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Five-Year Cervical Cancer Survival Rates by Stage at Diagnosis, Race, and Place of Residence in Georgia, USA

layal Mansour
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral study by

Layal Mansour

has been found to be complete and satisfactory in all respects,
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Review Committee
Dr. Vasileios Margaritis, Committee Chairperson, Public Health Faculty
Dr. German Gonzalez, Committee Member, Public Health Faculty
Dr. Pelagia Melea, University Reviewer, Public Health Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2022

Abstract

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BS, Walden University, 2021

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Despite breakthroughs and improvement in cervical cancer (cercancer) management strategies over the years, racial and geographical disparities on 5-year relative survival rates (RSRs) persist. Studies showed black women have higher mortality rates than white women with the majority of deaths occurring among women above age 45. The aim of this cross-sectional study was to investigate the predicting abilities of race and residence on 5-year RSRs by stage at diagnosis and the potential effect on survival probability in the early stage of cercancer for women above 45 years living in Georgia. Anderson's behavioral model for inequalities in healthcare was the theoretical framework of the study. A total of 2,811 cercancer patients residing in rural and urban locations who were diagnosed with cercancer between 1992 and 2016 were sampled from the Surveillance, Epidemiology, and End Results Program dataset. Data were analyzed using the Cox regression model. Age, treatment, and marital status accounted for the racial and residential-based differences in all stages and early-stage cercancer 5-year RSRs. Aging increased hazard rate and decreased patient survival time. Being married (including common law), unlike living with a domestic partner or being widowed, reduced the hazard rate and extended individual survival time. Additionally, conventional cancer treatment approaches increased cercancer hazard rate and reduced survival time. According to the study results, positive social change can be achieved by acknowledging that a shift of attention in policy guidelines from race and residence-based considerations to age, treatment, and marital status is essential in tailoring interventions towards addressing survival disparities.

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Dedication

The project is dedicated to cervical cancer and all cancer patients in the world.

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I would like to give special gratitude to several individuals and institutions for supporting me throughout my project. First, I wish to express my sincere gratitude to my supervisors Dr. Margaritis Vasileios (Chair) and Dr. German A Gonzalez (committee member) for their guidance, patience, and insightful ideas that have helped me tremendously at all times in my research and writing of this thesis. I also wish to greatly acknowledge the enthusiastic contribution and unceasing support by the URR, Dr. Pelagia Melea; Program director, Dr. Michelle Burcin; research coordinator, Tammy Root; and academic advisor, Laura Brodkey. The immense knowledge, profound experience, and professional expertise enabled me to complete this research successfully. Without the support and guidance, this project would not have been possible. Thank you.

I also wish to express my sincere thanks to the Walden University for accepting me into the doctorate program. I am deeply indebted to the National Cancer Institute and Centers for Disease Control and Prevention for allowing me to access and use the expansive SEER database for my project.

I also want to express my special appreciation to my family for the continuous support throughout my studies. To my kids, Cela, Lana, Eva, Jana, and Ahmad, who made me a better version of myself, stronger and more satisfied, just always remember not to stop fighting and always believe in yourself to attain your dreams.

To my parents my backbone. Thanks for trusting my dreams.

To my husband who always support my choices.

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Section 1: Foundation of the Study and Literature Review

Cervical cancer, which is the uncontrolled growth of abnormal cell changes in the cervix or the lower parts of the uterus, is one of the most common, deadliest, and preventable cancer types globally (Tabuchi, 2020). One of the major leading causes of cervical cancer is different types of human papillomavirus (HPV). Sexually active people are at a significant risk of contracting HPV, but only a few develop cervical cancer (Tabuchi, 2020). Once the cancerous cells start to grow, they eventually result in devastating health effects as they spread throughout the body (Rutherford, 2020). That is why early screening and treatment are essential for all women. The recommended screening is once or twice per year for all women aged between 16 and 65 (Tota et al., 2020). However, despite these interventions, cervical cancer mortality rates have remained relatively constant between 2000 and 2016 (Siegel et al., 2019).

Disparities in cervical cancer intervention implementation in the United States may also account for variations in morbidity and survival outcomes. According to the United Health Foundation Cancer Intervention Assessment Report, Georgia ranks low in the United States for implementation of cervical cancer prevention strategies (America's Health Ranking, 2021). The social implications of low rates of prevention strategies may be attributed to the racial disparities in cervical cancer survival rates, with Kaiser Family Foundation (2018) report showing high African American mortalities in Georgia (3.4 per 100,000 persons) than the average record of the United States (3.2 per 100,000 persons). These low rates of cercancer prevention strategies inform the current study’s focus on

racial and residential survival characteristics by stage of diagnosis among cervical cancer patients in Georgia.

In Section 1, an introduction subsection providing a background and problem concept of cervical cancer in Georgia is provided. The second subsection contains an elaboration of the problem statement, focusing on the study region and exploration of research questions that guided the study. The third subsection describes the potential social change contribution of the study by advancing knowledge and its possible application in addressing cervical cancer challenges in society. The next subsection provides the study purpose, indicating the research design and the specific areas of research analysis including assessment of variable associations. This subsection is followed by the research questions and hypotheses. Then, the theoretical foundation propositions and rationale applied in the research is discussed. The nature of the study focuses on study design and provides an overview of design rationale, variable categories, and methodology summary.

Further, an exhaustive literature review on cervical cancer concepts, methodologies, outcomes, and research gaps addressed by the current research is provided. This section is followed by the variable definitions and operationalization of terms, the assumptions adopted based on the context of the study, and the scope and delimitations that describe the aspects addressed in the study. The last subsection summarizes the extant literature, the contribution of the present study in filling the gap, and potential implications for social change.

Problem Statement

Over the years, governments, organizations, and individuals have been using many resources to support overcome cancer problems. One type of cancer that has received scientific breakthrough in prevention over the years is cervical cancer (Fontham et al., 2020). According to American Health Ranking, cervical cancer is one of the most treatable and preventable cancer types (America's Health Ranking, 2021). The regular Papanicolaou test (Pap smear) has substantially contributed towards the decline of cervical cancer cases and mortality rate (International Agency for Research on Cancer, 2018). Decker et al. (2019) also reported that the improvement in screening and treatment methods' efficiency is why the mortality rate has significantly dropped over the years. According to Gopalani et al. (2020), the incidence rate of cervical cancer among Black women reduced by 3% and among White women by 1.9% from 2000 to 2009. However, there is a racial disparity as Black women's incidence rate was relatively higher during that period compared to that of White women, 10.4 v. 7.8 new cases per 100,000 persons, respectively (relative risk =1.46) (Gopalani et al., 2020). The disparity is also evident in a 5-year cervical cancer diagnosis of the mortality rate as the black women recorded a rate of 4.3, which was higher than any other racial/ethical group in the United States (American Cancer Society, 2020). The data also show an increase in cervical cancer incidence rate from 7.6 to 8.5 during the 2013 to 2017 period. Accordingly, the United Health Foundation 2021 report ranks Georgia in 12th place for cervical cancer primary prevention measures in the United States (America's Health Ranking, 2021).

However, despite the significant reduction in cervical cancer among women in Georgia over the years, racial disparities on 5-year survival rate exist among women, with high mortality rates for Black women compared to White women in Alabama (Abdalla et al., 2020). According to Kaiser Family Foundation (2018), the mortality rate of African Americans in Georgia was 3.4 per 100,000 persons, which was slightly higher than the average record of the United States that was 3.2. The age-adjusted cervical cancer mortality rates of White women were significantly low (MR = 2.1) than for Black women (MR = 3.6), with an average mortality rate of 2.3 per 100,000 persons for all races in the United States (Siegel et al., 2019). The statistical records show that Black women's mortality rate is potentially higher in the overall United States. During hospitalization, the 2010-2013 death rates of Black women who have cervical cancer are higher than that of White women (Odekunle, 2017). Generally, these studies show that the cervical cancer mortality rates are potentially higher for Black women than White women and the United States female population's overall average rate. Siegel et al. (2019) noted that the United States age adjusted cervical cancer mortality rates remained the same for the period 2000 to 2016, with the survival trend unlikely to have changed within the period.

The statistical difference in cervical cancer mortality rates between Black women and White women in the United States over the last years calls for regional or localized in-depth and comprehensive research to provide state-based information on the disease burden. Majid et al. (2019) and Studts et al. (2012), in their studies, revealed a residential difference in screening participation, with rural women as under-screened highlighting

variation cervical cancer effects in the population. Limited health literacy, physician-client interaction difficulties, and logistic concerns among rural residents are potential challenges influencing their screening uptake (Beaber et al., 2015; McDonald et al., 2016). Previous studies have also highlighted the significance of the residential area in cervical cancer stage at diagnosis, survival, and population disparities (Nuño et al., 2012; Yu et al., 2019). Nuño et al. (2012) noted low cervical cancer screening and later-stage diagnosis among women in rural areas than those in urban counties. In a study conducted in rural areas of Washington State and Appalachian Kentucky, over a third of women (33%) did not comply with cancer screening guidelines (Yu et al., 2019). Thus, regardless of the high cancer screening rates in the U.S., residential characteristics continue to affect cervical cancer intervention strategies, with a potential effect on patient survival.

The stage at diagnosis has also been shown to have significant implications on the choice of treatment, potentially mediating quality of life and patient survival (Benard et al., 2017; Pollack et al., 2020; Rutherford, 2020). Additionally, access to screening services has been shown to influence the stage at diagnosis, revealing potential variation in the detection stage among the population mediated by the complex effect of racial and residential characteristics on health access (Benard et al., 2017; Yu et al., 2019). Although there is no standard stage at diagnosis for racial groups in the US population, some studies have highlighted the potential of later stage diagnosis for Hispanic and Black women, associated with a worse outcome compared to other racial groups (Arvizo & Mahdi, 2017; Olusola et al., 2019). Thus, literature on the standard stage at detection

for the U.S population and its implication on survival are insufficient for geographical or regional comparison due to the racial and structural health disparities in the country (Bradley et al., 2004). Given the prognostic value for the stage at diagnosis (Pollack et al., 2020; Rutherford, 2020), establishing the disease's population-based distribution is essential in population risk modification, formulation of tailored health service provision, and mitigation of health disparities.

The United States cervical cancer statistics, 2014-2018, show that the majority of deaths (~81.5%) occur among women aged above 45 years, with a median age of 58 years (U.S National Cancer Institute, 2020). Although there is an indication of decreasing age-adjusted death rates (0.7%) from 2009 to 2018 for the whole population, the report reveals an almost constant relative survival percent in the period. These statistical findings informed the present research's focus on the survival characteristics of cervical cancer patients aged above 45 years, essential in identifying challenges and progresses in disease control.

Potentially Social Change Implications of Study

Despite the benefits of screening for cervical cancer, not all American women access the intervention, disproportionately affecting women's quality of life (Fuzzell et al., 2021; Sabatino et al., 2021). The present study compared the racial differences in the 5-year relative survival rates of cervical cancer by stage at diagnosis for women living in Georgia, USA. Conducting a 5-year, 2012-2016, relative survival analysis for cervical cancer among women in Georgia, USA, provides essential statistical health information on survival patterns and disparities by stage at diagnosis, race, and residential

characteristics. This information can guide health care planning such as resource allocation and inform clinical and population-based care interventions (Oliveira & Niccolai, 2021). Thus, this research can contribute to the cyclical and ongoing progress of advancing knowledge on cervical cancer and its implications, providing insights that can help address cancer problems and health inequalities in the population. This information can promote social change by improving cancer prevention programs' effectiveness through resource allocation and targeted interventions.

The policymakers, healthcare departments, and the Georgia State government responsible for formulating and adopting health reforms all play a role in determining the most effective strategies to address cervical cancer mortalities by race and residential characteristics among women to overcome the disparity in relative survival rates. In their studies, Ojeaga et al. (2019) and Christensen (2020) reported that the racial disparity between Black women and White women is commonly associated with socioeconomic factors, cultural beliefs, healthcare attitudes, healthcare amenities, and resources. The study sought to determine if these factors contribute towards Black women and White women undertaking the screening and following up treatment procedure of cervical cancer (Palmer, 2019). Apart from that, the results can provide a better view of whether another factor may contribute to the racial disparity of cervical cancer relative survival rates. In other words, if the African American women are at a higher risk of dying of cervical cancer compared to White women, independent of the factors that shape the screening and treatment inquiry, this information is key to determining best public health

approaches to addressing not only cervical cancer, but the disparities between Black and White women (see Olusola et al., 2019).

Purpose of the Study

The study aims were to assess race and residence influence in the 5-year relative survival rates (RSRs) of cervical cancer (CerCancer) by stage at diagnosis in Georgia, USA. Specifically, this study had two purposes: (a) it examined the possible predicting abilities of race and residence (urban and rural) on 5-year RSRs of CervCancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in the State of Georgia and (b) the possible predicting abilities on survival probability in the early stage of CerCancer for women living in Georgia for each of the variables. The age cohort identified for the study was informed by the mortality statistics for cervical cancer patients aged above 45 years provided by U.S National Cancer Institute, in their 2020 report (USNCI, 2020).

Research Questions and Hypotheses

Research Question 1 (RQ1): What is the relationship between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$1: There is no significant association between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

H_a1: There is a significant association between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

Research Question 2 (RQ2): What is the relationship between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant, and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0 2$: There is no significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant, and unknown Stages) at diagnosis for women above 45 years living in Georgia.

$H_a 2$: There is a significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant, and unknown Stages) at diagnosis for women above 45 years living in Georgia.

Research Question 3 (RQ3): What is the relationship between race, residence (urban or rural), and survival probability in early stage of CerCancer for women living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0 3$: There is no significant relationship between race and survival probability in early stage of CerCancer for women living in Georgia.

$H_a 3$: There is significant association between race and survival probability in early stage of CerCancer for women living in Georgia.

Theoretical Framework of the Study

This study focused on Anderson's behavioral model to distinguish the widening disparity between the Black and White Americans and cercancer (Bradley et al., 2002). The framework has been used to explain people's use of healthcare amenities. It identifies three factors, including health beliefs, demographics, and other individual features such as family, need factors, community resources, income, and health insurance (Whorley, 2019). The model constructs differentiate equitable and inequitable access to care driven by enabling resources, demographic characteristics, social structure, and needs (Bradley et al., 2002). The model has been modified to explain the factors affecting health equity. These health system dynamics have been split into four sections: need factors, predisposing factors, enabling factors, and other predisposing factors (Whorley, 2019). Need factors include disease and intervention perception, health equity issues in physician evaluation, and care delivery. The predisposing factors include attributes such as race or ethnicity and education, while enabling factors entails underlying aspects such as residential areas, having primary care providers, and health insurance (Bradley et al., 2002). The other predisposing aspects are reinforcing factors such as social factors and demographics that limit healthcare access. The model has been expanded to include equity and socioeconomic status (Bradley et al., 2002). This health equity framework provides the link between the Black Americans health perception, providers' evaluation behaviors, delivery of care, and healthcare utilization. These underlying associations were fundamental in explaining racial and residential variation in healthcare seeking behaviors and utilization associated with knowledge, distrust, and structural racism in

healthcare, implicated in low cervical cancer screening uptake, access of care, and poor outcome among minority and rural populations.

Nature of the Study

The present study used cercancer cross- sectional data from Surveillance, Epidemiology, and End Results Program (SEER) to evaluate the 5-year relative survival rate of cercancer for Georgia women. The SEER program of the National Cancer Institute (NCI) collects data on cancer diagnoses, treatment, and survival for approximately 30% of the United States population (Abdalla et al., 2020). In the present study, I analyzed SEER cervical data drawn from the period between 1975 and 2016, appropriate in providing reliable racial and residential-based estimates of survival probabilities (Cancho et al., 2019). Using SPSS version 27, age-stratified relative survival analysis was conducted for cancer patients aged above 45 years in rural and urban population cohorts. These data estimation approaches provided the percentage of cancer patients alive 5 years after disease diagnosis allowing for a comparison of survival probability among these two study groups. Stage stratified analysis determined and compared relative survival for early-stage cervical cancer for Black and White women living in Georgia. This estimate provided the survival probability for each patient category following early-stage diagnosis with cercancer. Calculated statistics such as relative and confidence intervals (CI) were obtained. The 95% CIs was used to compare the two RSRs for two different or independent populations (Blacks and Whites stratified) by age group, place of residence, and stage of CerCancer).

Literature Search Strategy

The use of keywords like *cervical cancer, healthcare racial disparities, stage at diagnosis, mortality rate, Georgia, place of residence, Screening, cervical cancer treatment among African American women and White women* helped to narrow down on appropriate data sources to utilize in the research. I sought research articles in which investigators gathered qualitative or quantitative data on cervical cancer. Studies were limited to reviewed research published since 2014. The following five studies were vital in providing the relevant context for the research.

1. Blake, S. C., Andes, K., Hilb, L., Gaska, K., Chien, L., Flowers, L., & Adams, E. K. (2015). Facilitators and barriers to cervical cancer screening, diagnosis, and enrollment in medicaid: Experiences of Georgia's women's health medicaid program enrollees. *Journal of Cancer Education*.
    - The source's main objective was to provide information about the screening period and mortality period of Black women and White women in Georgia.
2. Decker, K., Sherling, D. H., Drowos, J., Hennekens, C. H., & Levine, R. S. (2019). Southeast United States counties in Georgia and Florida with lower cancer mortality rates in blacks: Possible clues to reducing racial inequalities. *Archives Public Health Research*.
    - The source provided more in-depth information on cancer mortality rates among African American and White women living in low-income Georgia regions. It provided information regarding the impact of socioeconomic

factors on the mortality rate of women diagnosed with cervical cancer in` Georgia.

3. Gopalani, S. V., Janitz, A. E., & Campbell, J. E. (2020). Cervical cancer incidence and mortality among Non-Hispanic African American and White women, United States, 1999–2015. *Journal of the National Medical Association*.
    - The report of the mortality rate of black women and white women in the United States includes statistics of Georgia. Therefore, the study drew information on the death rate for Black women and white women diagnosed with cervical cancer for five years between 1999 up to 2015.
4. Rutherford, Y. (2020). Predictors of late-stage cervical cancer diagnoses and disparities in the US (A closer look at the interactions between characteristics of access, women & place).
    - The source provided insightful information on the possible reasons for women's death in different states of the United States diagnosed with cervical cancer in the late stage. It provided insightful information on the reason for the disparity between black women and white women.
5. Siegel, R. L., Miller, K. D., & Jemal, A. (2019). Cancer statistics, 2019. *CA: A Cancer Journal for Clinicians*.
    - The source provided all the statistical records regarding the cervical cancer mortality rate of African American women and White women diagnosed with cervical cancer for five years in Georgia and other states.

Literature Review

The literature review aimed at finding the theoretical information regarding the 5-year cervical cancer survival rates by stage at diagnosis for White and Black women living in Georgia, USA.

The Health Burden of Cervical Cancer

Cervical Cancer Survival Characteristics

Cervical cancer poses a major health challenge to women all over the world. Nearly all cases of cervical cancer result from infection with the human papillomavirus (HPV). According to American Health Ranking (2021), the 5-year survival rate for all people with cervical cancer is 66%. However, survival rates can vary by factors such as race and age. For White women, the 5-year survival rate is 71% while the 5-year survival rate of Black women is 58% ("Explore Health Topics", 2021). As much as the cervical cancer death rates have declined in the United States, Black women still have a higher percentage in terms of the cervical cancer cases as well as the mortality rates (Sawaya & Huchko, 2017). Various studies by authors show that even after checking for various facilitators such as age and location, Black women are still at a greater chance to be diagnosed with cervical cancer as opposed to White women.

In 2015, Black women were more prone to be diagnosed with cervical cancer and were more likely to die from their disease (Ginsburg & Paskett, 2018). Recently, American Cancer Society data indicated that Black women have higher cervical cancer cases and mortality rates. In the past years, the cases of cervical cancer in Black women reduced with an increase in the rate of pap smear screening. Despite this, cervical cancer

still accounts for 25% of mortality rates in Black women from Georgia. Although occurrence rates are steady after age 40 among White women, in Black women they tend to rise with age. Five-year survival rates in black women have reduced from 64% to 59% between 2000 and 2018, whereas the survival rates among White women have risen from 70 to 72% ("Explore Health Topics", 2021)

Racial Disparity in Cervical Cancer Survival Rate for White and Black Women

Differences in terms of disease and race are rampant in many medical fields especially in the United States, cervical cancer not excluded. Race is an important factor that determines the occurrence and mortality rates of cervical cancer. Black women are more prone to contract HPV and have more persistent infections that can lead to cervical cancer, compared to White women (Luft et al., 2020). Luft et al. (2020) noted medical distrust and limited health literacy as fundamental factors mediating the high HPV infectivity rate and related complications among AAs. Research on Black and White patients from a hospital in Philadelphia established differences based on race in cervical cancer survival were a result of differences in socioeconomic and health insurance status. It is estimated that: Black women are 1.5 times more likely to test positive for high-risk HPV infections and 1.7 times more likely to have an abnormal Pap test. Furthermore, 56% of Black women were still infected 2 years after infection compared to just 24% of White women. Black women are 40% more likely to get cervical cancer and are two times more likely to die from the disease compared to White women. ("Explore Health Topics", 2021). These numbers are attributed to the underlying factors that allow HPV

infections to persist and become more detrimental to a woman's health. These factors include diet, stress, and lifestyle.

Diet and Cervical Cancer. An important factor to consider in the fight against cervical cancer is a healthy and all-inclusive diet. Deficiency or lack of enough nutrients for the body such as vitamin C and vitamin D can result to increased rates of HPV infection and low survival rates (Stevens et al., 2019). The demographics and socioeconomic classes which include some Black women are unable to afford a healthy meal due to various constraints which may include inadequate funds and lack of access to healthy living information. Unfortunately, Black women are more likely to live in low-income neighborhoods and therefore they may have limited access to healthy living choices (Afshar et al., 2020). Based on extant data, access to healthy food is a challenge for many Americans, especially those who come from low-income neighborhoods and in Black communities (Afshar et al., 2020; Koshiyama, 2019; Paskett et al., 2020). Having improved access to healthy food goes in line with positive feeding practices and a less susceptibility to related ailments (Simard et al., 2012), implicating dietary practices in cervical cancer disparity outcome in the population.

Stress. Black women have a higher chance of experiencing stress than White women. This is because of their different life experiences as well as societal and economic factors (Nolan et al., 2014). Black women are more likely to experience instances of racism throughout their life as opposed to White women and this contributes to the stress factor (Mosavel et al., 2017). In addition to this they also face discrimination which can largely cause or have a great impact on their mental wellbeing. This often

leads to stress which can adversely affect Black women's immune system and making it compromised. Hence, stress increases the risk of acquiring various diseases, cervical cancer being one of them.

Lifestyle. Certain lifestyle choices result in a higher risk of acquiring HPV infection. Some of these lifestyle choices include multiple sexual partners, alcoholism, and cigarette smoking (Stevens et al., 2019). These behavior choices are mostly practiced in low-income societies made up of Black women as opposed to White women. This then puts Black women at a higher risk of HPV infection which can lead to higher incidences of cervical cancer among Black women.

Residence and Cervical Cancer Distribution

Residential Disparities in Cervical Cancer

Residential characteristics can have fundamental influence on access to care. Research has established that black women from low-income societies experience low quality radiation therapy services as opposed to white women (Majid et al., 2019). This is because some of these patients are anemic, which means that they have low hemoglobin levels leading to ineffective radiation services which in turn can contribute to ineffective treatment outcome. Health care access is often a challenge among the minority and the marginalized populations. These populations are unable to access quality and efficient pap smear screening services and often discover that they have cervical cancer during the last stages of the disease (Reiter, & Linnan, 2018; Sawaya, & Huchko, 2017). Interestingly, Black women in Georgia have been found to have higher screening rates but unfortunately for most women the cervical cancer is detected in its last stages hence

this leads to a higher death rate than that of white women. A contributing factor to this could be insufficient follow up systems, more so those of irregular pap smears.

There is also the notion held by rural and minority groups women that cervical cancer is as a result of a person's sexual activity. Women who hold this view see no need to screen for cervical cancer especially if one has never or is currently not engaged in sex (Yu et al., 2019). There is also insufficient knowledge of the health threat posed by cervical cancer. Most women do not view cervical cancer as deadly. They instead place a lot of value on checking for breast cancer by carrying out a mammography as opposed to conducting cervical cancer screening. There exists increased cervical cancer knowledge among younger black women and most of them acknowledge having undergone a pap smear test (Ojeaga et al., 2019). It is crucial that all women irrespective of their pap smear history are given appropriate information concerning the importance of frequent screening for cervical cancer.

Healthcare Access

Racial Disparity in Vaccination and Screening Participation

The disparity in cervical cancer screening may be responsible for the observed variation in cervical cancer incidence and mortalities within the population. Research suggests that Black women are not likely to benefit from the HPV vaccine which is a factor that can lead to an increase in the infection rates (Reiter & Linnan, 2018; Sawaya & Huchko, 2017). These Black and White women are not infected by the same HPV subtypes (Nalley, 2021; Nolan et al., 2014). White women are mostly infected with strain 16,18,56,39 and 66 while Black women are mostly infected with strain 33, 35, 58, 66 and

68. However, the existing vaccines do not cover the strains of HPV that mostly affect Black women, which are strains 35, 66 and 68 (Strohl et al., 2017). This therefore puts Black women at a higher risk of HPV infection and shows disparities even in terms of cervical cancer vaccines among Black and White women.

Screening may potentially influence the distribution and cervical burden, causing inequalities in quality of life. A high rate of cervical cancer and especially among Black women is highly a preserve of elderly women who often have dismal cervical screening rates (Vaccarella et al., 2017). Findings from the National Health Interview suggest that almost one half of women ages 50-60 years did not get a Pap smear test done in the past three years. Cervical cancer occurrences in different groups of women shows varied cycle by age of the different women. Similarly, Blake et al. (2015) established that Black women and especially those with low income that made use of insurance that had been funded by the government experienced poorer performance status and often received lesser radiation doses for the disease than White women who were considered to be higher income patients.

Challenges to Cervical Cancer Screening in Black and White Women in Georgia

Inadequate or limited exit information may pose a significant threat to cervical cancer screening uptake. Some Black women are unable to comprehend information about cervical cancer (Beaber et al., 2015; McDonald et al., 2016). These include information on screening, risk associated behaviors as well as treatment. This lack of understanding can be attributed to the fact that guidelines on cervical cancer are constantly changing. Some women misunderstand what exactly is done during a pap

smear test with some being of the opinion that the pap smear is conducted to screen for sexually transmitted diseases.

Emotional factors can also limit Black women from accessing cervical cancer screening services. Some women cite fear of the pap smear test as well as fear of the diagnosis outcome as contributing factors to why they avoid undergoing cervical cancer screening (Nalley, 2021). Many women are of the thought that if they get an abnormal pap smear result, they might die from cervical cancer. This is particularly common among Black women who are already infected with HIV. This is because they are worried that the cervical cancer may damage their already overburdened immune system and that they may end up facing even more stigmatization. Some women are considering that if they are found to be having cervical cancer then they would get a hysterectomy. This acts a barrier to screening because many women fear that if they get the hysterectomy then they would become less of a woman hence they tend to shy off from cervical cancer screening.

Another challenge to cervical cancer screening among women is that there is lack of trust between the women and the health care providers. Some women do not feel safe when sharing confidential information about themselves and this therefore affects the quality and outcome of the screening process (Blake et al., 2015; Christensen, 2020; Palmer, 2019). This is sometimes caused by incompetence on the part of the health care providers who practice bias and can at times even be racist. This has been evidenced in a study by Beavis and Levinson (2016) whereby some women involved in the study were of the opinion that the health care provider was practicing racism and that they were

made to feel less of themselves because they were Black women. The relationship between the cancer patients and the health care providers is very crucial more so for immigrant women who are more often times not under any form of medical insurance and their priority is usually whether they may get deported if they visit the hospital for screening (Adekeye, et al., 2018; Blake et al., 2015; Fuzzell et al., 2021). Health care providers ought to establish healthy and effective ways of relating with the patients because this aspect greatly determines whether or not women present themselves for cervical cancer screening. Building trust between the providers and the patients ensures that the patients take up any recommendation coming from the provider as there already exists a good rapport between them.

Another contributing factor is the unreliable interpretation of pap smear results in most laboratories. Blake et al. (2015) reported that Black women receive poor quality treatment and therapy which was not as efficient and effective as that which is dispensed to White women. An instance of this is the health system challenges including limited provider density in clinical laboratories and insufficient facilities in rural settings resulting in long clinic waits or quality services challenges such that some of the pap smear results are never followed up (Adunlin et al., 2019; Moss et al., 2017)). In some areas Pap smears are conducted without the proper mechanism of follow up for instances of irregular results. Most Black women are often faced with limited availability of treatment options hence they are unable to have access to expert medical opinion and care.

Compliance Challenges to Cancer Screening Guidelines

Health literacy, especially on cervical cancer is essential for compliance with screening guidelines. Strohl et al. (2015) found that HPV awareness among White women was higher and that Black women were also not informed about the characteristics of HPV. A large number of Black women are not aware of the role played by HPV in causing Cervical Cancer (Kirca, 2017). And most women are also not aware that HPV is a sexually transmitted disease (Agarwal & Paliwal, 2019). Only a small percentage of Black women had knowledge concerning the HPV vaccine when compared to White women.

Numerous research findings have established that minority groups including some Black women lack the appropriate information on the link between cervical cancer screening and treatment options. Abdalla et al. (2020) reported that many women had little or no information concerning cervical cancer and this includes information on the various risks associated with cervical cancer as well as the extent of health threat posed by cervical cancer. Due to the lack of knowledge on HPV some women consider by mistake that the HPV vaccine is a type of contraceptive. Others on the other hand are of the notion that the HPV vaccine is being used adversely to cause Black women to become barren.

The Stage at Diagnosis

Population Disparities in Detection Stage

The burden of late-stage cervical cancer disproportionally affects some women more than others (Heard, 2018). Recent studies have shown that Black women have significantly increased chances of being diagnosed with late-stage cervical cancer as

opposed to their White counterparts. An analysis carried out in 2019 reported that Black women were diagnosed with more-advanced stages than Whites for all the four cancers with widely recommended screening procedures including those of cervical cancer (Olusola et al., 2019). Among these disparities, geographic and racial disparities have been the most persistent across various populations in the US including Georgia.

In the United States and specifically in Georgia, the advantages of early detection have not been realized by White and Black women equally. Racial differences exist between the Black and the White women (Kirca, 2017). Black women tend to be diagnosed at later stages and have higher mortality rates. Patients with stage I disease at diagnosis have a 90% 5-year survival rate, whereas corresponding survival rates for stage II and III diseases are 50 and 10%, respectively (Kirca, 2017). Patients with advanced disease at diagnosis (stage IV) also have more complications from hemorrhage, anemia, and radiation therapy. The late stage at diagnosis among Black women is identified as the lead cause of excess mortality and it is the impact of various interactions among several factors, during the different treatment stages.

Stage at Diagnosis and Treatment Choice

Challenges in health care access may be responsible for late-stage diagnosis of cervical cancer and especially the cervical irregularities leading to an increased mortality rate. This is especially true for the Black women as most of them do not have access to various services including proper and quality screening (Blake et al., 2014; Luft et al., 2020). This can be attributed to the expensive cost of this service which at times is not covered by the insurance. Coupled with this cost implication is the factor that the

screening services are not readily available for some of the Black women. Taking into account that cervical cancer that is detected in its early stages is highly treatable as long as there is adoption of new lifestyle choices and the appropriate measures put in place, it is possible for them to be room for improvement in terms of access to healthcare among Black women.

Stage at detection is critical in determining treatment choice. This is also causal factor for disparities in terms of treatment mechanism different for Black and White women. Melo, Ribeiro and Canevari (2018) reported that a lower percentage of Black women receive intracavitary radiation as opposed to White women. This serves as a contributing factor to the racial disparities that exist in terms of cervical cancer therapy. Reasons for not receiving this treatment mechanism among Black women included refusal by patients and multiple medical conditions at the same time.

Previous Research Strategies to Studying Disparities in Cervical Cancer Survival

Previous studies focused on quantitative approaches in investigating cervical cancer survival rates and disparities. A major benefit of this strategy is the goal to produce generalizable findings, essential in establishing comparative relationships and temporal factors influencing the observed outcome (Ferretti et al., 2021; Kurniawati et al., 2016). The few studies that utilized qualitative approaches aimed at assessing contextual factors such as knowledge, beliefs, and behaviors relating to cervical cancer and its intervention approaches (McNutt et al., 2019; Panda, 2016). Given the uncontrolled conditions in cervical cancer epidemiology research, these studies adopted descriptive approaches to assess variable relationships. The population conditions on

healthcare behaviors and the underlying factors in the occurrence of cervical cancer justify the use of descriptive approaches in this research area.

Over the years, several signs of progress have been made in understanding and mitigating the disease burden in the population. Technological advancement is one area in research that has substantially contributed to appropriate data collection and inferencing on cervical cancer social burden (Ferretti et al., 2021). A major contribution of technology in this research area relates to the facilitation of reliable data collection (Panda, 2016). Although some extant studies utilized primary data in investigating cervical cancer characteristics, these research works had restricted geographical coverage limiting population representativeness and results generalizability (Adem et al., 2019; Ferretti et al., 2021). However, these studies have filled a special gap in research providing the framework for comparison in the reliability of data collection instruments and validity of the findings (McNutt et al., 2019). However, a common trend in studying cervical cancer is the use of secondary data sources (McNutt et al., 2019; Panda, 2016). As part of the benefit of technological advancement, the development of reliable data collection tools has facilitated the gathering of huge data records with several variables. This technological achievement has also broadened the scope of the study allowing large geographical coverage and population representation.

Similar to its application in the current research, the development of the cervical cancer database has played a crucial role in analyzing the disease trend, factors influencing disease distribution, and variation in survival rates. The ability to collect and continuously update secondary data has expanded the scope of understanding cervical

cancer, its distribution, and the evaluation of intervention approaches (Bernasconi et al., 2020; Ferretti et al., 2021). Although most of these secondary sources are collected for the parent institutions' primary reasons, it has enabled the development of various research works for objective analysis of the disease on wider geographical coverage (Ferretti et al., 2021). Therefore, utilizing the U.S. cervical cancer data (SEER), the current study aimed to address the gap in the factors of cervical cancer survival disparities and its implication on patient survival for the Georgia region.

Definitions

Early-stage of diagnosis: Detection stage at the initial symptomatic level before progression from the formation site to other neighboring cells or areas of the body (USNCI, 2020)

Health service professional: Any certified individual with expertise in diagnosis, studying, treating, prescribing health interventions, and advancing evidence-based healthcare for cervical cancer management to meet population needs (Centers for Disease Control and Prevention (CDC), 2019).

Health service utilization: Quantification of healthcare use including timely access of quality care, providers, prescription drugs, and health insurance services for preventing, controlling, or treatment of cervical cancer and related ailments (Centers for Disease Control and Prevention (CDC), 2021).

Health systems: Describes the whole framework of United States healthcare structure including collaborative institutions, facilities, social support networks, human resource, and non-human elements devoted to providing health services for the protection

and improvement of individual and population health (Centers for Disease Control and Prevention (CDC), 2019).

Race: Categories of the population of the study identified based on social groupings, labeled based on physical traits, cultural, and ancestry characteristics (Flanagin et al., 2021) as recorded in the SEER registry.

Relative survival: Net survival quantification described as a ratio of surviving cancer population to the expected survivors in a comparable non-cancer population (USNCI, 2020)

Residence: Location or dwelling place where a person lived during cervical cancer diagnosis and treatment categorized as rural or urban setting as captured in the SEER registry.

Rural: The open country of settlements with fewer residents, inhabited by wealthy and large scale farmers**,** with fewer health facilities and medical practitioners limiting and delaying healthcare access for preventive care and emergencies compared to their urban counterparts (Rural health information hub, 2021)

Survival probability: Reliability estimates are calculated as the proportion of patients alive after a specific period (Kishore et al., 2010).

The stage at diagnosis: Extent of cervical cancer progression during the first diagnosis categorized in the SEER registry as Localized, Regional, Distant, and Unknown Stages.

Urban: The larger and densely settled areas that do not necessarily follow municipal boundaries, inhabited by relatively poor populations, with more health

facilities and medical practitioners than rural areas enhancing healthcare access (Georgians for a healthy future, 2020)

Assumptions

My main assumption was that, as part of quality indicators in the complex process of cervical cancer registration, the cancer registries provide accurately recorded data with standardized procedures for the validity of the information. I acknowledged procedures for a routine update of the data to have improved and slight variations might have influenced the analysis. However, my use of secondary data limited knowledge of the actual level of standardized recording. I, therefore, assumed that the changes uniformly affected the data with no substantial influence on survival variation characteristics. However, I selected variable categories (age at diagnosis, race, residence, age standard for survival, histology, and survival months) representing a range that we believed were plausible with overall patterns potentially similar across the population and the study period.

Scope and Delimitations

This study covered the predicting abilities of race and residence (urban vs. rural) on 5-year RSRs by stage (localized, regional, distant and unknown Stages) at diagnosis and survival probability in the early stage of CerCancer for women living in Georgia. The RSRs were limited to women above 45 years informed by the high mortality characteristics for cervical cancer patients aged above 45 years provided by U.S National Cancer Institute, in their 2020 report (USNCI, 2020). Early detection has also been shown to enable timely intervention to prevent progression and improve chances of

patient survival than other diagnostic stages. The use of SEER data comprising of cervical cancer records from 1975 to 2016 provided the information of all racial groups and residential characteristics of the Georgia population. Inferred statistical estimates from these data sets have been used and generalized to all populations in the country. Young's model and Rosenstocket healthcare utilization models were two other theories related to the study (Yang & Hwang, 2016), but not investigated in the current research.

Significance, Summary, and Conclusions

This research advanced knowledge on cervical cancer and its implications, providing insights that can help address cancer problems and health inequalities in the population. Given the racial and structural health disparities in cercancer survival, geographical-based detection stage characteristics are essential for comparison, formulating tailored health services, and mitigating health disparities. The findings can promote social change by improving cancer prevention programs' effectiveness through resource allocation and targeted interventions. Extant literature shows the high disparity in cervical cancer and survival characteristics with black women's experiences being worse than those of the White population and across the country averages. There is also sufficient information on the positive influence of the detection stage on cervical cancer management and the improvement of quality of life. Screening services are also implicated in stage at diagnosis and disparities in care mediated by residence and racial characteristics.

However, literature on the standard stage at detection for the U.S population and its implication on survival are insufficient for geographical or regional comparison.

Given the variation in screening services and healthcare utilization on racial and residential characteristics, with potential influence on life expectancy, establishing the relationship between race and residence with patient survival characteristics was essential in guiding tailoring of health service provision and mitigating health disparities in the population. Quantitative assessment allowed for reliable analysis of these variable relationships reflecting the actual conditions of disease distribution and outcome in the population.

Section 2: Research Design and Data Collection

The purpose of the current study was to explore the 5-year RSRs of Cervical Cancer (CerCancer) by stage at diagnosis and place of residence in Georgia, USA. Specifically, this study had two purposes: (a) it examined the possible predicting abilities of race and residence (urban and rural) on 5-year RSRs of cervical cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in the State of Georgia and (b) the possible predicting abilities on survival probability in the early stage of CerCancer for women living in Georgia for each of the variables.

The first part of this section provides an overview of the research design rationale, stating the type of data and the variable categories adopted in exploring the 5-year relative cervical cancer survival characteristics. This section also highlights the limitations of the research design and its significance in advancing current knowledge in cervical cancer survival. The second part describes the research methodology including target population, sampling strategy, data access, source reputability, power analysis, variable operationalization, and data analysis. The last part of this section highlights validity issues, including ethical considerations, and approaches to addressing these threats.

Research Design and Rationale

This study adopted quantitative research to allow for broader subject inclusion, objectivity, and provide representative results. Findley et al. (2021) highlighted that the quantitative approach is fundamental in finding relationships among variable categories

while also playing a critical role in inferencing and enhancing external research validity. Thus, using quantitative research allowed the incorporation of several outcomes in clinical practice essential in providing robust data on the relationship between variables of interest. Additionally, the extensive data adopted from several registries is fundamental in providing an actual cervical cancer condition in the population.

With the nature of the data providing for a population-based study, cross-sectional research was adopted in assessing cervical cancer patient survival characteristics. Apart from being cost-effective, the cross-sectional approach was appropriate in simultaneously studying and comparing multiple variable categories, suitable for descriptive epidemiological studies (Marczyk et al., 2021). Thus, since there was no implementation of any intervention on the subjects, using archival data made the cross-sectional study ethical and appropriate in assessing harmful outcomes in an instance.

Three variable categories were adopted in the study. The first variable category comprised two independent variables. Patients' race and residential characteristics were assessed on their influence on cervical cancer survival characteristics among women in Georgia. With the potential impact of the stage at diagnosis on patient survival outcome, the disease stage at diagnosis was adopted as a mediating variable. The third variable category was 5-year relative survival among patients above 45 years across race or residential areas and survival probability in early-stage cervical cancer.

Methodology

Population

The target population included all women residing in Georgia, USA, diagnosed with cervical cancer between 1975 and 2016 whose data are captured in the 18 SEER registries. Specifically, the data was drawn from Georgia registries. The SEER data are comprehensive cancer population-based information source managed by the NCI as part of a disease surveillance program in the United States. This program covers an estimated one-third (28%) of the US population and contains cancer statistics collected since 1973 from some of the country's registries (Katz, 2015).

Sampling and Sampling Procedures

My sampling procedure involved consideration of summary stages at diagnosis (localized, regional, distant, and unknown) for patient data diagnosed within the period 1975 to 2016, which are fundamental determinants of survival time (see Findley et al., 2021). However, the Great and the rural Georgia registries only contained data from 1992 to 2016. These cervical cancer statistics were collected from 18 SEER data registries submitted in November 2020. Access to these data registries involved the use of the SEER*Stat account provided through formal online documentation to the NCI.

Sampling Frame

The SEER data are age-standardized with standardized survival for adults 15 years and older, weighted by 5-year age categories, 15–44, 45–54, 55–64, 65–74, and above 74 (Duggan et al., 2016). Data selection included consideration of site, morphology, summary stage category, and staging schemes at diagnosis. The specific

variables of interest selected for the current study in each of the broad variable classification include age at diagnosis, year of diagnosis, race recode (race/ethnicity), summary stage, treatment summary, rural-urban continuum 2013, age standard for survival, SEER cause-specific death classification, histology recode, and survival months.

Data Accessibility and Permission

Through SEER Stat software, age standard, adult cancer populations' data were obtained, where the international age-standardized compares survival across time or different cancer populations with different age distributions (see Duggan et al., 2016; Rutherford et al., 2020). The present study adopted SEER program weighted data for age standard at diagnosis and cancer sites stage categorization involving: (a) localized, (b) regional, (c) distant, and (d) unknown-cancer of unknown primary origin (see Howlader et al., 2019) in the analysis.

Power Analysis:

All cervical cancer patient data meeting the study criteria was used in the research. Using a sample size determination formula, $n = (Z_{1-\alpha/2} + Z_{1-\beta}/ES)^2$, for standard power, 80%, (Allen, 2017), where ES = effect size calculated using overall population survival means and Georgia residents mean survival time, the current study had a statistical power > 80%, suitable to detect variable-related effects.

Research Questions and Hypotheses

Research Question 1 (RQ1): What is the relationship between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant

and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$1: There is no significant association between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

H_a1: There is a significant association between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

Research Question 2 (RQ2): What is the relationship between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$2: There is no significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

H_a2: There is a significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

Research Question 3 (RQ3): What is the relationship between race, residence (urban or rural), and survival probability in early stage of CerCancer for women living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$3: There is no significant relationship between race and survival probability in early stage of CerCancer for women living in Georgia.

H_a3: There is significant association between race and survival probability in early stage of CerCancer for women living in Georgia.

Instrumentation

The secondary data type was extracted using the SEER program developed by the NCI. The SEER program provides credible and accurate information on cancer incidences and survival rates within the United States. This data source maintains population-based cancer records for over 30% of the U.S. population operated as an NCI and CDC joined the project (USNCI, 2020). It is considered the cancer survival surveillance benchmark in the United States (Abdalla et al., 2020). Therefore, the dataset was vital in providing records of the Black and White women in Georgia who have been diagnosed and died of cervical cancer.

Operationalization of Variables

The variables investigated in addressing the research hypotheses included age standard for survival, race/ethnicity, residence (rural/urban), stage at diagnosis, and survival months (Table 1). All variable types are obtained from the SEER database.

Table 1

Operationalization of Variables

Variable	Measurement	Indicator	Categories
Race/ethnicity	Nominal	SEER patient recorded racial or ethnic group	1 = White 2 = Black 3 = Others
Residence	Nominal	Patient area of residence	1 = Urban 2 = Rural
Stage at diagnosis	Nominal	Cervical cancer stage at diagnosis	1 = Localized 2 = Regional 3 = Distant 4 = Unknown
Survival months	Continuous	Length of time, measured in months, a patient survives after initial cancer diagnosis	0 to 1188 months

Independent variable: Race/ethnicity, residence (rural/urban), and cancer stage at diagnosis were the independent variables.

Dependent Variable: The study's outcome was survival months, recorded within the data collection period. This variable was measured on continuous scale ranging from 0 to 1188 months according to SEER life expectancy categorization of 0 to 99 years (USNCI, 2020).

Study population and missing cases: Cervical cancer patient data used in the study consisted of 4,798 recorded statistics between 1975 to 2016 for both the Great and the Rural Georgia registries extracted from the parent 2020 SEER database. Survival months for 43 patients were recorded as unknown, representing approximately 0.01% of the data. However, the average survival time for the 5-year age group represented by the patient data was used to replace these missing values, as recommended by Madley-Dowd et al. (2019) in dealing with missing data values.

Table 2

Cervical Cancer Patient Data Set

Patient Data	*N*	Proportion (%)
Complete	4755	99.10
Incomplete	43	1.90
Total n	4798	100

Data Analysis

Analysis Techniques

Descriptive Statistics

First, all the variables under study were described statistically, using mean and standard deviation for the continuous variables and frequency percentage for categorical variables. Relative survival rates, calculated as proportions for racial groups, age-standardized categories, and residential areas by stage at diagnosis were provided in the analysis.

Multivariate Analysis

With the continuous outcome, the study assessed the potential association between the independent variables, early stage at diagnosis, race, and residence by stage of diagnosis, and cervical cancer patient survival characteristics in cox regression analysis, after running regression diagnostics. The assumptions of cox regression were met.

The significance level of $\alpha = 0.05$ was adopted in the hypothesis testing for variable associations and SPSS version 27 was used in the analysis.

Threat to Validity

The inability to control data collection processes or verify the data in the SEER data source created a potential risk for bias in the secondary data analysis. Although there is a rollout of recommended data collection protocols (USNCI, 2020), the limitation to oversee the data collection processes and the potential disparities in patient-healthcare system interaction might have affected the accuracy of the data.

External Validity

Despite the large sample size, the limited geographical coverage, with a focus on rural and great Georgia registries only, might not have provided a representative population limiting the generalizability of the cervical cancer survival statistics to other populations. Another threat to external validity included data bias resulting from the difference in the various racial groups' healthcare utilization (Squires and Anderson, 2015, National Center for Health Statistics, 2016), limiting statistical information captured and actual representation of these populations' survival characteristics.

Internal Validity

A key threat to internal validity in the SEER data was the biases in the data collection process that might be unnoticed but significantly affect the findings. Since the SEER information comprises data from a range of records, there is the possibility of regional and departmental differences or, over time, changes in collection procedures and measurement processes potentially affecting statistical accuracy. Given the varying contributions of different institutions to the data's availability, it limits study flexibility with variable comparison and adopted age-standardized categories.

Ethical Procedures

The study was presented for clearance by Walden Institutional Review Board (IRB). Permission for data access was done according to the SEER data regulations, requiring an online application for access and use through the SEER Stats software. Also, safekeeping of the data in electronic media was done to restrict unauthorized data access in adherence to ethical research guidelines.

Summary

The study adopted quantitative research design instrumental in inferential statistics and generalizability of the findings. The study assessed three variable categories (independent, mediating, and dependent variables) to help explain influence of race and residence, mediated by stage at diagnosis on cervical cancer patient survival characteristics. Extensive cervical data from SEER database maintained by NCI and CDC for patients diagnosed between 1975 and 2016 on Rural and the Great Georgia registries

were used. Ethical clearance procedures have also been highlighted. Presentation of results and discussion of the study findings was done in Section 3.

Section 3: Presentation of the Results and Findings

Purpose of the Study

The study examined (a) the possible predicting abilities of race and residence (urban and rural) on 5-year RSRs of cervical cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in the State of Georgia and (b) the possible predicting abilities on survival probability in the early stage of CervCancer for women living in Georgia for each of the variables.

Research Questions and Hypothesis

Research Question 1 (RQ1): What is the relationship between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$1: There is no significant association between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

H_a1: There is a significant association between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

Research Question 2 (RQ2): What is the relationship between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$2: There is no significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

H_a2: There is a significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia.

Research Question 3 (RQ3): What is the relationship between race, residence (urban or rural), and survival probability in early stage of CerCancer for women living in Georgia, adjusted for age at diagnosis, treatment, and marital status?

$H_0$3: There is no significant relationship between race and survival probability in early stage of CerCancer for women living in Georgia.

H_a3: There is significant association between race and survival probability in early stage of CerCancer for women living in Georgia.

Organization of the Section

The first subsection consists of data collection preview, providing information on data collection time frame and univariate results justifying covariates inclusion in the survival modelling. The results of the study, including descriptive statistics, evaluation of statistical assumptions, and findings organized by research questions and hypotheses are presented. The last subsection provides a summary of answers to research questions.

Data Collection of Secondary Dataset

Extensive cervical data from SEER database maintained by NCI and CDC was accessed for 2811 adult patients above 45 years diagnosed between 1975 and 2016 on Rural and the Great Georgia registries. However, the Great and the rural Georgia registries only contained data from 1992 to 2016, lacking cervical cancer data for the previous years, since SEER database was created. The 2811 cases were all the cervical cancer patients diagnosed within the study period, representing 100% representation of the study population.

Results

Patients' Sample Characteristics

In univariate analysis (Table 3), the mean age at diagnosis for the cohort was 60.66 years (*SD* = 12.02), with average survival time of 50.91 months, (*SD* = 54.26). Most patients, 66.0% (*n* = 1855) were White, with an approximate third, 32.3% (*n* = 909) Black, 1.5% (*n* = 41) other races, and 0.2% (*n* = 6) of unknown racial origins. Examining residential characteristics revealed that in metropolitan areas, 65.5% (*n* = 1841) had the largest patient population, with urban, 30.3% (*n* = 852) and rural, 4.2% (*n* = 118) accounting for slightly higher than a third of the cohort. Most diagnosis were at regional, 42.3% (*n* = 1190) and localized, 31.5% (*n* = 885) cancer stages, 17.2% (*n* = 484) distant, 1.3% (*n* = 37) blank, and 7.6% (*n* = 215) unknown. A large proportion were married patients, 38.2% (*n* = 1074), 15.0% (*n* = 423) were divorced, 20.3% (*n* = 571) were widowed, 17.7% (*n* = 498) were single, 2.0% (*n* = 57) were separated, and 6.6% (*n* = 185) had unknown marital status. Most patients received no treatment, with 61.2% (*n* =

1720) having their cervical cancer status diagnosed at autopsy (none), 19.2% (*n* = 539) others with no surgery to regional lymph nodes and 15.0% (*n* = 421) receiving nonprimary surgical procedure to distant lymph node(s). Based on the results, the notion that race and residential characteristics might influence survival probability appeared supported.

Table 3

Demographic Characteristics of the Sample of the Population of the Study

a) *Age at Diagnosis and Survival Months Characteristics*

Variable	Mean	*SD*	Minimum	Maximum
Age at diagnosis	60.66	12.02	45	99
Survival months	50.91	54.26	0	283

b) *Sample Racial Characteristics*

Race	Black	Other	Unknown	White
Percent(n)	32.3 (909)	1.5 (41)	0.2 (6)	66.0 (1855)

c) *Residential Characteristics*

Residence	Rural	Urban	Metropolitan
Percent(freq.)	4.2 (118)	30.3 (852)	65.5 (1841)

d) *Stage at Diagnosis Characteristics*

Stage Diagnosis	Blank	Distant	Localized	Regional	Unknown
Percent(n)	1.3 (37)	17.2 (484)	31.5 (885)	42.3 (1190)	7.6 (215)

e) *Sample's Marital Characteristics*

Marital status	Divorce	Married	Separated	Single	Unknown	Dom. partner	Widowed
Percent(n)	15.0 (423)	38.2 (1074)	2.0 (57)	17.7 (498)	6.6 (185)	0.1 (3)	20.3 (571)

f) *Sample's Treatment Characteristics*

RX rg LN	1-2	4 and more	Biopsy	Blanks	None	No. LN Unknown	Biop/LN diff	Biop/LN same/unstated time	Unknown
N	53	421	9	539	1720	11	1	9	48
Percent	1.9	15.0	0.3	19.2	61.2	0.4	0.0	0.3	1.7

Inferential Analysis per Research Question

Research Question 1

Research Question 1 was "What is the relationship between race and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?"

A log rank test was conducted to examine whether there were differences in the survival distribution for the different cervical cancer stages (localized, regional, distant and unknown Stages) at diagnosis based on racial category. The survival distributions for the four cervical cancer stages were statistically significantly different, $\chi 2$ (17) = 302.512,

$p < .001$, suggesting the model significantly predicted independent variable effect on the outcome (Table 4). The overall survival analysis indicated varying curves, implying that those patients diagnosed at cervical cancer stages have distinctively different chances of survival (Figure 1). It can be observed that average age at diagnosis is 60.65 years (Table 6), with more patients diagnosed at distant stage (6.2% censored) experiencing event compared to patients in all other cervical stages (Table 5).

Table 4

Omnibus Tests of Model Coefficients

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	*df*	*p*	Chi-square	*df*	p	Chi-square	*df*	*p*
22939.973	299.493	17	.000	302.512	17	.000	302.512	17	.000

Note. Beginning Block Number 1. Method = Enter.

Table 5

Event Status for Cervical Cancer by Stage at Diagnosis

Stratum	Strata label	Event	Censored	Censored Percent
1	Blank(s)	22	14	38.9%
2	Distant	454	30	6.2%
3	Localized	451	434	49.0%
4	Regional	833	357	30.0%
5	Unknown	135	78	36.6%
Total		1895	913	32.5%

Note. The strata variable is: Summary stage 2000 (1998+).

Table 6

Mean Age at Diagnosis Based on Patient's Race for Cervical Cancer Patients Above 45 Years

	Black	Other	Unknown	White	Total
Mean	62.84	59.93	53.33	59.61	60.65

Note. Other: American Indian/AK Native, and Asian/Pacific Islander.

Figure 1

Comparison of Patient Survival Probabilities by Stage at Diagnosis

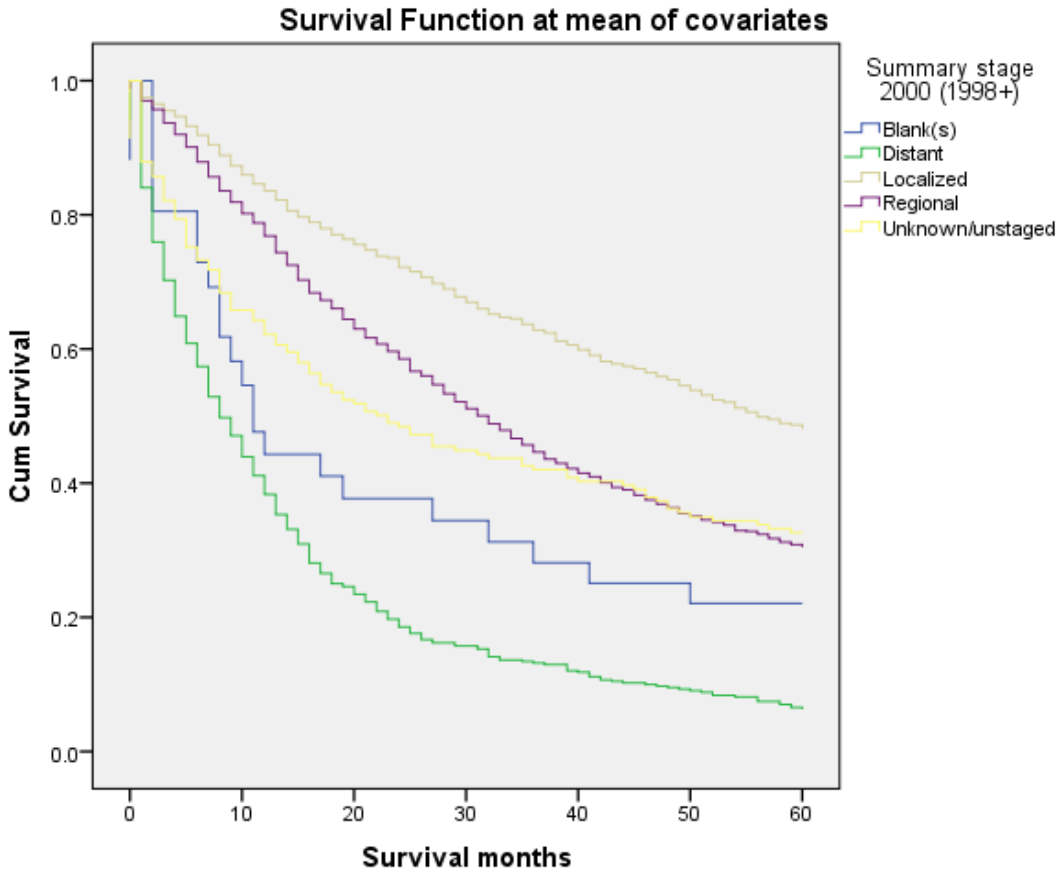
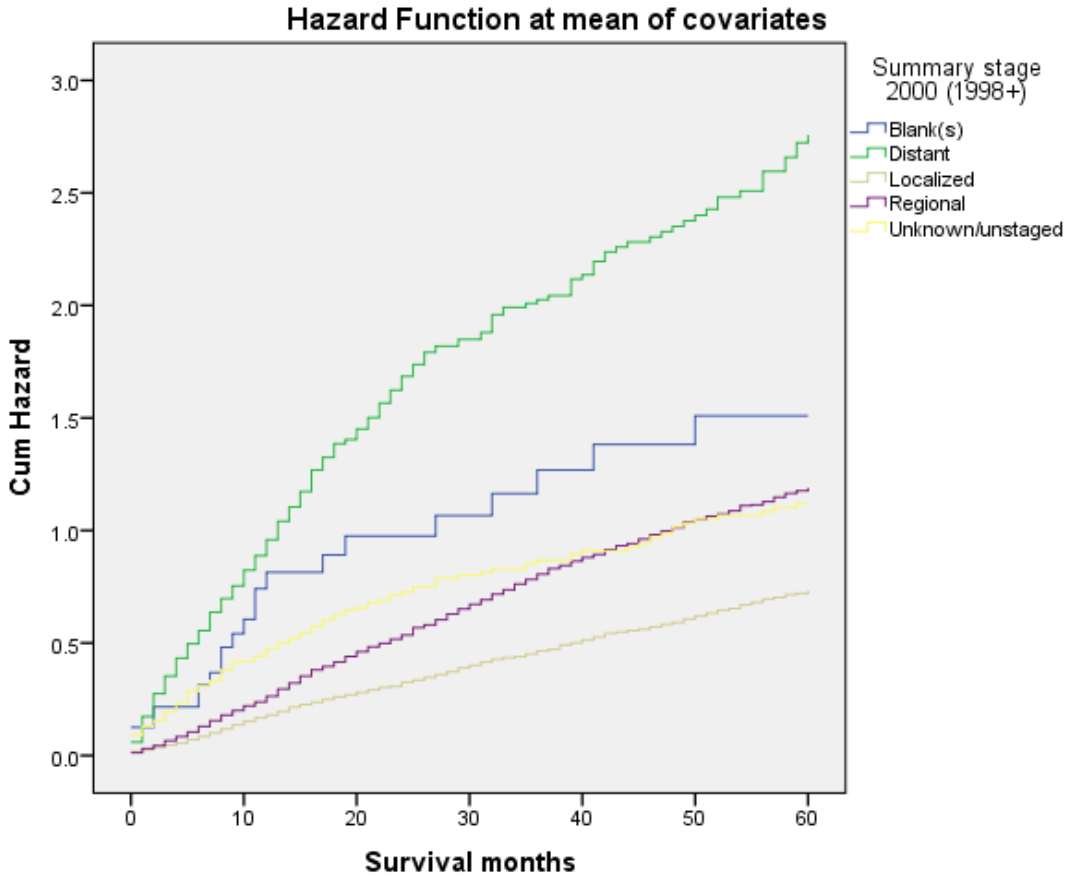


Figure 2

Comparison of Cervical Cancer Hazard Characteristics by Stage at Diagnosis



Cox Regression Assumptions

- Assumption 1: The survival probability is the same for censored and uncensored subjects;
- Assumption 2: The likelihood of the occurrence of the event is the same for the participants enrolled early and late;
- Assumption 3: The probability of censoring is the same for different groups
- Assumption 4: The event is assumed to occur at the defined time

A Kaplan-Meier examination of the hazard ratios shows non-crossing parallel curves indicating non-violation of the proportional hazard assumption (Figure 3), confirming Assumptions 1 and 2. A further assessment of outlier observations (Figure 4) shows that none of the individual data are extremely influential. The residual plots are roughly symmetrically distributed about zero with a standard deviation of 2. The residuals indicate that the event (positive values) and censoring (negative values) is the identical for participants and assumed to occur at defined time, confirming assumption 3 and 4. Thus, the assumptions for Cox regression are met.

Figure 3

Graphical Examination of Proportional Hazard Assumption

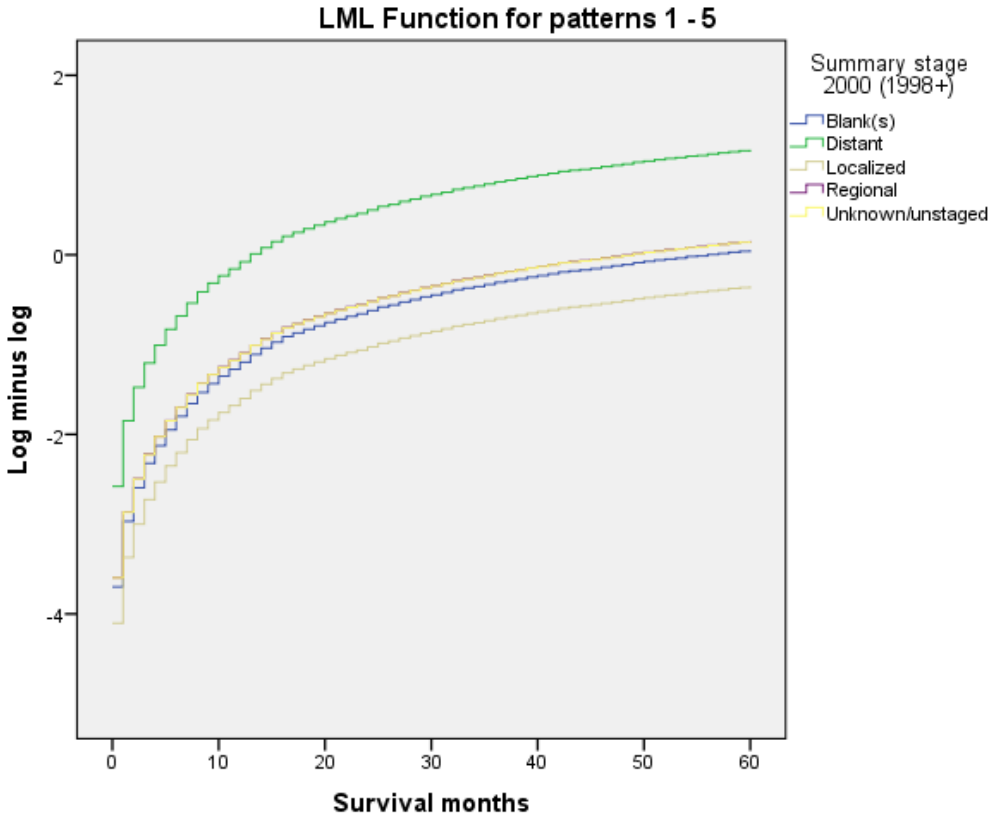
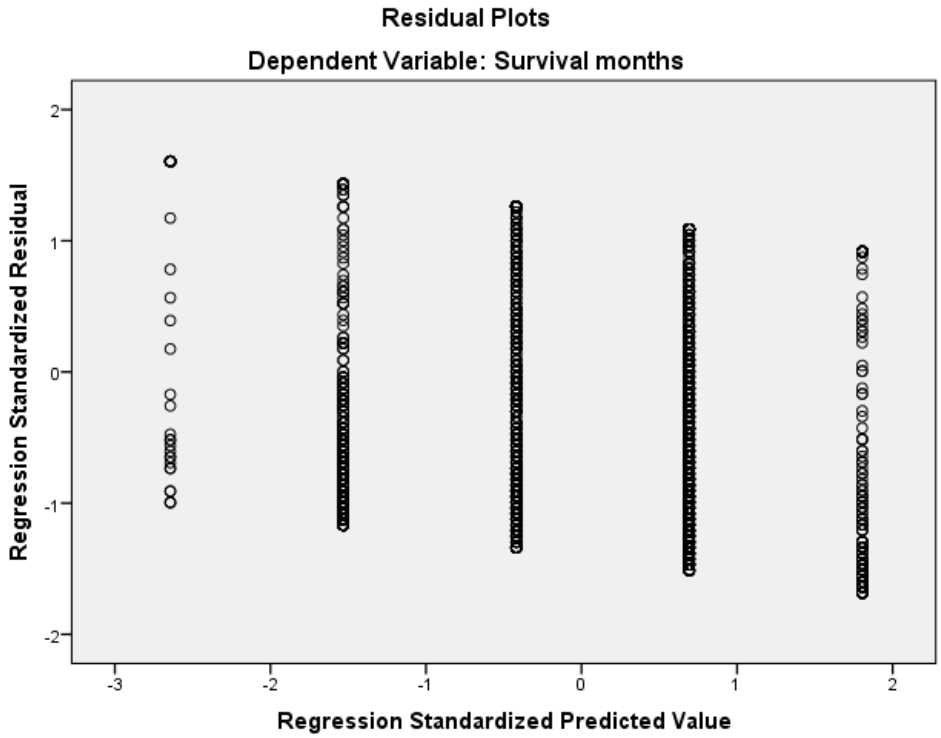


Figure 4

Residual Plots for Event and Censoring



Therefore, a Cox regression model fitted to the cervical cancer data investigated the relationship between race as explanatory variable and 5-year survival rate of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status as dependent variable (Table 7). The race effect, adjusting for the other covariates, was nonsignificant, $p = .214$. Therefore, the time to death for cervical cancer patients was not significantly prolonged by patient's race. However, age at diagnosis ($b = .02$, *s.e.* = .00, *OR* = 1.02, $p < 0.001$, 95% *CI*: 1.02 – 1.03), treatment ($p < 0.001$), and

marital status ($p < 0.001$) significantly predicted hazard rate for cervical cancer across the different racial groups (Table 7).

Treatment comprising any combination of surgical procedure (*b* = 1.39, *s.e.* = .56), blanks (*b* = 1.22, *s.e*. = .33), non-primary surgical procedure performed (*b* = 1.25, *s.e.* = .44), non-primary surgical procedure to distant lymph nodes (*b* = 0.98, *s.e.* = .42), non-primary surgical procedure to distant site (*b* = 2.03, *s.e.* = .47), non-primary surgical procedure to other regional sites (*b* = 1.78, *s.e.* = .38), and no treatment but diagnosed at autopsy (*b* = 1.82, *s.e.* = .33) were significant positive predictors of the hazard for cervical cancer death. These findings indicate that cervical cancer patients, for any race, receiving any of these treatment approaches were predicted to experience the event (death) than those with unknown treatment (death certificate only).

Divorced (*b* = -.17, *s.e*. = .08, *OR* = .85, p < 0.05, 95% CI: .72 – .10) and married (including common law) (*b* = -.18, *s.e*. = .07, *OR* =. 84, p < 0.05, 95% CI: .73 – .94) categories had negative coefficients, indicating a protective effect decreasing cervical cancer hazard rate. The divorced and married (including common law) cervical cancer patients, for any race, have decreased hazard rate for death as opposed to widowed patient category. Unmarried or domestic partner (*OR* = 3.53 , $p < 0.05$, 95% CI: 1.13 – 11.07) had positive coefficient (*b* = 1.26, *s.e*. = .58), indicating that Unmarried or domestic partner cervical cancer patients, for any race, have increased hazard rate for death as opposed to widowed patients. In principle, a patient, regardless of race, experiences similar cervical cancer hazard rate for particular age at diagnosis, treatment, and marital status.

Based on the findings, the null Hypothesis $H_{1,}$ "There is no significant association between race and 5-year Survival Rates (SRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia," was not rejected. A patient's race, adjusting for the other covariates, did not significant influence 5-year survival time ($p = 0.214$). Therefore, the time to death for cervical cancer patients was not found to be significantly prolonged by patient's race.

Table 7

Race Effect Estimates for Cervical Cancer Survival Adjusted for Age at Diagnosis, Treatment, and Marital status

	B	*SE*	Wald	*df*	*p*	*OR*	95.0% CI	
							Lower	Upper
Race (Ref:White)			4.476	3	.214			
Black	-.086	.051	2.857	1	.091	.917	.830	1.014
Other(American Indian/AK Native, Asian/Pacific Islander	.157	.185	.716	1	.397	1.170	.813	1.683
Unknown	.338	.456	.549	1	.459	1.403	.573	3.431
Age at diagnosis	.024	.002	114.113	1	.000	1.024	1.020	1.028
Marital Status at Diagnosis (Ref:Widowed)			29.178	6	.000			
Divorced	-.166	.083	3.957	1	.047	.847	.720	.998
Married (including common law)	-.181	.070	6.680	1	.010	.835	.728	.957
Separated	.247	.170	2.112	1	.146	1.280	.918	1.786
Single (never married)	.029	.078	.135	1	.713	1.029	.883	1.199
Unknown	.143	.102	1.969	1	.161	1.154	.945	1.408
Unmarried or domestic partner	1.269	.583	4.739	1	.029	3.557	1.135	11.151
Treatment (Ref:Unknown treatment; death certificate only)			113.810	7	.000			
Any combination of surgical procedures	1.400	.558	6.295	1	.012	4.053	1.358	12.095
Blank(s)	1.233	.333	13.688	1	.000	3.431	1.786	6.592
Non-primary surgical procedure performed	1.248	.437	8.139	1	.004	3.484	1.478	8.212
Non-primary surgical procedure to distant lymph node(s	.998	.416	5.746	1	.017	2.712	1.200	6.133
Non-primary surgical procedure to distant site	2.043	.470	18.874	1	.000	7.715	3.069	19.392
Non-primary surgical procedure to other regional sites	1.787	.375	22.746	1	.000	5.973	2.866	12.450
None; diagnosed at autopsy	1.833	.329	30.989	1	.000	6.253	3.280	11.924

Research Question 2

Research Question 2 was "What is the relationship between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status?"

A log rank test was conducted to examine whether there were differences in the survival distribution for the different cervical cancer stages (localized, regional, distant and unknown Stages) at diagnosis across residential areas. The survival distributions for the four cervical cancer stages were statistically significantly different, $\chi 2$ (16) = 298.483, $p < .001$, suggesting the model significantly predicted independent variable effect on cervical cancer hazard rate (Table 8). It is apparent that age at diagnosis is greater among patients residing in rural Georgia ($M = 63.85$) than those in urban ($M = 61.62$) and metropolitan areas ($M = 60.01$) (Table 9).

Table 8

Omnibus Tests of Model Coefficients

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	*df*	*p*	Chi-square	*df*	*p*	Chi-square	*df*	*p*
22944.002	295.106	16	.000	298.483	16	.000	298.483	16	.000

Note. Beginning Block Number 1. Method = Enter.

Table 9

Mean Age at Diagnosis Based on Residence for Cervical Cancer Patients Above 45 years

	Rural	Urban	Metropolitan
Mean	63.85	61.62	60.01

A Cox regression model was fitted to examine the relationship between residence as explanatory variable and 5-year survival rate of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status as dependent variable (Table 10). The residence effect, adjusting for the other covariates, was nonsignificant, $p = .837$. Thus, the time to death for cervical cancer patients was not significantly prolonged by patient's residence category. However, age at diagnosis ($b = .02$, *s.e.* = .00, $OR = 1.02$, $p < 0.001$, 95% *CI*: 1.02 – 1.03), treatment ($p < 0.001$), and marital status ($p < 0.001$) significantly predicted hazard rate for cervical cancer across the different residence categories (Table 10).

Treatment comprising any combination of surgical procedure ($b = 1.39$, *s.e.* = .56), blanks ($b = 1.21$, *s.e.* = .33), non-primary surgical procedure performed ($b = 1.25$, *s.e.* = .44), non-primary surgical procedure to distant lymph nodes ($b = 0.98$, *s.e.* = .42), non-primary surgical procedure to distant site ($b = 2.03$, *s.e.* = .47), non-primary surgical procedure to other regional sites ($b = 1.76$, *s.e.* = .37), and no treatment but diagnosed at autopsy ($b = 1.81$, *s.e.* = .33) were significant positive predictors of the hazard for cervical cancer death. These findings indicate that cervical cancer patients receiving any

of these treatments, regardless of residence area, were predicted to experience the event (death) than those with unknown treatment (death certificate only).

Married (including common law) (b = -.17, *s.e.* = .07, *OR* =. 84, $p < 0.05$, 95% *CI*: .74 – .97) patients had negative coefficient, indicating a protective effect decreasing cervical cancer hazard rate. The married (including common law) cervical cancer patient, regardless of residence area, have decreased hazard rate for death as opposed to widowed patient category. Unmarried or domestic partner (*OR* = 3.45 , $p < 0.05$, 95% *CI*: 1.10 – 10.80) had positive coefficient (b = 1.24, *s.e.* = .58), indicating that unmarried or domestic partner cervical cancer patients, regardless of residence area, have increased hazard rate for death as opposed to widowed patients. In principle, regardless of residence area, all patients experienced similar cervical cancer hazard rate for particular age at diagnosis, treatment, and marital status.

Therefore, given the results, the null Hypothesis H_2, "There is no significant association between residence (urban or rural) and 5-year Relative Survival Rates (RSRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia," was not rejected. A patient's residence, adjusting for the other covariates, did not significant influence 5-year survival time (p = .837). Thus, the time to death for cervical cancer patients was not found to be significantly prolonged by patient's residence.

Table 10

Residence Effect Estimates for Cervical Cancer Survival Adjusted for Age at Diagnosis, Treatment, and Marital Status

	B	*SE*	Wald	*df*	*p*	*OR*	95.0% CI	
							Lower	Upper
Residence (Ref:Metropolitan)			.355	2	.837			
Rural	-.023	.117	.038	1	.846	.978	.778	1.229
Urban	-.030	.051	.342	1	.559	.971	.879	1.072
Age at diagnosis	.023	.002	111.334	1	.000	1.024	1.019	1.028
Treatment (Ref:Unknown treatment; death certificate only)			112.989	7	.000			
Any combination of surgical procedures	1.388	.558	6.194	1	.013	4.006	1.343	11.952
Blank(s)	1.210	.333	13.209	1	.000	3.353	1.746	6.439
Non-primary surgical procedure performed	1.247	.437	8.136	1	.004	3.482	1.477	8.204
Non-primary surgical procedure to distant lymph node(s)	.973	.416	5.471	1	.019	2.646	1.171	5.980
Non-primary surgical procedure to distant site	2.029	.470	18.618	1	.000	7.603	3.026	19.107
Non-primary surgical procedure to other regional sites	1.763	.374	22.168	1	.000	5.831	2.799	12.148
None; diagnosed at autopsy	1.810	.329	30.275	1	.000	6.113	3.208	11.649
Marital status at diagnosis (Ref:Widowed)			27.230	6	.000			
Divorced	-.159	.083	3.656	1	.056	.853	.724	1.004
Married (including common law)	-.169	.070	5.929	1	.015	.844	.736	.967
Separated	.233	.170	1.890	1	.169	1.263	.905	1.761
Single (never married)	.010	.077	.017	1	.895	1.010	.868	1.176
Unknown	.147	.101	2.134	1	.144	1.159	.951	1.412
Unmarried or Domestic Partner	1.238	.583	4.511	1	.034	3.448	1.100	10.804

Research Question 3

Research Question 3 asked, "What is the relationship between race, residence (urban or rural), and survival probability in early stage of CervCancer for women living in Georgia, adjusted for age at diagnosis, treatment, and marital status?"

A log rank test examined whether there were differences in the survival distribution for the different cervical cancer stages (localized, regional, distant and unknown Stages) at diagnosis based on race and residence category. The survival distributions for the four cervical cancer stages were statistically significantly different, $\chi 2\ (17) = 103.501$, $p < .001$, suggesting the model significantly predicted race and residence variable effect on the cervical cancer hazard rate (Table 11). The average age at diagnosis was 58.50 years for both race and residence (Table 12).

Table 11

Omnibus Tests of Model Coefficients

-2 Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	*df*	*p*	Chi-square	*df*	*p*	Chi-square	*df*	*p*
5739.550	98.292	17	.000	103.501	17	.000	103.501	17	.000

Note. Beginning Block Number 1. Method = Enter.

Table 12

Mean Age at Diagnosis for Cervical Cancer Based on Patient's Race and Residence in Early Cervical Cancer for Women Above 45 Years

	Black			Other			Total
	Rur	Urb	Metr	Rur	Urb	Metr	
Mean	62.78	61.51	59.61	-	55.00	-	58.50

Note. Other: American Indian/AK Native, and Asian/Pacific Islander.
Rur: Rural; Urb: Urban; Metr: Metropolitan.

A Cox regression model fitted to the cervical cancer data investigated the relationship between race and residence as explanatory variable and 5-year survival rate in early stage cervical cancer for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status as dependent variable (Table 13). The race (p = .357) and residence (p = .781) effect, adjusting for the other covariates, was nonsignificant. Therefore, the time to death in early stage cervical cancer was not significantly prolonged by patient's race and residence. However, age at diagnosis (b = .02, *s.e.* = .01, *OR* = 1.02, $p < 0.001$, 95% *CI*: 1.01 – 1.03), treatment ($p < 0.001$), and marital status ($p < 0.05$) significantly predicted hazard rate in early stage cervical cancer across the different race and residence categories (Table 13).

Married (including common law) (b = -.30, *s.e.* = .18, *OR* =. 74, $p < 0.05$, 95% *CI*: .56 – .99) patients had negative coefficient, indicating a protective effect for cervical cancer hazard rate. The married (including common law) cervical cancer patients, regardless of race and residence area, have decreased hazard rate for death in early stage of cervical cancer as opposed to widowed patient category.

Treatment comprising any combination of surgical procedure (b = -.94, $s.e.$ = .31, OR =. 39, $p < 0.05$, 95% CI: .21 – .71) was significant negative predictor of the cervical cancer hazard rate among patients from metropolitan residence. Cervical cancer patients, of any race from metropolitan areas, receiving any combination of surgical procedure were predicted to have decreased hazard rate (death) than those with unknown treatment; death certificate only from the same residence (Table 14). In principle, regardless of race and residence, all patients experience similar hazard rate in early stage of cervical cancer for particular age at diagnosis, treatment, and marital status.

Relative to Research Question 3, race and residence, adjusting for the other covariates, did not significant influence cervical cancer patients 5-year survival time (race: p = .357; residence: p = .781). Therefore, null hypothesis $H_{3,}$ "There is no significant relationship between race, residence (urban or rural), and survival probability in early stage of CervCancer for women living in Georgia," was not rejected. The time to death in early stage cervical cancer was not significantly prolonged by patient's race and residence.

Table 13

Race and Residence Effect Estimates for Cervical Cancer Survival Adjusted for Age at Diagnosis, Treatment, and Marital Status

	B	*SE*	Wald	*df*	*p*	*OR*	95.0% CI	
							Lower	Upper
Race (Ref:White)			3.234	3	.357			
Black	-.133	.110	1.471	1	.225	.875	.706	1.086
Other (American Indian/AK Native, Asian/Pacific Islander)	.464	.370	1.572	1	.210	1.590	.770	3.286
Unknown	.106	.729	.021	1	.885	1.111	.266	4.638
Residence (Ref:Metropolitan)			.493	2	.781			
Rural	-.150	.259	.335	1	.562	.861	.519	1.429
Urban	-.050	.106	.225	1	.636	.951	.772	1.171
Age at diagnosis	.021	.005	20.006	1	.000	1.022	1.012	1.031
Treatment (Ref:Unknown treatment; death certificate only)			44.452	5	.000			
Any combination of surgical procedure	.048	1.032	.002	1	.963	1.050	.139	7.926
Blank(s)	.189	1.130	.028	1	.867	1.208	.132	11.060
Non-primary surgical procedure performed	-7.868	113.178	.005	1	.945	.000	.000	8.318E+092
Non-primary surgical procedure to distant lymph node(s)	.934	1.118	.698	1	.403	2.546	.284	22.781
Non-primary surgical procedure to distant site	1.018	1.023	.992	1	.319	2.769	.373	20.553
Marital status at diagnosis (Ref:Widowed)			14.431	6	.025			
Divorced	-.163	.179	.836	1	.361	.849	.598	1.205
Married (including common law)	-.301	.147	4.196	1	.041	.740	.555	.987
Separated	-.234	.380	.380	1	.538	.791	.376	1.666
Single (never married)	.000	.170	.000	1	.998	1.000	.716	1.395
Unknown	.240	.202	1.413	1	.235	1.271	.856	1.886
Unmarried or Domestic Partner	1.030	.726	2.012	1	.156	2.801	.675	11.627

Table 14

Race and Residence Effect Estimates for Cervical Cancer Survival Adjusted for Age at Diagnosis, Treatment, and Marital Status

Race recode (White, Black, Other)	Rural-Urban Continuum Code 2013 Metropolitan	B	*SE*	Wald	*df*	*p*	*OR*	95.0% CI Lower	95.0% CI Upper
	Treatment (Unknown treatment; death certificate only)			9.454	2[a]	.009			
	Any combination of surgical procedures	-.940	.306	9.454	1	.002	.390	.214	.711

Summary

The analysis of (a) the possible predicting abilities of race and residence (urban and rural) on 5-year survival rates (SRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in the State of Georgia and (b) the possible predicting abilities on survival probability in the early stage of CerCancer for women living in Georgia for each of the variables, answered the research questions and related hypothesis.

In RQ1, assessing whether race predicted 5-year survival rates (SRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status revealed no significant effect. The time to death for cervical cancer patients was not significantly prolonged by the patient's race, confirming the null hypothesis. Although odd ratios revealed being Black had a protective effect on cervical cancer hazard characteristics, with other races (American Indian/AK Native, Asian/Pacific

Islander) and unknown racial groups slightly more likely to have increased hazard rate than the White patient category, this relationship was not statistically significant, adjusted for age at diagnosis, treatment, and marital status. However, considering patient-disease characteristics, age at diagnosis, treatment, and marital status significantly predicted hazard rate for cervical cancer across the different racial groups. Age positively influenced the event, increasing hazard rate for death. Divorce and married (including common law) decreased hazard rate for death. Contrarily, unmarried or domestic partner increased hazard rate for death than being widowed. Treatment (any combination of surgical procedure, non-primary surgical procedure, non-primary surgical procedure to distant lymph nodes, non-primary surgical procedure to distant site, non-primary surgical procedure to other regional sites, and no treatment but diagnosed at autopsy) positively predicted event experience (death) compared to unknown treatment (death certificate only). In principle, regardless of race, all patients experience a similar cervical cancer hazard rate for particular age at diagnosis, treatment, and marital status.

In RQ2, assessing whether residence (urban or rural) predicted 5-year survival rates (SRs) of Cervical Cancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in Georgia, adjusted for age at diagnosis, treatment, and marital status revealed no significant effect. The time to death for cervical cancer patients was not significantly prolonged by the patient's residence, supporting the null hypothesis. Although odds ratios revealed living in rural or urban areas had a protective effect on cervical cancer hazard characteristics than living in metropolitan areas, this relationship was not statistically significant, adjusted for age at diagnosis,

treatment, and marital status. However, considering patient-disease characteristics; age at diagnosis, treatment, and marital status significantly predicted the hazard rate for cervical cancer across the different residence categories. Age had positive effect on event status, increasing hazard rate for death. Married (including common law) decreased hazard rate for death. Contrarily, unmarried or domestic partner increased hazard rate for death than being widowed. Treatment (any combination of surgical procedure, non-primary surgical procedure, non-primary surgical procedure to distant lymph nodes, non-primary surgical procedure to distant site, non-primary surgical procedure to other regional sites, and no treatment but diagnosed at autopsy) positively predicted event experience (death) compared to unknown treatment (death certificate only). Therefore, regardless of residence area, all patients experience a similar cervical cancer hazard rate for particular age at diagnosis, treatment, and marital status.

In RQ3, assessing whether race and residence (urban or rural (urban or rural) predicted survival probability in the early stage of CervCancer for women living in Georgia, adjusted for age at diagnosis, treatment, and marital status revealed no significant effect. The time to death in early-stage cervical cancer was not significantly influenced by the patient's race and residence, supporting the null hypothesis. Although odds ratios revealed race and residence had an effect on hazard characteristics in the early stage of CerCancer, this relationship was not statistically significant, adjusted for age at diagnosis, treatment, and marital status. However, considering patient-disease characteristics; age at diagnosis, treatment, and marital status significantly predicted hazard rate in early-stage cervical cancer across the different race and residence

categories. Age had positive effect on event status, increasing hazard rate for death in early stage of cervical cancer among the patients. Married (including common law) and treatment comprising any combination of surgical procedure in metropolitan residence decreased hazard rate for death in early stage of cervical cancer. According to these results, regardless of race and residence, all patients experience a similar hazard rate in the early stage of cervical cancer for particular age at diagnosis, treatment, and marital status. Generally, the analysis failed to reject the null hypotheses for all the research questions (RQ1, RQ2, and RQ3). Given the findings, their application to professional practice and implications for social change will be discussed in Section 4.

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

Discussion

The present study's purpose was twofold. First, it examined the possible predicting effects of race and residence (urban and rural) on 5-year survival characteristics of CervCancer by stage (localized, regional, distant and unknown Stages) at diagnosis for women above 45 years living in the State of Georgia. Secondly, it assessed the two factors possible predicting abilities of survival probability in the early stage of CerCancer for women living in Georgia for each of the variables. Cross-sectional data from SEER drawn from the period between 1975 and 2016 involving 2811 participants were used in the analysis. Persistent racial disparities in the 5-year survival rate in cervical cancer informed the need for localized in-depth and comprehensive research of disease burden in Georgia. By determining the race and residence predicting abilities on 5-year survival rates, the study highlighted the importance of state-based information of the disease burden in tailoring health interventions and mitigating health inequalities.

In assessing whether race and residence predicted 5-year survival rates of cervical cancer by stage (localized, regional, distant, and unknown stages) at diagnosis for women above 45 years, adjusting for age at diagnosis, treatment, and marital status, the results showed no association between the variables. Although odd ratios revealed race and residence had a protective effect on cercancer hazard characteristics, this relationship was not statistically significant. Thus, the time to death for cervical cancer patients was not significantly influenced by the patient's race or residence. Similar findings were also

reported in the early stage of cervical cancer. However, age at diagnosis, treatment, and marital status significantly predicted hazard rates across the different racial groups. Aging increased hazard rate and decreased patient survival time. Being married (including common law), unlike living with a domestic partner or being widowed reduced the hazard rate and extended individual survival time. Similarly, the conventional cervical cancer treatment approaches increased cercancer hazard rate and reduced survival time. Therefore, regardless of race and residence, patients experience a similar cervical cancer hazard rate for particular age at diagnosis, treatment, and marital status.

In this section, the findings of the study based on the objectives are discussed. This section also includes the interpretation of the findings, the study limitations, and recommendations for further research. Implications for professional practice and social change are also presented. In the last part, this section ends with the conclusion of the study, summarizing arguments, and providing the key essence of the research.

Interpretation of the Findings

The study showed no overall race and residence effect on cercancer survival rate among women above 45 years in Georgia. In principle, I observed patients experienced similar hazard rate for race and residence in both all stages and early-stage (localized) cercancer, indicating that age, treatment, and marital status (see Beavis & Levinson, 2016; Decker et al., 2019; Nolan et al., 2014; U.S National Cancer Institute, 2020), and not race or residence (see Benard et al., 2017), account for racial and geographical differences in 5-year relative survival among cercancer patients.

An assessment of racial influence on 5–year relative survival for all stages and early-stage cervical cancer among women 45 years and above demonstrated no statistically significant association. The finding suggests that race does not account for the observed population disparities in cercancer survival characteristics among women above 45 years of age in Georgia. While previous research has reported racial disparity in 5-year relative survival rates among cercancer patients in the United States, hinting at a possible cause-effect relationship (Ginsburg & Paskett, 2018), the present findings did not support this knowledge of perceived correlation. The deviation in race-based disparity in survival may be explained by the fact that contrary to previous research focuses on cercancer cohort above 15 years of age (Abdalla et al., 2020; Odekunle, 2017; Siegel, Miller, & Jemal, 2019), the current study investigated the relationship among adult population above 45 years. In retrospect, this nonconformity suggests that the race-5-year survival relationship might be a characteristic of cercancer patients above 45 years. However, the crude mean differences in cercancer survival months after 45 years of age, while not statistically significant, may be attributable to nonrace factors.

Research on patient residence influence on 5–year relative survival for all stages and early-stage cervical cancer among women 45 years and above demonstrated no statistically significant influence on 5–year relative survival. This deviation from documented evidence of geographical-related variation in relative survival (Majid et al., 2019; Nuño et al., 2012; Yu et al., 2019) indicates that nonresidence factors are responsible for the observed disparity in cohort survival outcome. With the current study's focus on patients aged above 45 years, it is debatable that aged-standardized

cohorts have varying residence effects accounting for the documented factor-based disparities in survival (Studts et al., 2012). The lack of cause-effect relationship between residence and 5-year cercancer survival, for both all stage and early-stage cancer in the present study is characteristically limited to the cohort. The findings suggest that age-standardized cancer categories experience unique cercancer-related challenges, identical among patients in a specific cohort (Rutherford et al., 2020). Based on the results, residential disparities in crude mean survival months and odd ratios highlight possible effects of other patient-related factors on relative survival outcomes among the study population.

The consideration of age, treatment, and marital status in racial and residence disparities of cercancer survival outcome, takes a step further the concerns for other patient characteristics in mediating survival outcome. The failure of patients' race and residence to influence survival time among patients above 45 years highlights the discrepancy in racial and geographical-based comparisons (Benard et al., 2017). In line with previous research (Studts et al., 2012), advancing age reduces survival times among cercancer patients above 45 years. In advancing knowledge on cercancer survival, the study indicates that marrying (including common law), unlike living with a domestic partner or being widowed reduced-hazard rate and extended individual survival time. In contrast to the early stage of cervical cancer, receiving any treatments in all other cervical cancer stages, regardless of race or residence, increased hazard rating and reduced survival time. The present findings on age, treatment and marital status influence on 5 -year survival affirm the concept that the race- geographically based comparisons

insufficiently enhance understanding and designing tailored cercancer interventions (Benard et al., 2017).

While health inequalities in survival outcomes exist across different cercancer patient categories (Abdalla et al., 2020; American Cancer Society, 2020; Siegel, Miller, & Jemal, 2019), the present findings imply that some cohorts may experience similar factors minimizing the effects of these social challenges. The lack of race-residence statistically significant influence on 5-year survival suggests that race- geographically based comparisons only provide oversimplified statistics likely to skew the general understanding of risks (Benard et al., 2017). Since most patients have unique healthcare needs, including healthcare access, screening services utilization, and treatment affordability (Adekeye et al., 2018; Blake et al., 2015; Decker et al., 2019; Fuzzell et al., 2021), the age, treatment, and marital status effect on survival time point to the need for more stratified interrogation to move the risk needle to specific factors.

In view of the theoretical framework adopted in the study, the finding supports the importance of predisposing factors in understanding cercancer disparities. Anderson's behavior model (as cited by Bradley et al., 2002) theorizes the structuring of healthcare disparities along distinct strata to address widening inequalities. The present study advances this conceptualization by narrowing down the fade-out effects of race and residence by highlighting the significance of age, treatment, and marital status in cercancer patient survival. Further, the finding underscores the possible contribution of these individual factors to cervical cancer health inequalities among other age-standardized cohorts. The study indicates that stratifying cercancer survival on

predisposing factors addresses oversimplification of survival disparities under race and geographical components, allowing for an in-depth understanding of the significant drivers of survival disparity essential for improving and mitigating inequalities in survival outcomes among patients above 45 years of age.

Limitations of the Study

Although the study calls for the rethinking of the factors influencing cervical cancer survival among women above 45 years, the possibility of data quality variation due to the inability to verify data quality from the SEER data source affects the validity of the findings. In addition, the limited geographical coverage, with a focus on rural and great Georgia registries only, does not provide a representative population limiting the generalizability of the cervical cancer survival statistics to other populations. We also did not consider race-based differences in healthcare utilization that might have influenced the interrelationship of factors (Squires & Anderson, 2015, National Center for Health Statistics, 2016), affecting the reliability of the findings. However, the selected variable categories (age at diagnosis, race, residence, marital status, and survival months) represent a range with overall patterns potentially similar across the population and the study period.

Recommendations

This study provides comprehensive research on factors influencing age-based cercancer survival for women above 45 years. Building on the present findings, further research is recommended on predictive factors for cercancer survival time across the age-standardized patient categories using the various components of the Anderson behavior

model. In addition, future studies can consider age and geographically representative sample for generalizable statistics to provide additional support for evidence-based interventions. Longitudinal research is also necessary for controlled data quality to provide an in-depth understanding of age, treatment, and marital status effect size in widening cervical cancer health disparities, relative to the race-geographical based inequality statuses evident in extant literature. There is further need for investigation of race-based differences in healthcare utilization that might have confounded the interrelationship of factors' influence on survival characteristics.

Implications for Professional Practice and Social Change

Professional Practice

The study's professional practice implications include a shift of attention in policy guidelines from the race and residence-based considerations to age, treatment, and marital status integration to tailored interventions for improved cercancer survival outcomes. Our study suggests that amending policies based on individual factors that define a patient's socio-clinical status can contribute significantly to prolonged cercancer survival time. Given predisposing factors are distinct for various patient categories; they provide policy areas for understanding and effecting interventions for prolonged cercancer survival.

Furthermore, the finding that cercancer survival differs by individual-based factors has implications on designed policy interventions for enhancing public awareness of cervical cancer survival among women aged 45 years and above. Sensitive information dissemination strategies would benefit health promotion campaigns for the various cancer

population groups. The rollout of education and outreach initiatives would be beneficial in maximizing the choice of cercancer care to address relevant challenges in survival.

In utilizing Anderson's behavioral model (1995), we expand its application and explanatory power in practice essential for future research modeling patient survival in chronic diseases. This expansion of theoretical application will require primary data to test patient factors' effects established in the study. Specifically, the theoretical expansion indicates that age, treatment, and marital status, but not race and residence as applied in practice, influence 5-year cercancer survival among women 45 years and above. The extent of age, treatment and marital status effect on 5-year cercancer survival among the cohort across populations remain a research problem, testable with models that consider multiple levels of influence among these factors. Alternative models with multiple level influences are necessary to address oversimplification and poor understanding of 5-year cercancer survival, essential in enhancing policy and program effectiveness for addressing cercancer-related health disparities.

Positive Social Change

The study findings indicating lack of race and residence predictive effects on 5-year cancer survival among women above 45 years highlights the common oversimplification and poor understanding of the cercancer disparity problem. The individual-based (age, treatment, and marital status) factor influence on survival trends is crucial for redesigning and prioritizing cercancer management strategies, evaluating impact, and progress towards addressing widening gaps in survival disparities. Using the regional surveillance data to develop cercancer management strategies, inform goal

reassessment, resource allocation, and targeted initiatives for prolonged cervical cancer survival time.

The health services departments of Georgia can rollout community outreach programs, a strategy towards enhancing awareness and mitigating the influence of the individual factors on cercancer survival rate. The community strategy is essential in achieving a population-wide impact on disease management choices, a fundamental step in addressing the persistent cercancer survival disparities. The federal state and local health care regulatory authorities can also use the information in designing alternative treatment initiatives, a step towards addressing the effect of conventional cercancer treatment choices on survival time. Federal, state, and local governments can use the statistics in developing targeted health care policies and impact evaluation approaches, essential in reducing survival disparities among populations struggling with cercancer inequalities.

Conclusion

Although cercancer survival trends have remained relatively stable in the last few years, reflecting effectiveness in intervention initiatives, racial and geographical survival inequalities and high mortality rates among women 45 years and above remain a healthcare problem. The study advances the understanding of the 5-year relative survival rate by stage at diagnosis, race, and place of residence in Georgia, USA. The research reveals that race and residence do not play a role in racial and geographical-based 5-year cercancer survival disparities among women 45 years and above. It further shows that age, treatment, and marital status are crucial individual factors responsible for the racial

disparities in cervical cancer relative survival rates among women 45 years and above. Thus, it is notable that variations in age, treatment type, and marital status influence disease progression and survival outcome, adding to widening disparities in cervical cancer burden among different cercancer patient categories. By advancing the understanding of individual factors influencing cercancer survival among women 45 years and above, the study extends the scope of available opportunities for designing effective ways to address disparity gaps and improve survival time in the community.

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