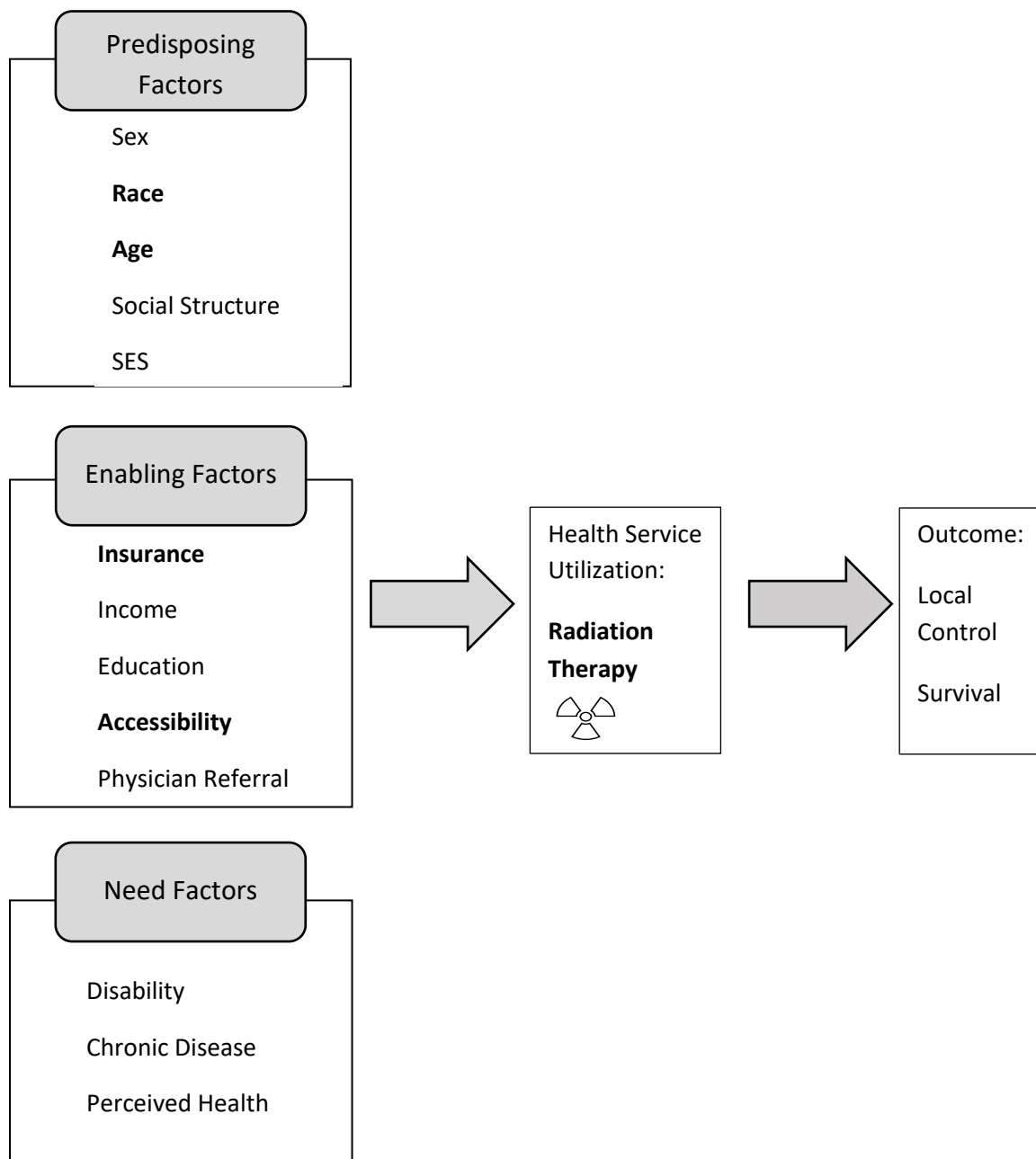
need factors include behavioral characteristics that cannot be measured in the SEER database and are beyond the scope of this study.

Predisposing demographic determinants include age, sex, and race and are variables with low degrees of mutability because they cannot be changed to alter health care utilization (Andersen, 1995). Therefore, the predisposing factors are generally used as independent variables in social studies. The enabling factors are income, insurance status, and health care facility access. These determinants are most changeable and contribute highly to the use of health services according to ABM.

After multiple revisions of the model, Andersen changed the ABM to go beyond health care utilization and to use health outcome as the endpoint (Andersen et al., 2014; Babitsch et al., 2012). Figure 1 is a diagram of the application of ABM to this study and the bold case variables are those that are included. The desired outcome was local control, with breast cancer survival being the ultimate outcome goal.

Figure 1

Application of Andersen's Behavioral Model



In this quantitative study, I examined identifiable factors obtained from cancer registry databases, such as race, county of residence (i.e., accessibility), and health insurance status, to determine their association with the use of radiation therapy for the treatment of early-stage breast cancer.

Nature of the Study

I used a retrospective, cross-sectional study design to determine the rates of receipt of radiation therapy for early-stage breast cancer in Georgia. Determination of cause and effect or reasons for the answers were possible in this quantitative study. A secondary database was used to determine whether the reported nationwide underutilization of radiation therapy by African American women and those living in rural areas are consistent in the state of Georgia. Furthermore, a correlational analysis showed which variables were associated with the omission of radiotherapy. The independent variables were race, health insurance status, and county of residence, while the dependent variable was radiation therapy use. The SEER database of the NCI was best suited for this study because it provided cancer statistics of the U.S. population, with specific registries from Atlanta, Greater Georgia, and Rural Georgia. The most current available version of the database included data from years up to 2016.

Literature Search Strategy

The literature search strategy I employed involved extracting keywords from the research questions to aid in my search. The Thoreau multidatabase search in the Walden University Library website was primarily used. Other specific journal searches for articles published in the past 5 years were conducted in the *Journal of the National*

Cancer Institute, Cancer Epidemiology, Cancer from The American Cancer Society, The New England Journal of Medicine, Lancet Oncology, International Journal of Radiation Oncology, Biology and Physics, American Journal of Public Health, and American Journal of Clinical Oncology. Keywords and phrases included *breast cancer disparities, cancer treatment disparities, racial inequalities in breast cancer, rural and urban residence disparities in breast cancer, radiation therapy treatment disparities in breast cancer, and cancer disparities in Georgia.* The searches uncovered a wealth of scholarly journal articles, from which I gathered information for this study. The primary articles used for this doctoral study are categorized in the following subsections.

Literature Review Related to Key Concepts

In this study, I examined the dependent factors related to the fact that African American women have higher mortality rates due to breast cancer than White women. These mortality differences have widened between 1979 and 2010, and a more recent study from 2018 showed that African American women still experienced the highest mortality rate from breast cancer compared to other racial groups (McCarthy et al., 2015; Sighoko et al., 2018). From an exhaustive search of the literature, I determined that the disparity was relevant in both breast cancer treatment and mortality. A distinctive difference between races existed in radiation therapy treatment and elimination of this disparity may lead to improved survival rates.

Breast Cancer Statistics

The American Cancer Society compiles lists of incidence rates of new cancer cases and deaths from cancer for each type of cancer; these lists and charts are

categorized by sex, race, state, stage, year, and others (Siegel et al., 2019). The American Cancer Society publishes a document annually that contains updated cancer statistics across the country, from which the breast cancer statistics for this study were obtained (see Siegel et al., 2019).

In addition, the official federal statistics on cancer are published by the Centers for Disease Control and Prevention (CDC, n.d.b) using the combined cancer registries of the SEER program from the NCI and the CDC's own National Program of Cancer Registries. These statistics allow researchers, clinicians, regulators, policymakers from the public, and the U.S. government to monitor cancer populations, evaluate the success of programs to prevent and diagnose cancer, and identify needs for cancer prevention (CDC, n.d.a).

The SEER Cancer Statistics Review is published on the SEER website and includes statistics from 1975 through 2016 (Howlader et al., 2019). It was released in April of 2019 and contains the most recent cancer incidence, mortality, survival, prevalence, and lifetime risk statistics. The tables and figures are presented in a pdf format and custom reports are easily generated for public use.

Breast Cancer Treatment

The foremost reference documents on the treatment of breast cancer are the NCCN Clinical Practice Guidelines in Oncology. These documents contain guidelines for the clinical decision-making process for clinicians that are formulated by affiliated medical institutions (NCCN, n.d.). The recommendations are evidence based and are grounded in clinical trials from around the United States. The NCCN Guidelines are the

recognized standard for clinical policy in cancer care and are frequently updated as information becomes available (NCCN, 2019a).

The NCCN Guidelines, Version 2.2019, Invasive Breast Cancer contains the recommendations for treatment of all four stages of invasive breast cancer. There exists a noninvasive type of breast cancer, ductal carcinoma in situ, which is referred to as Stage 0 and was not included in this study. The focus of this doctoral study is early-stage breast cancer, which is defined as Stage I and/or II for the purpose of this study (see NCCN, 2019b). Stage I is defined by the American Joint Committee on Cancer (AJCC) as breast tumors 2 cm or smaller in size and that has not spread to any lymph nodes (NCCN, 2019b). Stage II include those tumors that are between 2 cm and 5 cm, or cancer that has spread to the axillary lymph nodes (NCCN, 2019b). Stage II is a slightly more advanced form of the disease because it is either large or has spread beyond the original location.

The NCCN Guidelines for Stage I and II breast cancer recommend lumpectomy with a surgical staging of axillary lymph nodes (Gradishar et al., 2019). In the case of both negative and positive axillary nodes, radiation therapy is indicated as the recommended treatment by the NCCN following surgery. Another option that has similar outcome potential is a mastectomy, with or without radiation therapy (Fisher et al., 2002; Gradishar et al., 2019). Mastectomy is an option for those women who are unable or refuse to have a lumpectomy; however, radiation therapy is not typically indicated after mastectomy as it is postlumpectomy, except when surgical margins and/or nodes are positive (NCCN, 2019b).

Disparities in Breast Cancer Survival

According to a recent SEER Cancer Statistics Review, African American women have a 36% higher mortality rate due to breast cancer compared with White women (Howlader et al., 2019). Although this percentage included all stages of the disease and all ages, it demonstrates the racial disparities in breast cancer survival. The SEER review also noted that African American women have higher breast cancer mortality rates compared with White women despite a lower overall disease incidence (McCarthy et al., 2015). This statement reflects the SEER data from 1975–2016 for women with breast cancer. Specifically, the age-adjusted incidence rate for White women in the United States was 136.6 per 100,000 women per year compared with 124.0 for African American women (Howlader et al., 2019). However, the mortality rate for White women was 20.6 per 100,000 per year compared with 28.1 for African American women.

Other researchers have come to the same conclusions in other studies regarding the incidence and mortality rate differences between African American and White women. A large examination of 20,025 women presenting with Stage I, II, or III breast cancer between January 2000 and December 2007 resulted in the conclusion that African Americans are more likely to die from their breast cancer than other races regardless of their tumor subtype or stage (Warner et al., 2015). In this NCCN Breast Cancer Outcomes Database study, overall African Americans had a 21% higher risk of breast cancer-specific death than White Americans, Hispanic Americans, and Asian Americans (Warner et al., 2015).

Although progress has been made in the past few decades in reducing the racial disparity in mortality from many types of cancer and cardiovascular disease, the mortality rates remain higher for African American women (McCarthy et al., 2015). However, in contrast to other diseases, the disparity in breast mortality among young women seems to be widening (McCarthy et al., 2015).

Research into breast cancer incidence and mortality disparities was also published by the CDC in 2016. The authors examined data from 2000 to 2014 in the United States Cancer Statistics database and concluded that there was a trend in increasing African American breast cancer mortality in women older than 50 years (Richardson et al., 2016). In order to demonstrate regional differences in racial disparity in breast cancer, the SEER database was used to gather incidence and mortality data from 2010 to 2014 in a study of racial differences by state (DeSantis et al., 2017). The authors observed that the incidence rate was significantly higher for African Americans living in southern states, Indiana, Michigan, and the District of Columbia (DeSantis et al., 2017). Furthermore, the mortality rates during the study period were higher in the southern states, the District of Columbia, and a few Southwestern and Midwestern states. The mortality per 100,000 women ranged from 20.1 to 34.4, with the state of Georgia's mortality rate at 29.2 (DeSantis et al., 2017). The African American: White mortality ratio for Georgia was 1.45.

In a study of breast cancer mortality in the 50 largest U.S. cities, Hunt and Hurlbert (2016) found that in 24 of the cities studied, African American women died at a higher rate than White women. In the Avon Foundation-sponsored study, they compared

the mortality rate ratio of two 5-year periods, 2005–2009 and 2010–2014. They ranked the 50 cities in order of relative mortality rate between the two races and showed that Atlanta, GA had the highest difference. Atlanta’s rate ratio increased by 113% from the earlier period to the most recent time period, with the relative difference in mortality between African American and White women with breast cancer being more than 2:1 during 2010–2014. These results prompted the authors to advise that city-level data are important for planning effective public health interventions to improve breast cancer health care, treatment, and outcomes (Hunt & Hurlbert, 2016).

Disparities in Rural Breast Cancer Patients

In 2017, researchers at the CDC found that the death rate from 17 different cancers in rural counties in the United States was 14% higher than the rate in large metropolitan areas during the study period of 2009–2013 (Henley et al., 2017). For female breast cancer, the rural/urban difference was 18%; however, the statistics were not divided into cancer stage. The authors suggested that factors such as environmental exposures, behavior, race, and access to care were contributors to the disparity.

In 2016, Congress funded the Cancer Moonshot with \$1.8B over a 7-year period (NCI, n.d.a). This initiative was established to hasten cancer research, make treatment more accessible to patients, and improve the prevention and detection of cancer at an earlier stage. The Cancer Moonshot initiative emphasized the importance of increasing research into disparities between rural and urban cancer patients (Unger et al., 2018). With the recognition of this disparity, researchers have sought to determine if cancer outcomes in rural areas were due to inadequate access to quality cancer care, disease

type, socioeconomic status (SES), health insurance coverage, social structure, treatment, or other factors. In an effort to narrow down the possible reasons, researchers at the Fred Hutchinson Cancer Research Center analyzed the survival outcomes for rural cancer patients participating in clinical trials (Unger et al., 2018). The authors found that among patients enrolled in 44 NCI-sponsored Southwest Oncology Group (SWOG) treatment trials, including a wide variety of cancer types and stages, there were no differences in survival outcomes by residency status. This important finding showed that within a clinical trial setting, under similar treatment conditions, rural and urban residing patients have similar outcomes. Therefore, the authors suggested that the survival differences for rural and urban residing cancer patients may be partially due to inadequate receipt of guideline-concordant cancer care instead of reasons such as cancer stage and SES (Unger et al., 2018). Their study included clinical trials for 17 various cancer types and for hormone receptor-positive and negative breast cancers, the cancer-specific survival rate was slightly worse for rural patients versus urban residing patients (Unger et al., 2018). Not all rural- and urban-residing patients have access to clinical trials conducted by large academic institutions; therefore, the reasons for disparities in treatment options for cancer patients warrant further investigation.

Radiation Therapy Disparities

The literature contained several articles that contained evidence showing there was a racial disparity in those who receive radiation therapy for breast cancer; however, most were not published in the last 5 years. As early as 1985, researchers recognized that radiation therapy was underutilized following breast-conserving surgery (BCS) in women

with early-stage breast cancer (Lazovich et al., 1991). The authors of this study, however, did not comment on differences between races and the use of radiation therapy as adjuvant treatment. Mandelblatt et al. (2002) found that even though the breast cancer mortality rates had begun to decline, African American women actually experienced an increase in mortality rates. The authors concluded that when African American women received breast-conserving surgery, they would be less likely than White women to receive radiation therapy. This was the first large-scale, nationally represented sample of women that compared treatment received by African Americans and Whites. Since then, there have been several other national and regional studies that associated racial disparities in the use of radiation therapy treatment.

There were striking racial disparities in the types of therapy deemed necessary for breast cancer. Bickell et al. (2007) studied medical records of 677 women with breast cancer in New York City during 1999–2000. Their results were similar to those of Mandelblatt et al. (2002) and showed that racial minority women had twice the risk of White women for not receiving necessary adjuvant treatment for early-stage breast cancer. These conclusions were further verified by Sail et al. (2012) who studied records of 54,682 women with early-stage breast cancer and found that the percentage of women who did not receive radiation therapy after breast-conserving surgery increased from 1992 to 2002. They also determined that the disparities in receipt of radiation therapy between African American and White women increased during the time period. Another large-scale study by Smith et al. (2010) used the national Medicare database to identify 34,080 older women treated with BCS for invasive breast cancer in 2003. Substantial

racial disparities were found in radiation therapy use across the United States with 74% of White women receiving radiation therapy and 65% of African Americans.

Suboptimal use of radiation use can be detrimental to survival. Gold et al. (2008), identified factors associated with suboptimal use of radiation therapy and how it impacted the survival of women diagnosed with early-stage breast cancer. The authors used SEER data and found that delays in incomplete radiation treatment resulted in a reduction in disease-free survival. While they did not associate the differences between racial groups, the results were important for future studies.

In 2012, Tuttle et al. published a large-scaled nationwide study to determine which early-stage breast cancer patients do not receive radiation therapy after breast-conserving surgery in the United States. This study was based on breast cancer population-based data from the SEER database from 1992 through 2007. Of the 294,000 patients with nonmetastatic breast cancer who underwent surgery, 21% did not receive radiation therapy (Tuttle et al., 2012). The omission of radiation therapy increased during those years significantly for African American women and those considered high risk. The authors noted that the reasons for the increased omission were unclear, but they speculated as to some possibilities such as transportation, communication between medical specialists, and the side effects of radiation treatment.

In 2012, Markossian and Hines examined the disparities in late-stage breast cancer in Georgia. The authors used SEER data from 1992-2007 to compare treatment and outcome by age, race, and rural/urban residence (Markossian & Hines, 2012). The objective of the study was to calculate odds ratio (OR) for receipt of surgery and adjuvant

treatment, OR for late-stage diagnosis, OR for risk of death, OR for age, and OR for residence locale. The authors stated that Georgia contained a high variation in urban and rural residence, and SES. And as part of the southeast, it had a greater percentage of African American than other parts of the United States. The results of the study were that urban residents were more likely to receive BCS and radiation therapy. Rural patients were more likely to receive a mastectomy and were characterized as having the lowest SES. Rural residents had 41% decreased odds of receiving radiation regardless of stage or race. African American women had 7% decreased odds of receiving radiation regardless of stage or residence (Markossian & Hines, 2012). As for mortality, the study found that African American women had a 50% increased risk of death due to breast cancer than White women, but this statistic did not consider the stage. Also determined was that there was not a significant association in mortality between rural and urban residents (Markossian & Hines, 2012). The authors noted that further research was necessary to address the associations between outcomes and treatment for various stages of breast cancer. This gap in the recent literature was explored in my doctoral study.

Other publications became available that verified the racial disparities in radiation therapy used for the treatment of advanced-stage breast cancer (Loveland-Jones et al., 2016; Martinez, Tseng, et al., 2012). Additional studies analyzed racial disparities in breast cancer for specific locations in the United States (Dragun et al., 2011; Markossian et al., 2014; Ohri et al., 2016; Parise et al., 2012; Peipins et al., 2013; Schroen et al., 2005; Voti et al., 2006; Yeboa et al., 2016).

The literature supported the rationale that increased distance to radiation treatment centers reduced the likelihood of receipt of proper adjuvant therapy (Baldwin et al., 2012; Lin et al., 2018; Peipins et al., 2013; Unger et al., 2018). For many breast cancer patients who resided in rural areas, travel of greater than 50 miles was required to reach centers which offered radiation therapy. There was even evidence that the problem of rural treatment access affected African Americans more so than White women and rural women were less likely to complete their radiation treatment course than urban residing women (Martinez, Shah, et al., 2012; Unger et al., 2018). In addition to travel distance, there were other reasons that contribute to the rural/urban residence disparity in the use of radiation therapy including SES, social support, comorbidities, health insurance status, education, and regional medical practice patterns (Baldwin et al., 2012). A study examined women with early-stage breast cancer living in Kentucky and found there were significant disparities in the use of radiation therapy with those living in rural areas using radiation therapy less often (McClelland et al., 2017).

A current study in the *Advances in Radiation Oncology* journal made use of SEER data of 2006–2011 to determine the frequency of racial disparities in guideline-concordant cancer care for select cancers. The authors only examined postmastectomy Stage III breast cancer and found that African American patients were less likely than White patients to receive guideline-concordant care, as defined by NCCN Guidelines (Fang et al., 2018). In this study for Stage III breast cancer, the use of radiation was 53% in African Americans and 61% in White patients.

There was one recent (2014–2019) publication found that examined the racial disparities in the receipt of radiation therapy for early-stage breast cancer (Yeboa et al., 2016). The authors in this article used SEER data for 2004–2009 to determine that the racial disparities in postlumpectomy radiation therapy increased over the time period. Although the use of lumpectomy with radiation therapy decreased by 3.1% in White women, the decrease was more than double that in African American women (Yeboa et al., 2016). The authors noted that appropriate receipt of radiation therapy for breast cancer was an important public health issue because in women under the age of 70, it reduces local cancer recurrence by about two thirds. Of the 67,124 women studied, there was a decrease in the use of postlumpectomy radiation therapy over the study period, and the decreased use was more prevalent in African Americans (Yeboa et al., 2016). The study also considered some underlying causes of the disparities such as health insurance status, the quality of the treating physicians and hospitals, the travel distance to treating facilities, the density of radiation oncologists per area, and the patients' own perceptions of the medical field (Yeboa et al., 2016). All of these were speculative and warrant further study.

Definitions

The following terms were used throughout this study:

Adjuvant therapy: In cancer treatment, adjuvant therapy is the additional treatment given after the primary treatment to lower the risk of recurrence. In breast cancer care, surgery is usually the first treatment, and the adjuvant therapy may include chemotherapy radiation therapy, and hormonal therapy (NCCN, 2019b)

Breast-conserving surgery: An operation that removes the cancer tumor and other surrounding tissue but not the whole breast is breast conserving (NCCN, 2019b). It is also called lumpectomy or breast sparing surgery.

Early-stage breast cancer: Breast cancer that has not spread outside of the breast or adjacent lymph nodes is referred to as early stage. For the purpose of this study, the early stages will include Stage I and Stage II breast cancers (NCCN, 2019b).

The focus of this doctoral study was early-stage breast which was defined as Stage I and II for the purpose of this study (NCCN, 2019b). Stage I is defined by the AJCC as breast tumors 2 cm or smaller in size and that has not spread to any lymph nodes (NCCN, 2019b). Stage II is divided into two parts. Stage IIA is defined as breast tumors that are no larger than 2 cm and have spread to a few axillary lymph nodes, or breast tumors between 2 cm and 5 cm that have not spread to lymph nodes (NCCN, 2019b). Stage IIB are breast tumors between 2 cm and 5 cm that have spread to a few local lymph nodes, or tumors that are larger than 5 cm that has not spread (NCCN, 2019b). Stage IIIA is often considered an early-stage breast cancer because it consists of tumors greater than 5 cm that has spread to local lymph nodes. However, Stage IIIA was not included in this study due to the discrepancy in publications, between which stages constitute “early-stage.”

It must be noted that breast cancer staging of groups 0-IV is generally used by patients and nononcology practitioners. It is easy to comprehend and considered layman’s terminology in the United States. The AJCC required that registries and clinicians use the TNM (tumor, node, and metastasis) staging categories in the United States because tumor

grading and biomarker testing were routinely available (Giuliano et al., 2017). Starting with the November 2018 submission of registry data, SEER began accepting data based on TNM staging. Beginning with cases diagnosed in January 2019, all cancer registries in the United States changed collecting stage using the TNM classification (SEER, n.d.a). Therefore, when accessing the SEER database for this study, early-stage breast cancers were included T1-2, N0-1, M0 disease. This classification referred to tumors ≤ 5 cm without extension to the chest wall, negative lymph nodes or positive axillary nodes, and no metastatic disease (Giuliano et al., 2017).

Insurance: The SEER category of Insurance includes codes for uninsured, any Medicaid, insured, and insured/no specifics will be used for this study.

Mortality rate: Mortality is used as a term used for the incidence of death in this study. It is defined as the number of deaths over a certain period of time or within a given group of people, and often described as an annual rate per 100,000 (Zeegers et al., 2016)

NCI: The NCI is the U.S. government's principal agency for cancer research and training and is part of the National Institutes of Health (NCI, 2018).

NCCN: The NCCN is an alliance of 28 leading cancer centers devoted to patient care, research, and education (NCCN, 2019a). NCCN publishes Clinical Practice Guidelines in Oncology are evidence-based documents that detail the sequential management and interventions that apply to all cancers in the United States. The NCCN Guidelines are continuously updated to reflect new clinical data as available and are intended to assist in the decision-making of clinicians involved in cancer care (NCCN, 2019b)

National Institutes of Health: The National Institutes of Health is a U.S. federal agency that conducts research and supports the research of scientists in universities, hospitals, and research institutions. It is the largest biomedical research agency in the world (National Institutes of Health, 2019).

Race: The SEER category of race/ethnicity will be examined. Only the codes for White and African American are relevant to this study.

Radiation oncologist: A radiation oncologist is a medical physician trained to treat cancer with ionizing radiation (American Cancer Society, n.d.).

Radiation: The SEER category of Rx summary – radiation has codes for several types of radiation therapy. “External beam,” “radioactive implant,” “combination,” “radiation NOS,” and “other” codes were relevant to this study. However, the codes for “patient refused radiation therapy,” and “radiation recommended but unknown if administered” were indicated that radiation was not received.

Radiation therapy: Radiation therapy or radiotherapy, is the use of high energy ionizing radiation to kill cancer cells and shrink tumors (NCCN, 2019b)

Residence: The SEER category of state-county was analyzed for the location of residence. The Rural Georgia SEER Registry included 10 counties: Glascock Greene, Hancock, Jasper, Jefferson, Morgan, Putnam, Taliaferro, Warren, and Washington counties (Georgia Center for Cancer Statistics, 2010). The Atlanta SEER Registry was used to gather urban residing patient data and includes the counties of Clayton, Cobb, Dekalb, Fulton, and Gwinnett (Georgia Center for Cancer Statistics, 2010).

SEER: SEER is a U.S. federal program to collect cancer statistics and is supported by NCI. SEER gathers and publishes data from population-based cancer registries that comprise about 35% of the U.S. population (SEER, n.d.b). The program comprises a national database with information on patient demographics, tumor site and stage, treatment, and follow-up status. It also charts cancer incidence and survival and reports that information to other federal agencies such as the National Center for Health Statistics (Duggan et al., 2016).

Surgical oncologist: A surgical oncologist is a medical specialist who is trained to perform surgical biopsies and remove tumors in cancer patients. The surgical oncologist typically treats breast cancer patients first and then refers them for adjuvant therapy if needed.

Survival rate: The survival rate refers to the percentage of people in a group who are alive for a specific period of time after their diagnosis or treatment (NCCN, 2019b)

SWOG: The SWOG Cancer Research Network is an NCI supported group that conducts clinical trials in adults with cancer. Patients are enrolled in SWOG trials at more than 650 institutions in the United States (Unger et al., 2017).

Urbanicity: Urbanicity refers to the degree to which a geographical area is urban. (Empson et al., 2019)

Assumptions and Limitations

There were assumptions made in this study for the accuracy of the SEER database. Population-based tumor registries such as those comprising the SEER database may have data misclassification and reporting bias. Furthermore, a report demonstrated

that population-based registries were particularly variable in the accuracy of radiation therapy coding (Walker et al., 2013). This article compared the accuracy of registry radiation therapy coding compared with Medicare claims and found that all registries studied were not consistent to some degree with Medicare. The registries that were examined included those in SEER and the Florida, New York, and Texas state registries. The SEER database was more consistent with Medicare than the other state registries. The authors summarized the study by commenting that population-based tumor registries are critical to oncologic research and that future work should identify the use of electronic medical records to improve their accuracy (Walker et al., 2013). But because the SEER data are the most widely used for medical research, I assumed that it was accurate for my study, which compared relative statistics between races and residence locale. Another assumption was made regarding women with Stage I or II breast cancer who were ineligible for BCS and radiation therapy by the NCCN criteria. I assumed that all women with early-stage breast cancer were recommended to receive radiation therapy by their physician because only a small percentage were ineligible due to comorbidities.

There were limitations to my study related to the possible misclassification of a race from medical records. However, this limitation was assumed to be minimal between the African American and White races. Another limitation of the SEER database included the use of county-based rural/urban residential designations. SEER did not allow for zip code classification and therefore I could not perform a more detailed analysis of the rural/urban counties. Also, SEER did not record SES status and therefore, no assumptions were made on its contribution to the receipt of radiation therapy.

Scope and Delimitations

This doctoral study was limited to female patients with only Stage I and II invasive breast cancer. Because male breast cancer was rare, the small number of male breast cancers were excluded from my study. However, one national study did determine that there existed racial disparities with male breast cancer, and there was increased mortality in the African American population (Crew et al., 2007).

Because the use of a secondary data set was required for my doctoral degree, I relied on those variables attainable in the database to answer my research questions. Determinants related to patient beliefs and experiences, physician recommendations, health literacy rate, and facility quality were not available in this secondary database and therefore, not within the scope of this study. No generalizability beyond the state of Georgia was implied.

Significance

Disparities in breast cancer treatment and survival have persisted for years and have increased (McCarthy et al., 2015). African American women and those women residing in rural areas experience worse outcomes due to breast cancer than Caucasian women and those living in urban areas. African American women have a 40% higher breast cancer mortality than White women, even though they have a lower incidence of breast cancer (Noone et al., 2016). According to Desantis et al. (2006), African American women began having lower rates of breast cancer incidence and higher death rates in the 1980s. Women with breast cancer who lived outside of urban areas had worse survival outcome and tended to underutilize radiation therapy (Lin et al., 2018; Unger et al.,

2018). Studies have shown that living in the Southeastern United States was associated with lower rates of radiation therapy use after lumpectomy than other parts of the country (Baldwin et al., 2012; Chagpar et al., 2008; Dragun et al., 2011).

Therefore, determination of the reasons for the greater mortality rates of vulnerable patients is vitally important for the public health of the country. A documented reason for worse outcomes in breast cancer care is the lack of adjuvant radiation therapy following surgery (Dragun et al., 2011; Martinez, Tseng, et al., 2012; Smith et al., 2010; Tuttle et al., 2012; Whelan et al., 2000). Efforts to increase the proper receipt of radiation therapy by those who underutilize it, could increase the survivability of breast cancer, the most commonly diagnosed cancer in women in the United States (Yeboa et al., 2016). In the case of racial minorities, this lower rate of use of an important part of breast cancer treatment could be responsible for the fact that the survival rate for African American women with breast cancer is lower than that of White women (Hunt & Hurlbert, 2016; McCarthy et al., 2015; Ohri et al., 2016; Sighoko et al., 2018). Positive social change is promoted by increasing survival from early-stage breast cancer by African American women and those residing in rural areas.

Summary and Conclusions

The nature of this study focused on quantitative research to understand what factors led some women to underutilize radiotherapy even though it was an important adjuvant treatment for early-stage breast cancer. Multiple studies have shown that adherence to guideline-concordant treatment can be linked to inferior survival in these patients (Dragun et al., 2011; EBCTCG et al., 2011; Fang et al., 2018; Hamidi et al.,

2010; Smith et al., 2010; Tuttle et al., 2012). Radiation therapy eliminates possible microscopic disease adjacent to the primary tumor, which is responsible for recurrences and the spread to other organs (NCCN, 2019b). The lower rate of use of radiation therapy for breast cancer care by African Americans could be responsible for the fact that their survival rate is lower than that of White women (Hunt & Hurlbert, 2016; McCarthy et al., 2015; Ohri et al., 2016; Sighoko et al., 2018).

Even though multidisciplinary cancer care is available in all large cities in the United States, those living in rural areas and racial minorities do not receive radiation treatments as often as White women living in urban areas. Continued study of the lack of receipt of radiation therapy is warranted to measure the progress or lack of improvement in reducing the differences. A review of the literature has not demonstrated a recent study of the differences in rates of use of radiation therapy adjusted by race between rural, and urban residing women in the South to determine if the disparities have lessened.

Interventions have improved access to cancer care, but some populations have not seen improved survival rates as a result. Thus, endeavors to continue the monitoring of proper breast cancer care receipt are an essential responsibility for public health researchers and my goal for this study. Because the lowest rates of use of radiation therapy have been shown to be in the Southern region of the United States, this study focused on the state of Georgia (Dragun et al., 2011). Analysis of recent updates of the SEER registries, and of patients residing in rural areas of the southern United States is not available in the literature to my knowledge. Therefore, I aim to increase the knowledge of

the receipt of adjuvant radiation therapy for early-stage breast cancer with this doctoral study.

Section 2: Research Design and Data Collection

Underutilization of radiation therapy by African American women and women residing in rural areas signifies an important disparity in the treatment of early-stage breast cancer. Adjuvant radiation therapy following breast-conserving surgery reduces the risk of recurrence by two thirds over treatment with surgery alone (EBCTCG et al., 2011; Fisher et al., 2002). The objective of this doctoral study was to determine the association of specific variables with the lack of receipt of radiation therapy in Georgia.

In this second section of the study, I identify the research design and rationale for the study by stating the variables and connecting the research questions to the design. The methodology of the study is described by defining the target population, sample size, instrument for the secondary data, and the data analysis plan. Finally, I discuss the threats to validity and the ethical procedures followed to gain access to the database.

Research Design and Rationale

In this doctoral study, I employed the quantitative method for data collection, analysis, and interpretation. This method is the best design for an experimental study to determine the relationship between the variables (Creswell, 2009). In this study, the independent variables were race, county of residence, and health insurance status, and the dependent variable was usage of radiation therapy. I used statistical analysis to determine the relationship between the independent variables and the patients' receipt of radiation therapy for treatment of early-stage breast cancer.

I collected national tumor registry data from the SEER database, which is publicly available to researchers at no cost. Therefore, there was no time or resource constraints in

the collection of data for this study. This represented an advantage to using secondary databases as opposed to primary data collected by survey. Collecting high-quality data is both expensive and time consuming (Rudestam & Newton, 2015). Another reason why a quantitative method was most appropriate for this study was that it was consistent with most other prior studies in the literature related to the topic.

Methodology

Population

The target population for this study was women with early-stage breast cancer residing in the state of Georgia. According to the latest statistics from the Georgia Department of Public Health (2018), the breast cancer incidence for females in Georgia 2012–2016 was 36,399. All the records of women with early-stage breast cancer residing in Georgia that were available in the SEER 2016 database were included in this study. The statistics gathered comprised the most recent and up-to-date set of breast cancer records in the state. Because I used this secondary database and records of all female patients with early-stage breast cancer were included, random sampling of the data was not necessary.

Sample and Sampling Procedures

The exclusion and inclusion criteria focused on collecting the largest population groups for statistical significance and for the most health impact. This study only included two races because the population of Georgia was comprised of about 60% White, 32% African American, and only 8% all other races (U.S. Census Bureau, n.d.).

Only female patients were included because male breast cancer was considered rare. In Georgia, only 55 males were diagnosed with breast cancer each year (Georgia Department of Public Health, 2018). That was too few to calculate reasonable statistics when compared with 36,000 female breast cancer patients. Additionally, the vast majority of the literature focusing on breast cancer disparities did not include males.

Only early-stage breast cancer was included in this study for a couple of reasons. The first reason was that 68% of breast cancers in Georgia were diagnosed as early-stage and had the greatest cure rate (Georgia Department of Public Health, 2018). The second reason was that the NCCN (2019b) recommended treatment for most early-stage (i.e., Stage I and II for this study) was breast-conserving surgery followed by adjuvant radiation therapy. Postlumpectomy radiation was contraindicated for women with preexisting comorbidities, or women electing mastectomy over breast-conserving surgery, and women with poor clinical status (Siegel et al., 2019). However, for the other invasive cancer Stages III and IV, radiation therapy was less often widely recommended for treatment (NCCN, 2019b). In this study, I focused on breast cancer for which adjuvant, postlumpectomy radiation therapy was recommended by NCCN guidelines.

The anticipated sample size was around 25,000 because 68% of the approximately 36,000 breast cancer cases in Georgia were early-stage during 2012–2016 (Georgia Department of Public Health, 2018). This number was more than sufficient to confidently draw conclusions from the results. An adequate sample size is necessary to reach the predetermined power or probability sufficient for the test to result in the rejection of the null hypothesis (Cohen, 1988). I used an online statistical power calculator to calculate

the a priori sample size given the power, alpha, and effect size (see Faul et al., 2007). An acceptable power was .80, or the probability that the test detected a true relationship. The conventional alpha or significance levels were .05 or .01. By using the larger alpha of .05, more opportunities were provided to reject the null hypothesis (see Faul et al., 2007). Cohen (1988) suggested a choice of values based on estimations of a small, medium, or large effects, which require respectfully decreasing sample sizes. A small effect size of .2 would require a larger sample but was necessary when the actual variance between the test groups was not known. The allocation ratio, or proportion of size of the two study groups, was about 2.2 according to the Georgia Department of Public Health (2018).

Using the G*Power online calculator, the *t* test for two independent means resulted in a sample size of 916 (see Faul et al., 2007). The input values were effect size = .2, alpha = .05, power = .8, and allocation ratio = 2.2. The calculated sample size was significantly smaller than the study sample. G*Power also allows for the post hoc calculation of power if the sample size is known. With this calculation, a sample size of 520 gave 100% statistical power, which referred to a sure ability to detect a real relationship between the variables (see Cohen, 1988). For the logistic regression test, I conducted a G*Power calculation that resulted in a sample size of 510, using the same input parameters as the *t* test (see Faul et al., 2007). The post hoc test showed that about 3,000 samples were needed to reach 100% power.

I signed the Data Use Agreement for the 1975–2017 SEER Research Data File and sent it to SEER. I was then provided with an ID number that allowed me to access the database. A separate Data Use Agreement for SEER Radiation Therapy and

Chemotherapy Information form was also signed to allow me to gain access to the radiation therapy data.

Instrumentation and Operationalization of Constructs

In Georgia, the cancer registry process started with requiring all health care providers to report specific cancer information on their patient population to the Georgia Comprehensive Cancer Registry (GCCCR, 2018). The health care providers included hospitals, outpatient surgical facilities, laboratories, radiation therapy and chemotherapy centers, physicians and their offices, and any other facilities involved in diagnostic evaluations or treatment of cancer patients (Georgia Department of Public Health, n.d.). The Rollins School of Public Health at Emory University collected and maintained cancer data for the GCCCR. The Georgia Center for Cancer Statistics (n.d.) at Emory University participated in the NCI's national databases providing population-based incidence data as part of the SEER program. The SEER database was the source of the secondary data used in this doctoral study.

GCCCR submitted its data to the North American Association of Central Cancer Registries (NAACCR), which is a professional organization that develops data standards and certifies cancer registries (Georgia Department of Public Health, 2014). The NAACCR evaluates data for completeness, timeliness, and accuracy as well as determines whether they meet the National Data Quality Standard. GCCCR consistently met the National Data Quality Standard criteria and received Gold Certification for the past 8 years, which included incidence data from 2008 to 2016, the most recent registry data (NAACCR, 2019). This designation allowed the GCCCR data to be included in the

U.S. Cancer Statistics Registry for Surveillance, the official government statistics on cancer, which included the NCI's SEER program. Gold Certification was the highest standard classification that the NAACR used in categorizing registries for inclusion in the U.S. National Cancer Statistics. The Gold Standard signified that the cancer registry met all the criteria, including 95% completeness in case ascertainment; fewer than 0.1% duplicate case reports; all data variables used to create incidence by cancer type, sex, race, age, and county were 100% error-free; and others (NAACCR, 2019).

The SEER Program, therefore, included registry data that satisfied quality standards at the state level. In addition, the program included a quality improvement process conducted by a staff of statisticians, registrars, and contractors whose goal was to monitor and report outcomes and results of data edits, completeness audits, and study plans (NCI, n.d.c). The SEER quality improvement staff also set standards for data collection by cancer registries and provided technical coding manuals and training materials to cancer registrars seeking credentialing. To maintain the high-quality standard, the SEER Program developed a broad set of field edits that prevented and corrected errors in the data. Electronic edits were also used to authenticate codes as well as check for missing data and other errors. I used the most recent SEER database with radiation therapy treatment data that was published in April 2019 (SEER, 2019b).

The independent variables that were analyzed to answer the research questions were race, county of residence in Georgia, and health insurance status. The dependent variable was radiation therapy use. These variables were operationalized in the SEER Data Record Description for Cases Diagnosed in 1975–2017. The variable for race was

coded as 1 for African American and 2 for White. These were the only two codes that were used for the study although the race recode had codes for other and unknown. Other races likely comprised an exceedingly small and statistically insignificant percentage of women undergoing treatment for breast cancer in Georgia. The residence county in SEER was operationalized as a state and county Federal Information Processing System Code. Georgia's Federal Information Processing System code was 13 and each county had a three-digit code. The insurance status variable consisted of five codes: 1 = uninsured, 2 = any Medicaid, 3 = insured, 4 = insured/no specifics, and 5 = insurance status unknown. I designated Codes 2, 3, 4 as insured for this study. The dependent radiation therapy variable was described by SEER as 1 = external beam, 2 = radioactive implant, 3 = radioisotopes, 4 = combination, 5 = radiation not specified, 6 = other radiation, 7 = refused radiation therapy, and 8 = none/unknown. Types 1, 2, 3, 4, 5, and 6 were designated as "Yes," received radiation. Types 7 and 8 were designated as "No," did not receive radiation. The other variables used in this study included sex (female), primary site (breast), primary surgical site (lumpectomy), and stage (i.e., I, IIA, and/or IIB).

Confounding variables could have had a role in obscuring the results of this study. In medical research such as this, relationships between cause and effect could be blurred by confounders which should be controlled (see Jager et al., 2008). Additionally, confounders are variables whose presence affects the variable being studied (Pourhoseingholi et al., 2012). One such confounder was patient age, which could influence their cancer treatment choice. Older women may not have opted for radiation therapy because their mobility was limited making it difficult for them to attend daily

radiation therapy treatments. Older women with early-stage breast cancer may have also decided with their physician that adjuvant treatment would likely not extend their life. Therefore, I stratified the patient age at diagnosis variable to determine the relationship between age and receipt of radiation. Another potentially confounding variable was the tumor size. Patients with smaller tumors may have opted to not receive further adjuvant treatment for their cancer. The AJCC “T” variable designated tumor size. T1a tumors were more than 1 but not more than 5 mm in greatest dimension, T1b tumors were more than 5 mm but not more than 1 cm, T1c were more than 1 cm but not more than 2 cm, and T2 tumors were more than 2m but not more than 5 cm. Therefore, the tumor size variable was contained in the breast cancer stage and was controlled by stratifying the tumor stage. Typically, in breast cancer research, parameters, such as tumor grade and histology, and hormone receptor status may be considered confounding variables and should be controlled. However, in this study, I focused solely on the treatment of early-stage breast cancer with radiation therapy and, therefore, grade, histology, and receptor status did not influence whether radiation therapy is recommended. According to the NCCN (2019b) Guidelines, all early-stage breast cancer should receive adjuvant radiation therapy following breast-conserving surgery regardless of other cancer specific parameters.

Data Analysis Plan

The data analysis was conducted with the SEER*Stat (version 8.3.8) statistical software program that was provided by the NCI at no cost to researchers when access to the databases was approved (SEER, 2020). SEER*Stat was a tool that allowed the

researcher to produce statistics for studying the impact of cancer on a population. Because SEER*Stat only allowed determination of frequencies, distributions, trends, and survival, the SEER database was imported in IBM Statistical Package for Social Science (SPSS) version 27 for tests of associations and chi-square tests.

The first research question was analyzed with a logistic regression test to determine the association between patients' race and use of radiation therapy after controlling for patient age at diagnosis. The second question was assessed with a logistic regression test to determine if county of residence and health insurance status predicted the use of radiation therapy after controlling for patients' race and age. The following table summarized the data analysis plan for this study. All tests utilized the commonly used 95% significance. A probability value greater than .05 meant that the results were not statistically significant, and the null hypothesis was not rejected.

Table 1

Summary of Statistical Tests Used to Test the Hypotheses

Research Questions	Variables	Tests
1. Is there an association between patient race (i.e., African American versus White) in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia?	Race, age, use of radiation therapy	Logistic regression
2. Does patients' residence (i.e., rural versus urban) and health insurance status predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia?	County, health insurance, race, use of radiation therapy	Logistic regression

Threats to Validity

Threats to validity exist in most social science research studies and this study was no exception. Threats to internal validity may have resulted in untrustworthiness of the reported observations and interpretations unless the threats were considered and accounted for as much as possible. In this doctoral study, "history" was a type of internal threat that was considered. This threat could invalidate results of a study when changes occurred over time that affected the study population. In this study the rurality of a location of residence for the population could have changed, whereby business development increased, and a radiation therapy center was built nearby. If a previously rural, low-income area suddenly had access to treatment facilities in proximity, this could have affected the results of the study. Another example of this threat was if the study population had a change in health insurance coverage, which allowed better access to medical treatment. However, the historical internal threat to validity was not valid in this study because the time window of the population cancer records was the last 5 years. This short time period did not allow large scale changes to development or health insurance, which was a political issue.

Another potential threat to internal validity involved the under ascertainment of radiation therapy rates by SEER (Yeboa et al., 2016). A study of the under ascertainment of radiation therapy by SEER registry data suggested that caution was advised when using SEER to compare survival rates and receipt of radiation among population groups. However, this limitation was rationalized by explaining that in studies of relative rates, the under ascertainment of radiation therapy had not been found to vary by race. Also, the

authors speculated that reporting of radiation therapy would be consistent year by year, so that reporting a trend over time was still valid.

Threats to external validity typically involved generalization of the results. I would argue that generalization of the findings to the future was not a goal of this study. The research questions were designed to use current data to determine if trends in breast cancer disparities were decreasing. Therefore, the view of this study was backward in time rather than futuristic. Also, actual patient records were to be examined and not averages of sample populations. The threats to external validity were thus minimized by this study.

Ethical Procedures

The cancer data that make up the SEER database was collected from state-mandated cancer registries. For example, in Georgia, the Georgia Department of Public Health (2018) established the GCCR with funding from the CDC. The GCCR participated in the NCI's national cancer databases, which SEER was associated. The ultimate goal of the state and national cancer registries was the reduction of cancer-related morbidity and mortality through research and education. The registries were uniquely capable of achieving the goals by describing cancer through each state and providing data for scientific publications. Studies have provided evidence to show how cancer registry data can be used to study and improve clinical outcomes and the quality of cancer care in the United States. McLaughlin et al., (2010) studied the question of whether cancer registries were unconstitutional because the data was collected with government funds and without consent or knowledge of patients. As concerns about

individual privacy and the alleged indignity of patient's medical information being transmitted to government officials had come into question, the authors sought to answer the concerns by analyzing state registry laws. They concluded that state cancer registration would survive constitutional review, protects privacy rights in the United States, and justifies public health expenditures for government benefits. The authors also stated that the benefits of cancer registration outweighed any perceived moral considerations regarding human indignity and privacy concerns (McLaughlin et al., 2010).

There were no alternatives to population-based cancer registries that could provide accurate and comprehensive epidemiologic assessments of cancer and databases such as SEER were necessary for the public health. State registries took great care to protect patient and hospital anonymity. No patient identifiers were collected, and analyses were reported only at a cumulative level (Bilimoria et al., 2008). Any statistics that were gathered contained retrospective data and individual records were not discernible. Confidentiality was of paramount importance for all cancer registries and there could be no actual or perceived breach of confidentiality in any cancer registry. To access the SEER database for this doctoral study, I was required to read, sign, and comply with a data-use agreement. The agreement emphasized that protection of patient identities was of utmost importance and that every effort had been made to exclude identifying information on individual patients. Also, by signing the document, I agreed to make no attempt to identify any individuals from the files and would not publish any

information on individual patients. Before collection of the data, the Walden IRB Approval Number 07-14-20-0618699 was obtained.

Summary

In Section 2, I described the research design and data collection method of my doctoral study. The research design was a quantitative method that used a secondary database to answer the research questions. The methodology of the study included a description of the instrumentation by identifying the Georgia state registry that was incorporated into the national cancer registries of the SEER database. Also, possible confounding variables were discussed. The independent variables, which were analyzed were race, county of residence, and insurance status. The dependent variable was radiation therapy use. The data analysis was conducted with the SEER*Stat and SPSS statistical software tools. The statistical tests that were run to answer the research questions were defined in a table of the data analysis plan.

Following the methodology section, I described some threats to internal validity of the results of the study. These included the possible change of the health care environment over the time span of the study, and the documented fact that use of radiation therapy was not always ascertained properly in registry data. However, these threats were rationalized by the fact that the time span of the study was relatively short and only 5 years. Also, the threat of under validation of radiation therapy codes in the database was explained by the fact that it was not likely to be dependent on race.

Finally, in this section I described studies which refuted the possible breach of confidentiality and constitutionality of state-mandated cancer registries. Considerable

efforts were undertaken to ensure these ethical values were not violated. There were substantial numbers of research studies on cancer that depended on valid, accurate, and confidential data from cancer. The SEER database was well suited for use as a secondary database for cancer studies. In Section 3 the statistical analysis of the SEER cases in this study will be explained along with the resulting findings.

Section 3: Results and Findings

The purpose of this study was to determine if African American women in Georgia with early-stage breast cancer were receiving adjuvant radiation therapy at a greater rate compared with White women in the most recent 5 years than in the past. Additionally, a couple of the factors for receipt of radiation therapy were explored by race of participants. The research questions were as follows:

RQ1: Is there an association between patient race (i.e., African American versus White) in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia?

RQ2: Does patients' residence (i.e., rural versus urban) and health insurance status predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia?

The hypotheses in the study were that there was an association between race and use of radiation therapy and that residence and health insurance status do predict the usage of radiotherapy among women in Georgia.

In Section 3, I review the data collection procedures using a secondary data set and the results of statistical tests used to answer the research questions. The first tests are run to define the descriptive statistics of the sample. Then, logistic regression tests are used to reject or fail to reject the null hypotheses. I use tables and figures to illustrate the results. Finally, the answers to the research questions are summarized.

Data Collection of Secondary Data Set

Following receipt of approval from the Walden University IRB in July 2020, I signed and executed the SEER Data Use Agreement. This allowed me access to the database for research purposes. The agreement stated that I would not attempt to identify the patients and that individual case files would only be identified by an ID number. Learning the coding system of the vast SEER database proved to be an arduous task and selecting the relevant variables for this study was time consuming. However, the technical staff at NCI were most helpful and after several months, the selected variables were exported in a format readable by SPSS. Within SPSS, I recoded the variables and evaluated the statistical tests.

Some changes to the previously detailed data collection process were necessary after I examined the database. When the inclusion criteria of only Stage I and II breast cancers was applied, the total number of cases was reduced to 22,115. However, this amount remained greater than the population sample of 3,000 that was previously calculated as required for 100% power. The percentage of African Americans in the sample was 28% and Whites made up 72% of the cases. The cases were limited to female breast cancer patients diagnosed between the years of 2012 and 2016. This time frame includes the last 5 years of cases available in the SEER database and was the focus of this study (see SEER, 2019a). Only African American and White patients were included as explained previously. I divided breast cancer data into Stages I, IIA, and IIB for early-stage inclusion rather than use the T designation. The SEER incidence database utilized a

stage coding restricted to breast cancer for 1988–2015 data, and a derived stage coding for 2016 data (Ruhl et al., 2016).

Another revision to the original selection criteria was the inclusion of only patients from 45 to 79 years of age. Breast cancer patients younger than 45 tend to have more aggressive cancer and, thus, are more likely to opt for a course of treatment involving a mastectomy. After a mastectomy, radiation therapy may not be recommended in cases involving negative nodes, tumors ≤ 5 cm, and margins ≥ 1 mm (NCCN, 2019b). Patients older than 80 years are less likely to choose radiation treatment due to ambulation difficulties and poor health. Additionally, radiation therapy may not be necessary for older patients (Tuttle et al., 2012). Therefore, medical and external issues confound the guideline concordance of treatment and were avoided by limiting the included age groups from 49 to 79 years of age.

Descriptive Statistics

I collected the descriptive statistics of the sample of cases from the three registries that included patients from Georgia from 2012 to 2016. The registries were listed as Atlanta Metropolitan (1975+), Rural Georgia (1992+), and Greater Georgia (2000+; see SEER, 2019b). The Rural Georgia cases were from the counties of Glascock, Greene, Hancock, Jasper, Jefferson, Morgan, Putnam, Taliaferro, Warren, and Washington. They were indicated in blue on Figure 2. The Atlanta Metropolitan counties included Clayton, Cobb, Dekalb, Fulton, and Gwinnett counties and are indicated in green on the map. The Greater Georgia registry included all the other 144 counties in Georgia. Therefore, by using the Atlanta Metropolitan, Rural Georgia, and Greater Georgia registries, all

counties in Georgia were included in the analysis for the first research question. Only Atlanta Metropolitan and Rural Georgia registries were included for the second research question.

Figure 2*Map of Georgia Counties*

Note. Adapted from *Georgia Counties*, by The Georgia Department of Transportation, (2012).

http://www.dot.ga.gov/DriveSmart/MapsData/Documents/Statewide/Counties_Map_122812.pdf

Table 2 indicated that the total number of cases were 22,115, with the racial breakdown of 27.9% African American and 72.1% White. The ages were categorized by groupings of 5 years in the database with the greatest number of cases in the 65–69 group. The year of diagnosis ranged from 2012 to 2016, with a majority of patients diagnosed in 2016. Stages I and II were included for early-stage breast cancer, and the

SEER database further divided Stage II into IIA and IIB. The greatest number of cases were Stage I (59.6%). The three Georgia registries included were Atlanta (33.9%), Rural Georgia (1.7%), and Greater Georgia (64.5%).

Table 2

Georgia Patient Characteristics Year of Diagnosis 2012-2016

	Number	Percentage
Total	22,115	100.0%
Race		
African American	6,172	27.9%
White	15,943	72.1%
Age at diagnosis		
45–49	2,336	10.6%
50–54	3,066	13.8%
55–59	3,396	15.4%
60–64	3,931	17.8%
65–69	4,118	18.6%
70–74	3,161	14.3%
75–79	2,107	9.5%
Stage		
I	13,179	59.6%
IIA	6,094	27.6%
IIB	2,842	12.8%
Residence		
Metro Atlanta	7,490	33.9%
Greater Georgia	14,254	64.5%
Rural Georgia	371	1.7%
Year of diagnosis		
2012	4,100	18.5%
2013	4,278	19.3%
2014	4,442	20.1%
2015	4,571	20.7%
2016	4,724	21.4%

Note. Data are from SEER (2019a).

The database included a variable indicating the type of radiation therapy received. For all types, including beam radiation, brachytherapy, radioisotopes, combination of beam with implants, and radiation not specified, I recoded the variable “Yes.” If the type was listed as none or refused, it was recoded as “No.” The number of women in Georgia aged 45–79 diagnosed between 2012 and 2016 with early-stage breast cancer who received radiation therapy was 12,235 (55.3%). The number of women who did not receive radiation therapy was 9,880 (44.7%).

Bivariate Analyses

I examined the age and stage variables were examined to determine if there was a significant association between the races. Table 3 lists the numbers of White and African Americans who received radiation therapy for each stage of cancer. As seen, the majority of both African American and White women who received radiation therapy had Stage I disease ($p = .000$, $\chi^2 = 232.822$, $df = 2$).

Table 3*Use of Radiation Therapy by Race and Stage in Georgia*

Race	Radiation Therapy		Total
	African American	White	
Stage			
I	3,186 (24.2%)	9,993 (75.8%)	13,179
IIA	1,986 (32.6%)	4,108 (67.4%)	6,094
IIB	1,000 (35.2%)	1,842 (64.8%)	2,842
Total	6,172 (27.9%)	15,943 (72.1%)	22,115

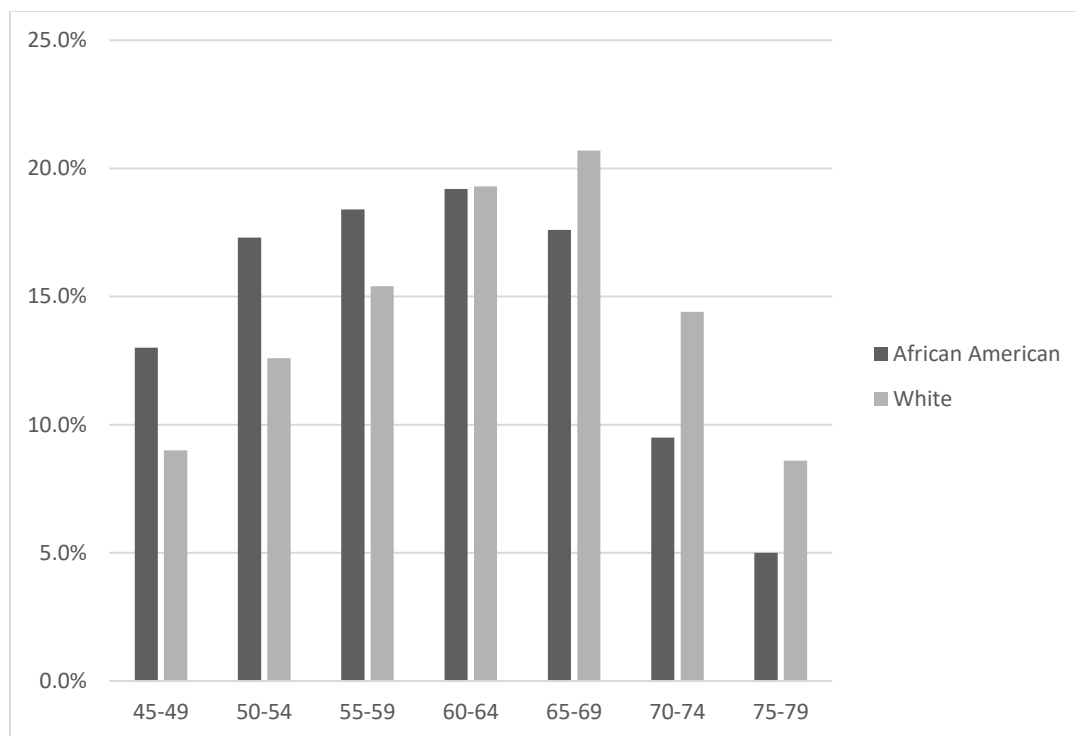
Note. Data are from SEER (2019a).

Pearson chi-square = 232.500, $df = 2$, $p = .000$.

I performed the same chi-square analysis on the different age groups for Whites and African Americans to determine the association of use of radiation. Figure 3 shows the age groups for radiation use. Most White women who received radiation were in the 65–69 age group (19.5%), and most African American women who received radiation therapy were in the 60–64 age group (18.2%). The association between age and radiation use was significant at the .05 level ($p = .000$, $\chi^2 = 251.165$, $df = 6$).

Figure 3

Age at Diagnosis of Women With Early-Stage Breast Cancer Who Received Radiation Therapy in Georgia 2012–2016



Note. Data are from SEER (2019a).
Pearson chi-square = 251.165, $df = 6$, $p = .000$.

Research Questions and Hypotheses

The research questions and hypotheses were restated below. Following each question, the relevant statistical tests and results were given. Table 4 indicates the recoding that was necessary to run binary logistic regression tests.

Table 4

Recoding of Dependent and Independent Variables

	Recode
Radiation use	
Yes	1
No	0
Race	
African American	1
White	2
Age at diagnosis	
45-49	1
50-54	2
55-59	3
60-64	4
65-69	5
70-74	6
75-79	7
Residence	
Metro Atlanta	1
Rural Georgia	2
Insurance status	
Yes	1
No	0

Research Question 1 Results

The first question was answered using a logistic regression test. The results were not significant, and the null hypothesis was not rejected.

RQ1: Is there an association between patient race (i.e., African American versus White) in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia?

H_0 1: There is no significant association between race in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia.

H_a 1: There is a significant association between race in the use of radiation therapy for treatment of early-stage breast cancer after controlling for age at diagnosis among women in Georgia.

A binary logistic regression analysis was conducted to investigate if patient race was associated with use of radiation therapy for treatment of early-stage breast cancer after controlling for patients' age. The outcome variable was radiation therapy usage and possible predictor variables were race and age. Initially the regression test was run with race as the predictor variable. This analysis revealed that race was not a predictor of radiation therapy use because the independent variable was not significant ($p = .201$). Patient age was next added as a controlling variable and the model showed that race was still not a predictor ($p = .517$). However patient age was significant and therefore a predictor of radiation therapy use ($p = .000$). The unstandardized B value was negative ($B = -.045$) and $\text{Exp}(B) = .956$. The reference value for the radiation therapy variable was

“Yes.” Therefore, for every 5-year increase in age, the odds ratio for radiation therapy usage decreased 4.4%. The logistic regression results are displayed in Table 4.

Table 5

Age and Race Association With Radiation Therapy Use for Women in Georgia Diagnosed 2012-2016

	<i>B</i>	S.E.	Wald	<i>df</i>	Sig.	Exp(B)	95% C.I. Lower	95% C.I. Upper
Race	.020	.030	.420	1	.517	1.020	.961	1.082
Age	-.045	.008	35.999	1	.000	.956	.942	.970
Constant	.390	.035	123.878	1	.000	1.477		

Note. Data are from SEER (2019a). Variable reference: Radiation therapy = Yes

There was not statistically significant association in the use of radiation therapy for the treatment of early-stage breast cancer between White and African American women in Georgia during the years of 2012 and 2016. Therefore, the null hypothesis failed to be rejected after controlling for age.

Research Question 2 Results

The second question was answered with a logistic regression test, which used the independent variables of patient residence and health insurance status. The dependent variable was radiation therapy usage. The regression test did not show an association between residence and health insurance status with radiation therapy usage, and therefore, the null hypothesis was not rejected.

RQ2: Does patients' residence (i.e., rural versus urban) and health insurance status predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia?

H₀1: Patients' residence, and health insurance status do not predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia.

H_a1: Patients' residence, and health insurance status do significantly predict the use of radiation therapy for treatment of early-stage breast cancer after controlling for race (i.e., African American versus White) and age among women in Georgia.

For RQ2 the SEER registry variable indicating residence was imported along with the radiation variable for each case selected using the criteria of female African American or White with breast cancer, aged 45–79, diagnosed during the years of 2012 and 2016, and residing in Georgia. Of the three registries, Atlanta Metro, Rural Georgia, and Greater Georgia, only the Atlanta and Rural registries were included to determine the association between radiation use among African American and White women residing in rural and urban counties. The health insurance status variable along with the radiation treatment variable was imported to SPSS for each case. Insurance variable was recoded to “Yes” for insured and Medicaid types, and “No” for those insured. The 401 cases, which indicated insurance unknown, were not included in this analysis. Table 5 lists the frequencies for the variables of interest in the study sample.

Table 6*Patient Characteristics of Women Residing Only in Urban and Rural Counties**Diagnosed 2012–2016*

	Number	Percentage
Total	7,861	100%
Race		
African American	2,934	37.3%
Caucasian	4,927	62.7%
Residence		
Metro Atlanta	7,490	95.3%
Rural Georgia	371	4.7%
Insurance status		
No	149	1.9%
Yes	7,712	98.1%
Radiation therapy after surgery		
No	3,506	44.6%
Yes	4,355	55.4%

Note. Data are from SEER (2019a).

A binary logistic regression analysis was run to determine whether the independent variables of patients' residence and health insurance status predicted the outcome variable of radiation therapy use while controlling for patients' race and age. In Block 1 of the analysis, residence ($p = .610$) and insurance status ($p = .153$) did not significantly predict radiation therapy use. In Block 2 of the model patients' race and age were included as control variables. The result indicated that the independent variables of residence ($p = .644$) and insurance status ($p = .143$) still did not predict radiation therapy usage. The B values for residence ($B = -.049$) and health insurance status ($B = -.243$) were

both negative indicating that urban residence (i.e., Atlanta Metro) and affirmative health insurance status were associated with radiation therapy use. The logistic regression analysis is reported in Table 7.

Table 7

Residence, Insurance Status, Age, and Race Association With Radiation Therapy Use for Women in Georgia Diagnosed 2012-2016

	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>	<i>95% C.I.</i> <i>Lower</i>	<i>95% C.I.</i> <i>Upper</i>
Race	.053	.047	1.272	1	.259	1.055	.961	1.157
Residence	-.049	.107	.214	1	.644	.952	.772	1.174
Insurance	-.243	.166	2.143	1	.143	.785	.567	1.086
Age	.000	.013	.000	1	.986	1.000	.975	1.025
Constant	.205	.059	12.110	1	.001	1.227		

Note. Data are from SEER (2019a). Variable references: Radiation therapy = Yes, Residence = Atlanta, Insurance status = Yes

The null hypothesis failed to be rejected because patients' residence and health insurance status did not significantly predict radiation therapy use after controlling for race and age.

Summary

The statistical analysis of the SEER data revealed interesting and encouraging results. Even though the hypotheses of the study were not consistent with the data, the results showed that African American women in Georgia were receiving radiation therapy more often compared to White women that in the past. The most recent years that the SEER registries were available included 2012–2016.

The first research question asked if there was a significant association between African American and White women's race and their use of radiation therapy in Georgia after controlling for their age? The data revealed that there was not a significant association in the use of radiation between women of the two races. The null hypothesis, which stated that there was no significant association, failed to be rejected.

The second research question focused on residence in rural versus urban counties in Georgia and health insurance status. The question was whether the independent variables predicted the use of radiation therapy. The logistic regression model showed that they did not significant predict the dependent variable and therefore, the null hypothesis was not rejected.

In Section 4, interpretations of the results, the application of the study to professional practice and implication for social change will be discussed. The findings of the statistical analysis of the secondary data will be compared with that found in the literature described in Section 1. The findings are then analyzed in the context of the theoretical framework of ABM. The limitations of the study along with recommendations for further research in breast cancer treatment disparities are described. My recommendations for the application of the study for professional practice and the potential impact for positive social change are also provided.

Section 4: Application to Professional Practice and Implications for Social Change

I conducted this retrospective quantitative study to extend the knowledge gained from prior research into the underutilization by African American women of radiation therapy for early-stage breast cancer in Georgia. The study was designed to determine the rate of receipt of radiation therapy and the association with two factors that could be reasons for the utilization disparities. I analyzed secondary data from the SEER database of the NCI.

Implications for Findings

The two research questions were answered by the findings. I developed the first question to determine whether there was a significant association in the rate of use of radiotherapy for the treatment of early-stage breast cancer and race among women in Georgia after controlling for their age. The corresponding null hypothesis failed to be rejected. There were no statistically significant association between use of radiotherapy for treatment of early-stage breast cancer and race.

The literature, as cited in Section 1, contained a consensus that African American women underutilize radiation therapy compared to White women in previously published studies. Bickell et al. (2007) showed African American women had twice the risk of White women for not receiving adjuvant radiation therapy for early-stage breast cancer. Sail et al., (2012) demonstrated similar results and further determined that the disparities in receipt of radiation therapy were increasing. Tuttle et al. (2012) conducting the largest study to date of more than 294,000 women, showed a significantly greater percentage of White women received radiation therapy than African American women for

postlumpectomy breast cancer. Their study included data for women diagnosed with breast cancer from 1992 through 2007 from the SEER database.

Further prior studies revealed evidence that reflect disparities. Markossian and Hines (2012) examined the disparities in late-stage breast cancer experienced by women in Georgia by also using SEER data from 1992–2007 to calculate odds ratios for receipt of surgery and radiation therapy. Their results showed that urban residents were more likely to receive surgery and radiation therapy compared with rural residents. Martinez, Shah et al. (2012) further showed that the problem of rural radiation treatment access affected African American women more so than White women. The study using the most recent patient data was conducted by Yeboa et al. (2016). In their study, the SEER database was used to analyze patient cases diagnosed between 2004 and 2009, and the researchers determined that not only did the use of lumpectomy with radiation therapy decrease over the study period but that the decrease in radiation therapy use with African American women was double that of White women. Parekh et al., (2018) studied the impact of race and other factors on receipt of radiation after breast-conserving surgery, concluding that of the women under the age of 70 who underwent surgery for breast cancer from 2004 to 2014, White women were significantly more likely to receive radiation therapy than African American women (90.2% versus 85.3%, $p < .0001$). Their study did, however, provide a somewhat agreeable finding to the current study because the authors showed that the percentage of women nationwide receiving radiation therapy after breast surgery decreased in 2013 and 2014, the last years of their study.

Therefore, there was much evidence of the underutilization of radiation therapy by African American women compared to White women published in the scientific literature. The goal of this study was to analyze data from the most recent SEER database of women diagnosed with early-stage breast cancer diagnosed between 2012 and 2016 in Georgia to determine if the trend of racial disparities had continued or improved.

With the second research question, I sought to examine whether patients' county of residence in Georgia and their health insurance status predicted their use of radiotherapy for early-stage breast cancer. The analysis showed that residence and health insurance status did not significantly predict radiation therapy use, and thus, the null hypothesis failed to be rejected. Unlike the previously reported studies in the literature, the percentage of women living in rural counties of Georgia received radiation therapy in a greater percentage than those who did not; however, the rural versus urban residence usage of radiation therapy was not found to be statistically significant.

Contrary to the results of the current study, the scientific literature reported that rural versus urban residential disparities exist in breast cancer treatment and mortality. Rural women in Georgia were found to have a higher death rate due to breast cancer than those living in urban areas (Markossian et al., 2014). In another study of rural patients in Georgia, Guy et al. (2015) found that only 35.2% received guideline-concordant treatment including radiation therapy for early-stage breast cancer. Furthermore, the problem of rural treatment access affected African American women more so than Whites (McClelland et al., 2017; Unger et al., 2018).

Accessibility to radiation therapy had been studied in the literature and shown to be a factor in radiation therapy usage in rural areas and urban residential counties. Recent literature supported the idea that increased travel distance to radiation therapy facilities in rural areas reduced the likelihood of receipt of radiation therapy (Lin et al., 2018; Longacre et al., 2019; Unger et al., 2018). Data from the Radiological Physics Center at MD Anderson in Houston, Texas and my personal knowledge of Georgia radiation therapy centers revealed that there were no treatment facilities in any of the 10 counties in the SEER rural Georgia registry (Radiological Physics Center, n.d.). Therefore, those women residing in the rural counties had to use private or public transportation to get to their radiation treatments. There were relatively few (371) women with Stages I or II breast cancer residing in these counties and diagnosed during the study period.

Studies in the literature have also demonstrated that lack of health insurance coverage in women with breast cancer was related to omission of radiation therapy after lumpectomy (Churilla et al., 2017; Freedman et al., 2011; Parekh et al., 2018). In a study of SEER data of early-stage breast cancer patients, Churilla et al. (2017) found a 10% difference in rates of omission of radiation therapy following surgery according to health insurance status. In an older study, a 12% difference was reported in radiation therapy usage rates between insured and uninsured patients in the National Cancer Database (Freedman et al., 2011).

I used ABM as the conceptual framework of this study. The ABM enabling factors of health insurance and accessibility (i.e., residence) were most relevant and were used to determine if the radiation therapy health service was associated to them. Further

investigation is needed to analyze the affects that the health service has on the survival outcome.

Limitations of the Study

This study had inherent limitations related to the use of population-based tumor registries. The SEER database used was comprised of registries throughout Georgia that were subject to data misclassification. Specifically, reporting biases had been demonstrated in the inaccuracy of radiation therapy coding for Medicare claims (Walker et al., 2013). Discrepancies in registry recorded treatment and the actual treatment delivered to the patient may also exist. The weakness of tumor registry-based databases was, however, balanced by the ability of researchers to analyze large sample sizes. Therefore, the scientific literature heavily relied on SEER databases for most retrospective studies, and the database was used in the majority of the studies found in my literature search. SEER specifically listed the high overall sensitivity of the radiation therapy usage data as $> 85\%$, which was determined by Noone et al. (2016). This limitation related to database use was due to the incompleteness of the radiation therapy variables as defined by tumor registries (see Jaggi et al. 2012). Additionally, the lack of data on systemic therapy in the SEER data could affect treatment decisions (Churilla et al., 2017).

An additional weakness in the SEER database was the lack of case-specific SES. The rural and urban residential counties in the SEER registries were defined by Georgia Center for Cancer Statistics (n.d.). Because only the county was known to me in the database, I could not draw any conclusions of income or education level. These factors

could vary substantially in a county and may have an impact on treatment. I used the rural Georgia registry in SEER; however, there could be other rural counties in Georgia that may have led to different findings in this study.

Finally, there are patient and medical factors that affect cancer treatment decisions that were not captured in this study. Variables, such as progression of disease, response to chemotherapy and surgery, comorbidities, and hormone receptor positivity, could all influence a physician or patient's treatment choice. In addition, provider biases toward certain treatments, family history, and patient fears about radiation therapy could have impacted their decision. A limitation as cited by SEER was the biases associated with unmeasured reasons for receiving or not receiving radiation therapy and/or chemotherapy (see Noone et al., 2016).

Care should be taken with regard to comparison of the results of this study to other areas in the United States. No generalizability beyond Georgia was intended because the analyses were limited to the SEER registries of Atlanta, rural Georgia, and greater Georgia. However, the population may be representative enough of the southeastern U.S. population in demographics and economics to warrant that comparison.

Recommendations

Future study of the disparities in early-breast cancer treatment was needed and, therefore, was the inspiration of this study. While the results did not follow the trends seen in the literature, they have justified a much larger nationwide study to validate that the disparities in breast cancer treatment were on the decline. The interventions that have been put in place by organizations such as the Avon Foundation in Atlanta can be having

a significant impact in erasing racial and economic disparities in breast cancer. The true test of the interventions, however, will be whether survival rates were affected.

Another aspect of breast cancer treatment that can have had an impact in the findings is the widespread adoption of innovation in radiation therapy. In the past, the common dose and fractionation of radiation therapy after surgery called for 5 to 7 weeks of daily treatment. More recently, clinical trials have demonstrated that the use of shorter courses of therapy have comparable outcomes and toxicity with long-term treatment (Smile et al., 2016). These types of novel radiation schemes, called accelerated partial-breast irradiation and hypofractionated whole breast irradiation, have been receiving wide-spread implementation. Hypofractionated whole breast irradiation radiation treatments are delivered in as few as 15 fractions, which greatly reduce the number of times patients must visit the facility and also the cost of treatment. A particularly innovative type of treatment, called intraoperative radiotherapy, is delivered in one session in the operating room, immediately after a lumpectomy. It has been popular with patients in the limited number of facilities where it is offered. The increased convenience of shorter courses of treatment may improve compliance by patients to complete their therapy.

Implications for Professional Practice and Social Change

This study has delivered an important addition to the evidence of eliminating disparities in breast cancer care. Previously, the trends of underutilization of radiation therapy were thought to be a cause of declining survivability by African American women in the southern United States. However, as shown by the results of this study,

recently the rate of use of radiation therapy by African Americans and those living in rural areas has been increasing. Although the results were not significant, a trend may be starting to occur.

While this good news shows a movement toward less disparities, in the professional practice of radiation therapy, much is still needed to ensure the equitable delivery of breast cancer care. For instance, fulfilling transportation needs for patients to attend appointments for physician visits, treatment, and follow up would help to ensure that all patients are given access. The use of health care navigators can also help patients find their way through the complicated maze of multidisciplinary breast cancer care. This may reduce the likelihood of some patients being lost in the network of breast care specialists.

Another important strategy that can further influence receipt of radiation therapy is the development of a more culturally competent medical workforce. Diversification of the physician workforce may help to improve outcomes for African Americans because they are underrepresented in most oncological specialties (McClelland et al., 2017). A workforce study done by the American Society for Radiation Oncology in 2017 determined that only 2% of U.S radiation oncologists were African American (Fung et al., 2019). Current interventions to enhance the cultural competence training of medical providers and staff can lead to less bias and more understanding of the ability to care for diverse populations.

This study impacts social change by providing evidence for the positive changes to breast cancer treatment with radiation therapy. Disparities in breast cancer treatment and

survival have persisted for decades leading up to this study. Previously shown in the literature, African American women and those residing in rural areas experienced a higher mortality rate due to breast cancer than Whites and those living in urban areas (McCarthy et al., 2015; McLafferty et al., 2011; Sighoko et al., 2018). This public health issue has received much attention in recent years and interventions to turn around the trend have been instituted. The Radiation Oncology Institute (n.d.), a nonprofit foundation, works to increase the knowledge of the critical role of radiation therapy in the treatment of cancer through the funding of research and education. Along with other advocacy groups, the Radiation Oncology Institute is working to improve diversity and inclusion in radiation therapy that will improve cancer care and outcomes. This study demonstrates that these efforts may be beneficial for many patients.

Conclusion

The goal of this study was to supplement the literature with recent data regarding disparities in radiation therapy for early-stage breast cancer treatment. I used the most current SEER registries from Georgia to determine whether the trends in underutilization of radiation therapy by African American women and those residing in rural areas have continued. The results from early-stage breast cancer patients diagnosed from 2012–2016 indicated that the trend has started to reverse and that the use of radiation therapy by those populations has increased to that of the rates of White women and those living in urban Atlanta. For far too long, disparities in survival rates for breast care have widened to the point of a public health crisis. The barriers to improving the survival rates may be breaking down, and as seen in the results of this study, breast cancer treatment is

becoming more equitable across racial and geographic boundaries in Georgia. The elimination of more cancer disparities may be possible in the foreseeable future.

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