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Disparities in Cervical Cancer Survival Amongst White and African American Women

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This is to certify that the doctoral study by

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Walden University
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Abstract

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MHA, Western Kentucky University, 2015

MBBS, University of Nigeria Nsukka, 2008

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Cervical cancer disproportionately impacts racial and ethnic minorities in the United States. The continuum in the disturbing morbidity and mortality trends declined markedly in 2020. However, there are more than 13,000 diagnosed cases, and almost 4,300 related deaths, and significant racial disparities in cervical cancer survival persist. The socio-ecological model served as the theoretical framework. Chi-square tests and binary logistic regression analyses were used to analyze data from the National Cancer Institute Surveillance, Epidemiology, and Ends Results Summary. The purpose of the study was to assess the association between race/ethnicity-related disparities in sociodemographic, histopathological, and treatment-related factors and cervical cancer survival rates amongst White and African American women in the United States. Age, marital status, year of diagnosis (except for 2013–2017, $p = .945$), geographical location (except Detroit Metropolitan, $p = .090$, Georgia, $p = .505$, Hawaii, $p = .691$, Louisiana, $p = .995$, and New Mexico, $p = .060$), tumor grade (except Grade II, $p = .187$), histological type (except squamous cell carcinoma, keratinizing, $p = .127$, and other types, $p = .213$), stage of cancer, and treatment-related factors were significant predictors ($p < .05$) of cervical cancer. The study findings may lead to positive social change by informing strategies linked to implementing long-term interventions, programs, and policies to address race/ethnicity-related disparities, address the patient's social and behavioral factors, and diversify and create a culturally competent healthcare system.

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Dedication

I dedicate this achievement to my family and friends who, with love, guidance, support, and the core tenets of positive social change, have accompanied me on my doctoral journey. I want to dedicate this dissertation to my late dad (Justus Tasie Ogoke), my mum (Christiana Ehochi Ogoke), my siblings - Iheanyichukwu, Chinonyerem, Chioma, Chinyere, Obioma, and Ginikachukwu, my wife Sarah, my adorable children Ellianna Jo Ada and Justus Thomas JaaChi, and to my nephews and nieces. Also, to my cousin James Ubachunwa, your support and encouragement have been unwavering.

I dedicate this dissertation to all individuals diagnosed with cancer of the cervix or who are currently undergoing treatment and battling cancer survival. I also dedicate this work to those who provided selfless service and support to improve care for vulnerable populations and build an equitable healthcare system globally. I hope that increased awareness of public health will have the potential to help mitigate disparities and reduce the number of new cancer cases, as well as the illness, disability, and death caused by cancer in the United States and worldwide.

Acknowledgments

I sincerely thank my committee chair, Dr. Pelagia Melea, for the encouragement, guidance, support, timeless commitment, prompt and actionable feedback, unending communication, and excellent mentorship during the doctoral process. Also, I would thank the committee member, Dr. W. Sumner Davis, and the University Research Reviewer (URR), Tolu F. Osoba, for the valuable contributions and feedback on my doctoral study process.

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Section 1: Foundation of the Study and Literature Review

Introduction

Cervical cancer is a preventable public health problem and a leading cause of gynecological cancer death that commonly affects women worldwide (Campos et al., 2017b). Cervical cancer illuminates the continuum of disparities in incidence, mortality, and survival globally (Andersson et al., 2017). It is also the fourth most common cause of cancer death worldwide, with 85% of the disease burden mainly affecting women from less developed regions of the world in which participation in screening programs is the lowest (Campos et al., 2017b). However, in the United States, it is the third most common gynecological malignancy (Vengaloor et al., 2021). The high-risk human papillomavirus (HR HPV) is the significant etiologic factor for cervical cancer; however, screening programs and prevention of this malignancy by Papanicolaou (Pap) test (cytology based) and subsequent cervical dysplasia treatments effectively reduced cervical cancer mortality (Andersson et al., 2017). Compared with cytological screening, HPV deoxyribonucleic acid (DNA)-based screening provides greater protection against invasive cervical carcinomas, and HPV vaccination successfully reduced the proportion of abnormal cytology screening tests, decreasing the subsequent need for diagnostic colposcopy (Fontham et al., 2020).

Cervical cancer disproportionately affects women from minority groups in higher income countries and women in low-resource regions of the world with higher rates and insufficient care (Liverani et al., 2020). There have been more effective strategies for early detection, prevention, and treatment available for cancer (Loomans-Kropp & Umar,

2019). However, racial and ethnic minorities, particularly African American women, continue to experience significant disturbing trends in cancer morbidity, mortality, and survival disparities when compared to White women (Zhang et al., 2019). In a study of the U.S. Military Health System, where women had access to equal care regardless of race, ethnicity, or socioeconomic status (SES), race was not an independent predictor of survival after controlling for access to equal care, and there were no differences in 5- and 10-year survival (Pfaendler et al., 2018). Though incidence and mortality declined markedly in the United States, in 2020, more than 13,000 diagnosed cases of invasive cervical cancer, an estimated 4,290 deaths from cervical cancer, and persistence of disparities in cervical cancer survival by race/ethnicity underscore the need for increased access and adherence to recommended screening practices for both primary and secondary prevention (Fontham et al., 2020).

In this section, I will state the research problem and describe significant gaps in the current practice-based research regarding disparities in cervical cancer survival rates amongst White and African American women. I will discuss the purpose of the study by providing a concise statement that connects the problem being addressed and the focus of the study. Additionally, I will discuss the research questions (RQs) and corresponding hypotheses, describe the theoretical foundation for the study, and provide a comprehensive review of current literature related to study variables and the scope of the study topic. I will also offer concise operational definitions of the study variables; the rationale for selecting the research design and methodology; the assumptions, scope, and

delimitations; and limitations vital to the study. Finally, I will conclude this section by providing a summary, conclusions, and a brief introduction to Section 2.

Problem Statement

Globally, cervical cancer remains the fourth most prevalent malignant gynecological neoplasm affecting females, resulting in an incidence of 604,000 cases and 342,000 deaths in 2020 (Sung et al., 2021). Although over 240,000 women had cervical cancer by 2013 in the United States, the economic burden of cervical cancer incidence and mortality remained highest in the Southern states (Gopalani et al., 2018; Kobetz et al., 2018). While the disease incidence decreased by about 0.2% per year, mortality decreased by 0.7% per year (Vengaloor et al., 2021). However, in 2018 and 2019, respectively, there were approximately 13,240 new cases with an estimated 4,170 deaths (Olusola et al., 2019) and an estimated incidence of 13,170 cases and 4,250 deaths from cervical cancer (Vengaloor et al., 2021). Disparities in race/ethnicity influenced the disparate prevalence of HPV at 25% among Caucasian and 35% among African American groups, respectively, and are related to significantly longer persistence after infection of high-risk HPV types in young African American women compared to young White women (Hirth, 2019).

Essential factors such as sociodemographic (race/ethnicity, age at diagnosis, geographical location, marital status, insurance status, education level, and individual or neighborhood economic status), pathological (tumor grade, cancer stage, histological type), and mode of treatment, which predict 5□year survival, are also associated with the disease burden and the disparities and have been related to the risk of advanced-stage

cancer at diagnosis (Kweon et al., 2017). In particular, younger women under 40 make up an estimated 30% of newly diagnosed cervical cancer cases, representing a major public health problem (Steiner et al., 2021). However, there is a gap in the collective knowledge of the roles of sociodemographic (age at diagnosis, geographical location) and histological factors (subtypes of tumor and characteristics of tumor) associated with the cancer stage at diagnosis according to the primary site, and locally advanced disease when stratified by race/ethnicity for the survival time following the diagnosis of cervical cancer. Due to the continuum in societal health disparities by race/ethnicity, African American women continue to have a higher risk of a diagnosis of cervical cancer, higher incidence rates, and lower survival rates compared to White women (10.4 vs. 7.8 per 100,000 persons; Yoo et al., 2017).

Furthermore, socioeconomic disadvantage in median household income and value, median educational attainment, neighborhood poverty level, diminishing accessibility to preventive care, sociocultural barriers, high healthcare needs, and profound health inequities contribute to the disproportionate burden of disease incidence, survival, and mortality rates and differential health outcomes (Johnson et al., 2020). Over the years, trends indicating decreased incidence of cervical cancer used as markers for evaluating cervical cancer screening for early detection, prevention, and appropriate follow-up have prevented the proliferation of abnormal invasive cancers that otherwise would result in risk of dying from cervical cancer (Benard et al., 2017). There is a gap in literature concerning the widening disparity in geographic and sociodemographic factors (age, highest level of education attained, marital status, health insurance status,

employment status, place of residence, and distance from hospital) increasing barriers to the prevention, treatment, and survival of cervical cancer. Disparate impacts on cervical cancer mortality, incidence, and survival rates illuminate longstanding health disparities between the least and most advantaged social groups in the United States (Singh & Jemal, 2017).

Researchers have noted wide geographical disparities in the overall incidence, mortality, and survival of women with cervical cancer that have adversely affected women in Appalachia, the South Atlantic, and the lower Mississippi Valley (Powell et al., 2018). Women who reside in these medically underserved and rural communities are significantly impacted by distance from the nearest gynecologic and obstetrics health provider and comprehensive cancer center, highlighting the importance of geographic location in obtaining and completing high-quality cancer treatment (Powell et al., 2018). As such, women who have low SES, who live in rural areas, who are uninsured, and who lack access to better income, education, or occupation are less likely to be regularly screened for cancer because of their limited access to medical care facilities and have a higher risk of advanced cancer at diagnosis (Kweon et al., 2017). Thus, there is a gap in the literature concerning widening variations of geographical location as potentially modifiable barriers to both prevention and treatment of cervical cancer and the effects of these factors on stage at diagnosis and their interaction with other factors that impact cervical cancer outcomes.

Despite notable advances in preventing precancerous changes and earlier stages of cervical cancer through the Pap test, there have been significant disparities in cancer

incidence and death rates in the United States (Yoo et al., 2017). Further, poor access to cervical cancer screening services, progressive transformation to malignant lesions, and a lack of follow-up, disproportionately affecting the uninsured, underinsured, never-insured, underserved, and the never-served, result in skewness toward the unscreened population (Benard et al., 2017). The study is crucial for evaluating the potentials of existing cervical cancer early detection programs for cervical cancer screening and gaps in the literature regarding incidence, mortality, and survival rates amongst White and African American women in the United States. Singh and Jemal (2017) examined disparities in cancer mortality, incidence, and survival in relation to several cancers, including cervical cancer in the United States between 1950 and 2014, and the National Cancer Institute Surveillance, Epidemiology, and Ends Results Summary (SEER) cancer registry database was one of the data sources used.

Despite widespread HPV testing, cytology of the cervix, cotesting (HPV testing + cytology), and increasing uptake of HPV vaccination, more than 50% of newly diagnosed cases are in their advanced stage, which results in high rates of morbidity and mortality and increased risk of recurrence (Powell et al., 2018). There is significant evidence suggesting a genetic basis of disparity because the contributing factors from the disparities in social determinants of health (low SES, lack of access to reliable transportation, lack of health insurance, and minority race), stage at diagnosis, guideline-adherent care, and outcomes of cervical cancer disparities are complex and multifactorial (Powell et al., 2018); however, the persistence of racial differences in cervical cancer survival remains unclear regardless of these factors. Thus, there is a gap in the research

on racial differences in the molecular landscape and cancer types (histology types) and a need for a better understanding of the multifactorial etiology and pathogenesis of disparities in cervical cancer survival.

Furthermore, studies have not found disparities in disease burden and survival amongst African American and White American women between 2000 and 2017 using the Incidence SEER Research Plus Data 18 Registries, November 2019 Submission 2000 to 2017 dataset of cases diagnosed in 1975–2017. Thus, an understanding of the variations in trends between 2000 and 2017 is vital for implementing effective and efficient cervical cancer screening algorithms and treatment strategies and underpinning the date of diagnosis and the date of definitive treatment to reduce disparities in incidence, mortality, and survival. The FIGO staging system as a therapeutic model exposes the extent and aggressiveness of cervical tumors for precise and practical prognostication of cervical cancer patients, thereby improving individualized treatment, quality of life, and quality of survival over the long term (Chen et al., 2021). Additionally, the therapeutic decision-making process in clinical assessment is vital for underpinning overall cervical cancer survival (Chen et al., 2021). Thus, there is a gap in predicting the prognosis of cervical cancer because patients with similar pathological characteristics and clinical tumor stages have different prognoses. Therefore, understanding these variations and determinants contributing to cervical cancer disparities is a critical public health approach to developing strategies for promoting early, effective, and efficient cervical cancer screening among the population with a high disease burden (Gibson et al., 2019).

Purpose of the Study

The purpose of this quantitative study was to assess the association between disparities in race/ethnicity-related characteristics and cervical cancer survival outcomes between African American and White women in the United States. The study included the modifier effect of how race/ethnicity-related differences in age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status influence cervical cancer survival rates amongst White and African American women in the United States.

The secondary data set used for this study was retrieved from SEER. The dependent variable (DV) for the study was the cervical cancer survival rate. The independent variables (IVs) were race/ethnicity-related disparities in age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status.

Research Questions and Hypotheses

The following RQs and corresponding hypotheses guided this study:

RQ1: Is there a statistically significant association between race/ethnicity-related disparities in the age at diagnosis, year of diagnosis, marital status, and

geographical location and the cervical cancer survival rate among African American and White women?

$H_0$1: There is no statistically significant association between race/ethnicity-related disparities in the age at diagnosis, year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African American and White women.

H_A1: There is a statistically significant association between race/ethnicity-related disparities in the age at diagnosis, year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African American and White women.

RQ2: Is there a statistically significant association between race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African American and White women?

$H_0$2: There is no statistically significant association between race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African American and White women.

H_A2: There is a statistically significant association between race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African American and White women.

RQ3: Is there a statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status and the cervical cancer survival rate among African American and White women?

H_03: There is no statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status and the cervical cancer survival rate among African American and White women.

H_A3: There is a statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status and the cervical cancer survival rate among African American and White women.

Theoretical Foundation for the Study

The socio-ecological model (SEM) was the underlying theoretical framework behind this study for understanding the predictive association between race/ethnicity-related disparities in the sociodemographic, histopathological, and treatment-related factors with the cervical cancer survival rate among African American and White women. Bronfenbrenner (1977) identified the microsystem, mesosystem, and exosystem as the three ecological environments that influence interactions of individuals with their environments as an outcome such as cervical cancer occurs through interaction between a person and her environment. The SEM captures multilevel systems by incorporating the intrapersonal, interpersonal, organizational, community, and public policy levels to address connections both within and across levels in a study. The SEM provides a useful framework to understand how the interrelationship between the patient, the immediate environment (e.g., family, friends), the healthcare system (e.g., oncologic and primary care providers), and the society shape perceptions and decisions (e.g., public attitudes, policy, media campaigns, research funding), which impact the survival outcomes from cervical cancer (Hamann et al., 2018).

Population health is the collective health of individuals; hence, cervical cancer screening and prevention targeted at high-risk individuals and the general population will influence variability in cervical cancer survival to show that individual risk is the mixture of genetic and environmental factors, such as behavior, lifestyle, and exposure to a known carcinogen such as HPV (Loomans-Kropp & Umar, 2019). According to the theoretical framework, information disseminated at the community level for early

cervical cancer screening and HPV vaccination will improve survival prolongation and substantially impact the individual level to translate to a population-level benefit. Besides, an underpinning of the multilevel approach (organizational, environmental, and policy changes) is crucial for implementing interventions at the individual level, when adapted at the interpersonal level (social support system, oncologic/health care providers [HCPs], patient navigators) to influence individual behaviors over the long term (Hamann et al., 2018).

Furthermore, at the community level, a community-based educational program may play an essential role in improving knowledge and attitudes toward cervical cancer screening in an underserved population and promoting positive social changes in addressing health disparities in cervical cancer survival (Fang et al., 2019). In developed countries, the repeated screening programs at the individual level created psychosomatic pressure on healthy women in the program and posed substantial economic burdens on the government budget at the public policy level of the SEM (Hu & Ma, 2018). The inverse relationship between social class and disease burden highlights the disparities in race/ethnicity and SES, which also exist for cervical cancer (Singh & Jemal, 2017). Though African American women have a higher risk of developing advanced cervical cancer regardless of age at diagnosis, geographical location, and health insurance status, there was no association between residing further from a health provider or in a rural area and a higher risk of advanced disease (Powell at al., 2018). However, disparities exist in cervical cancer incidence and outcomes and are multifactorial and necessitate further research into socioeconomic, biological, and systems causes (Powell et al., 2018).

Hence, SEM relates to the study approach for understanding the inconsistencies in the national screening program and addressing the existence of significant African American–White disparities in cancer, which are essential for defining and measuring disparities in sociodemographic, histopathological, and treatment factors throughout the continuum of cancer epidemiology, from exposures through outcomes at the individual or ecological level. With an assessment of the critical RQs, the SEM identifies negative sociodemographic characteristics that disproportionately impact African Americans after controlling for age at diagnosis, cancer stage, histological type, cancer treatment, geographical location, and treatment status, presenting the opportunity for a level playing field from which subsequent cancer outcomes across population groups may be compared (Johnson et al., 2020). Thus, SEM was an appropriate theoretical framework in this study, and potentially beneficial interventions can be designed, implemented, and evaluated to monitor and reduce race/ethnicity-related cervical cancer disparities at the public policy level, which has remained a long-term goal in the United States (Singh & Jemal, 2017).

Nature of the Study

A quantitative research approach was used to address the three RQs. The quantitative study used a cross-sectional design to measure the relationships among the DV and IVs and how the sample results may generalize to a broader population of women with cervical cancer from 2000 to 2017. The quantitative experimental approach was useful in measuring the association of racial disparities among White and African American women with the cervical cancer survival rate when stratified by the age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic

confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status. Table 1 shows the study variables for each RQ.

Table 1

Study Variables for Each Research Question

Research question (RQ)	Dependent variable	Independent variable
RQ 1	Cervical cancer survival rate	Race/ethnicity-related disparities in the age at diagnosis, the year of diagnosis, marital status, and geographical location
RQ 2	Cervical cancer survival rate	Race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis
RQ 3	Cervical cancer survival rate	Race/ethnicity-related disparities in the mode of treatment (surgical, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status

The manipulation of the IVs showed the effect on the DV. The experimental research used data collected over time between 2000 and 2017. The SEER Cancer Statistics Review (CSR) contains statistics from 1975 through 2017, and the most recent year for which data were available on the most recent cancer incidence, mortality, survival, prevalence, and lifetime risk statistics, which were published yearly by the Surveillance Research Program of the NCI (Howlader et al., 2020). Using the data from 1975 to 2017 collected by SEER, I analyzed the racial/ethnic disparities and the cervical

cancer survival rate among African American and White women from 2000 to 2017 to determine the characteristic(s) predicting the disparities in disease burden and survival of those diagnosed with cervical cancer in the United States. The stage of cancer is categorized into localized, regional, distant, or unstaged. The data registry included SEER registries in California (Greater Bay Area, San Francisco–Oakland, San Jose–Monterey, Los Angeles, Greater California), Connecticut, Detroit, Georgia (Atlanta, Rural Georgia, Greater Georgia), Hawaii, Idaho, Iowa, Kentucky, Louisiana, Massachusetts, New Jersey, New York, New Mexico, Seattle (Puget Sound), Utah, and SEER 18 Areas (Howlader et al., 2020). In 2018, an estimated 293,394 women were living with cervical cancer in the United States, and in 2021, cervical cancer represented 0.8% (n = 14,480) of all new cancer cases and 0.7% (n = 4,290) of all new cancer deaths in the United States (Howlader et al., 2020).

Literature Search Strategy

I searched the CINAHL, NCI, Google Scholar, PubMed, and MEDLINE databases, for peer-reviewed journal articles and literature on the study variables and concepts relevant to the study. I selected articles published in the last 5 years to include literature from 2017 to the present to develop cerebral information on the public health study variables and concepts. Additionally, I extended the search criteria to include studies and works of literature published since the beginning of the millennium in order to achieve a foundational understanding of theoretical concepts and variables as articulated by other researchers, rather than to provide explicit conclusions regarding the

logical relationships between the dependent (outcome) variable and the independent (predictor) variables for the study.

I used search terms related to the study topic, cervical cancer (*cervical cancer screening*, *HPV testing*, *cytology*, *cervical cancer survival*, *cervical cancer disparities*, *quality of life*), as well as related to the study population race/ethnicity (*African American*, *Black*, *White*, *Caucasian*, *Hispanic White*, *Non-Hispanic White women*, *cancer survivors*), concepts (*intrapersonal*, *interpersonal*, *organizational*, *community*, *public policy*), and variables (*race/ethnicity-related differences in age at diagnosis*, *year of diagnosis*, *marital status*, *geographical location*, *diagnostic confirmation*, *grade of tumor at diagnosis*, *histological type*, *cancer stage at diagnosis*, *mode of treatment* [surgery, radiation therapy, chemotherapy, and combination therapies], and *treatment outcome/status*) to define the keywords. I used information from webpages and results from older literature relevant to the research topic to gain foundational understanding and not merely conclusions on the public health issue.

I used the following search keywords: *cancer of the cervix*, *cervix uteri*, *cancer risk*, *HPV + cervical cancer*, *racial disparities*, *cervical oncology + disparities*, *SEER*, *measuring the occurrence of disease*, *cervical staging*, *cervical cancer management*, *cancer risk + African American + White women*, *disparities in cancer risk*, *neighborhood SES disparities*, *adherence to guidelines + cervical cancer treatment*, *cervical cancer + life expectancy + quality of life*, *cervical cancer + social determinants of health*, *cervical cancer + disease burden*, *disease grade + disparities + survival*, *age at diagnosis + late-stage cancer*, *rural health + urban health*, *epidemiology*, *gynecological neoplasms*, *Pap*

test, *histology + cervical cancer*, *year at diagnosis + disparities*, *prevalence*, *cervical cancer decline + incidence*, *changes in cancer survival*, and *cervical cancer + health disparities + healthcare disparities.* The literature related to the key variables and concepts was reduced from the results obtained to contain the words *racial/ethnic disparities*, *cervical cancer*, *cervical cancer survival*, *disease trend*, and *health disparities* within the article's title or abstract to address the public health concerns.

Theoretical Framework

Intrapersonal-Level Factors

HPV infections are associated with the epidemiology of cervical cancer in the young and adults globally, and multilevel social determinants (personal and environmental factors) explain the lower uptake of HPV vaccinations and how these screening disparities emerged (Moss et al., 2021). Additionally, risk factors such as the use of oral contraceptives, multiparity, immunosuppression, smoking, obesity, early marriage, multiple sexual partners, and insufficient vegetable and fruit intake influence HPV infections (Kirubarajan et al., 2021). Barriers to cervical cancer screening include poor knowledge, lack of awareness about where services are attainable, concern regarding partner disapproval, cost, time constraints, repetitive screening frequency, embarrassment, perception of not being susceptible, fear of virginity loss, low accessibility, fear of cancer diagnosis, and fear of intimate nature of the examination (Kirubarajan et al., 2021). Other barriers include the HCP never having recommended the Pap test, fear of pain and discomfort, perception of low sensitivity of the test, the misconception of severe complications of the test, physician gender, the uncertainty of

reliability of Pap smears, discontinuity of care from the HCP after moving away for work/school, difficulty in finding a female HCP, fear of discomfort and invasiveness of the test, negative past experiences, limited choice in HCP, fear of parental disapproval, low accessibility, and lack of privacy in a small community (e.g., running into someone they know at the clinic; Kirubarajan et al., 2021).

Moss et al. (2021) explored the personal (e.g., healthcare mistrust) and environmental (e.g., travel time to healthcare providers) factors related to colorectal and cervical cancer screening after recruiting 100 women aged 50–65 years (primarily non-Hispanic White) from 14 rural, segregated counties in a Northeastern U.S. state. Though 89% of participants were up to date for cervical screening and 65% were up to date for colorectal screening, the barriers to screening were grouped into three factors—privacy concerns, logistical barriers, and lack of trust in the adequacy of healthcare services—and were associated with lower odds of screening (e.g., insurance status and healthcare mistrust: interaction $p = .02$ for cervical; interaction $p = .05$ for colorectal; Moss et al., 2021). Therefore, regardless of the stage of the disease, identifying factors responsible for cancer care disparities will reduce the time from symptom onset to cancer treatment initiation for advanced□stage cancer, increasing the likelihood of positive treatment outcomes (Brown et al., 2018).

Interpersonal-Level Factors

Several studies posit that immediate interpersonal interactions (social circles, family support, friends), interactions with healthcare providers, and receipt of information about cervical cancer and the Pap test from healthcare providers significantly

impact practicing prevention behaviors and influence the likelihood of women undergoing cervical cancer screening and allowing their children to partake in HPV vaccination programs (Kung et al., 2019). Perceived susceptibility to cervical cancer is associated with a family history of the disease and perceived risk of HPV exposure (to undergo colposcopy; Gibson et al., 2019). In a study by Nyambe et al. (2019) addressing the relationship between knowledge about cervical cancer, attitudes, self-reported behavior, and immediate support system towards screening and vaccination for cervical cancer by Zambian women and men, findings resonated with previous studies indicating that knowledge of cervical cancer influences women to practice screening and agree to vaccination.

In a study by Kung et al. (2019) conducted in India to understand whether women living with Human Immunodeficiency Virus (HIV [WLWH]) have a higher risk of cervical cancer than women without HIV using the SEM as a tool, limited education and knowledge about cervical cancer and cancer screening were independently associated with lower rates of screening. However, family and community support, communication with HCPs, and being part of a social network that included other women who had received screening resulted in increased cervical cancer screening among diverse populations (Kung et al., 2019). In a qualitative descriptive design by Kim et al. (2018) to explore men's awareness of women's cervical cancer, based on the situational awareness model, the respondents classified the awareness of cervical cancer into individual factors (knowledge about cervical cancer, interest in women's health) and system/task factors (relationship with women, men's responsibility).

However, the role of men and cervical-cancer-related perceptions of men in the awareness of and interest in the prevention of cervical cancer was low (Kim et al., 2018). Hence, there is a need to engage men in preventing cervical cancer because awareness of cervical cancer is expected to affect men's health behavior and attitude, considering various demographic and social backgrounds (age, marriage) and family relationships (Kim et al., 2018). Further, this shows that if a woman's social network (husband, partner) supports primary prevention, it illuminates the decision of most women to discuss their screening decisions with members of their social network. Thus, positive behavior in women towards preventive measures and increased HPV vaccine uptake in their children influenced the continuum of HPV vaccine uptake in the United States and England, as daughters with mothers who practiced screening were more likely to be vaccinated than those with unscreened mothers (Nyambe et al., 2019).

Organizational-Level Factors

At the organizational level that surrounds the interpersonal band of the SEM, barriers prevent patients from initiating screening through screening programs or at screening health facilities. Secondary prevention through cervical cancer screening allows for early cancer detection (prior to the development of symptoms), resulting in less aggressive treatments, less time spent in recovery, and improved survival rates, thus reducing cancer morbidity and mortality. However, when women do not attend screening programs, precancerous changes progress aggressively to cervical cancer requiring adequate treatments. Ferdous et al. (2018) summarized findings related to barriers experienced by immigrant women in Canada while accessing cervical cancer screening.

Despite having reasonable access to medically necessary hospital and physician services without paying out of pocket, immigrant women in Canada do not benefit, increasing the underscreened population.

The barriers identified are economic (transportation/childcare/time off work), healthcare-system-related barriers (dearth of acceptable HCPs/female providers), cultural barriers (physician–patient hierarchy), language barriers, knowledge-related barriers, and individual-level barriers (Ferdous et al., 2018). Additionally, the increased burden of cervical cancer can be due to several factors such as unfavorable attitudes of coworkers at the workplace, late detection of most cases, and lack of trust in the screening services (Belay et al., 2020). Other factors are low socioeconomic conditions, lack of service or service for the underserved, poor public health campaigns and awareness, limited resources, and lack of trained human power. However, there is a need to create opportunities for cervical cancer screening at the local community levels through effective media and awareness campaigns (Belay et al., 2020).

Community-Level Factors

Current efforts in addressing the cervical cancer burden aim to eliminate disparities in cervical cancer survival through efficient and effective information dissemination and create awareness in collaboration with public media about cervical cancer prevention, screening, treatment options, and early symptoms (Binagwaho et al., 2018; Wassie et al., 2019). The community engagement campaign disseminates information via churches, media (newspapers and radio), and local and national leaders to demonstrate the high acceptability of the vaccine and its subsequent high uptake

(Binagwaho et al., 2018). The global strategy of using population-based cancer registries (PBCRs) facilitates the implementation of evidence-based interventions for eliminating cervical cancer by meeting ambitious targets for HPV vaccination, cervical cancer screening, and management of the detected cervical disease (Piñeros et al., 2021). Over time, PBCRs assess cancer burden information and generate incidence rates per 100,000 persons per year in the defined population at risk in monitoring and evaluating national progress in cervical cancer surveillance and control (Piñeros et al., 2021).

Researchers revealed that HPV vaccination alone results in an impact delay and is suboptimal at reaching the threshold for elimination as rapidly as the WHO 90:70:90 strategy (Binagwaho et al., 2019). According to the WHO-recommended strategy, 90% of girls should be vaccinated by age 15; 70% of women aged 35 to 45 years should, at a minimum, have undergone screening; and 90% follow-up treatment of precancerous lesions and invasive procedures cancers should be attained (Binagwaho et al., 2019). However, the reluctance to adopt preventive measures (prophylactic HPV vaccines and Pap smear screening) that significantly reduce the incidence and mortality rate of cervical cancer in Whites results in a higher rate of HPV infection and cervical cancer incidence and mortality in underserved areas in the United States (Karuri et al., 2017). Further, there is a need for health education and promotion involving a continuous cascade of training that includes teachers, HCPs, stakeholders, and community representatives to enlighten the community and educate the entire population about the importance of the implementation plan as a public health measure (Binagwaho et al., 2019). Thus, there will be a considerable reduction in cervical cancer deaths by 30% by 2030 and in cervical

cancer incidence to a threshold of four per 100,000 woman-years before the end of the current millennium (Binagwaho et al., 2019).

Public-Policy-Level Factors

In public health, policymaking entails enacting laws and other actions (such as public health funding) encompassing the regulations that reflect given positions, attitudes, and cultural ideals, as well as devising policy alternatives that meet stated government goals, which requires comprehensive systems thinking (Mukherjee et al., 2021). In the heart of policy design, policies are meticulously crafted and shaped by partisan electoral or legislative bargaining processes, especially in widespread public crises; however, some policy alternatives are better developed than others (Mukherjee et al., 2021). Acceptability, adoption, appropriateness, and feasibility are critical health service implementation components that enable the conscious design of public policy for cervical cancer prevention and control, extrapolating to an elevated global population-based level (Rahman et al., 2019). Notably, the critical indicators of cervical cancer survival, such as access to quality primary health care services (e.g., cervical cancer screening) and culturally competent communication strategies, disproportionately affect low-income women with cervical cancer, leading to disparities in survival (Rahman et al., 2019).

Furthermore, using the SEER database, Yang et al. (2018) estimated national cervical cancer incidence from 1976 to 2009 for examining early, late, and race-specific trends in cancer incidence and calculated the estimated number of cancers prevented over the past three decades. The authors found that prevention improved in the population studied at the early and late stages, and racial disparity in cancer rates reduced during an

era of widespread Pap smear screening. Hence, there was a significant decrease in the incidence of early-stage and late-stage disease, from 9.8 to 4.9 cases per 100,000 women ($p < .001$), and from 5.3 to 3.7 cases per 100,000 women ($p < .001$), respectively. There was decreased incidence among African American women from 26.9 to 9.7 cases per 100,000 women ($p < .001$), resulting in a more significant decline than in White women and women of other races. Therefore, Yang et al. (2018) maintained that widespread Pap smear screening significantly reduced the cervical cancer disease burden to between 105,000 and 492,000 over the past three decades in the United States.

Literature Review Related to Key Variables and/or Concepts

The literature review related to the key variables and concepts included a comprehensive review of the current body of literature consistent with the scope of the study and relevant in identifying the continuum in the disparities in cervical cancer survival amongst African Americans and White women in the United States.

The Anatomy and Physiology of the Cervix

The female reproductive system comprises the external genitalia (labia majora, labia minora, Bartholin's glands, and clitoris) and the internal reproductive organs (vagina, uterus [the *fundus*, the body(*corpus*), the *isthmus*, and the *cervix uteri*], ovaries, and fallopian tubes; Ameer et al., 2021; Wang et al., 2018). The nonkeratinizing squamous cell epithelium with mucus-secreting glands lines the exocervix, while columnar epithelium, with endocervical glands, lines the fusiform endocervical canal above the external *os*; however, it is difficult to identify the border between the uterus and cervix (Yellon, 2020). The squamocolumnar junction, known as the transformation

zone, is the most vulnerable to the development of squamous neoplasia (Meeta et al., 2020). Additionally, the columnar epithelium of the endocervix may extend onto the exocervix in early childhood, during pregnancy (as cervix size increases in volume and width), or with the use of oral contraceptive pills, in a condition known as *eversion* or *ectopy* (Yellon, 2020). However, the transformation zone usually recedes entirely into the endocervical canal due to hormonal changes, and many postmenopausal women will have an unsatisfactory colposcopy leading to psychological and potential domestic and social consequences (Meeta et al., 2020).

The Human Papillomavirus

HPV is a small, circular double-stranded DNA virus with an icosahedral capsid and a genome that harbors eight partially overlapping open reading frames (Benoit et al., 2018b, p. 3; Karuri et al., 2017). Globally, it is responsible for the most common sexually transmitted infection, usually via direct contact (Benoit et al., 2018b, p. 4). The virus is organized into three regions containing genes: the early region containing genes E1-E7, the late region containing genes L1-L2, and the upstream regulatory gene (Benoit et al., 2018b, p. 3; Karuri et al., 2017). The late structural proteins L1 and L2 are necessary for virion capsid production and protection linked to expression of immunogenicity (L1) and for viral entry into cells, transport of viral materials into the nucleus, and binding with the DNA (L2) crucial for future vaccine development (Benoit et al., 2018b, p. 3; Karuri et al., 2017). The causal role of HPV in developing cancers of the uterine cervix, vagina, anus, vulva, penis, oropharynx, nonmelanoma skin cancer, cancer of the conjunctiva, and head and neck cancers in kidney transplant recipients have biological and epidemiological

distributions (Egli-Gany et al., 2019; Karuri et al., 2017). In hierarchical order, HPVs have genera, species, types, and causative genotypes belonging to the Alpha genus; most significantly, the Alpha 7 and Alpha 9 types constitute the most frequently implicated genus ingrained in cervical cancer cases worldwide (Karuri et al., 2017).

Generally, HPV infection is associated with 90% of cervical cancers, and over 100 distinct HPV subtypes are high-risk (Types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68, 73, and 82) and low-risk (Types 6 and 11), and are distinctive in their association with invasive cancer (Egli-Gany et al., 2019; Shea et al., 2020). Though, HPV types 16 and 18 (included in all three commercially available HPV prophylactic vaccines) are etiologically responsible for about 30-40% of cancers of the vulva, penis, oropharynx, and 70% of cancers of the cervix, vagina, and anus, the low-risk types 6 and 11 cause anogenital warts, and do not cause invasive cancer (Egli-Gany et al., 2019; Shea et al., 2020). Other factors such as long-term use of hormonal contraceptives, high parity, smoking cigarettes, coinfection with HIV, coinfection with Chlamydia trachomatis and herpes simplex virus type-2 (HSV-2), immunosuppression, and some dietary deficiencies, also increases the risk of HPV infection (Egli-Gany et al., 2019; Jacot-Guillarmod et al., 2017; Martinelli et al., 2019). The increased progression from cervical HPV infection to cancer occurs in the basal epithelial cells of the lower reproductive tract, and the prevalence of HPV 16 and 18 are 2.8% and 1.0%, respectively (Benoit et al., 2018b, p. 4). Also, intrauterine exposure of the fetus to diethylstilbestrol (DES), older age, having many sexual partners, and ingestion of drugs for preventing organ rejection after transplant increases the risk of HPV infection and raises the increased risk of cervical

cancer (Egli-Gany et al., 2019). Besides, the chronicity of HPV infection from high-risk HPVs (HR HPV) results in Cervical Intraepithelial Neoplasia (CIN) progression following inefficient clearance, leading to modification of genome sequences, with distinct clinical manifestation on human physiology (Karuri et al., 2017).

Cervical Cancer Screening

In the mid-20th century, the advancements in primary preventive tools, emphasis on increased cervical cancer screening practices, and cervical cancer vaccines against HPV influenced the decline in incidence and mortality rates in the United States (Karuri et al., 2017; Lei et al., 2020). However, the socioeconomic burden and disparities in the incidence of and mortality from cervical cancer among minorities in underserved communities remain essentially high (Fontham et al., 2020; Karuri et al., 2017). The primary goal of cervical cancer screening in detecting treatable abnormalities and precancerous cervical lesions, evolved over the years, influenced by the in-depth understanding of the causative role (cause) of HPV during infection (especially the HR HPV types), the natural course of the disease (infectivity and cervical cancer), and the changing screening test technology and guidelines (Fontham et al., 2020; Lei et al., 2020). Notably, the efficacy or effectiveness of the HPV vaccine protects against HPV infection, genital warts, and high-grade precancerous cervical lesions such as CIN (Alsous et al., 2021; Lei et al., 2020). HPV vaccination represents a primary prevention method, while cervical cancer screening is a secondary prevention method, and diagnosis and treatment of invasive cervical cancer involve tertiary prevention (Obol et al., 2021).

Public education and advocacy, knowledge of the increasing burden of cervical cancer may create social change in screening strategies for detecting undetectable precancerous cervical lesions and removing them early to prevent development into cervical cancer (Obol et al., 2021). However, disparities by race/ethnicity persist in advanced cancer, increasing the need for early access and adherence to recommended cervical cancer screening strategies and effectively reducing the disparities in incidence and mortality rates (Fontham et al., 2020; Shin et al., 2019). The cervical cancer screening modalities include cytology (also known as Pap test or Pap smear), Primary HPV test, and cotesting (cytology and HPV test administered together). Though HPV testing offered better performance than cytology in detecting cervical histopathology (including adenocarcinoma), the same barriers exist at the intrapersonal (embarrassment, anxiety, and concern for pain), interpersonal (embarrassment, inconvenience), organizational (clinic appointment, trust in the test, and available time), and community (public attitude) levels as that for Pap test (Shin et al., 2019). These psychological and structural barriers contribute to the disparities in access to care; however, studies revealed that urine sampling is potentially more favorable, less invasive, and convenient in eliminating these reported burdens (Shin et al., 2019).

Researchers claimed that since the introduction of Pap smear tests in the 1940s by George Papanicolaou, the incidence rate decreased by as much as 80%, yielding breakthroughs in reducing the incidence and mortality from cervical cancer, particularly in high-income countries (Romli et al., 2020). However, disparities exist in screening programs offering Pap smear tests, with less success in low- and middle-income countries

due to a lack of infrastructure, resources, and awareness about cervical cancer among women and HCPs (Romli et al., 2020). Though the false-negative results obtained using the conventional Olympia microscope for Pap smears was between 6% and 25%, and the Pap test had a sensitivity of 51% and a specificity of 98%, the rate of developing cervical cancer following a negative routine Pap smear (cytology) was 7.5 per 100,000 women per year (Benoit et al., 2018b, p. 4). William et al. (2019) revealed that the development of the Pap smear analysis tool for the detection of cervical cancer from Pap smear images allocated more results on the suspicious slides to eliminate false-negative results and helped to reduce the extended time (5 to 10 minutes) required for the cytotechnician to screen around 5,000-12,000 cells from Pap smears manually.

The cervical cancer incidence and mortality rates were higher in underserved populations in the Appalachian Mountain region than in the Northern Plains in the United States (Karuri et al., 2017). The disparities in the incidence and mortality rates were due to the reluctance to adopt preventive measures (prophylactic HPV vaccines and Pap smear screening) that had significantly reduced the incidence and mortality rates of cervical cancer in Caucasian women (Karuri et al., 2017). HPV DNA testing have been demonstrated in a large, randomized trial in India to reduce incidence and mortality of advanced cervical cancer by 50% in women above 30 years, demonstrating the potential for improved population-level health and outcomes (Campos et al., 2017a). According to the World Health Organization (WHO), when resources are available, it is recommended for women aged 30 to 40 years to screen with HPV testing and treating eligible HPV-positive cases with cryotherapy using the Screen-and-Treat strategy (Campos et al.,

2017a). However, with limited resources, a cheaper but less sensitive visual inspection with acetic acid (VIA) can provide positive outcomes, requiring rigorous training of providers and stringent quality control measures (Campos et al., 2017a).

Although HPV DNA tests, one of the most intensively studied alternatives to cervical cytology screening, detect precancerous lesions and cancer in virtually all cervical cancers raising hopes and expectations for better prevention of the disease, but in clinical practice, HPV DNA detection methods have low specificity (Koliopoulos et al., 2017). However, may result in high false-positive results and unavoidable referral to colposcopy, leading to psychological side effects and downstream overdiagnosis and overtreatment (Schiffman & de Sanjose, 2019). Schiffman and de Sanjose (2019) further reiterated that the currency in HPV tests and testing strategies results in disparities in false-positive results from cervical screening sensitivity with devastating overreaction to HPV positivity, causing psychological and possible iatrogenic physical (e.g., obstetrical) harm. When the HPV test results are false-positive, this does not mean that HPV is not present, but the detection of HPV infections are not destined to cause cervical cancer; hence, it is vital to address the interpretation of the HPV testing (Koliopoulos et al., 2017). Researchers maintained that when the interpretation of the positivity rate of HPV testing is higher than cytology, most positive test results do not indicate a high absolute risk of cancer (Koliopoulos et al., 2017). Therefore, if not reversed in time to better minimize harm to untold numbers of women, outweighing the trade-offs and the cost of missing cancer against the harm done by hundreds or thousands of flawed HPV tests and

excessive clinical responses to positive HPV testing results would be extremely difficult (Schiffman & de Sanjose, 2019).

Cytologic Guidelines of Cervical Cancer Screening

The American Cancer Society (ACS) consensus guidelines for the management of cervical screening abnormalities have been updated from 2002, 2012 to the current 2020 Risk-Based Management to accommodate the three available cervical screening strategies: Cervical cytology alone (also known as Pap test or Pap smear), Primary HPV screening/test, and Cotesting with HPV testing and cervical cytology (Fontham et al., 2020; Perkins et al., 2020). The new guidelines data recognize a risk of developing cervical precancerous lesions or cancer using current screening test results, previous screening tests, biopsy results, and personal factors such as age and immunosuppression (Perkins et al., 2020). In 2012, the ACS recommended routine screening/cytology every three years starting at age 21 years, cytology alone every three years until age 29, to continue cotesting from age 30-65 years, and to discontinue screening in women more than 65 years with a history of negative results and in women posthysterectomy (Fontham et al., 2020; Liverani et al., 2020). However, the ACS 2020 guidelines recommended no screening for less than 25 years olds, to initiate cotesting every five years or cytology alone every three years for 25 to 65-year-olds if primary HPV testing is unavailable, to discontinue screening in women above 65 years with a history of negative results or posthysterectomy (Fontham et al., 2020; Liverani et al., 2020).

Human Papillomavirus Vaccination

Recent studies have shown that further inequalities and geographic disparities in cervical cancer burden continued to rise despite HPV vaccination uptake and cervical cancer screening across different regions and by race/ethnicity, and may contribute to continuing disparities in HPV-related cancers in the United States (Hirth, 2019). Likewise, despite the large body of evidence demonstrating that HPV vaccination as a public health intervention is highly effective and cost-effective, the persistence of inequities, inequalities, and disparities in HPV vaccination uptake and population-based cervical cancer screening exist (Brisson et al., 2020). Racial disparities in the distribution of HPV types in cervical cancer exist, because compared to Whites, African Americans and Hispanic women are less likely to have high-grade cervical lesions positive for HPV types 16 and 18 (Hirth, 2019). However, large randomized clinical trials revealed that these vaccines are safe and highly effective against high-risk HPV types 16 and 18 (in 70% of cases), HPV types 16, 18, 31, 33, 45, 52, and 58 (in 90% of cases), and vaccine-type persistent infection and cervical precancerous lesions (with vaccine efficacy ≥ 93%) (Brisson et al., 2020).

Most significantly, there had been declines in age-standardized cervical cancer incidence in high-income countries, more than 73-85% in vaccine-type HPV prevalence and 41–57% in high-grade lesions less than 10 years after the implementation of HPV vaccination (Brisson et al., 2020). Unfortunately, disparities in HPV-related cervical cancer rates will likely continue due to uneven vaccination rates across geographies and race/ethnicity, even with evidence that HPV prevalence decreased (Hirth, 2019). The

cost-effectiveness of the Papillomavirus Rapid Interface for Modelling and Economics (PRIME) strategy, published in 2014, could prevent an estimated 690,000 cases and 420,000 deaths from cervical cancer that could potentially impact over 58 million 12-year-old girls after receiving HPV-16/18 vaccination globally, at the cost of US$4 billion (Oberlin et al., 2018). Therefore, by expanding access to HPV vaccination to all girls, disparities in vaccine-type HPV infections and cervical cancer deaths each year can be averted across geographies and race/ethnicity (Hirth, 2019).

Cervical Cancer Diagnosis, Prognosis, and Treatment

Globally, cervical cancer is a gynecologic malignancy and represents one of the four most common leading causes of death, with more than 12,000 new cases and more than 4,000 cancer deaths (ratio 3:1) reported in the United States in 2016 (Li et al., 2021). Despite advancements in treatment and care, incidence continues to increase, and there is still a lack of methods for early diagnosis and effective treatment for gynecologic malignancies, including endometrial cancer, ovarian cancer, cancer of the cervix, and breast cancer, which are significant causes of death among women globally (Bai et al., 2020). In the United States, cervical cancer persistently and disproportionately impacted the groups of socioeconomically disadvantaged and racial and ethnic minorities, resulting in prevalence, incidence, and mortality (Pfaendler et al., 2018). Also, gynecologic cancer disparities exist between African Americans and White women, and no form of cancer critically demonstrates the outstanding efficacy of screening (especially with the broad range of sensitivity 30-87% for Pap test), early diagnosis, and treatment on mortality rate than cervical cancer (Chrysostomou et al., 2018). Though genetic and lifestyle factors

enhance the probability of developing a persistent infection, the epidemiologic, clinicopathologic, and landscape/molecular genetics play vital roles in the pathogenesis of cervical cancer (Lin et al., 2019; Shanmugasundaram & You, 2017). Thus, in-depth comprehension of the potential molecular mechanisms of carcinogenesis with specific biological markers for these diseases would influence the future diagnosis, prognosis, and treatment of female reproductive system cancer and breast cancers (Bai et al., 2020).

The multistep biological process in developing cervical cancer in women involves genetic and transcriptional changes resulting from persistent infection with HR HPV types (most commonly 16 and 18; Benoit et al., 2018a, p. 37; Li et al., 2021). However, both the host and viral characteristics such as HPV exposure, viral oncogenicity, destabilization of the immune response, and presence of co-carcinogens contribute to the risk factors for cervical cancer (Zhou et al., 2019). Cervical cancer (a skin-associated virus) develops from the persistent infection of oncogenic HR HPV types 16 and 18, responsible for 70% of cervical cancer and precancerous cervical lesions (Gearhart, 2020; Li et al., 2021). Other risk factors such as a prior history of sexually transmitted diseases, early stage of first sexual intercourse, long-term use of hormonal contraceptives, multiple sexual partners, multiparity, young age at first birth, use of nicotine, certain Human Leukocyte Antigen (HLA) subtypes, coinfection with HIV, Chlamydia trachomatis, gonorrhea, and HSV-2, immunosuppression, and some dietary deficiencies, also increase the disease burden (Benoit et al., 2018a, p. 37; Li et al., 2021).

HPV infections are transient, infect immature basal epithelial cells and not mature superficial squamous cells in areas of epithelial damage (at the transformation zone;

Gearhart, 2020). Besides, alone does not cause malignant transformation, except during HPV replication to induce DNA synthesis in the host cells; hence, HPV tests have low specificity for cervical cancer (Gearhart, 2020). The expression of short, non-coding single strands of RNAs, called microRNAs (miRNAs), and the integration of the HPV genome into the host cell results in the primary viral E6 and E7 oncoproteins, whose overexpression contributes to cervical carcinoma development (Sammarco et al., 2020). However, the involvement of other cofactors with HPV as risk factors determines if there will be regression or persistence and eventual progression to cancer (Lin et al., 2019; Shanmugasundaram & You, 2017). Hence, susceptibility to these risk factors may prevent the natural clearance of HPV in some populations causing more disparities (Gearhart, 2020). Likewise, persistent HPV infection becomes challenging to manage due to cell-mediated immunity (CMI), which probably plays a significant role in wart regression (Gearhart, 2020; Shanmugasundaram & You, 2017).

According to the World Health Organization (WHO, 2020), suspicion of cervical cancer symptoms necessitates referral to an appropriate facility for further evaluation, diagnosis, and treatment. The symptoms of suspicion of early-stage cervical cancer may include irregular spotting in women of reproductive age, postmenopausal bleeding, post-coital bleeding, bleeds after a pelvic examination, and increased vaginal discharge, unusually foul-smelling (WHO, 2020). However, the Centers for Disease Control and Prevention (CDC, 2021) revealed that the early stages of cervical cancer might be asymptomatic but present with symptoms and signs during the advanced stages of cervical cancer. As cervical cancer advances, more severe symptoms like persistent back,

leg, and pelvic pain, vaginal bleeding, pain during sexual intercourse (dyspareunia), loss of appetite, fatigue, weight loss, vaginal discomfort, and unusual foul-smelling vaginal discharge may appear. Other symptoms of advanced cervical cancer include pelvic fullness, unilateral leg swelling, or swelling of both extremities, bladder irritability, trouble peeing and tenesmus, and common signs include obstructive renal failure (kidney failure), fungating cervical mass, unilateral leg edema (Benoit et al., 2018a, p. 37).

The abnormal cells can be detected during early regular check-ups and hospital visits through history taking, physical exam, HPV DNA tests, abnormal Pap tests, endometrial curettage, colposcopy, or cervical biopsy; and when found early, the prognosis (chances of recovery and survival) is better (Benoit et al., 2018a, p. 37; National Cancer Institute [NCI], 2021). Moreover, tests are done after a diagnosis of cervical cancer to utilize information needed from the staging process for determining the stage of the disease within the cervix (regional) or to other parts of the body (distant metastases). The tests and procedures used in the staging process include CAT scan (CT scan), Positron Emission Tomography scan (PET scan), Magnetic Resonance Imaging (MRI), Ultrasound exam, Chest Xray, and lymph node biopsy, and laparoscopy (National Cancer Institute [NCI], 2020). Notably, cervical cancer diagnosis entails histopathologic examination, the staging of the disease, which is characterized based on tumor size and spread of the disease within the pelvis, and the irreversible potential of metastatic spread of altered and abnormal cells to other distant anatomical regions. (Šarenac & Mikov, 2019; WHO, 2020).

Histological Types and Subtypes of Cervical Cancer

Adenocarcinoma and squamous cell carcinoma make up 25% and 69% of the cervical cancers in the United States, respectively, and of all adenocarcinomas, adenosquamous carcinomas subtypes represent 20-30%, while of all invasive cervical cancers, the small cell carcinomas represent 0.5-5% (Benoit et al., 2018a, p. 39; Saleem et al., 2019). The adenocarcinomas do not have visible lesions since they do not arise from the squamous epithelium of the exocervix like the squamous cell carcinomas (Benoit et al., 2018a, p. 39). Though they consist of mixed glandular and squamous carcinoma, the adenosquamous carcinoma behaves like adenocarcinoma and is commonly associated with the HPV-18 genotype (Benoit et al., 2018a, p. 39; Saleem et al., 2019). Metastases are rare in verrucous carcinoma, a well-differentiated squamous cell carcinoma; hence, radiation therapy is the treatment of choice (Benoit et al., 2018a, p. 39). Furthermore, other poorly differentiated or unspecified types include clear cell carcinoma associated with DES exposure (Benoit et al., 2018a, p. 39). The neuroendocrine carcinomas include the small cell (the most common subtype), large cell, and carcinoid carcinoma (Benoit et al., 2018a, p. 39).

In a descriptive study of 154 cervical cancer cases in Southwestern Ethiopia by Saleem et al. (2019), there were similarities in the findings concerning squamous cell carcinoma with other prior studies. The authors also claimed an increased frequency of small cell carcinomas than that found for adenocarcinomas. An estimated 91% of the cervical cancer cases observed in the study were squamous cell carcinomas (including keratinizing, nonkeratinizing, and basaloid subtypes), while almost 6%, 3%, and 1% were

small cell carcinomas, adenocarcinomas, and adenosquamous carcinomas, respectively (Saleem et al., 2019). Notably, there were disparities amongst women diagnosed at a late stage (in a California database) with squamous cell carcinoma concerning the keratinizing and the nonkeratinizing squamous cell carcinoma, with the former less radioactive and associated with shorter overall survival (Saleem et al., 2019). Also, Saleem and associates mentioned that almost 52% of the keratinizing squamous cell carcinoma subtype is associated with a higher likelihood of advanced-stage disease and a lower overall 5-year survival (Saleem et al., 2019).

Cervical Cancer Staging

Staging is critical in oncology since the spread of cancer could be through the direct infiltration (tissue), the lymphogenic spread (lymphatic system), and the hematogenous (blood) route (Šarenac & Mikov, 2019; NCI, 2020). Clinical staging (based on the results of the doctor's physical exam, tests, and procedures), pathologic staging (based on findings at surgery), posttherapy or postneoadjuvant therapy staging, and restaging are the four staging types (Šarenac & Mikov, 2019). Also, four factors—the location of the primary tumor, tumor size and extent, involvement of lymph nodes, and whether there is distant metastasis—influence the cancer stage (American College of Surgeons, n.d.). However, the International Federation of Gynecology and Obstetrics (FIGO) or parallel TNM system maintained by the American Joint Committee on Cancer (AJCC) and the Union for International Cancer Control (UICC) was the most used staging system essential for communicating, collaborating, and predicting the best

courses of treatment and cancer survival (American College of Surgeons, n.d.; Steiner et al., 2021).

Furthermore, the FIGO classification alone has limited predictive value, which motivated a couple of prognostic models to predict survival and guide treatments (He et al., 2021). Hence physicians recommended surgery as the standard treatment for early-stage cancers (FIGO stage ≤ IIA) and chemoradiotherapy in a more advanced stage of the disease (Steiner et al., 2021). Also, He et al. (2021) reiterated that the prognostic model's algorithm allows clinicians to predict the risk of occurrence, disease progression, and clinical outcome of cervical cancer and predict and guide treatments based on different tumor and demographic characteristics. However, researchers opined that racial and ethnic disparities exist along the continuum of care from cervical cancer screening, access to care, referral for specialty treatment, and enrollment in clinical trials creating a survival gap independent of sociodemographic factors, disease stage, and access to treatments (Nazha et al., 2019). Also, the advanced stage at diagnosis, race, insurance status, and SES of patients are related to differences in cervical cancer-specific survival because after correcting for hysterectomy, the mortality rate was 10.1 per 100,000 for African American women compared to 4.7 per 100,000 for White women (Pfaendler et al., 2018).

TNM Staging

The references and tools on the TNM system developed by the AJCC equip clinicians with swift access to resources essential for staging different cancer types based on specific standardized criteria to make reasonable decisions on the patient's treatment

(American College of Surgeons, n.d.). The tools on the AJCC TNM Staging System essential for designing prognostic and treatment plans consist of the extent of the primary tumor (T), the extent of cancer spread to the lymph nodes near the cervix (N), and the presence of metastasis to nearby tissues (M), and illuminates the severity of the disease, on the magnitude of the original (primary) tumor, and the extent of cancer spread (American College of Surgeons, n.d.; Šarenac & Mikov, 2019).

AJCC TNM Staging System by American College of Surgeons (n.d.):

TX: Primary tumor cannot be assessed.

T0: No evidence of primary tumor.

Tis: Cervical carcinoma in situ (early cancer that has not spread to neighboring tissue).

T1–T4: Size and extent of the primary tumor.

T1: Cervical carcinoma confined to the uterus.

T1a: Invasive carcinoma diagnosed only by microscopy.

T1b: Clinically visible lesion confined to the cervix.

T2: Cervical carcinoma invades beyond the uterus but not to the pelvic wall or the lower third of the vagina.

T2A: Tumor without parametrial invasion.

T2B: Cervical carcinoma with an invasion of the parametrium.

T3: Tumor extends to the pelvic wall and involves the lower third of the vagina and causes hydronephrosis.

T3a: Tumor involves the lower third of the vagina, with no extension to the pelvic wall.

T3b: Tumor extends to the pelvic wall and causes hydronephrosis.

T4: Tumor invades bladder, rectum and extends beyond the true pelvis.

NX: Regional lymph nodes cannot be assessed.

N0: No regional lymph node metastasis (no cancer found in the lymph nodes).

N1-N3: Involvement of regional lymph nodes metastasis (number and/or extent of spread).

M0: No distant metastasis (cancer has not spread to other parts of the body).

M1: Distant metastasis (cancer has spread to distant parts of the body).

FIGO Staging

The FIGO staging system often used for assessing gynecologic cancers, such as cervical cancer, is categorized as Stages I, II, III, and IV. These categories divide into either A or B subcategories and may also have subtypes designated by number 1 or 2 specific to the staging carcinoma of the cervix.

Stage 0: Abnormal cells that may form in the cervix lining are carcinoma in situ.

Stage I: Stage I is carcinoma strictly confined to the cervix and divided into Stages IA (IA1 and IA2) and IB (IB1 and IB2) based on the size of the tumor, the deepest point of tumor invasion, and diagnosed only by microscopic examination of the removed tissue.

Stage IA: Stage IA is divided into stages IA1 and IA2. Invasive carcinoma, diagnosed exclusively by microscopy. The stromal invasion is limited to a maximum

depth of 5.0 mm measured from the base of the epithelium and a horizontal spread of 7.0 mm or less. Venous blood, lymphatic or vascular space invasion does not affect the classification (Benoit et al., 2018a, p. 40).

Stage IA1: The tumor is limited to the cervix, with a 3.0 mm or less stromal invasion in depth and a horizontal spread of 7.0 mm or less (Benoit et al., 2018a, p. 40).

Stage IA2: The tumor is restricted to the cervix, with a stromal invasion of more than 3.0 mm and not more than 5.0 mm in depth and a horizontal spread of 7.0 mm or less (Šarenac & Mikov, 2019).

Stage IB: Divided into stages IB1 and IB2 based on the size of the tumor and the deepest point of tumor invasion, but the lesions are more extensive than stage IA2. The lesions are clinically visible, limited to the cervix, or microscopically detected (Šarenac & Mikov, 2019).

Stage IB1: Clinically visible or microscopic lesion greater than IA2, but 4 cm or less in the largest diameter (Šarenac & Mikov, 2019).

Stage IB2: Clinically visible lesion more than 4 cm in the largest diameter (Šarenac & Mikov, 2019).

Stage II: Carcinoma extends beyond the cervix, involves the upper two-thirds of the vagina, but not as far as the lower third, but does not extend into the pelvic wall (Šarenac & Mikov, 2019).

Stage IIA: Tumor with no parametrial involvement (Šarenac & Mikov, 2019).

Stage IIA-1: Clinically visible lesion 4.0 cm or less in the largest dimension (Šarenac & Mikov, 2019).

Stage IIA-2: Clinically visible lesion more than 4.0 cm in the largest dimension (Šarenac & Mikov, 2019).

Stage IIB: Tumor spread to the parametrial area but not into the pelvic sidewall (Šarenac & Mikov, 2019).

Stage III: Carcinoma extending into the pelvic sidewall and involves the lower third of the vagina, which on rectal examination, reveals that there is no cancer-free space between the tumor and the pelvic sidewall. Cases with hydronephrosis or a non-functioning kidney fall under Stage III cancers (Šarenac & Mikov, 2019).

Stage IIIA: The tumor involves the lower third of the vagina, but there is no extension into the pelvic sidewall (Šarenac & Mikov, 2019).

Stage IIIB: Tumor extension into the pelvic sidewall causing hydronephrosis or non-functioning kidney (Obstructive Uropathy) (Šarenac & Mikov, 2019).

Stage IV: The carcinoma has extended beyond the true pelvis or has clinically invaded the mucosa of the bladder or rectum, and there is metastatic dissemination (Šarenac & Mikov, 2019).

Stage IVA: Spread of the tumor into adjacent pelvic organs (Šarenac & Mikov, 2019).

Stage IVB: Spread to distant organs (Šarenac & Mikov, 2019)

A study by Abdalla et al. (2020) of 3,484 African Americans and 21,059 Whites diagnosed with CerCancer extracted from 2004 to 2013 from the SEER database assessed racial differences in the 5-year relative survival rates (RSRs) of Cervical Cancer (CerCancer) by stage at diagnosis, between African Americans and White women, living

in Alabama, USA. The authors used SEER* Stat software to incorporate age groups, CerCancer stages, county, and year of diagnosis to compare the RSR between African Americans and Whites. Abdalla et al. (2020) maintained that quantifying changes in cancer survival trends over time in patients with advanced treatment therapies becomes difficult due to the limitations in the practical values of clinical trials in determining that the improvement of survival of cancer patients is due to the improvement of cancer treatment regimens or increased life expectancy of the population. Also, calculating cancer-specific survival as a cause of death from information pulled from death certificates is often inaccurate since they do not reflect cancer-associated mortality in patients who die from complications and death due to cancer (Abdalla et al., 2020).

In a study by Nyambe et al. (2019) concerning knowledge, attitudes, and practices of cervical cancer promotion among Zambian women and men, after considering the heterogeneity of the target population in terms of relative wealth, gender, education, and levels of knowledge, the sample size was 100 women and 100 men in Chilenje, and 200 women and 200 men in Kanyama. However, researchers opined that a sample of size n = 100 (50 in each group) would be adequate to detect a difference between two groups of 1 standard deviation with 99% power at a 1% level of significance by an independent sample *t*-test (Nyambe et al., 2019). The null-hypothesis significance testing (NHST), where the probability is lower than some conventional threshold or alpha level (for example, $\alpha = .05$), remains the primary statistical tool in data analysis; however, there are concerns about Type I errors or rejection of the null hypothesis when true (Masharipov et al., 2021; Tijmstra, 2018). Poor intuitions about power may lead to incorrect inferences

when reducing the possibility of Type II errors, overestimating power, and underestimating required sample sizes leading to nonsignificant results in research designs, not representative of the study population (Masharipov et al., 2021). Researchers opined that a two-tailed significance level of 5% (Type I error: α =.05), a statistical power of 0.8 (Type II error: β =.2), a large effect size of 0.5, and R^2 of .5 for power analysis of correlational studies research and evaluation of substantive hypotheses (Masharipov et al., 2021; Tijmstra, 2018).

Treatment of Cervical Cancer

Knowing the cancer stage is a pathway for clinicians and patients to plan for efficient and effective cancer treatment, improve cancer survival and survival time since diagnosis, and achieve a health-related quality of life (NCI, 2020). Treatment of cervical cancer depends on the stage of the disease, the histological type (type of cervical cancer), local and distant metastases, degree of tumor differentiation (grade G), primary lesion size, the location of primary tumor within the cervix, age, and general well-being of the patient, and the concomitant desire to have children (American Cancer Society [ACS], 2020e; Šarenac & Mikov, 2019; WHO, 2020). Surgery, radiotherapy (XRT), chemotherapy, immunotherapy, and targeted therapy are the five therapeutic modalities for cancer of cervix uteri combined or given independently (NCI, 2020). Due to the advancement in oncology and medicine, researchers continued to develop standard care and clinical trial treatments meant to help improve current treatments or obtain information on novel treatments, making them available for patients with cervical cancer (NCI, 2020).

However, disparities in clinical trials exist for underrepresented populations, jeopardizing researchers' ability to assess the safety and effectiveness of new approaches to cancer care and follow-up studies, and almost 50% of the adult trials failed to meet the targeted recruitment goal (Yates et al., 2020). Notably, the underrepresented communities receive hourly wages and do not reside in areas with easily accessible care, requiring long-distance travel, and are less likely to participate in research or seek out options for care scheduled weekly (Yates et al., 2020). Thus, the inclusion of a diverse population in clinical trials will explore the differences in lived experiences, opportunity, and exposure to environmental stressors and toxins among racial/ethnic groups resulting in the development of efficacious interventions that can be translated well into real-world use in different populations (Nazha et al., 2019; Yates et al., 2020).

Surgical procedures are essential for removing tumors to improve survival and the quality of life, and different methods exist depending on the cancer stage at presentation. The different types of surgical procedures used in the treatment of cervical cancer include conization, total hysterectomy, radical hysterectomy, modified radical hysterectomy, radical trachelectomy, bilateral salpingo-oophorectomy, and pelvic exenteration (NCI, 2020). Conization (cone biopsy) involves removing a cone-shaped piece of tissue from the cervix and cervical canal for microscopic studies of cancer cells in diagnosis and treatment (NCI, 2020). The various types of conization procedures available include Cold-knife Conization, Loop Electrosurgical Excision Procedure (LEEP), and Laser surgery, and are dependent on the location of the abnormal lesions in the cervix. Total hysterectomy is the surgical excision of the uterus and cervix, and this procedure is

carried out through the vagina (Vaginal hysterectomy) and via a large or small abdominal incision referred to as Total Abdominal Hysterectomy (TAH) and laparoscopic hysterectomy, respectively (NCI, 2020). Radical hysterectomy is the surgical removal of the uterus, cervix, part of the vagina, and the ligaments and tissues around these organs (ovaries, fallopian tubes, nearby lymph nodes may be spared or removed) (NCI, 2020).

However, the modified radical hysterectomy is a surgical procedure for removing the uterus, cervix, upper part of the vagina, and ligaments and tissues that closely surround these organs but spares some tissue or organs like the nearby lymph nodes. The treatment option for young patients with early invasive uterine cervical cancer who desire to preserve their fertility is radical trachelectomy with pelvic lymphadenectomy (Shinkai et al., 2020). The treatment procedure is performed even during pregnancy, and it involves the removal of the cervix, nearby tissue, lymph nodes, and superior part of the vagina, sparing the uterus and the ovaries (NCI, 2020). Another surgical procedure used in cervical cancer treatment is bilateral salpingo-oophorectomy for the removal of both ovaries and both fallopian tubes (NCI, 2020). Also, with the involvement of the surrounding structures located both anteriorly (bladder) and posteriorly (rectum, lower colon), pelvic exenteration is the surgical procedure used to remove these structures and the cervix, vagina, ovaries, and nearby lymph nodes (NCI, 2020). However, plastic surgeons make artificial openings for the vagina, urination, and stools for the damaged structures (NCI, 2020).

Radiation therapy uses high-energy X-rays or other types of radiation to inhibit cancer growth and destroy cancer cells, which depends on the type and stage of cancer

treated, thereby sparing nearby healthy tissues (NCI, 2020). The two types of radiation therapy are External Radiation Therapy or External Beam Radiation Therapy (EBRT) and Internal Radiation Therapy or Brachytherapy, which may be used to relieve symptoms (Palliative therapy) and improve quality of life (ACS, 2020b). EBRT uses stronger X-rays from a machine placed outside the body and may be combined with chemotherapy (concurrent chemoradiation) to treat cervical cancer cells (ACS, 2020b). For patients who are unfit for surgery or chose not to have surgery, those who cannot tolerate chemoradiation, EBRT is the primary treatment of choice (ACS, 2020b). The side effects of EBRT are fatigue, stomach upset, diarrhea, nausea, vomiting, skin changes, radiation cystitis (irritation of the bladder causing urgency, frequency, dysuria, and hematuria), vaginal pain, menstrual changes, anemia, neutropenia, and thrombocytopenia (ACS, 2020b; NCI, 2020).

In brachytherapy, a radioactive substance placed in wires, catheters, needles, and seeds, travels over a short distance directly into or near cancer via the vagina (and sometimes in the cervix). Brachytherapy is rarely used alone in early-stage cervical cancers; however, it finds use in combination (given right after) with EBRT to treat cervical cancer (ACS, 2020b). Some side effects of brachytherapy include fatigue, diarrhea, nausea, irritation of the bladder, low blood counts, and vaginal discomfort, irritation, and discharge (ACS, 2020b). The long-term side effects women can experience related to radiation months to years after treatment are psychosocial consequences, vaginal stenosis, vaginal dryness, rectal bleeding, rectal stenosis, urinary problems (blood in urine, vesicovaginal fistula, bladder dysfunction, and chronic radiation cystitis),

swelling of legs (resulting in lymphedema), and hip fractures from weakened bones (ACS, 2020b). Though patients treated with radiotherapy are unfit for surgery, have inoperable tumors, and report deterioration in physical, emotional, social, and economic support and compromised quality of life, smoking during radiation therapy increases cardiovascular death and further complications in oncology treatments and decreases overall survival outcomes (Mayadev et al., 2018).

The use of antineoplastic drugs injected into the vein or given orally to treat cervical cancer in chemotherapy stops the growth of cancer cells by either killing cancer cells in most parts of the body or stopping them from dividing and depends on the type and stage of the cancer being treated (ACS, 2020a; NCI, 2020). For example, the weekly use of cisplatin before irradiation appointment or the combination of cisplatin, 5-fluorouracil (5-FU) given every three weeks during radiation as part of the primary treatment for cervical cancer (concurrent chemoradiation), are some of the advances of use of anti-cancer drugs with radiation therapy in cancer treatment (ACS, 2020a). While anti-cancer drugs kill cancer cells, they could also damage some normal cells resulting in side effects which in the short term, can abate after treatment is completed or may become permanent over a long time (ACS, 2020a). The short-term side effects include nausea, vomiting, diarrhea, hair loss, mouth sores, fatigue, and they depend on the type and dose of the drugs and the treatment duration (ACS, 2020a). Other side effects include shortness of breath from anemia, bruising or bleeding from mild injuries due to thrombocytopenia, a high infection rate due to neutropenia, osteoporosis, menstrual

changes (premature menopause, infertility), neuropathy, and nephrotoxicity (ACS, 2020a).

Using drugs or other substances to identify, target, and attack specific cancer cells without affecting the normal cells explains targeted therapy for cervical cancer treatment (ACS, 2020d; NCI, 2020). Monoclonal antibody therapy is a targeted therapy where antibodies recognize substances on cancer cells or normal substances that may help cancer cells grow by attaching to them, killing the cancer cells, blocking their growth, or keeping them from spreading (ACS, 2020d; NCI, 2020). Like chemotherapy, targeted therapy is given alone or alongside radioactive material directly to cancer cells. An example is Bevacizumab which binds to vascular epithelial growth factor (VEGF) during angiogenesis (Angiogenesis Inhibitors) to inhibit tumor growth and activation in new blood vessels and treats metastatic and recurrent cervical cancers (ACS, 2020d; NCI, 2020). The side effects include high blood pressure, nausea, fatigue, problems with wound healing, bleeding, blood clots, and heart attack, and abnormal fistula between the vagina and the colon or intestine (ACS, 2020d).

Immunotherapy, also referred to as biotherapy, uses the patient's immune system to effectively recognize and destroy cancer cells, especially for the treatment of metastasized and recurrent cervical cancer, by restoring the body's natural defenses against cancer (ACS, 2020b). Following the development of an immune response, the body protects itself from an automatic attack of the normal cells using checkpoints; however, these checkpoints are mimicked by cancer cells, causing an attack of the immune system (ACS, 2020b; NCI, 2020). Hence, the mechanism of action of these

drugs (Immune Checkpoint Inhibitors) is to inhibit the binding of cancer cells at these checkpoints (ACS, 2020b). Drugs such as Pembrolizumab, a type of immune checkpoint inhibitor, treat metastatic and recurrent cervical cancer and s given as an intravenous (IV) infusion every three weeks (ACS, 2020b; NCI, 2020).

Table 2 shows the treatment options for cervical cancer by the cancer stage.

Table 2

Treatment Options for Cervical Cancer by Stage

Stage of cancer	Fertility-sparing treatments	Non-fertility-sparing treatments
Stage IA1	Cone biopsy Radical trachelectomy Radical trachelectomy + Lymphadenectomy	Simple hysterectomy Cone biopsy Radical hysterectomy + Lymphadenectomy Surgery + EBRT + Brachytherapy Chemotherapy + EBRT + Brachytherapy
Stage IA2	Cone biopsy Radical trachelectomy + Lymphadenectomy	EBRT + Brachytherapy Radical hysterectomy + Lymphadenectomy EBRT + Chemotherapy + Brachytherapy
Stage IB1 and IB2	Radical trachelectomy + Lymphadenectomy	Radical hysterectomy EBRT + Chemotherapy +Brachytherapy EBRT + Brachytherapy Concurrent chemoradiation
Stage IIA1		Radical hysterectomy + Lymphadenectomy + Radiation EBRT + Brachytherapy ± Chemotherapy
Stage IIA2		Chemoradiation + Lymph nodes dissection and

Stage of cancer	Fertility-sparing treatments	Non-fertility-sparing treatments
		sampling + Concurrent chemoradiation Chemoradiation + hysterectomy
Stage IIB, III, IVA		Chemotherapy + EBRT + Brachytherapy
Stage IVB		Radiation therapy ± Chemotherapy Targeted therapy + Chemotherapy Immunotherapy

Pfaendler et al. 2018 conducted a retrospective population-based cohort study of stage IB-IIA invasive cervical cancer cases reported to the California Cancer Registry from January 1, 1995, through December 31, 2009, to examine associations between patient, tumor, and treatment characteristics and NCCN guideline adherence (defined by year- and stage-appropriate surgical procedures, radiation, and chemotherapy), and cervical cancer-specific 5-year survival. The authors reported that out of the 6,063 patients identified, more than 45% received NCCN guideline-adherent care, and 18.8% received treatments in high-volume centers (≥20 cases per year). The multivariate analysis revealed that the lowest SES (*aOR* = 0.69, 95% CI = 0.57-0.84), low-middle SES (*aOR* = 0.76, 95% CI = 0.64-0.92), and Charlson-Deyo comorbidity score ≥1 (*aOR* = 0.78, 95% CI = 0.69-0.89) were patient characteristics associated with receipt of nonguideline care. Pfaendler et al. also reported lower NCCN guideline adherent care in low-volume centers (45.9%) than in high-volume centers (50.9%) (effect size = 0.90, 95% CI = 0.84-0.96), and more deaths from cervical cancer in the nonadherent group

(13.3%) than in the adherent group (8.6%) (effect size = 1.55, 95% CI = 1.34-1.80). Notably, there was an increased risk of dying from cervical cancer amongst African Americans (*aHR* 1.56, 95% CI = 1.08-2.27), Medicaid payer status (*aHR* 1.47, 95% CI = 1.15-1.87), and Charlson-Deyo comorbidity score ≥1 (*aHR* 2.07, 95% CI = 1.68-2.56) (Pfaendler et al., 2018).

Definitions

This section provides concise definitions of the IVs and DV.

Age at diagnosis is a sociodemographic characteristic that defines the patient's age at diagnosis and treatments, from participation in a cervical cancer screening program, including women with no prior history of screening for cervical cancer and women due or overdue for screening visits in the communities (Musa et al., 2017).

Cancer stage at diagnosis determines the extent (advanced and non-advanced) and spread (localized, regional, distant) of the tumors of the cervix and is vital for developing a cervical cancer treatment (American College of Surgeons, n.d.; Höhn et al., 2021).

Cervical cancer survival rate is the DV which refers to survival rates and percentage, survival time dissimilarities of people with the same type and stage of cervical cancer over 60 months of follow-up (Wassie et al., 2019). Also, it depends on the study period variation, the stage and overall condition of patients during the presentation, variations of waiting time for treatment, and differences in cancer care policy over a certain amount of time (Wassie et al., 2019).

Diagnostic confirmation is the precise and accurate method used to diagnose cervical cancer at the time of diagnosis and the entire course of the disease, which entails a Pap test, pelvic exam, colposcopy, biopsy, health history, physical examination, laboratory, and imaging tests (Dunyo et al., 2018; Howlader et al., 2021).

Geographical location describes the place of residence using SEER registries from California and Georgia combined into state-level groupings as the geographic indicator available for analysis at the individual level (Howlader et al., 2021).

Grade of tumor at diagnosis determines how the biological behavior of the tumor and tumor tissues under microscopy predicts the growth and spread, which affects survival rates (Howlader et al., 2021). The tumors could be low grade and less likely to be aggressive (well-differentiated, moderately differentiated cancers) or high grade and more aggressive (undifferentiated, poorly differentiated cancers), depending on the abnormality, structure, and growth rate (Habeeb & Habeeb, 2019).

Histological type of tissues and origin of the cancer cell types from their primary sites (endocervix and ectocervix) described using the third edition of the International Classification of Diseases for Oncology [ICD-0-3] (Howlader et al., 2021; Saleem et al., 2019). These are squamous cell carcinoma, adenocarcinoma, squamous cell carcinoma keratinizing, squamous cell carcinoma non-keratinizing, squamous cell carcinoma micro-invasive, adenosquamous carcinoma, endometroid carcinoma, adenocarcinoma endocervical type, and other types (Benoit et al., 2018a, p. 39; Howlader et al., 2021).

Marital status is a sociodemographic and individual factor that identifies the patient's marital status at cervical cancer diagnosis and is associated with the presentation stage, affecting survival rates (Dunyo et al., 2018; Howlader et al., 2021).

Mode of treatment describes effective treatment options for persistent, recurrent, or metastatic cervical cancer via surgery, radiation therapy, chemotherapy, and combination therapies (Gadducci & Cosio, 2020; Howlader et al., 2021). The different methods of treatment depend on the type and stage of cancer. Surgery or radiation therapy combined with chemotherapy may be used for the earliest stages of the disease, while radiation therapy with chemotherapy is used in later stages (Gadducci & Cosio, 2020). More advanced stages also respond to chemotherapy alone; however, there is a higher risk of recurrence and decreased survival rate for both locally advanced and metastatic disease (Cohen et al., 2020; Gadducci & Cosio, 2020).

Race/ethnicity-related disparities exist between African Americans and Whites in the United States, which are multifactorial sources of the problem, involving barriers to access to care, adherence to follow-up, and treatment guideline compliance at the patient, provider, healthcare system, and community levels, leading to broader inequalities, social injustices, and poor access to care (Liddell et al., 2018).

Treatment outcome/status is an IV that refers to a patient's survival status or outcome following treatment, measured by being alive or dead from a patient's clinical data file from scheduled or unscheduled visits (Wassie et al., 2019).

Year of diagnosis is essential for the study to determine the number of years participants reported late presentation and advanced stages, affecting survival rates (Dunyo et al., 2018).

Assumptions

The study was conducted based on the assumption that the researchers conducted detailed analyses and data collection using the SEER database in an ethical and rigorous approach. The SEER program accurately provided information on cancer incidence and survival and represented population-based registries located across the United States (Howlader et al., 2021). Another assumption was that the data on patient demographics, primary tumor site, tumor grades, stage of disease, treatment, and active follow-up for vital status collected by the researchers in the SEER database was essential for this study. Hence, it was assumed that the study participants truthfully and accurately responded to the study questions associated with the variables during the original data collection procedure (Howlader et al., 2021). Also, when comparing the SEER database with other databases, it was assumed that the methodology used in computing survival was similar, making the comparison of survival by stage possible.

In addition, there should be the completeness of case ascertainment, rules used to determine multiple primaries, follow-up, rules used in assigning and coding cause of death, and the sources and procedures used in obtaining population estimates when comparing with other databases (Howlader et al., 2021). The SEER dataset for this study had the best fit due to the selected population, large sample size, and data generated for variables of interest. Also, based on the RQs and hypotheses, the SEER database

provided the dataset suitable for gauging the chosen DV and IVs into the appropriate levels of measurement when recoded for the study. It is assumed that race/ethnicity-related disparities by age, year of diagnosis, marital status, and geographical location will impact cervical cancer survival rate. It is expected that race/ethnicity-related disparities by diagnostic confirmation, tumor grade, histological type, and cancer stage at diagnosis will impact cervical cancer survival rate. Likewise, it is assumed that race/ethnicity-related disparities by mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status will impact cervical cancer survival rate.

Scope and Delimitations

The specific aspects of the research problem addressed in the study are the race/ethnicity-related disparities associated with the cervical cancer survival rate among African Americans and White women in the United States. The specific focus was to explore the association between race/ethnicity-related disparities in age at diagnosis, the year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment, and treatment outcome/status with cervical cancer survival rate. The secondary data included a large nationwide population of patients of diverse backgrounds and settings diagnosed with cervical cancer between 2000 and 2017. Data were from the Incidence SEER Research Plus Data 18 Registries, November 2019 Submission 2000 to 2017 dataset of cases diagnosed in 1975-2017 from the NCI SEER database. Also, the current study excluded cervical cancer survivors of any age who did not report in the SEER data

between 2000 and 2017. Moreover, data on the patient's insurance status, SES, level of education, income level, use of nicotine, obesity, early stage of first sexual intercourse, long-term use of hormonal contraceptives, multiple sexual partners, multiparity, and young age at first birth were not available.

The SEER database did not collect these potentially confounding factors and the confounders concerning research participants and practice settings for the data analysis. In addition, as an observational study, a causal effect for making inferences about the predictive association between race/ethnicity-related disparities in the sociodemographic, pathological, and treatment factors with the cervical cancer survival outcomes could not be established (Reita et al., 2021). The SEER data were potential strength for studying larger and more representative samples of women under real-world conditions to produce results with higher generalizability to the United States population. The observational study addressed the systematic underrepresentation of African American women in randomized control trials (RCTs) to benefit the entire demographic spectrum of patients with cervical cancer in the United States. The awareness of the systematic underrepresentation of women and specific sub-populations in RCTs contributed to the knowledge and ability to capture patients of diverse backgrounds and settings in the study (Gershon et al., 2021). The SEER data available for the study included large numbers of patients, provided more power, and allowed heterogeneity evaluation of treatment effect of cervical cancer patients (Gershon et al., 2021). Also, using the SEER data as secondary data required less time and was less costly in conducting the study (Gershon et al., 2021).

Furthermore, there was perceived susceptibility to an individual's cervical cancer and screening behavior due to variability in time (Gibson et al., 2019). Also, secondary data sources may not represent the wider population (Thompson, 2017). The limitations may include constraints on the research design, sampling and sampling procedures, the sample size, methods for cleanup and handling the missing data, difficulty in getting information on variables, covariates, and confounders relevant for the study (Bero et al., 2018; Thompson, 2017). The impact of missing data on the study may result in loss of information, biased estimates of parameters, increased standard errors, biases in statistical power, and weakened generalizability of findings (Bero et al., 2018; Thompson, 2017). Additionally, there may be a risk of recall or information bias from self□rating subjective cancer-specific outcomes by participants who were not blind to the study during data collection from follow-up (González-Fraile et al., 2021).

Significance, Summary, and Conclusions

Globally, poorer cervical cancer survival for minorities and women from socioeconomically disadvantaged groups results from having decreased access to optimal screening, decreased receipt of guideline-adherent care, increased incidence, later stage at diagnosis, and higher mortality from cervical cancer (Pfaendler et al., 2018). In the United States, African Americans and Hispanic/Latina women develop aggressive cervical cancer, often detected in advanced stages (Olusola et al., 2019). Dunyo et al. (2018) reiterated that low SES is associated with late presentation of cervical cancer, and biological behavior of the tumor predicts the stage at diagnosis in a study about the sociodemographic, clinical, and histological characteristics associated with late

presentation of cervical cancer cases attending Gynecological Oncology care at Catholic Hospital, Battor Ghana. Disparities exist by the stage at presentation, treatment differences, comorbid conditions, and SES; however, when uncorrected for hysterectomy, there was a higher cervical cancer incidence and mortality among African Americans (race) and the South region (geographical location), leading to a continuum in the underestimation of regional and racial disparities (Yoo et al., 2017).

However, to reconcile the disparity in the Appalachians socioeconomic conditions and reduce the increased burden on public health, there is a need to aim for the universal use of effective bivalent, quadrivalent, and nonavalent vaccines on the rates of initiation, progression, and ultimately invasive cervical cancers (Karuri et al., 2017). In a study by Wassie et al. (2019), the time of death was the outcome variable. The authors measured sociodemographic and individual-level factors (marital status, residence, age at diagnosis, substance use, number of children, region, occupation, religion), pathological and clinical factors (stage at presentation, histopathology, anemic status, comorbidity, types of comorbidities) and Treatment-related factors (chemotherapy, radiation, surgery, aim of radiotherapy, combination of treatments modalities) as the IVs (Wassie et al., 2019). The sociodemographic factors such as race/ethnicity, age, insurance status, marital status, level of education, geographical location, number of children, and cervical cancer screening practices were associated with the stage at presentation and survival rates in the distressed areas (Dunyo et al., 2018).

However, this was especially important in ensuring additional cervical cancer screening to reduce cervical cancer risk factors, like HR-HPV infection, age, smoking,

childbirth, use of oral contraception, obesity, unhealthy diet, lack of physical activity, and alcohol consumption, which were prevalent among African American women in these economically distressed Appalachia areas, where 42% live in rural areas, compared with 20% nationally (Karuri et al., 2017; Olusola et al., 2019). Compared to previously screened patients (*OR* = 3.91; 95% CI = 1.43–10.69), the previously unscreened patients were nearly four times likely to present late, and there was no association observed with sociodemographic and histological characteristics when adjusted for age at presentation (Dunyo et al., 2018). Karuri et al. proposed evidence-based interventions in implementing healthcare policies and systems needed for reducing inequalities in cancer incidence and uptake of cancer as a remarkable HPV screening strategy in reducing ethnic, racial, and regional differences in the incidence and mortality of cervical cancers among women in the United States.

According to epidemiologic studies, in women aged 20-39 years in the United States, cervical cancer is the second leading cause of cancer-related deaths, with an average of ten deaths per week, and an increasing number of young women have been diagnosed with cervical cancer (Pan et al., 2021). Although age, ethnicity-HPV types, and immunosuppression were associated with a greater risk of mortality among women with cervical cancer, the effect of marital status as a social factor to survival was uncertain because there was a link between being unmarried and a higher rate of mortality for various types of malignancies, including breast, colorectal, ovary, and endometrial cancers (Machida et al., 2017). A retrospective, observational study by Machida et al. (2017) examined more than 86,000 women with invasive cervical cancer

identified in the SEER Program between 1973 and 2013, where 18,324 single women and 38,713 married women were compared using multivariable binary logistic regression models. The authors reported that unmarried marital statuses were associated with young age, race [African American/Hispanic ethnicity], Western US residents, uninsured status, high-grade tumor, squamous histology, and increased infectious mortality in advanced-stage cervical cancer on multivariable analysis (all, $p < .05$).

Furthermore, compared to the women with the married statuses, women who had unmarried statuses were associated with an increased cumulative risk of all-cause mortality (5-year rate; 32.9% vs. 29.7%, $p < .001$) and infectious mortality (0.5% vs. 0.3%, $p < .001$). Also, there were increased cumulative risk of all-cause mortality (adjusted hazards ratio [*HR*], 1.15; 95% confidence interval [CI], 1.11–1.20; $p < .001$) and infectious mortality on multivariable analysis (adjusted HR, 1.71; 95% CI, 1.27–2.32; $p < .001$) for unmarried marital statuses. Despite the well-known influence of tumor factors, psychosocial factors for infectious mortality even in early-stage disease, the underuse of the health care system, the inadequate social support on mental wellbeing, immune function, and overall health for single women were more likely to present with advanced cervical cancer stage (Machida et al., 2017). Hence, of the sociodemographic factors, marital status was an independent prognostic factor for advanced-stage disease and a significant predictor of morbidity and mortality (Alyabsi et al., 2021).

Sociodemographic factors such as age at diagnosis, marital status, insurance status, employment status, religion, and ability to afford the cost of screening did not determine an individual's health decision-making and intention to screen (Ebu, 2018).

However, these characteristics were modifiable variables that impact an individual's decision to adopt appropriate health behaviors and engage in cervical cancer screening, because cervical cancer screening efforts aimed at preventing cervical cancer can significantly reduce the morbidity and mortality associated with this cancer (Ebu, 2018). Over the years, the recommended screening modalities for cervical cancer contributed to a significant reduction in the burden of cervical cancer. However, due to cost, access problems, poor health literacy, psychosocial factors, discomfort with the screening procedure, and fear of cancer, these benefits were not realized in underserved, uninsured, and underrepresented populations, leading to more disparities in cervical cancer survival (Musa et al., 2017).

Abdalla et al. (2020) recommended promoting early diagnosis through quality screening, follow-up after abnormal Pap test results, and access to quality health care for African Americans, the uninsured, and the older people living in Alabama's Black Belt region. Also, Gibson et al. (2019) emphasized addressing perceived susceptibility, disparities in disease recognition and management, and developing culturally relevant strategies for promoting cervical cancer screening among African American women in the Mississippi Delta. The researchers maintained that confounder factors such as race and ethnicity, biological characteristics, and social determinants of health influenced disparities (Gibson et al., 2019; Singh & Jemal, 2017). Whites diagnosed with early stages were more likely to survive than African Americans, and African Americans were more likely to be diagnosed with advanced stages of the disease than Whites (Abdalla et al., 2020; Gibson et al., 2019; Singh & Jemal, 2017).

Gibson et al. (2019) also maintained that racial/ethnic and geographic disparities in cervical cancer incidence and mortality still existed among African American women in the Mississippi Delta, a high-poverty region of the state between the Mississippi and Yazoo rivers, irrespective of the substantial reduction in the burden of cervical cancer nationwide from cervical cancer screening. Watson et al. (2017) examined high-grade cervical cancer precursors (CIN III/AIS) in four population-based cancer registries (Louisiana, Kentucky, Michigan, and Los Angeles) in the United States between 2009-2012, by age, race, and histology for determining the burden of preventable disease, identifying effects of vaccination on future diagnoses, and developing targeted programs. According to Watson et al. (2017), Kentucky (69.8) had the highest rate of CIN III/AIS, followed by Michigan (55.4), Louisiana (42.3), and Los Angeles (19.2). However, in Michigan, the declines in CIN III/AIS rates among women aged 15-19 (37%), 20-24 (14%), and 25-29 (7%) have been linked to the updated screening recommendations and the impact of HPV vaccination (Watson et al., 2017).

Although cervical cancer incidence and mortality decreased following the widespread uptake of routine screening (Pap smear) and treatment of high-grade precursor lesions, disparities still existed in the United States; hence, there was a need to enhance access and ensure equal and adequate treatment of all women with cervical cancer as an effective strategy for improving outcomes (Markt et al., 2018). Therefore, understanding the variations in molecular biological basis can help in developing strategies aimed at promoting screening rates in the underserved and population at risk, to build affordable, effective, and efficient health care systems that simultaneously address

multiple factors that would improve cervical cancer screening rates and overall outcomes among this population with a high disease burden (Gibson et al., 2019; Musa et al., 2017; Olusola et al., 2019). Section 1 described the foundation of the study and literature review and how the current study was performed to address the research gaps identified in the literature review. The following section, Section 2, describes the research design and methodology and its rationale for connection to the proposed RQs.

Section 2: Research Design and Data Collection

Introduction

In Section 1, I described the foundation of the study and literature review; in this section, I describe and justify the research design and the rationale, methodology, and ethical considerations for the quantitative cross-sectional study. I describe the methodology to determine the study population, sample size, sampling procedures for data collection, instrumentation, operationalization constructs, data analysis, and threats to validity. I conclude the section with a discussion on ethical considerations related to gaining access to the secondary dataset and an overall summary of the section before reporting the study findings in the next section.

The aim of this quantitative study was to assess the potential association of disparities in cervical cancer survival outcomes amongst African Americans and Whites in the United States. In this study, the race/ethnicity-related disparities in age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status were explored for possible associations with the cervical cancer survival rates between both racial groups. This study filled a gap in research by assessing the disparities in cervical cancer survival outcomes between African American and White women in the United States from 2000 to 2017, which previous research had not addressed using the SEER Research Plus data 18 Registries dataset. The research variables included cervical cancer survival rate as the DV and age

at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment, and treatment outcome/status as IVs. The covariate variable (CV) was race/ethnicity.

The research study was conducted to advance knowledge of the sociodemographic, histopathologic, and treatment-related factors on racial/ethnic disparities in cervical cancer survival outcomes among African American and White women in the United States. I selected the RQs to close gaps in the association between race/ethnicity-related disparities in sociodemographic, histopathologic, and treatment-related factors with the cervical cancer survival rate among African American and White women.

Research Design and Rationale

This quantitative study used a cross-sectional design, and the study variables included cervical cancer survival rate as the DV; the age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment, and treatment outcome/status as the IVs; and race/ethnicity as the CV. I designed this study as a secondary analysis of the Incidence SEER Research Plus data 18 (Sub 2000–2017) cross-sectional dataset using the quantitative correlational design to test the hypothesis associated with each RQ. I used the SEER cancer registry database because NCI characterizes cancer health disparities in cancer burden, cancer control, cancer incidence, mortality, and survival among specific population groups in their geographic locations

(Zahnd et al., 2018). I selected the dataset for its relevancy in assessing risk factors, mortality, survival, and outcomes and to help guide public health interventions and public policy (Zahnd et al., 2018).

Furthermore, the SEER data registry used standardized methods to collect population-based data on individual cancer cases, enhancing the validity and generalizability of study outcomes (Zahnd et al., 2018). Using secondary data from the SEER registry for cross-sectional analysis required less time and was inexpensive (Gershon et al., 2021). The secondary analysis of the existing SEER data tested hypotheses in the target population groups concerning the predictive association between disparities in the sociodemographic, pathological, and treatment factors on the cervical cancer survival rate without influencing any factors and eliminating associated uncertainty with causal determinations (Reita et al., 2021). The research design used the correlational approach to guide the analysis of the relationships between the DV, IVs, and CV to answer the three RQs. The goal of the research was to contribute to the general knowledge base by identifying and statistically testing factors supported by theory and literature as potential contributors to disparities and identifying efforts to assess racial differences in the survival ratios of cervical cancer between African American and White women, using SEER data from 2000 to 2017.

Methodology

Population

The SEER Program supported by the Surveillance Research Program (SRP) in NCI's Division of Cancer Control and Population Sciences provided information on

cancer statistics as the secondary data source for this study (Howlader et al., 2020). For this study, I selected the Incidence-SEER Research Plus Data, 18 Registries, November 2019 Submission (2000–2017) for cases diagnosed from 1975 to 2017. Based on the 2010 census, the SEER 18 covered nearly 28% of the U.S. population (Howlader et al., 2020). The SEER*Stat statistical software 8.3.9.2 (a powerful PC tool) was used to view and extract individual cervical cancer records and generated the dataset from Cervix Uteri statistics for the study (Howlader et al., 2020). However, access was required to view the SEER Research Data before using the SEER*Stat software (Howlader et al., 2020).

The case listing session was used to identify all cervical cancer patients diagnosed from 2000 to 2017, and the eligible participants included all individuals of African American and White race/ethnicity diagnosed with primary cervical cancer. There were 63,242 participants registered in the SEER database, but only $N = 56,388$ were eligible participants (White; $n = 47,407$, African American; $n = 8,981$) for the study. Hence, 6,854 participants with other races/ethnicities diagnosed with primary cervical cancer were excluded from the study. The study participants were in Alaska, California, Connecticut, Georgia, Hawaii, Idaho, Iowa, Kentucky, Louisiana, Massachusetts, Detroit (Metropolitan), New Jersey, New Mexico, New York, Utah, and Seattle (Puget Sound) within the SEER registries from California and Georgia (Howlader et al., 2020).

Sampling and Sampling Procedures

The data on cervical cancer cases in the United States ($N = 56,388$) included White ($n = 47,407$) and African American ($n = 8,981$) patients from the SEER Research Plus Data Registries, November 2009, Sub (2000–2017) with cases diagnosed from 1975

to 2017. The case listing session showed socioeconomic status (education level, income level, employment status, family poverty level), but the data were not retrievable for the study as confounders. Data on participants' marital status were available and were extracted from the SEER dataset. The quantitative cross-sectional study used the nonprobability sampling method as the sampling strategy because the secondary dataset from the SEER registry provided rich information about the target population (inclusion criteria; Yang et al., 2020). The nonprobability sampling technique is potentially helpful for finite population inference in observational studies (Yang et al., 2020). Drabble et al. (2018) maintained that nonprobability sampling yields larger samples and is more cost-effective for statistical comparison within groups for examining differences, contending that nonprobability sampling methods contribute substantially to understanding sexual-orientation-related health disparities.

Furthermore, the findings align with this study, which used convenience sampling, a nonprobability sampling method, to study the disparities in the target population. The SEER Research Plus data 18 obtained were used to answer the overarching RQs of this study.

RQ1 was as follows: Is there a statistically significant association between race/ethnicity-related disparities in the age at diagnosis, year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African American and White women? The RQ had cervical cancer survival rate as the DV; age at diagnosis, year of diagnosis, marital status, and geographical location as the IVs; and race/ethnicity as the CV for participants who met the eligibility criteria.

RQ2 was the following: Is there a statistically significant association between race/ethnicity-related disparities in diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African American and White women? The RQ had cervical cancer survival rate as the DV; diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage as the IVs; and race/ethnicity as the CV for participants who met the eligibility criteria.

RQ3 was the following: Is there a statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status and the cervical cancer survival rate among African American and White women? The RQ had cervical cancer survival rate as the DV; mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status as the IVs; and race/ethnicity as the CV for participants who met the eligibility criteria.

Though the instrument contained sociodemographic information such as age, race, gender, and marital status, there was no identifiable information. The SEER database was deidentified and contained no patient names, and no readily available identifiers such as Social Security numbers were used; however, each participant had a randomly assigned patient ID. There was informed consent at the time of data collection by the SEER registry. Given that data were deidentified, patient sociodemographic information, clinical information, medical records, treatments, follow-up, and death certificates were secured. The study participants were a more representative sample of the

population diagnosed with cervical cancer. When transferring information into the database, SEER staff members used standardized data collection methods to gather accurate and complete information.

Power Analysis

In a study by Sharma et al. (2022) on explaining correlates of cervical cancer screening among minority women in the United States, a minimum of 154 participants was required to create a moderate effect size to $f^2 = 0.15$. The Type I error $\alpha = 5\%$, power $1\text{-}\beta = 95\%$, and total number of variables $N = 15$ were integrated into the multivariable regression analysis. I used the G*power 3.1.9.7 software by Faul et al. (2007) to compute the sample size for logistic regression by performing the "a priori: compute required sample size - given α, power ($1\text{-}\beta$), and effect size" power analysis for z-tests using $\alpha = .05$, $1\text{-}\beta = 0.95$, X-parm $\mu = 1$, X parm $\sigma = 1.5$, $R^2 = 0$. For the normal X distribution: Pr (Y=1 | X=1) $H_0 = .5$, a minimum of 166 cases were needed to detect a small effect at $R^2 = 0$. The sample size affects both the hypothesis and the study design, and the use of a statistically incorrect sample size will lead to unsatisfactory results in clinical and laboratory studies resulting in time loss, cost, and ethical problems (Serdar et al., 2021). Therefore, a minimum of 166 cases were needed as the total sample size to detect a small effect size to $R^2 = 0$, which met the minimum requirements to yield hypothesized effects. The significance level is inversely proportional to the sample size, and a larger sample size will lead to a lower probability of making a Type I error. Additionally, power is directly proportional to the sample size; hence, the larger the

sample size, the lower the probability of making a Type II error and the higher the power of a test during analysis.

Instrumentation

The SEER program of the NCI is an authoritative source of comprehensive information that currently collects and publishes cancer incidence and survival data from population-based cancer registries, covering almost 50% of the U.S. population (NCI, n.d.). The National Center for Health Statistics and the Census Bureau provide data on mortality and population, respectively reported by SEER annually in print and electronic formats available to the public for research, analysis, and improving national estimates (NCI, n.d.). The Incidence-SEER Research Plus Data 18 Registries, November 2019, Submission 2000–2017 held the SEER data appropriate for the study. However, I accessed the SEER Research Plus databases through a multiple-step request process (recommended for noninstitutional users).

The application form, SEER Research Data Use Agreement, SEER Treatment Data Limitations, and Best Practices Assurance were acknowledged prior to submitting the form and verifying the email address. Then, I gained access using the SEER*Stat username and temporary password after downloading and installing the current version of the SEER*Stat program. With the preceding facts in mind, I sought approval from the local ethics committee to use the database. The SEER databases were appropriate for the study because information concerning race/ethnicity-related disparities in cervical cancer among African Americans and Whites were available. Moreover, the information collected were relevant for study to determine the significant relationships between the

age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, mode of treatment, and treatment outcome/status with cervical cancer survival rate.

Operationalization of Constructs

The operational constructs consisted of the dependent, independent, and covariate variables and the hypotheses for all RQs, stating the association between a DV and IV(s). Understanding the role of the IVs in accounting for the DV was essential for the study. The RQs gave insights into the association between an IV and a DV. Researchers opined that low SES, insurance status, race, age at diagnosis, marital status, and geographical location are associated with late presentation of cervical cancer and survival (Dunyo et al., 2018). Therefore, the study variables cervical cancer survival rate (DV), age at diagnosis (IV), year of diagnosis (IV), marital status (IV), geographical location (IV), diagnostic method of confirmation (IV), grade of tumor at diagnosis (IV), histological type (IV), cancer stage at diagnosis (IV), mode of treatment (IV), treatment outcome/status (IV), and race/ethnicity (CV) were operationalized (see Table 3).

Race/ethnicity was the SEER variable name transformed to *Race_EthnicityCA*; the values were 1 = African American and 2 = White. The level of measurement was nominal (categorical variable). The new variable name was *race/ethnicity of participants*.

The SEER variable name *age recode with single ages and 100+* was transformed to *age at diagnosis*; the values were 1 = under 18 years, 2 = 19–45 years, 3 = 46–55 years, 4 = 56–65 years, 5 = 66–75 years, and 6 = 76+ years. The new variable name was *age at diagnosis*, and the level of measurement was ordinal (categorical variable).

The SEER variable name *year of diagnosis* was transformed to *Year_diagnosis*; the values were 1 = 2002 or earlier, 2 = 2003–2007, 3 = 2008–2012, and 4 = 2013–2017. The new variable name was *year of diagnosis*, and the level of measurement was nominal (categorical variable).

The SEER variable *Maritalstatusatdiagnosis* was transformed to *Maritalstatusrecode*. Before recoding, single = 1, married = 2, separated/divorced = 3, widowed = 4, and unknown = 5. After the recode, the values included legally married = 1, not legally married = 2, widowed = 3, and unknown = 4. The variable name was *marital status at diagnosis*, and the level of measurement was nominal (categorical variable).

SEER Registry (with CA & GA as whole states) was transformed to *Geographical_location*, with values Alaska Natives = 1, California = 2, Connecticut = 3, Detroit (Metropolitan) = 4, Georgia = 5, Hawaii = 6, Iowa = 7, Kentucky = 8, Louisiana = 9, New Jersey = 10, New Mexico = 11, Seattle (Puget Sound) = 12, and Utah = 13. The level of measurement was nominal (categorical variable), and the new variable name was *geographical location*.

The SEER variable *diagnostic confirmation* transformed to *Diagnostic_Method* had the following values: positive histology = 1, positive cytology = 2, positive histology PLUS = 3, positive microscopic confirmation = 4, positive laboratory test/marker study = 5, direct visualization without microscopic conformation = 6, radiology and other imaging techniques without microscopic confirmation = 7, clinical diagnosis only = 8, and unknown = 9. The recoded values were 1 = 1 + 2 + 3 + 4; 2 = 5 + 6 + 7 + 8; and 3 =

9. The value 1 = microscopically confirmed, 2 = not microscopically confirmed, and 3 = unknown. The level of measurement was nominal (categorical variable), and the variable name was *diagnostic method of confirmation*.

The SEER variable *Grade* was transformed to *Grade_of_Tumor* with values unknown, well-differentiated as Grade I, moderately differentiated as Grade II, poorly differentiated as Grade III, and undifferentiated/anaplastic as Grade IV. After the recode, well differentiated/Grade I = 1, moderately differentiated/Grade II = 2, poorly differentiated/Grade III = 3, undifferentiated, anaplastic/Grade IV = 4, and unknown = 5. The new variable was *Grade of Tumor at Diagnosis*. The level of measurement was Nominal (categorical variable).

The SEER variable *ICD-0-3-Histology/Behavmalignant* was transformed to *TumorHistology*, and the new variable name was *Histological Type*. The values after sorting the dictionary and recoding include squamous cell carcinoma, NOS = 1, adenocarcinoma = 2, squamous cell carcinoma nonkeratinizing, NOS = 3, squamous cell carcinoma keratinizing, NOS = 4, adenosquamous carcinoma = 5, squamous cell carcinoma, microinvasive = 6, adenocarcinoma, endocervical type = 7, endometroid carcinoma = 8, and the other types = 9. The level of measurement was Nominal (categorical variable).

The *SEERhistoroc_stage_A_1973_2015* variable transformed to *StageCancer* represents the collaborative stage (CS) and extent of disease simplified as the stage in situ, localized, regional, distant, unknown/unstaged. After recode, localized = 1, regional = 2, distant = 3, and unstaged = 4. Localized is the non-advanced stage

disease, while regional and distant represent the advanced stage disease. The new variable was the *stage of disease at diagnosis* with a Nominal level of measurement (categorical variable).

The *mode of treatmen*t consisted of *surgery, radiotherapy, chemotherapy, and combination therapies (systemic surgical and surgical radiation sequence)*. The SEER variable *Reason no cancer-directed surgery* renamed as *Surgical treatment* was transformed into *Treatmentbysurgery*, which had two values (dichotomous), The values were 1 = surgery performed, and no surgery = 2, and the level of measurement was Nominal (categorical variable).

The SEER variable *Radiation recode* transformed as *Treatmentbyradiation* and labeled as *Radiation Therapy* also had two values (dichotomous); 1 = radiation performed, and no radiation = 2. The level of measurement was Nominal (categorical variable).

Also, SEER variable *chemotherapy recode* was transformed into *treatmentbychemotherapy* and labeled as *Chemotherapy*. This had two values (dichotomous); 1 = had chemotherapy, and no chemotherapy = 2. The level of measurement was Nominal (categorical variable).

The SEER stat variable name *RX_Summ_Systemic_Sur_Seq* which recorded the sequencing of combination therapy (systemic therapy and surgical therapy) given as part of the first-course treatment, was transformed into Nominal variable *SystemicSurgical* and labeled as *Systemic therapy and surgical procedure*

administered. The values were 1 = no, 2 = given/sequence known, and 3 = given but sequence unknown. The level of measurement was Nominal (categorical variable).

The SEER stat variable *RX_Summ_Radiation_sequence_with_surgery* which recorded the sequencing of combination therapy (surgery and radiation therapy) given as part of the first-course treatment, was transformed into Nominal variable *SurgicalRadiationSequence* and labeled as *Surgery and radiation therapies administered*. The values were 1 = no, 2 = given/sequence known, and 3 = given but sequence unknown. The level of measurement was Nominal (categorical variable).

The SEER Stat variable *Vital status recode (study cutoff used)* was transformed to *PatientTreatmentOutcome* and labeled as *Patient status after treatment*. The values were alive = 1 and dead = 2. The level of measurement was Nominal (categorical variable).

The SEER Stat variable *Survival_months* was transformed to *CervicalCancerSurvivalRate* and labeled as *Cervical Cancer Survival Rate*. This was the DV Cervical Cancer Survival Rate, and it was a categorical variable with a Nominal level of measurement. The values were 1 = under 60 months, and 2 = > 60 months when dichotomized and was labeled Cervical Cancer Survival Rate (dichotomy).

Table 3

Description of the Independent Variables, Dependent Variables, and Covariate

Variable	SEER*Stat variable name	Operational definition	Role in RQs	Measurement
Race/ethnicity of participants	Race/ethnicity	1 = African American 2 = White	CV: RQ1, RQ2, RQ3	Nominal
Age at diagnosis	Age recode with single ages and 100+	1 = Under 18 years 2 = 19–45 years 3 = 46–55 years 4 = 56–65 years 5 = 66–75 years 6 = 76+ years	IV: RQ1	Ordinal
Year of diagnosis	Year of diagnosis	1 = 2002 or earlier 2 = 2003–2007 3 = 2008–2012 4 = 2013–2017	IV: RQ1	Nominal
Marital status at diagnosis	Marital status at diagnosis	1 = Legally married 2 = Not legally married 3 = Widowed 4 = Unknown	IV: RQ1	Nominal
Geographical location	SEER Registry (with CA & GA as whole states)	1 = Alaska Natives 2 = California 3 = Connecticut 4 = Detroit (Metropolitan) 5 = Georgia 6 = Hawaii 7 = Iowa 8 = Kentucky 9 = Louisiana 10 = New Jersey 11 = New Mexico 12 = Seattle (Puget Sound) 13 = Utah	IV: RQ1	Nominal
Diagnostic method of confirmation	Diagnostic confirmation	1 = Microscopically confirmed 2 = Not microscopically confirmed 3 = Unknown	IV: RQ2	Nominal
Grade of tumor at diagnosis	Grade	1 = Well differentiated/Grade I	IV: RQ2	Nominal

Variable	SEER*Stat variable name	Operational definition	Role in RQs	Measurement
		2 = Moderately differentiated/Grade II 3 = Poorly differentiated/Grade III 4 = Undifferentiated, anaplastic/Grade IV 5 = Unknown		
Histological type	ICD-0-3-histology/behav, malignant	1 = Squamous cell carcinoma, NOS 2 = Adenocarcinoma 3 = Squamous cell carcinoma nonkeratinizing, NOS 4 = Squamous cell carcinoma keratinizing, NOS 5 = Adenosquamous carcinoma 6 = Squamous cell carcinoma, microinvasive 7 = Adenocarcinoma, endocervical type 8 = Endometroid carcinoma 9 = Other types	IV: RQ2	Nominal
Stage of disease at diagnosis	SEER Historic Stage A (1973–2015)	1 = Localized 2 = Regional 3 = Distant 4 = Unstaged	IV: RQ2	Nominal
Surgical treatment (dichotomous)	Reason no cancer-directed surgery	1 = Surgery performed 2 = No surgery	IV: RQ3	Nominal
Radiation therapy (dichotomous)	Radiation recode	1= Radiation performed 2 = No radiation	IV: RQ3	Nominal
Chemotherapy (dichotomous)	Chemotherapy recode (yes/no/unk)	1 = Had chemotherapy 2 = No chemotherapy	IV: RQ3	Nominal
Systemic therapy and surgical procedure administered	RX summ systemic/sur seq	1 = No 2 = Given/sequence known 3 = Given but sequence unknown	IV: RQ3	Nominal

Variable	SEER*Stat variable name	Operational definition	Role in RQs	Measurement
Surgery and radiation therapies administered	RX summ-surg/rad seq	1 = No 2 = Given/sequence known 3 = Given but sequence unknown	IV: RQ3	Nominal
Patient status after treatment	Vital status recode (study cutoff used)	1 = Alive 2 = Dead	IV: RQ3	Nominal
Cervical cancer survival rate (dichotomous)	Survival months	1 = Under 60 months 2 = > 60 months	DV: RQ1, RQ2, RQ3	Nominal

Data Analysis Plan

An application on the use of the SEER database was submitted to the Walden Institutional Review Board (IRB) committee for approval to obtain and analyze the SEER Research Plus database before starting the study analysis. The application was approved, and the IRB approval number is 07-06-22-0935067. Quantitative data for the study was extracted from the SEER database using the SEER*Stat statistical software 8.3.9.2. I utilized the processes for obtaining the SEER data, viewed, and extracted individual cervical cancer records through the software, and generated the dataset from Cervix Uteri statistics for the study. The SEER data registry consists of information on the demographics, cancer identification, staging, treatment, follow-up, and death, required for the study. I checked for incorrectly entered or skipped data (missing data), saved it in excel format, and then transferred it to Statistical Package for the Social Sciences, IBM SPSS 28 software for windows for performing the data analyses. The process was essential to identify and minimize the impact of untoward errors or bias and to

communicate information and findings from the study. Also, during recoding and computing variables, responses to variables with three or more categories were changed to fewer responses to avoid bias due to classification errors.

Descriptive analyses of the categorical data reported in frequencies and percentages were performed for all the variables under investigation to summarize and characterize the data. Researchers opined that low SES, insurance status, race, age at diagnosis, marital status, and geographical location are associated with the stage of cervical cancer at diagnosis, which affects survival outcomes (Dunyo et al., 2018). Also, the SEER data described and assessed differences (disparities) in cancer incidence, mortality, survival, risk factors, outcomes, and trends among populations to guide interventions and public policy (Zahnd et al., 2018). The researchers also opined that the strength of consistency in the SEER registry for population-based data collection enhanced the validity and generalizability of studies utilizing data on individual cancer cases (Zahnd et al., 2018). Thus, to make sense of the data, frequency distribution and the graphical representation of the data were used to organize and summarize the data systemically to visually present and illustrate relationships in the data (Mishra et al., 2018).

Furthermore, the graphical or visual displays, e.g., the pie charts and bar graphs, showed the differences in frequencies or percentages among the nominal or ordinal variables from the study variables (Frankfort-Nachmias & Leon-Guerrero, 2018c, pp. 38-41; Mishra et al., 2018). Inferential analyses were performed to examine and draw conclusions about the association between the independent and dependent variables for

the study's various RQs. Interpretation of the data is essential by critically examining the results to ensure generalizability (Mishra et al., 2018). The chi-square tests were conducted to test the association between two cross-tabulated investigated characteristics to show that the variables were statistically independent (Frankfort-Nachmias & Leon-Guerrero, 2018b, p. 290). The chi-square was vital for the study to test the differences between the observed and expected frequencies; thus, there was no association between the variables if the null hypothesis were true (Frankfort-Nachmias & Leon-Guerrero, 2018b, p. 290). Following descriptive statistics of the sociodemographic characteristics by chi-square test, the correlational analysis was used for the study using binary logistic regression analysis. I conducted binary logistic regression models in all three RQs. I applied the data analysis methods and the logistic models for each RQ to test for the corresponding null hypothesis. The binary logistic regression analysis was essential in the study to estimate the value of a categorical DV using one or more independent categorical variables (the linear prediction model; Frankfort-Nachmias & Leon-Guerrero, 2018a, p. 325).

Analysis Plan Addressing the Research Questions and Hypotheses

The three RQs were described to show the analysis plan for each RQ.

RQ1: Is there a statistically significant association between race/ethnicity-related disparities in the age at diagnosis, the year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African Americans and White women?

$H_0$1: There is no statistically significant association between race/ethnicity-related disparities in the age at diagnosis, the year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African Americans and White women.

H_A1: There is a statistically significant association between race/ethnicity-related disparities in the age at diagnosis, the year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African Americans and White women.

RQ2: Is there a statistically significant association between race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African Americans and White women?

$H_0$2: There is no statistically significant association between race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African Americans and White women.

H_A2: There is a statistically significant association between race/ethnicity-related disparities in the diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at

diagnosis and the cervical cancer survival rate among African Americans and White women.

RQ3: Is there a statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status and the cervical cancer survival rate among African Americans and White women?

$H_0$3: There is no statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status and the cervical cancer survival rate among African Americans and White women.

H_A3: There is a statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status and the cervical cancer survival rate among African Americans and White women.

Table 4

Data Analysis Plan Showing Research Questions, Variables, and Statistical Tests

RQ	Dependent variable	Independent Variable	Covariate	Statistical tests	Purpose
RQ1	Cervical cancer survival rate	Age at diagnosis Marital status at diagnosis Year of diagnosis Geographical location	Race/ethnicity of participants	Chi-square test, binary logistic regression	Exploring the relationships between the categorical dependent and independent variables and to identify the odds of predicting the disparities in cervical cancer survival rate with the sociodemographic factors.
RQ2	Cervical cancer survival rate	Diagnostic method of confirmation Grade of tumor at diagnosis Histological type Stage of disease at diagnosis	Race/ethnicity of participants	Chi-square test, binary logistic regression	Exploring the relationships between the categorical dependent and independent variables and to identify the odds of predicting the disparities in cervical cancer survival rate with histopathologic factors.
RQ3	Cervical cancer survival rate	Surgical treatment Radiation therapy Chemotherapy Systemic therapy and surgical procedure administered Surgery and radiation therapies administered Patient status after treatment	Race/ethnicity of participants	Chi-square test, binary logistic regression	Exploring the relationships between the categorical dependent and independent variables and to identify the odds of predicting the disparities in cervical cancer survival rate with treatment-related factors.

Threats to Validity

The quality of data from the SEER database was essential for the quantitative cross-sectional research design to ensure minimal threats to the internal and external validity of the study. The nonrandom selection of a small sample size for the study results in selection bias and limits the generalizability of the study. Hence, selecting a large sample size from the SEER database eliminated the biases resulting from selecting a small sample size for the study. Also, in the same purview, conducting statistical analysis using a large sample size improved the generalizability of the study, thereby minimizing threats to external validity. Nationwide, the burden of cervical cancer reduced, but racial/ethnic and geographic disparities in cervical cancer still exist (Gibson et al., 2018). Moreover, African American women and women living in the Southern United States are at higher risk than Whites resulting in frustrations, apathy, and deaths (Gibson et al., 2018). Thus, specific populations are more susceptible to experimental mortality than others, which threatens the internal validity and can confound the effects of the experimental treatments if not controlled.

Ethical Procedures

Notably, the SEER data were de-identified and available for public use, and researchers collected information without permission. The data were anonymous, emphasizing the need to protect the participants and eliminate any risk of disclosing confidential information resulting in bias or conflict of interest in the study. Moreover, researchers opined that the risk of re-identification abounds in Big Data practices due to the deepening of the digital divide; hence, ensuring the participant's anonymity is critical

for the SEER database (Favaretto et al., 2020). However, access to the SEER Research Plus databases required a more rigorous process, including user authentication through an Institutional Account or a multiple-step request process for noninstitutional users.

Furthermore, I gained access to the SEER Research Plus database as a noninstitutional user, logged into the DATA Request System with a personal email account, completed the application form, acknowledged SEER Research Data Use Agreement, SEER Treatment Data Limitations, and Best Practices Assurance, submitted the form and verified the email address. Then, I downloaded, installed, and logged on, gaining access to the current version of the SEER*Stat program using the SEER*Stat username and temporary password. Additionally, I applied ethics of professionalism and ensured integrity when handling the SEER data throughout the dissertation process and beyond. No other person had access to the SEER data stored and securely saved on a personal computer with a protected password file for access and processing. Upon completing the dissertation, the data will be destroyed and permanently deleted from the computer five years after completion of the dissertation.

Summary

In Section 2, I described the cross-sectional research design and methods to determine the significant relationships between the race/ethnicity-related disparities in the age at diagnosis, the year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, stage of disease at diagnosis, mode of treatment, and treatment outcome/status, with cervical cancer survival rate. Also, I identified the dependent, independent, and covariate variables and utilized the codebook

for the SEER Research Plus data, 18 Registries, Nov 2019, Sub 2000-2017. I provided a rationale for conducting a well-designed observational study, including clearly defined RQs, careful selection of an appropriate data source, and the inclusion of data analysis plans. I described the external and internal validity threats appropriate to the study. I also described ethical procedures related to institutional permissions, recruitment, data collection and storage, confidentiality, and concerns related to confidential data. Then, based on the methodologies described in the present section, I presented the study results and findings in the following section (Section 3).

Section 3: Presentation of the Results and Findings

Introduction

This quantitative cross-sectional study's research design, rationale, methodology, and ethical considerations were described and justified in Section 2. In Section 3, I present the results and findings of the statistical analyses. Additionally, I describe the data collection methods of the secondary data set, the time frame for data collection, and the sample's demographic characteristics. Next, I present tables and figures to illustrate the results and report the baseline descriptive and inferential statistics that appropriately characterize the sample. Finally, I summarize the statistical analyses to test the RQs and corresponding hypotheses by providing the answers to each RQ.

The purpose of this quantitative study was to assess whether there was a significant relationship between sociodemographic, histopathologic, and treatment-related factors on racial/ethnic disparities in cervical cancer survival outcomes among African Americans and White women in the United States. The following RQs and corresponding hypotheses were evaluated in this study:

RQ1: Is there a statistically significant association between the independent categorical variables (race/ethnicity, age at diagnosis, year of diagnosis, marital status, and geographical location) and the cervical cancer survival rate (categorical DV) among African American and White women?

$H_0$1: There is no statistically significant association between race/ethnicity-related disparities in age at diagnosis, year of diagnosis, marital status, and geographical location and the

cervical cancer survival rate among African American and White women.

H_A1: There is a statistically significant association between race/ethnicity-related disparities in age at diagnosis, year of diagnosis, marital status, and geographical location and the cervical cancer survival rate among African American and White women.

RQ2: Is there a statistically significant association between the independent categorical variables (race/ethnicity, diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis) and the cervical cancer survival rate (categorical DV) among African American and White women?

$H_0 2$: There is no statistically significant association between race/ethnicity-related disparities in diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African American and White women.

$H_A 2$: There is a statistically significant association between race/ethnicity-related disparities in diagnostic confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis and the cervical cancer survival rate among African American and White women.

RQ3: Is there a statistically significant association between the independent categorical variables (race/ethnicity, mode of treatment [surgery, radiation therapy, chemotherapy, and combination therapies], and treatment outcome/status) and the cervical cancer survival rate (categorical DV) among African American and White women?

$H_0$3: There is no statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status and the cervical cancer survival rate among African American and White women.

H_A3: There is a statistically significant association between race/ethnicity-related disparities in the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies) and treatment outcome/status and the cervical cancer survival rate among African American and White women.

Accessing the Data Set for Secondary Analysis

The study's secondary data, the Incidence-SEER Research Plus Data, 18 Registries, November 2019 Submission (2000–2017) for cases diagnosed from 1975 to 2017, were collected from the NCI's SEER database. The SEER program collects and publishes comprehensive data on cancer incidence and survival from population-based cancer registries in the U.S. population (NCI, n.d.). Besides, the participants were recruited from Alaska, California, Connecticut, Georgia, Hawaii, Idaho, Iowa, Kentucky,

Louisiana, Massachusetts, Detroit (Metropolitan), New Jersey, New Mexico, New York, Utah, and Seattle (Puget Sound) within the SEER registries from California and Georgia. I was granted permission to access the SEER Research Plus database as a noninstitutional user with a verified email account. Additionally, I logged into the DATA Request System, completed the application form, and acknowledged the SEER Research Data Use Agreement, SEER Treatment Data Limitations, and Best Practices Assurance, emphasizing adherence to the SEER database guidelines for data usage. Afterward, I downloaded, installed, and logged on, gaining access to the current version of the SEER*Stat program using the SEER*Stat username and temporary password. I applied ethics of professionalism and ensured integrity when handling the SEER data. The SEER*Stat statistical software 8.3.9.2 extracted individual cervical cancer records and generated the study's statistical dataset. The subsample (eligible participants) included all individuals of African American and White races/ethnicity diagnosed with primary cervical cancer in the case listing session from 2000 through 2017. The variables selected for data collection included race/ethnicity of participants, age at diagnosis, marital status at diagnosis, year of diagnosis, geographical location, diagnostic method of confirmation, grade of tumor at diagnosis, histological type, stage of disease at diagnosis, surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, patient status after treatment, and cervical cancer survival rate.

Although 63,242 participants registered in the SEER database had cervical cancer, only 56,388 (89.2%) were eligible for the study. Hence, 6,854 (10.8%) participants from

other races/ethnicities diagnosed with primary cervical cancer were excluded from the study. Therefore, as explained previously, only Whites and African Americans were included in the sample (White; n = 47,407 [84.1%], African American; n = 8,981 [15.9%]), as shown in Figure 1. The operationalization of the data revealed the total number of predictors N = 15 for the study; however, there were no invalid responses for all the IVs selected for the study. The study sample had only n = 343 (0.6%) invalid responses (missing data) for the DV cervical cancer survival rate.

Study Results

Chi-square tests were conducted to investigate the differences between the observed and expected frequencies in all three RQs and if there was no relationship between the variables if the null hypothesis were true. Additionally, I conducted binary logistic regression analyses for all three RQs to investigate the association between one or more independent categorical variables and a categorical DV and the odds of predicting the disparities in sociodemographic, histopathological, and treatment-related factors and cervical cancer survival rate. Further, the application of the data analysis methods and the logistic models for each RQ tested for the corresponding null hypothesis.

Descriptive and Demographic Characteristics of the Sample

Descriptive analyses of the categorical data were reported in frequencies and percentages and performed for all the variables under investigation to summarize and characterize the data. Additionally, the graphical or visual displays, with the pie charts and bar graphs, showed the differences in frequencies or percentages among the

categorical variables from the study variables. The frequency and percentage summaries of the sociodemographic, histopathologic, and treatment-related factors with the cervical cancer survival rates among African American and White women were reported. The sociodemographic variables included race/ethnicity of participants (CV), age at diagnosis (IV), marital status at diagnosis (IV), year of diagnosis (IV), and geographical location (IV). The histopathologic variables included diagnostic method of confirmation (IV), grade of tumor at diagnosis (IV), histological type (IV), and stage of disease at diagnosis (IV). The treatment-related factors were surgical treatment (IV), radiation therapy (IV), chemotherapy (IV), systemic therapy and surgical procedure administered (IV), surgery and radiation therapies administered (IV), and patient status after treatment (IV). The DV was the cervical cancer survival rate. The codebook of variables for the data analysis is outlined in Table 5.

The sample comprised White (n = 47,407; 84.1%) and African American (n = 8,981; 15.9%) participants with cervical cancer registered in the SEER database, as shown in Table 6. In the study, 11,065 (19.6%) of the participants were aged 46–55 years, with 30,448 (54%) participants aged 19–45 years, 7,486 (13.3%) aged 56–65 years, 4,310 (7.6%) aged 66–75 years, and 483 (0.9%) less than 18 years old. Only 4.6% (2597) of the participants were 76 years of age and older. In the United States, cervical cancer mostly affects women aged 20 to 39 years (Pan et al., 2021); thus, the finding correlated with the current study, where about 55% of the participants were 45 years old or younger. Figure 2 shows a bar chart representation of the age of the participants.

Though the marital statuses of 3,422 (6.1%) participants were unknown, less than 42% of participants were not legally married (*n* = 22,911; 40.6%), 10.5% (*n* = 5,900) were widowed, and 42.8% (*n* = 24,155) were legally married. Figure 3 is a bar chart representation of the marital status at diagnosis. The proportion of cervical cancer diagnosed from 2003 to 2007 (*n* = 15,683; 27.8%) fell by 0.5% from 2008 to 2012 (*n* = 15,389; 27.3%). As shown in Figure 4, the proportion of cervical cancer diagnosed from 2013 to 2017 fell by 0.5%. Only 18.1% (*n* = 10,204) were diagnosed before 2002 for the study. The disease incidence decreased by about 0.1% per year between 2003 and 2017. The participants in California (*n* = 22,525; 39%) and Hawaii (*n* = 237; 0.4%) represented the locations with the highest and lowest frequencies in the data. There were no data recorded for Alaska Natives; hence, Alaska Natives were excluded from the sample. Whereas Georgia (*n* = 7,065; 12.5%) and New Jersey (*n* = 7,072; 12.5%) represented 25% of the sample concerning geographical location, Utah (*n* = 1,093; 1.9%) and New Mexico (*n* = 1,279; 2.3%) comprised less than 5% of the sample participants. Geographical location information is visually displayed in Figure 5.

The presence of cervical cancer was confirmed during the entire course of the disease via histology, cytology, immunophenotyping, and microscopy, making up 98% (*n* = 55,283) of all the samples. About 1.4% (*n* = 751) were unknown, and 0.6% (*n* = 354) were not microscopically confirmed but confirmed via laboratory test, direct visualization, radiology, and clinical diagnosis. Figure 6 visually displayed the percentages of diagnostic method of confirmation. Although 31% (*n* = 17,492) of participants reported unknown tumor grade at diagnosis, Grade I/well-differentiated

tumor (*n* = 5,370; 9.5%), Grade II/moderately differentiated tumor (*n* = 16,226; 28.8%), Grade III/poorly differentiated tumor (*n* = 15,903; 28.2%), and Grade IV/ undifferentiated, anaplastic tumor (*n* = 1,397; 2.5%) made up the cervical cancer cases (see Figure 7). At more than 40% (*n* = 25,269; 44.8%), squamous cell carcinoma represented the most common of the histologic types, followed by adenocarcinoma (*n* = 7,682; 13.6%), and they both made up almost 59% of the histological types for the study. Notably, 27.8% of the participants' histological types comprised squamous cell carcinoma, nonkeratinizing (*n* = 5,166; 9.2%), squamous cell carcinoma, keratinizing (*n* = 4,092; 7.3%), squamous cell carcinoma, microinvasive (*n* = 2,048; 3.6%), adenosquamous carcinoma (*n* = 1,987; 3.5%), adenocarcinoma, endocervical type (*n* = 1,408; 2.5%), and endometroid carcinoma (*n* = 957; 1.7%). Other histological types not listed in the above types made up 7.3% (*n* = 7,779) of the participants' histological types. Figure 8 displays percentages of histological types.

Furthermore, 41% (*n* = 23,139) of cervical cancers were diagnosed at a localized stage, 32.5% (*n* = 18,327) were diagnosed at a regional stage, and 10.8% (*n* = 6,078) were diagnosed at a distant stage. The proportion of unstaged cervical cancers was 15.7% (*n* = 8,844). In the study, 56.3% (*n* = 31,743) of women diagnosed with cervical cancer had surgery, while 43.7% (*n* = 24,645) did not have surgery performed during treatment. Also, 52.3% (*n* = 29,497) of women diagnosed with cervical cancer received radiation therapy, whereas 47.7% (*n* = 26,891) did not. Almost 56% (*n* = 31,480; 55.8%) did not receive chemotherapy, while 44.2% (*n* = 24,908) received chemotherapy. A total of 11.8% (*n* = 6,641) had sequencing of both systemic therapy and surgical procedures

administered as part of the first course of treatment. However, 37.1% (*n* = 20,943) of the participants received systemic therapy and surgery, but the therapy sequence was unknown. Thus, 48.9% (*n* = 27,584) had both systemic therapy and surgery (combination therapy), and 51.1% (*n* = 28,804) did not. About 77.6% (*n* = 43,782) of the participants never had surgery and radiation therapy administered together (combination therapy), while 22.4% (*n* = 12,606) had both surgery and radiation therapy. Of the participants who had combination therapy, the sequence was known in 22.2% (*n* = 12,494), and unknown in 0.2% (*n* = 112), respectively. After treatment, the patient status revealed that 38.6% (*n* = 21,766) were dead, and 61.4% were listed as alive throughout the study. In Figure 17, follow-up at 60 months showed 56.1% (*n* = 31,629) of participants, and beyond 60 months, 43.3% (*n* = 24,416); however, 343 were missing from the final sample (lost from follow-up).

Table 5

The Codebook of the Variables for the Data Analysis

Variable	Measurement	Values recoded from SEER*Stat variable	Variable role
Cervical cancer survival rate	Nominal	MMMM	Dependent variable
Cervical cancer survival rate (dichotomous)	Nominal	1 = under 60 months 2 = > 60 months	
Race/ethnicity of participants	Nominal	1 = African American 2 = White	Covariate variable
Age at diagnosis	Ordinal	1 = Under 18 years 2 = 19–45 years 3 = 46–55 years 4 = 56–65 years 5 = 66–75 years 6 = 76+ years	Independent variable
Year of diagnosis	Nominal	1 = 2002 or earlier 2 = 2003–2007 3 = 2008–2012 4 = 2013–2017	Independent variable
Marital status at diagnosis	Nominal	1 = Legally married 2 = Not legally married 3 = Widowed 4 = Unknown	Independent variable
Geographical location	Nominal	1 = Alaska Natives 2 = California 3 = Connecticut 4 = Detroit (Metropolitan) 5 = Georgia 6 = Hawaii 7 = Iowa 8 = Kentucky 9 = Louisiana 10 = New Jersey 11 = New Mexico 12 = Seattle (Puget Sound) 13 = Utah	Independent variable
Diagnostic method of confirmation	Nominal	1 = Microscopically confirmed 2 = Not microscopically confirmed 3 = Unknown	Independent variable
Grade of tumor at diagnosis	Nominal	1 = Well differentiated/Grade I 2 = Moderately differentiated/Grade II	Independent variable

Variable	Measurement	Values recoded from SEER*Stat variable	Variable role
		3 = Poorly differentiated/Grade III 4 = Undifferentiated, anaplastic/Grade IV 5 = Unknown	
Histological type	Nominal	1 = Squamous cell carcinoma, NOS 2 = Adenocarcinoma 3 = Squamous cell carcinoma nonkeratinizing, NOS 4 = Squamous cell carcinoma keratinizing, NOS 5 = Adenosquamous carcinoma 6 = Squamous cell carcinoma, microinvasive 7 = Adenocarcinoma, endocervical type 8 = Endometroid carcinoma 9 = Other types	Independent variable
Stage of disease at diagnosis	Nominal	1 = Localized 2 = Regional 3 = Distant 4 = Unstaged	Independent variable
Surgical treatment (dichotomous)	Nominal	1 = Surgery performed 2 = No surgery	Independent variable
Radiation therapy (dichotomous)	Nominal	1 = Radiation performed 2 = No radiation	Independent variable
Chemotherapy (dichotomous)	Nominal	1 = Had chemotherapy 2 = No chemotherapy	Independent variable
Systemic therapy and surgical procedure administered	Nominal	1 = No 2 = Given/sequence known 3 = Given but sequence unknown	Independent variable
Surgery and radiation therapies administered	Nominal	1 = No 2 = Given/sequence known 3 = Given but sequence unknown	Independent variable
Patient status after treatment	Nominal	1 = Alive 2 = Dead	Independent variable

Table 6

Frequency and Percentage Summaries of the Variables

Variables	Values	Frequency	Percent	Cumulative percent
Race/ethnicity of participants	African American	8,981	15.9	15.9
	White	47,407	84.1	100.0
Age at diagnosis	Under 18 years	483	0.9	0.9
	19-45 years	30,448	54.0	54.9
	46-55 years	11,064	19.6	74.5
	56-65 years	7,486	13.3	87.8
	66-75 years	4,310	7.6	95.4
	76+ years	2,597	4.6	100.0
Marital status at diagnosis	Legally married	24,155	42.8	42.8
	Not legally married	22,911	40.6	83.4
	Widowed	5,900	10.5	93.9
	Unknown	3,422	6.1	100.0
Year of diagnosis	2002 or earlier	10,204	18.1	18.1
	2003-2007	15,683	27.8	45.9
	2008-2012	15,389	27.3	73.2
	2013-2017	15,112	26.8	100.0
Geographical location	Alaska Natives	0	0.0	0.0
	California	22,525	39.0	39.0
	Connecticut	2,117	3.8	43.7
	Detroit (Metropolitan)	2,913	5.2	48.9
	Georgia	7,065	12.5	61.4
	Hawaii	237	0.4	61.8
	Iowa	1,928	3.4	65.2
	Kentucky	3,751	6.7	71.9
	Louisiana	3,879	6.9	78.8
	New Jersey	7,072	12.5	91.3
	New Mexico	1,279	2.3	93.6
	Seattle (Puget Sound)	2,529	4.5	98.1
	Utah	1,093	1.9	100.0
Diagnostic method of confirmation	Microscopically confirmed	55,283	98.0	98.0
	Not microscopically confirmed	354	0.6	98.6
	Unknown	751	1.4	100.0
Grade of tumor at diagnosis	Well differentiated/I	5,370	9.5	9.5
	Moderately differentiated/II	16,226	28.8	38.3

Variables	Values	Frequency	Percent	Cumulative percent
	Poorly differentiated/III	15,903	28.2	66.5
	Undifferentiated, anaplastic/IV	1,397	2.5	69.0
	Unknown	17,492	31.0	100.0
Histological type	Squamous cell carcinoma, NOS	25,269	44.8	44.8
	Adenocarcinoma	7,682	13.6	58.4
	Squamous cell carcinoma, nonkeratinizing, NOS	5,166	9.2	67.6
	Squamous cell carcinoma, keratinizing, NOS	4,092	7.3	74.9
	Adenosquamous carcinoma	1,987	3.5	78.4
	Squamous cell carcinoma, microinvasive	2,048	3.6	82.0
	Adenocarcinoma, endocervical type	1,408	2.5	84.5
	Endometroid carcinoma	957	1.7	86.2
	Others	7,779	13.8	100.0
Stage of disease at diagnosis	Localized	23,139	41.0	41.0
	Regional	18,327	32.5	73.5
	Distant	6,078	10.8	84.3
	Unstaged	8,844	15.7	100.0
Surgical treatment	Surgery performed	31,743	56.3	56.3
	No surgery	24,645	43.7	100.0
Radiation therapy	Radiation performed	29,497	52.3	52.3
	No radiation	26,891	47.7	100.0
Chemotherapy	Had chemotherapy	24,908	44.2	44.2
	No chemotherapy	31,480	55.8	100.0
Systemic therapy and surgical procedure administered	No	28,804	51.1	51.1
	Given/sequence known	6,641	11.8	62.9
	Given but sequence unknown	20,943	37.1	100.0
Surgery and radiation therapies administered	No	43,782	77.6	77.6
	Given/sequence known	12,494	22.0	99.8
	Given but sequence unknown	112	0.2	100.0

Variables	Values	Frequency	Percent	Cumulative percent
Patient status after treatment	Alive	34,622	61.4	61.4
	Dead	21,766	38.6	100.0
Cervical cancer survival rate (dichotomous)	Under 60 months	31,629	56.1	56.4
	>60 months	24,416	43.3	43.6
	Missing	343	0.6	100.0

Figure 1

Bar Chart Showing Race/Ethnicity of Participants

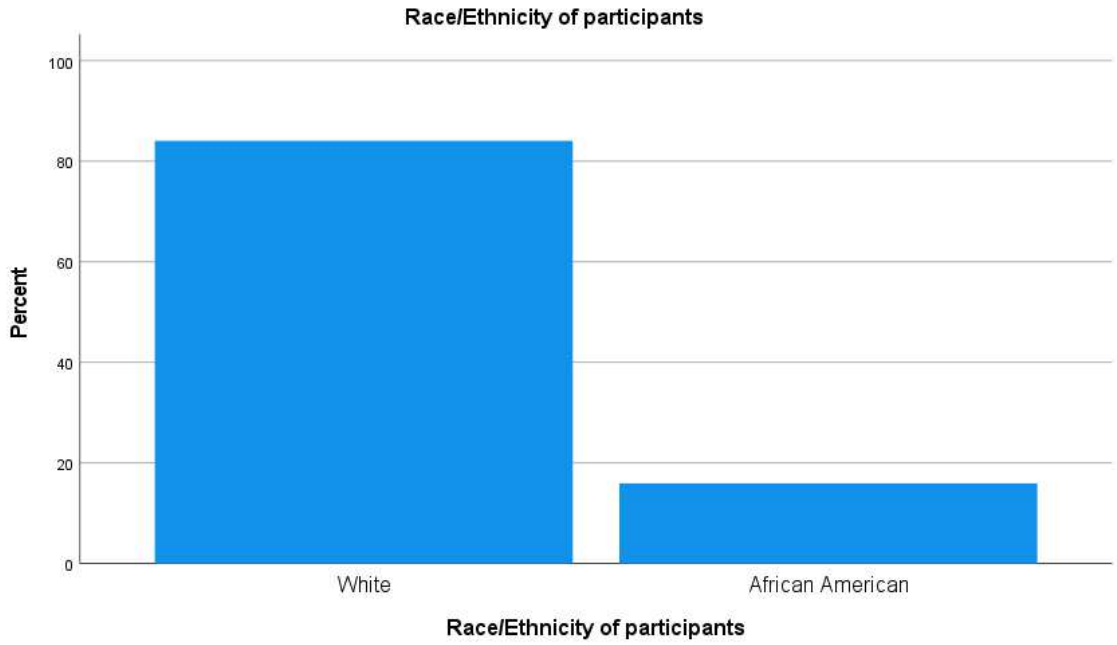


Figure 2

Bar Chart Showing Age at Diagnosis of Participants

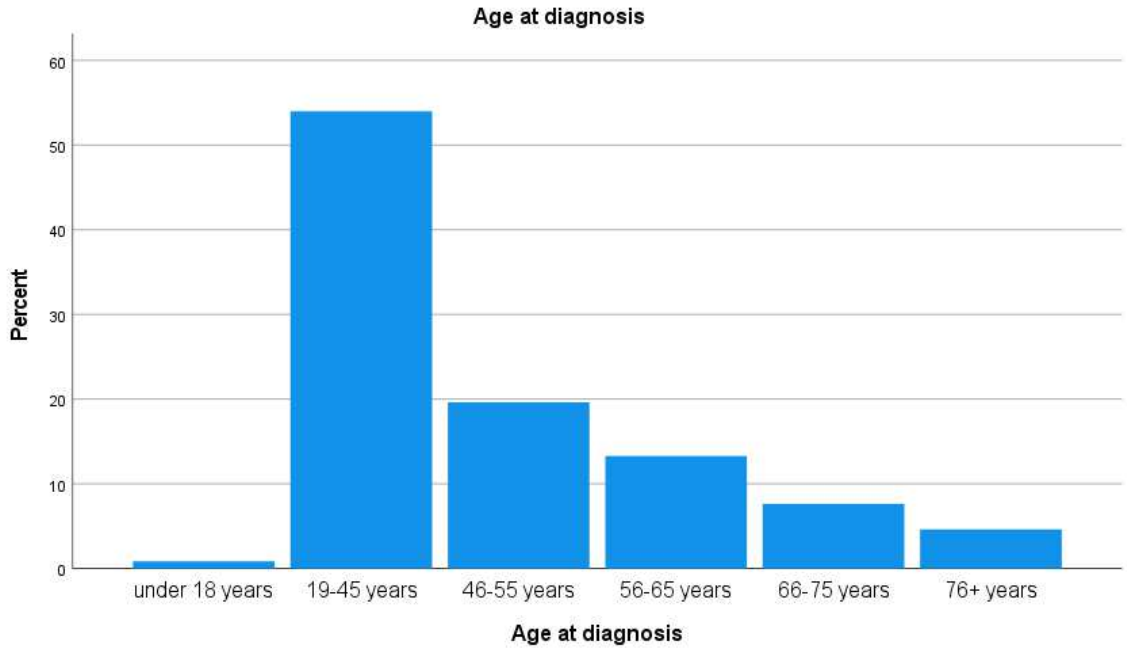


Figure 3

Bar Chart Showing Marital Status of Participants

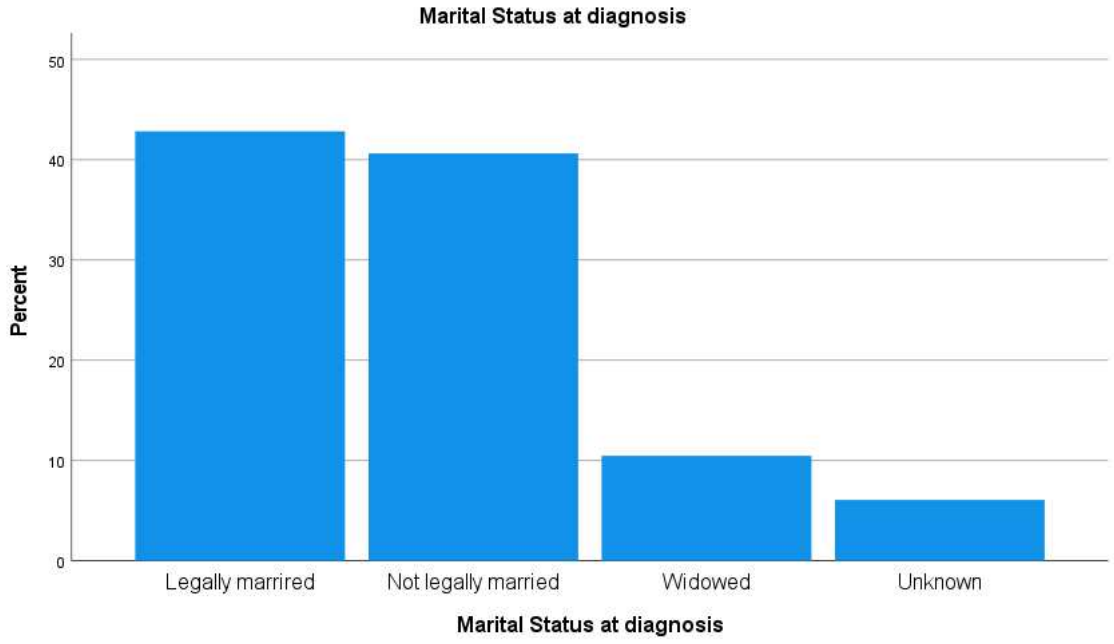


Figure 4

Bar Chart Showing Year of Diagnosis of Participants

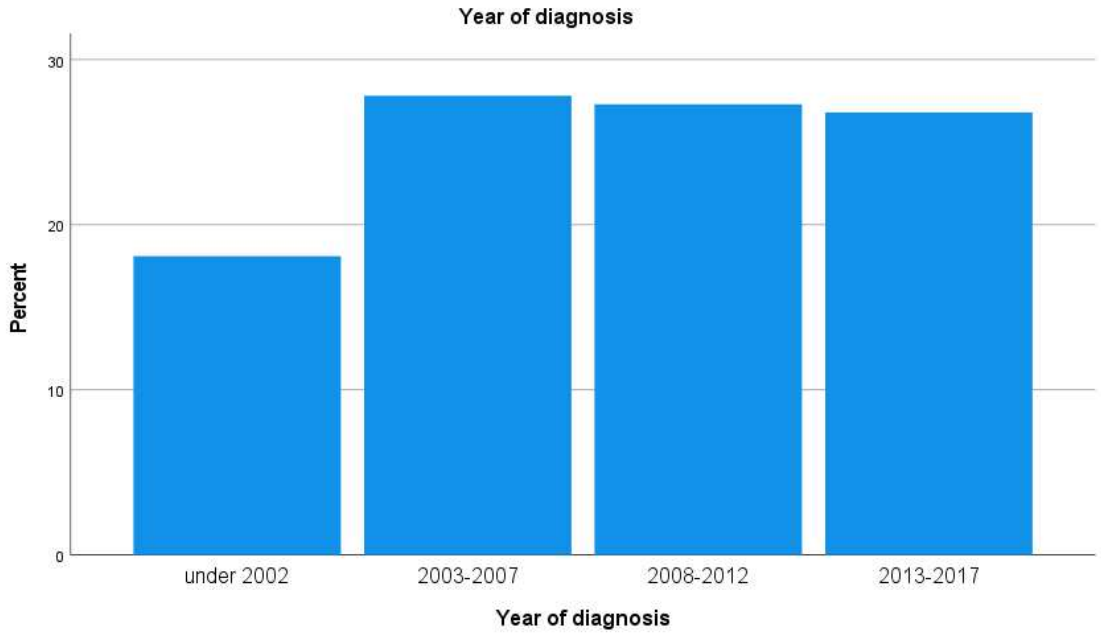


Figure 5

Bar Chart Showing Geographical Locations of Participants

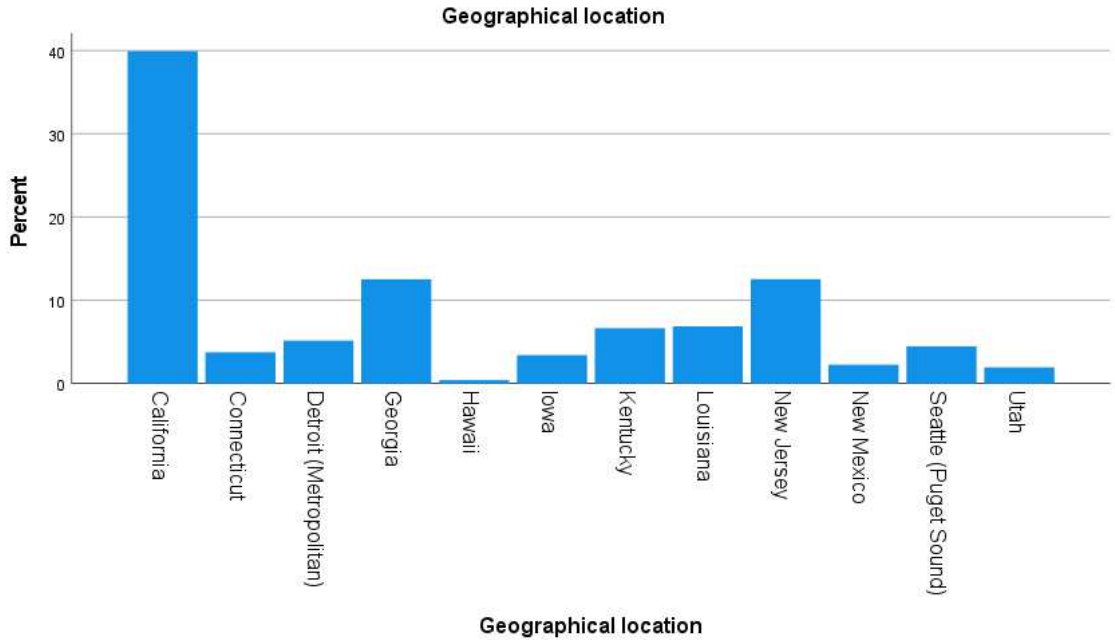


Figure 6

Pie Chart Showing Diagnostic Method of Confirmation

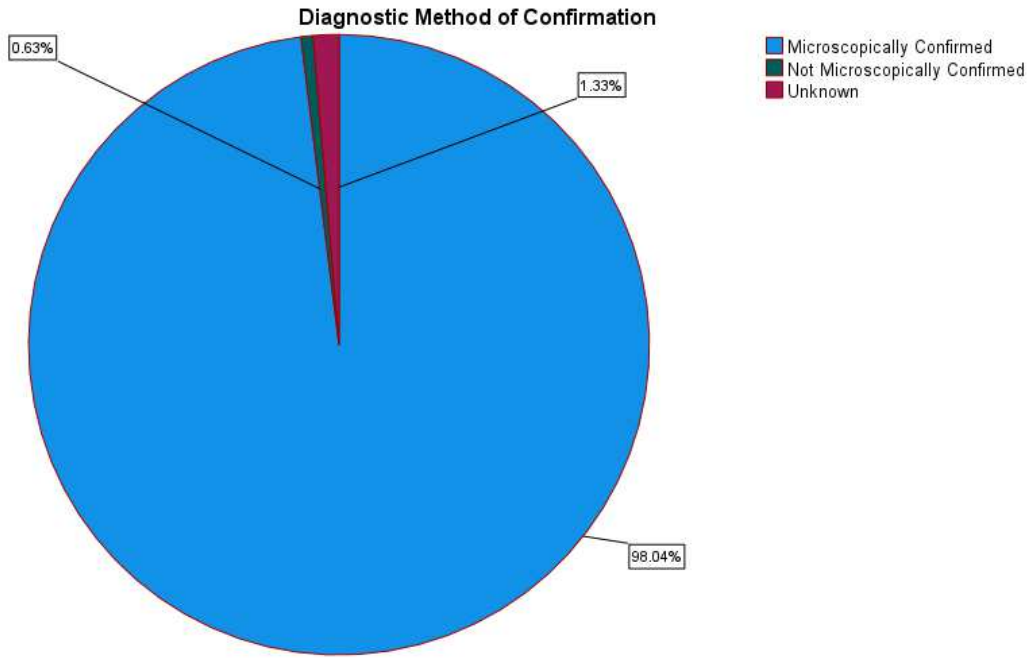


Figure 7

Bar Chart Showing Grade of Tumor at Diagnosis

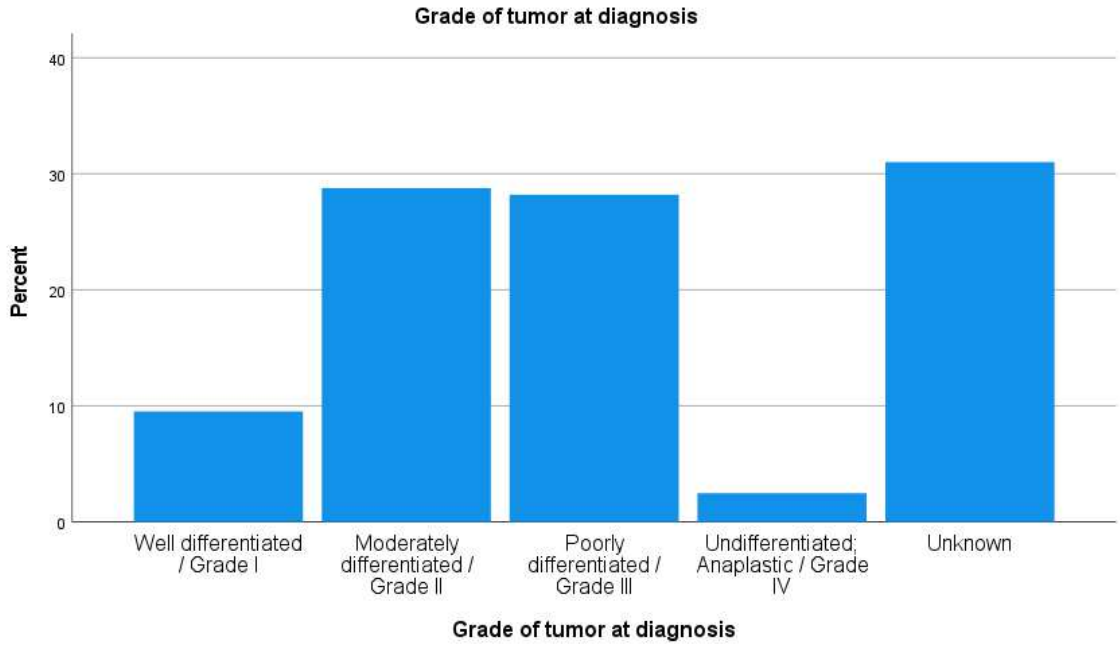


Figure 8

Bar Chart Showing Histological Type

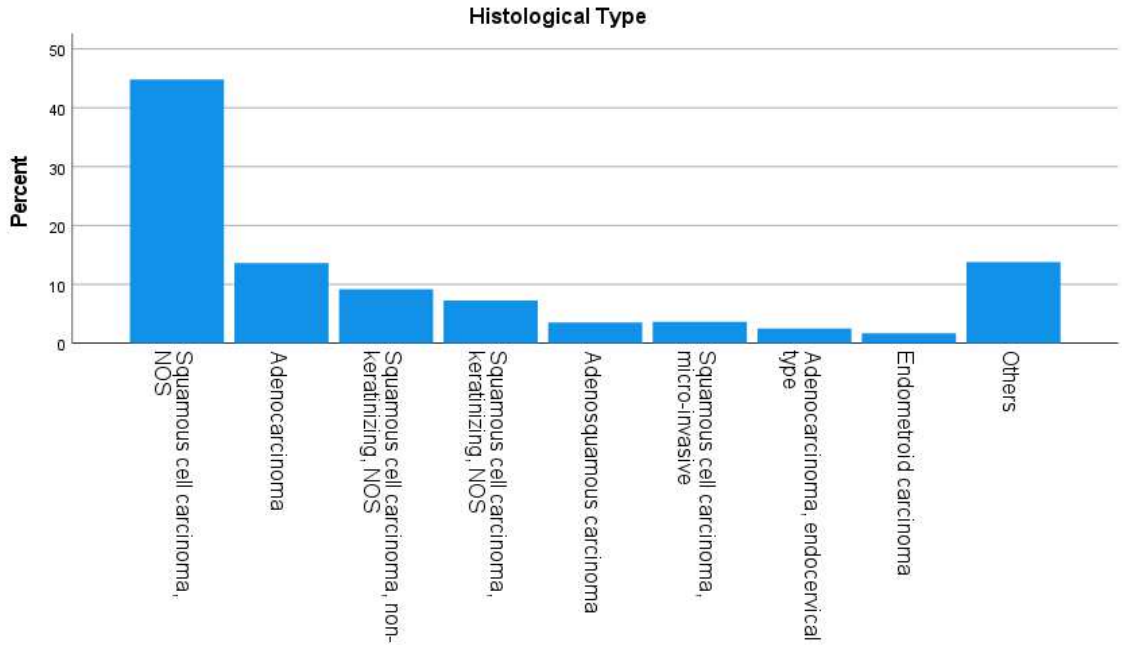


Figure 9

Bar Chart Showing Stage of Disease at Diagnosis

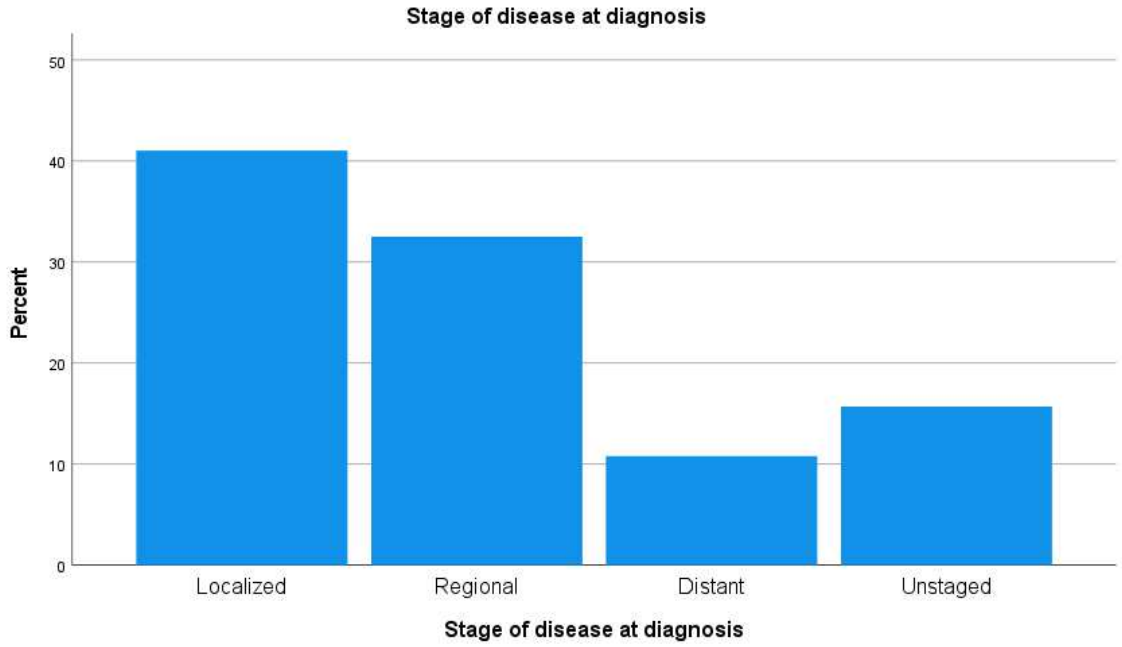


Figure 10

Bar Chart Showing Surgical Treatment

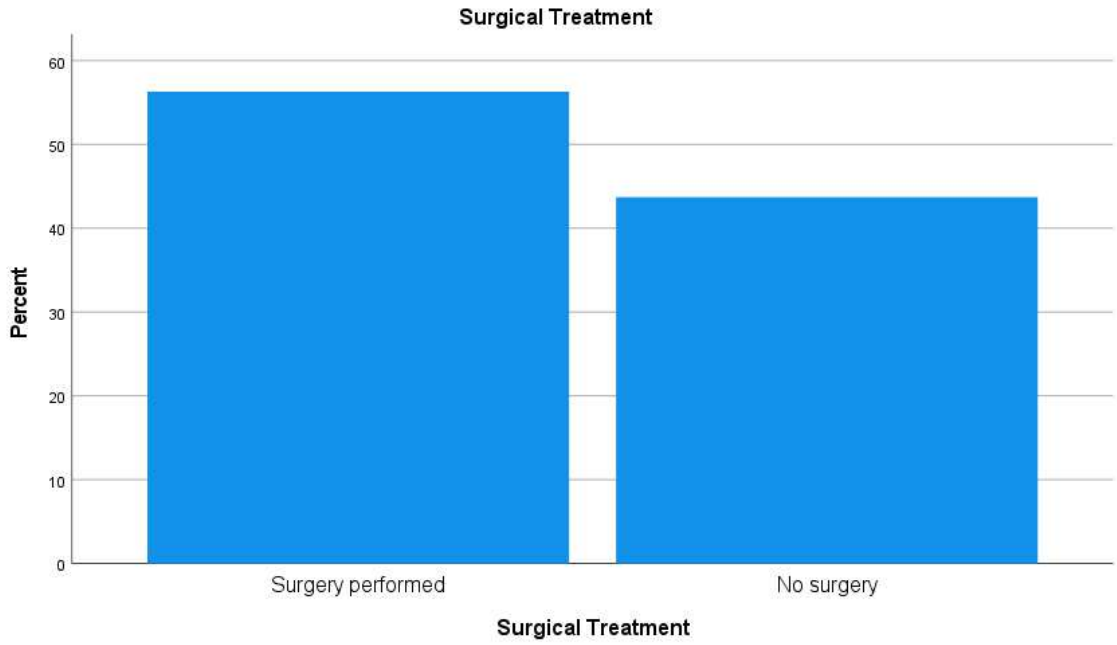


Figure 11

Bar Chart Showing Radiation Therapy

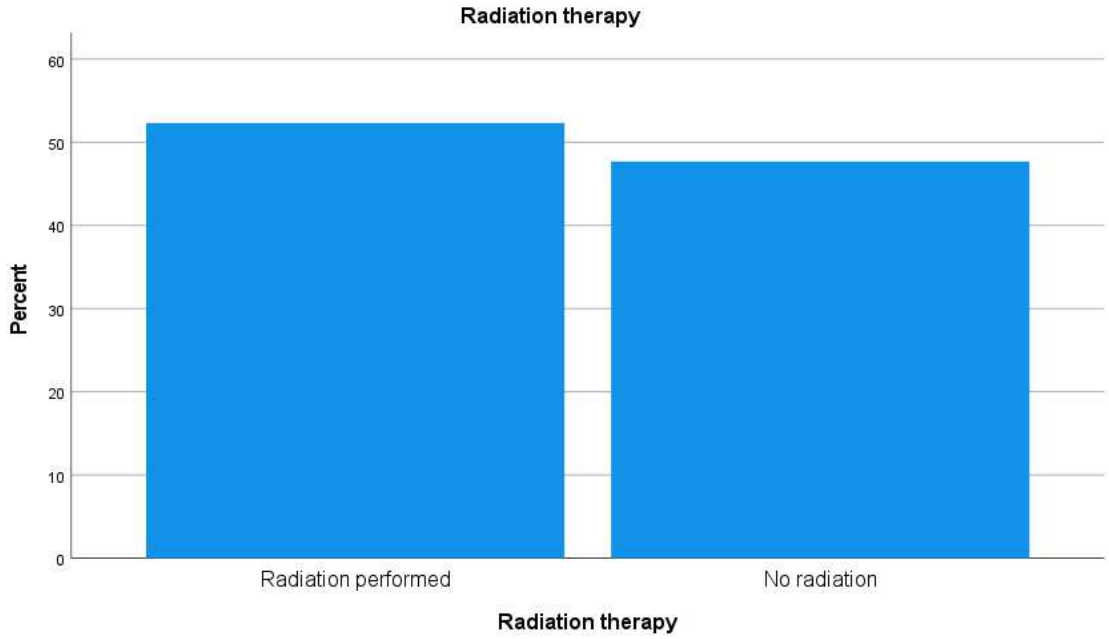


Figure 12

Bar Chart Showing Chemotherapy

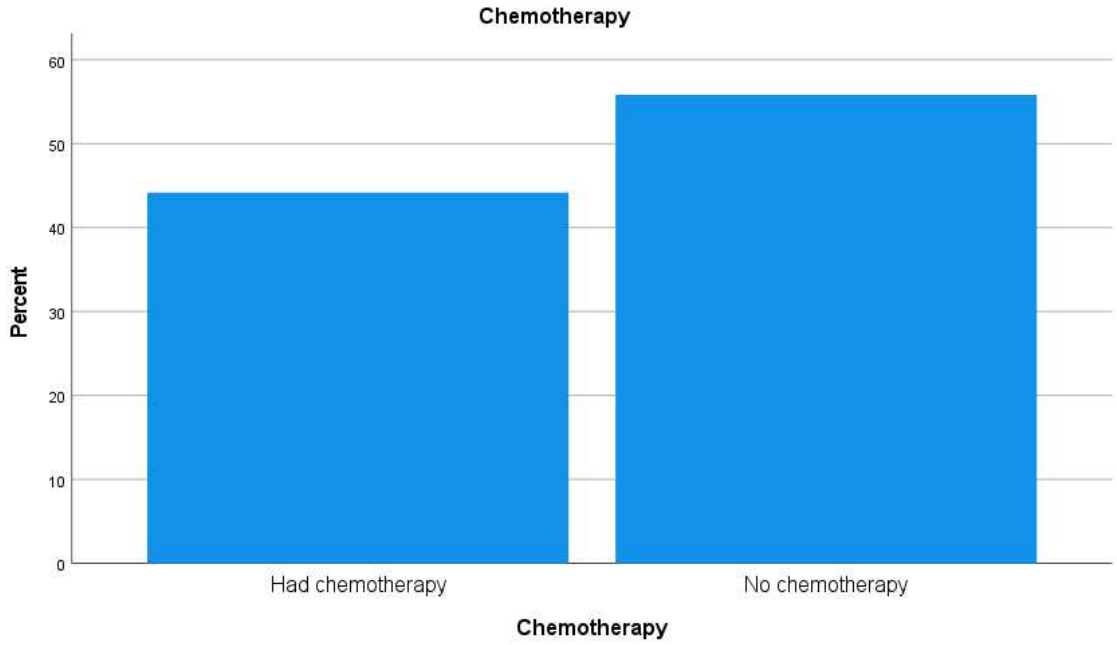


Figure 13

Bar Chart Showing Systemic Therapy and Surgical Procedure Administered

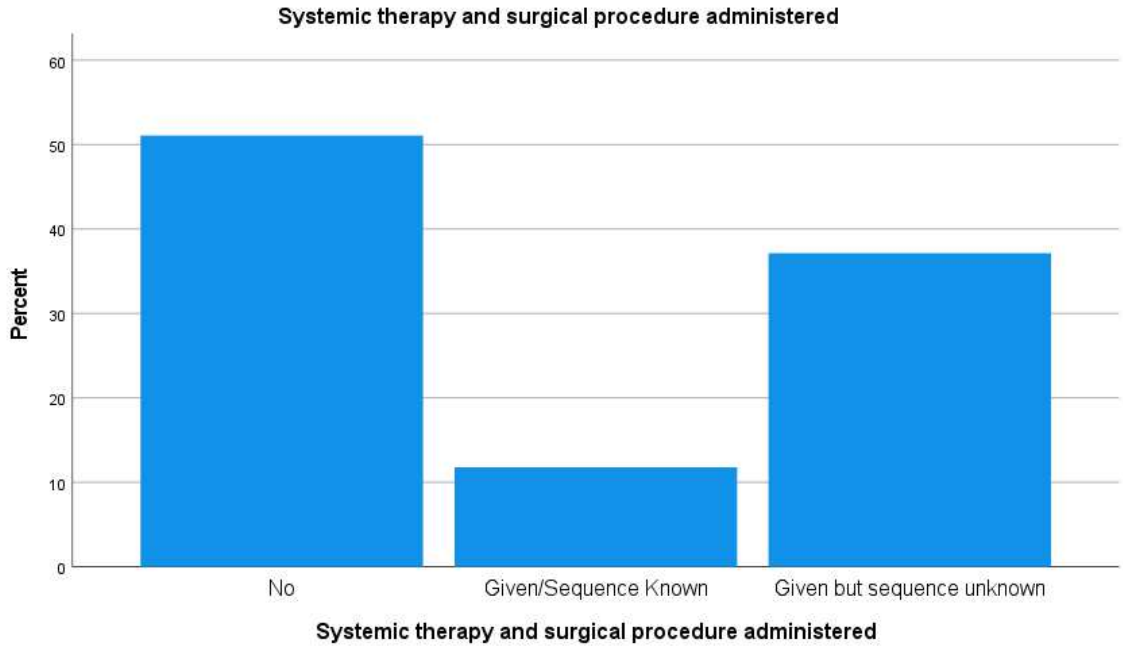


Figure 14

Bar Chart Showing Surgery and Radiation Therapies Administered

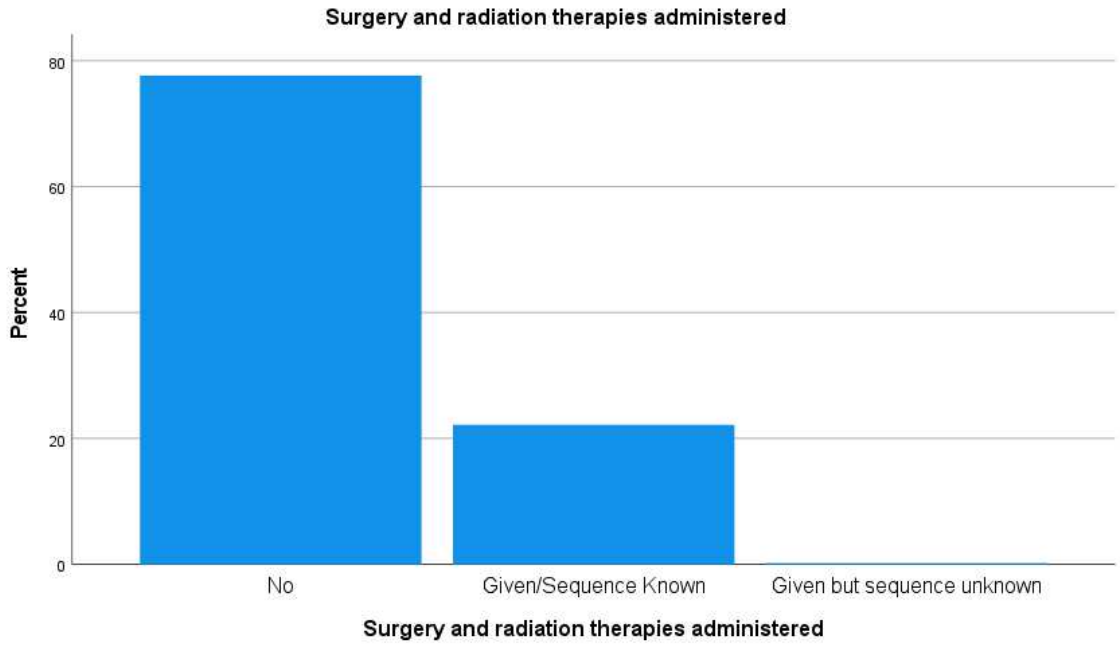


Figure 15

Bar Chart Showing Patient Status After Treatment

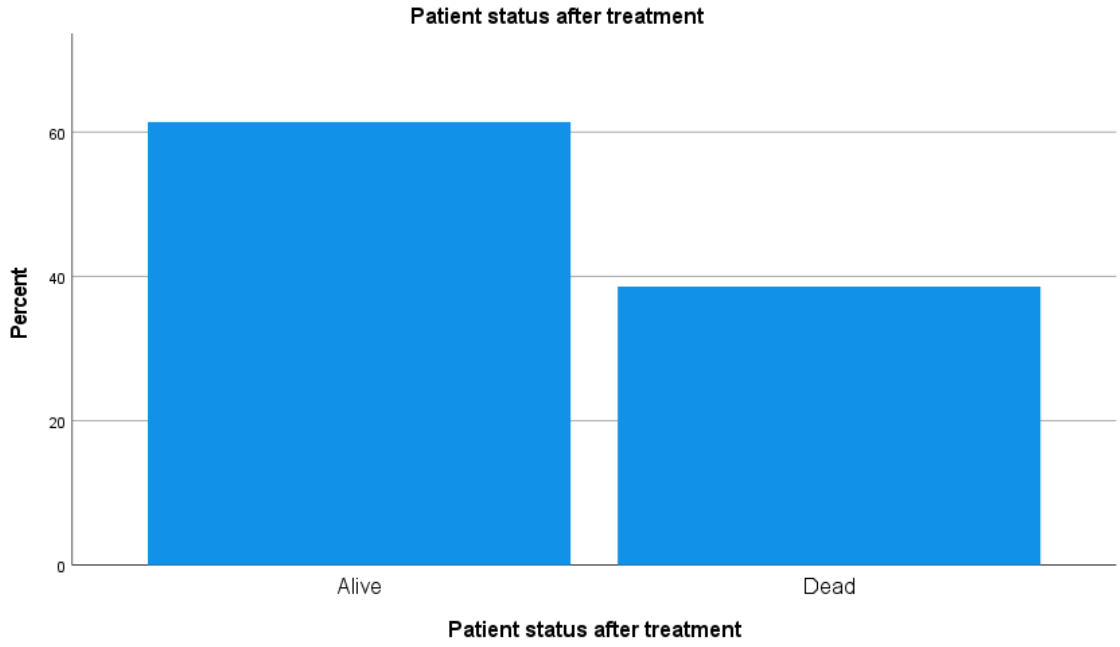


Figure 16

Bar Chart Showing Cervical Cancer Survival Rate

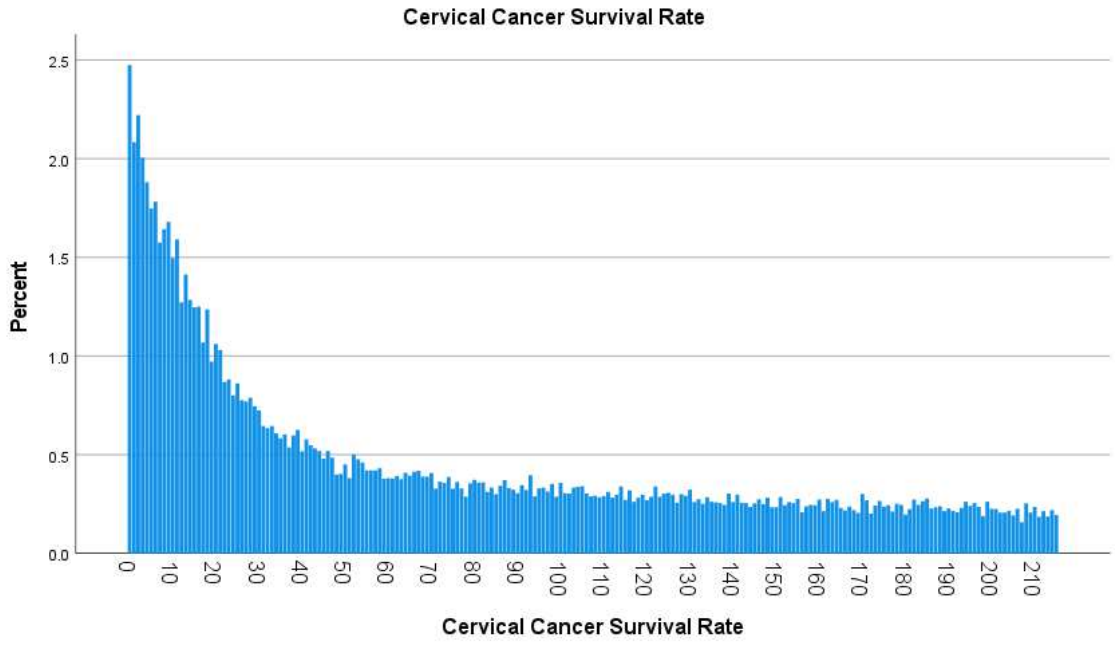
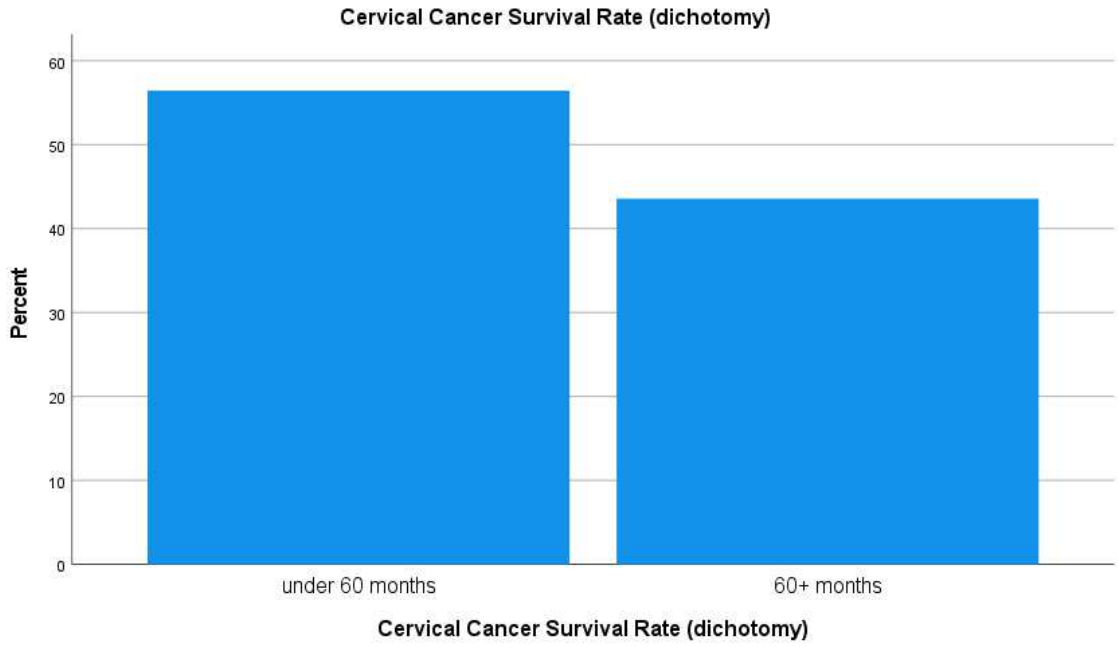


Figure 17

Bar Chart Showing Cervical Cancer Survival Rate (Dichotomized)



Chi-Square Test for Univariate Analysis and Independence of Categorical Variables

Approximately 84% and 87.4% of the respondents who reported race as African Americans, and Whites were between 19 and 65 years of age (see Table 7). Most of the respondents, 48.5% (*n* = 4,358) for African Americans and 55% (*n* = 26,090) for Whites, were aged 19 to 45 years. One percent of the respondents were African Americans (1%, *n* = 88) or Whites (0.8% [~1%], *n* = 395), and they make up about 1% (0.9%, *n* = 483) of all patients (under 18 years) included in the study. More than 15% of respondents aged 66-75 years (*n* = 820, 9.1%) and 76 years and older (*n* = 535, 6%) were African Americans, while less than 12% of Whites aged 66-75 (*n* = 3,490, 7.4%) and 76 years and older (*n* = 2,062, 4.3%), respectively, had cervical cancer. Compared to White women, higher percentages of African American women were in the older age groups.

Only 26% (*n* = 2,331) of African Americans and 46% (*n* = 21,824) of Whites reported being legally married. Compared to Whites (*n* = 18,067, 38.1%), more than 50% of African Americans (*n* = 4,844, 53.9%) were not legally married. Also, there were more widowed participants for African Americans (13.8%) than Whites (9.8%), respectively. Additionally, 28.4% (*n* = 2,549) of African Americans and 27.7% (*n* = 13,134) of Whites, make up the incidence of cervical cancers reported from 2003 to 2007, respectively. However, the incidence was almost the same for African Americans and Whites from 2008 to 2012 (27.4%; *n* = 2,458 vs. 27.3%; *n* = 12,931) and from 2013 to 2017 (26.45%; *n* = 2,372 vs. 26.9%; *n* = 12,740), where more than 25% presented with cervical cancer, respectively. A higher percentage of African American women were selected from Detroit (Metropolitan [10.9%, *n* = 983]), Georgia (26.7%; *n* = 2,395),

Louisiana (17.7%; *n* = 1,593), and New Jersey (16.4%; *n* = 1,469). Compared to African Americans (19.6%; *n* = 1,762), more than 40% of White (43.8%; *n* = 20,763) participants were selected from the SEER register in California for the study. The percentage of African Americans were more than Whites in Georgia (26.7%; *n* = 2,395 vs. 9.9%; *n* = 4,670), Kentucky (34%; *n* = 301 vs. 7.3%; *n* = 3,450), and Louisiana (17.7%; *n* = 1,593, vs. 4.8%; *n* = 2,286) which represent the Appalachia region.

The characteristic of the diagnostic method of confirmation for both African Americans (97.8%; *n* = 8,782) and Whites (98.1%; *n* = 46,501) was confirmed during the entire course of the disease via histology, cytology, immunophenotyping, and microscopy. African American women (6%; *n* = 538, *p* <.001) were one and half times less likely to develop Grade I/well differentiated tumors than White women (10.2%; *n* = 4,832, *p* <.001). Additionally, White women (29%; *n* = 13,751, *p* <.001) had a higher percentage of developing Grade II/moderately differentiated tumors than African American women (27.6%; *n* = 2,473, *p* <.001). Compared to Whites (30.1% and 30.7%), African American women (34% and 32.5%) were more linked with the development of aggressive, high-grade (Grade III or IV) and unknown tumors. Also, compared to Whites (43.1%; *n* = 20,421) African American women (54%; *n* = 4,848) were more associated with the diagnosis of squamous cell carcinoma, the most common of all cervical cancer histology types. However, the squamous cell carcinoma nonkeratinizing type were more common in Whites (9.3%; *n* = 4,426, *p* <.001) than African Americans (8.2%; *n* = 740, *p* <.001), and the squamous cell carcinoma keratinizing type were more common in African Americans (8.6%; *n* = 773, *p* <.001) than Whites (7%; *n* = 3,319, *p* <.001).

Adenocarcinoma and endometroid carcinoma were more common in Whites (14.8%; *n* = 6,998 and 1.9%; *n* = 884) than in African Americans (7.0%; *n* = 684 and 0.8%; *n* = 73). Adenocarcinoma (endocervical type) occurred more in Whites (2.8%; *n* = 1,323) than in African Americans (0.9%; *n* = 85).

Furthermore, 41% of cervical cancers were diagnosed at a localized stage, 32.5% were diagnosed at a regional stage, and 10.8% were diagnosed at a distant stage. African Americans (16.5%; *n* = 1,483) and Whites (15.5%; *n* = 7,361) make up the cervical cancers reported at unstaged stage of disease at diagnosis. The proportion of cervical cancers diagnosed at a local stage were 8.4% lower for African Americans (34%; *n* = 3,055, *p* <.001) versus Whites (42.4%; *n* = 20,084, *p* <.001). Although higher proportions of cancers were diagnosed at regional stages (37%; *n* = 3,324 vs. 31.6%; *n* = 15,003) and distant stages (12.5%; *n* = 1,119 vs. 10.5%; *n* = 4,959), these were lower for White compared to African American women. Compared to White, a higher percentage of African American women underwent radiation (58.9%; *n* = 5,291 vs. 51.1%; *n* = 24,206) and chemotherapy (47.9%; *n* = 4,300 vs. 43.5%; *n* = 20,608) as the mode of treatment. White women (58.7%; *n* = 27,829) underwent surgical treatment more than African American women (43.6%; *n* = 3,914). Also, White women had more combination therapy than African American women for Chemotherapy + Surgery (49.3%; *n* = 23,397 vs. 46.7%; *n* = 4,187) and Surgery + Radiation (22.9%; *n* = 10,862 vs. 19.4%; *n* = 1,744). Although African American women (37.8%; *n* = 3,367, *p* <.001) survived more than five years (>60 months) after treatment, there were more survivors for Whites (44.7%; *n* = 21,049, *p* <.001) during the same periods. However, after treatment and follow-up, there

were more deaths for African Americans (49.7%; $n = 4,466$, $p < .001$) than Whites (36.5%; $n = 17,300$, $p < .001$), but 50.3% ($n = 4,515$) and 63.5% ($n = 30,107$) of African Americans and Whites survived, respectively.

Table 7

Descriptive Characteristics of Women Diagnosed With Cervical Cancer, SEER 2000–2017 by Race/Ethnicity

Characteristics	African American ($N = 8,981$) *n* (%)	White ($N = 47,407$) *n* (%)	Overall ($N = 56,388$) *n* (%)
Age at diagnosis			
Under 18 years	88 (1.0)	395 (0.8)	483 (0.9)
19-45 years	4,358 (48.5)	26,090 (55.0)	30,448 (54.0)
46-55 years	1,873 (20.9)	9,191 (19.4)	11,064 (19.6)
56-65 years	1,307 (14.6)	6,179 (13.0)	7,486 (13.3)
66-75 years	820 (9.1)	3,490 (7.4)	4,310 (7.6)
76+ years	535 (6.0)	2,062 (4.3)	2,597 (4.6)
Marital status at diagnosis			
Legally married	2,331 (26.0)	21,824 (46.0)	24,155 (42.8)
Not legally married	4,844 (53.9)	18,067 (38.1)	22,911 (40.6)
Widowed	1,235 (13.8)	4,665 (9.8)	5,900 (10.5)
Unknown	571 (6.4)	2,852 (6.0)	3,422 (6.1)
Year of diagnosis			
2002 or earlier	1,602 (17.8)	8,602 (18.1)	10,204 (18.1)
2003-2007	2,549 (28.4)	13,134 (27.7)	15,683 (27.8)
2008-2012	2,458 (27.4)	12,931 (27.3)	15,389 (27.3)
2013-2017	2,372 (26.4)	12,740 (26.9)	15,112 (26.8)
Geographical location			
California	1,762 (19.6)	20,763 (43.8)	22,525 (39.9)
Connecticut	279 (3.1)	1,838 (3.9)	2,117 (3.8)
Detroit (Metropolitan)	983 (10.9)	1,930 (4.1)	2,913 (5.2)
Georgia	2,395 (26.7)	4,670 (9.9)	7,065 (12.5)
Hawaii	8 (0.1)	229 (0.5)	237 (0.4)
Iowa	48 (0.5)	1,880 (4.0)	1,928 (3.4)
Kentucky	301 (34)	3,450 (7.3)	3,751 (6.7)
Louisiana	1,593 (17.7)	2,286 (4.8)	3,879 (6.9)
New Jersey	1,469 (16.4)	5,603 (11.8)	7,072 (12.5)
New Mexico	17 (0.2)	1,262 (2.7)	1,279 (2.3)

Characteristics	African American (*N* = 8,981) *n* (%)	White (*N* = 47,407) *n* (%)	Overall (*N* = 56,388) *n* (%)
Seattle (Puget Sound)	110 (1.2)	2,419 (5.1)	2,529 (4.5)
Utah	16 (0.2)	1,077 (2.3)	1,093 (1.9)
Diagnostic method of confirmation			
Microscopically confirmed	8,782 (97.8)	46,501 (98.1)	55,283 (98.0)
Not microscopically confirmed	60 (0.7)	294 (0.6)	354 (0.6)
Unknown	139 (1.5)	612 (1.3)	751 (1.3)
Grade of tumor at diagnosis			
Well differentiated/I	538 (6.0)	4,832 (10.2)	5,370 (9.5)
Moderately differentiated/II	2,475 (27.6)	13,751 (29.0)	16,226 (28.8)
Poorly differentiated/III	2,826 (31.5)	13,077 (27.6)	15,903 (28.2)
Undifferentiated, anaplastic IV	222 (2.5)	1175 (2.5)	1,397 (2.5)
Unknown	2,920 (32.5)	14,572 (30.7)	17,492 (31.0)
Histological Type			
Squamous cell carcinoma, NOS	4,848 (54.0)	20,421 (43.1)	25,269 (44.8)
Adenocarcinoma	684 (7.0)	6,998 (14.8)	7,682 (13.6)
Squamous cell carcinoma, nonkeratinizing, NOS	740 (8.2)	4,426 (9.3)	5,166 (9.2)
Squamous cell carcinoma, keratinizing, NOS	773 (8.6)	3,319 (7.0)	4,092 (7.3)
Adenosquamous carcinoma	260 (2.9)	1,727 (3.6)	1,987 (3.5)
Squamous cell carcinoma, microinvasive	240 (2.7)	1,808 (3.8)	2,048 (3.6)
Adenocarcinoma Endocervical type	85 (0.9)	1,323 (2.8)	1,408 (2.5)
Endometroid carcinoma	73 (0.8)	884 (1.9)	957 (1.7)
Others	1,278 (14.2)	6,501(13.7)	7,779 (13.8)
Stage of disease at diagnosis			
Localized	3,055 (34.0)	20,084 (42.4)	23,139 (41.0)
Regional	3,324 (37.0)	15,003 (31.6)	18,327 (32.5)
Distant	1,119 (12.5)	4,959 (10.5)	6,078 (10.8)
Unstaged	1,483 (16.5)	7,361 (15.5)	8,844 (15.7)
Surgical Treatment			
Surgery performed	3,914 (43.6)	27,829 (58.7)	31,743 (56.3)
No surgery	5,067 (56.4)	19,578 (41.3)	24,645 (43.7)
Radiation therapy			
Radiation performed	5,291 (58.9)	24,206 (51.1)	29,497 (52.3)
No radiation	3,690 (41.1)	23,201 (48.9)	26,891 (47.7)
Chemotherapy			
Had chemotherapy	4,300 (47.9)	20,608 (43.5)	24,908 (44.2)

Characteristics	African American (N = 8,981) n (%)	White (N = 47,407) n (%)	Overall (N = 56,388) n (%)
No chemotherapy	4,681 (52.1)	26,799 (56.5)	31,480 (55.8)
Systemic therapy and surgical procedure administered			
No	4,794 (53.4)	24,010 (50.6)	28,804 (51.1)
Given/sequence known	930 (10.4)	5.711 (12.0)	6,641 (11.8)
Given/sequence unknown	3,257 (36.3)	17,686 (37.3)	20,943 (37.1)
Surgery and radiation therapies administered			
No	7,237 (80.6)	36,545 (77.1)	43,782 (77.6)
Given/sequence known	1,728 (19.2)	10,766 (22.7)	12,494 (22.2)
Given/sequence unknown	16 (0.2)	96 (0.2)	112 (0.2)
Patient status after treatment			
Alive	4,515 (50.3)	30,107 (63.5)	34,622 (61.4)
Dead	4,466 (49.7)	17,300 (36.5)	21,766 (38.6)
Cervical Cancer Survival Rate (dichotomy)			
Under 60 months	5,544 (62.2)	26,085 (55.3)	31,629 (56.4)
>60 months	3,367 (37.8)	21,049 (44.7)	24,416 (43.6)

Chi-Square Test for Research Question 1

For RQ1, no expected cell frequency was less than 5 for all the variables. The Pearson chi-square test for independence indicated a significant association between the variables race/ethnicity and age at diagnosis, $\chi 2$ (5, n = 56,388) = 155.819, p = <.001 (therefore, rejected the null hypothesis), phi = .053 (see Tables 9, and 10) with a 2 by 6 table (see Table 8). The value of Cramer's V = .053 (but not = 1) indicated a weak association between the two variables. A degree of freedom of 5 detected a small effect size using Cohen's criteria of 0.04 for a small effect, .13 for a medium effect, and .22 for a large effect. The chi-square test for independence (with Yates' Continuity Correction) indicated a significant association between the race/ethnicity and marital status at

diagnosis, $\chi 2$ (1, n = 56,388) = 1243.548, p = <.001 (therefore, rejected the null hypothesis), phi = -.148 (see Tables 12, and 13) with a 2 by 2 table (see Table 11). The phi coefficient value of -.148 (~-.15) detected a small to medium effect, using Cohen's criteria of .10 for a small effect, .30 for a medium effect, and .50 for a large effect.

A chi-square test performed between race/ethnicity and year of diagnosis, showed there was no significant association, $\chi 2$ (3, n = 56,388) = 2.266, p = .519 (>.05), therefore, failed to reject the null hypothesis, phi = .006 (see Tables 15, and 16) with a 2 by 4 table (see Table 14). The value of Cramer's V (.006) indicated no association between the two variables. A degree of freedom of 3 detected a small effect size using Cohen's criteria of 0.06 for a small effect, .17 for a medium effect, and .29 for a large effect. There was a significant association between race/ethnicity and geographical location for the 2 by 12 table, $\chi 2$ (11, n = 56,388) = 6556.930, p = .000 (rejected the null hypothesis), and phi = .341 (see Tables 18, and 19). Using the formula, Cramer's V = $\sqrt{(\chi 2/n)}$ / min (c-1, r-1), where $\chi 2$ is the chi-square statistic, n = total sample size, r = number of rows, and c = number of columns, the Cramer's V = .10 with the degree of freedom of 11. Therefore, the Cramer's V of .006 detected a small effect size.

Table 8

Race/Ethnicity of Participants and Age at Diagnosis Crosstabulation

			Age at diagnosis						
			under 18 years	19–45 years	46–55 years	56–65 years	66–75 years	76+ years	Total
Race/ethnicity of participants	White	Count	395	26,090	9,191	6,179	3,490	2,062	47,407
		% within Race/ethnicity of participants	0.8%	55.0%	19.4%	13.0%	7.4%	4.3%	100.0%
		Adjusted residual	-1.4	11.3	-3.2	-3.9	-5.8	-6.7	
	African American	Count	88	4,358	1,873	1,307	820	535	8,981
		% within Race/ethnicity of participants	1.0%	48.5%	20.9%	14.6%	9.1%	6.0%	100.0%
		Adjusted residual	1.4	-11.3	3.2	3.9	5.8	6.7	
Total		Count	483	30,448	11,064	7,486	4,310	2,597	56,388
		% within Race/ethnicity of participants	0.9%	54.0%	19.6%	13.3%	7.6%	4.6%	100.0%

Table 9

Chi-Square Tests for Age at Diagnosis

	Value	*df*	Asymptotic significance (2-sided)
Pearson chi-square	155.819 [a]	5	< .001
Likelihood ratio	152.608	5	< .001
Linear-by-linear association	138.766	1	< .001
N of valid cases	56,388		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 76.93.

Table 10

Symmetric Measures for Age at Diagnosis

		Value	Approximate significance
Nominal by nominal	Phi	.053	<.001
	Cramer's V	.053	<.001
N of valid cases		56,388	

Table 11

Race/Ethnicity of Participants and Marital Status at Diagnosis Crosstabulation

			Marital status at diagnosis		
			Not married	Legally married	Total
Race/Ethnicity of participants	White	Count	25,583	21,824	47,407
		% within Race/Ethnicity of participants	54.0%	46.0%	100.0%
		Adjusted residual	-35.3	35.3	
	African American	Count	6,650	2,331	8,981
		% within Race/Ethnicity of participants	74.0%	26.0%	100.0%
		Adjusted residual	35.3	-35.3	
Total		Count	32,233	24,155	56,388
		% within Race/Ethnicity of participants	57.2%	42.8%	100.0%

Table 12

Chi-Square Tests for Marital Status at Diagnosis

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	1243.368 [a]	1	<.001		
Continuity correction [b]	1242.548	1	<.001		
Likelihood ratio	1302.712	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	1243.346	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 3847.20.

[b] Computed only for a 2x2 table.

Table 13

Symmetric Measures for Marital Status at Diagnosis

		Value	Approximate significance
Nominal by nominal	Phi	-.148	<.001
	Cramer's V	.148	<.001
N of valid cases		56,388	

Table 14

Race/Ethnicity of Participants and Year of Diagnosis Crosstabulation

			Year of diagnosis				
			under 2002	2003-2007	2008-2012	2013-2017	Total
Race/Ethnicity of participants	White	Count	8,602	13,134	12,931	12,740	47,407
		% within Race/Ethnicity of participants	18.1%	27.7%	27.3%	26.9%	100.0%
		Adjusted residual	.7	-1.3	-.2	.9	
	African American	Count	1,602	2,549	2,458	2,372	8,981
		% within Race/Ethnicity of participants	17.8%	28.4%	27.4%	26.4%	100.0%
		Adjusted residual	-.7	1.3	.2	-.9	
Total		Count	10,204	15,683	15,389	15,112	56,388
		% within Race/Ethnicity of participants	18.1%	27.8%	27.3%	26.8%	100.0%

Table 15

Chi-Square Tests for Year of Diagnosis

	Value	*df*	Asymptotic Significance (2-sided)
Pearson chi-square	2.266 [a]	3	.519
Likelihood ratio	2.263	3	.520
Linear-by-linear association	.184	1	.668
N of valid cases	56,388		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 1625.21.

Table 16

Symmetric Measures for Year of Diagnosis

		Value	Approximate Significance
Nominal by nominal	Phi	.006	.519
	Cramer's V	.006	.519
N of valid cases		56,388	

Table 17

Race/Ethnicity of Participants and Geographical Locations Crosstabulation

			Geographical location												
			CA	CT	Detroit (Metro)	GA	HI	IA	KY	LA	NJ	NM	Seattle (Puget Sound)	UT	Total
R/E	W	Count	20,763	1,838	1,930	4,670	229	1,880	3,450	2,286	5,603	1,262	2,419	1,077	47,407
		% within R/E of participants	43.8%	3.9%	4.1%	9.9%	0.5%	4.0%	7.3%	4.8%	11.8%	2.7%	5.1%	2.3%	100.0%
		Adjusted residual	42.9	3.5	-27.0	-44.1	5.3	16.4	13.7	-44.3	-11.9	14.4	16.3	13.2	
	AA	Count	1,762	279	983	2,395	8	48	301	1,593	1,469	17	110	16	8,981
		% within R/E of participants	19.6%	3.1%	10.9%	26.7%	0.1%	0.5%	3.4%	17.7%	16.4%	0.2%	1.2%	0.2%	100.0%
		Adjusted residual	-42.9	-3.5	27.0	44.1	-5.3	-16.4	-13.7	44.3	11.9	-14.4	-16.3	-13.2	
Total		Count	22,525	2,117	2,913	7,065	237	1,928	3,751	3,879	7,072	1,279	2,529	1,093	56,388
		% within R/E of participants	39.9%	3.8%	5.2%	12.5%	0.4%	3.4%	6.7%	6.9%	12.5%	2.3%	4.5%	1.9%	100.0%

Note. R/E = race/ethnicity; W = White; AA = African American.

Table 18

Chi-Square Tests for Geographical Locations

	Value	*df*	Asymptotic Significance (2-sided)
Pearson chi-square	6556.930 [a]	11	.000
Likelihood ratio	6315.117	11	.000
Linear-by-linear association	239.616	1	<.001
N of valid cases	56,388		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 37.75.

Table 19

Symmetric Measures for Geographical Locations

		Value	Approximate significance
Nominal by nominal	Phi	.341	.000
	Cramer's V	.341	.000
N of valid cases		56,388	

Chi-Square Test for Research Question 2

For RQ2, no expected cell frequency was less than 5 for all the variables. The chi-square test for independence (with Yates' Continuity Correction) indicated an insignificant association and perfectly negative relationship between race/ethnicity and diagnostic method of confirmation, $\chi 2$ (1, n = 56,388) = 3.648, p = .062, therefore, failed to reject the null hypothesis, phi = -.008 (see Tables 21, and 22) with a 2 by 2 table (see Table 20). The phi coefficient value of -.008 (~-.01) detected a small effect size, using Cohen's criteria of .10 for a small effect, .30 for a medium effect, and .50 for a large effect. The Pearson chi-square test for independence indicated a significant association

between race/ethnicity and grade of tumor at diagnosis, $\chi 2$ (4, n = 56,388) = 193.520, p = <.001, therefore, rejected the null hypothesis, and phi = .059 (see Tables 24, and 25) with a 2 by 5 table (see Table 23). The value of Cramer's V = .059 (not = 1) indicated a weak association between the two variables. A degree of freedom of 4 detected a small effect size using Cohen's criteria of 0.05 for a small effect, .15 for a medium effect, and .25 for a large effect.

Furthermore, there was a significant association between race/ethnicity and histological type for the 2 by 9 table (see Table 26), $\chi 2$ (8, n = 56,388) = 712.697, p = <.001, therefore, will reject the null hypothesis, and phi = .112 (see Tables 27, and 28). Using the formula, Cramer's V = $\sqrt{(\chi 2/n)}$ / min (c-1, r-1), the Cramer's V = .04 with the degree of freedom of 8. Therefore, the Cramer's V of .112 (~.11) detected a small effect size. A chi-square test performed between race/ethnicity and stage of disease at diagnosis, showed significant association, $\chi 2$ (3, n = 56,388) = 227.773, p = <.001, therefore, will reject the null hypothesis, and phi = .064 (see Tables 30, and 31) with a 2 by 4 table (see Table 29). The value of Cramer's V = .064 indicated a weak association between the two variables. A degree of freedom of 3 detected a small effect size using Cohen's criteria of 0.06 for a small effect, .17 for a medium effect, and .29 for a large effect.

Table 20

Race/Ethnicity of Participants and Diagnostic Method of Confirmation Crosstabulation

			Diagnostic method of confirmation		
			No	Yes	Total
Race/Ethnicity of participants	White	Count	906	46,501	47,407
		% within Race/Ethnicity of participants	1.9%	98.1%	100.0%
		Adjusted residual	-1.9	1.9	
	African American	Count	199	8,782	8,981
		% within Race/Ethnicity of participants	2.2%	97.8%	100.0%
		Adjusted residual	1.9	-1.9	
Total		Count	1,105	55,283	56,388
		% within Race/Ethnicity of participants	2.0%	98.0%	100.0%

Table 21

Chi-Square Tests for Diagnostic Method of Confirmation

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	3.648 [a]	1	.056		
Continuity correction [b]	3.491	1	.062		
Likelihood ratio	3.530	1	.060		
Fisher's exact test				.060	.031
Linear-by-linear association	3.648	1	.056		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 175.99. [b] Computed only for a 2x2 table.

Table 22

Symmetric Measures for Diagnostic Method of Confirmation

		Value	Approximate significance
Nominal by nominal	Phi	-.008	.056
	Cramer's V	.008	.056
N of valid cases		56,388	

Table 23

Race/Ethnicity of Participants and Grade of Tumor at Diagnosis Crosstabulation

			Grade of tumor at diagnosis					
			Well differentiated / Grade I	Moderately differentiated / Grade II	Poorly differentiated / Grade III	Undifferentiated; anaplastic / Grade IV	Unknown	Total
Race/Ethnicity of participants	White	Count	4,832	13,751	13,077	1,175	14,572	47,407
		% within Race/Ethnicity of participants	10.2%	29.0%	27.6%	2.5%	30.7%	100.0%
		Adjusted residual	12.4	2.8	-7.5	.0	-3.3	
	African American	Count	538	2,475	2,826	222	2,920	8,981
		% within Race/Ethnicity of participants	6.0%	27.6%	31.5%	2.5%	32.5%	100.0%
		Adjusted residual	-12.4	-2.8	7.5	.0	3.3	
Total		Count	5,370	16,226	15,903	1,397	17,492	56,388
		% within Race/Ethnicity of participants	9.5%	28.8%	28.2%	2.5%	31.0%	100.0%

Table 24

Chi-Square Tests for Grade of Tumor at Diagnosis

	Value	*df*	Asymptotic significance (2-sided)
Pearson chi-square	193.520 [a]	4	<.001
Likelihood ratio	209.851	4	<.001
Linear-by-linear association	71.071	1	<.001
N of valid cases	56,388		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 222.50.

Table 25

Symmetric Measures for Grade of Tumor at Diagnosis

		Value	Approximate significance
Nominal by nominal	Phi	.059	<.001
	Cramer's V	.059	<.001
N of valid cases		56,388	

Table 26

Race/Ethnicity of Participants and Histological Type Crosstabulation

			Histological type									
			SCC, NOS	AC	SCC, NK, NOS	SCC, K, NOS	ASC	SCC, MI	AC, ECT	EMC	Others	Total
R/E of participants	W	Count	20,421	6,998	4,426	3,319	1,727	1,808	1,323	884	6,501	47,407
		% within R/E of participants	43.1%	14.8%	9.3%	7.0%	3.6%	3.8%	2.8%	1.9%	13.7%	100.0%
		Adjusted residual	-19.1	18.1	3.3	-5.4	3.5	5.3	10.3	7.1	-1.3	
	AA	Count	4,848	684	740	773	260	240	85	73	1,278	8,981
		% within R/E of participants	54.0%	7.6%	8.2%	8.6%	2.9%	2.7%	0.9%	0.8%	14.2%	100.0%
		Adjusted residual	19.1	-18.1	-3.3	5.4	-3.5	-5.3	-10.3	-7.1	1.3	
Total		Count	25,269	7,682	5,166	4,092	1,987	2,048	1,408	957	7,779	56,388
		% within R/E of participants	44.8%	13.6%	9.2%	7.3%	3.5%	3.6%	2.5%	1.7%	13.8%	100.0%

Note. AA = African American; AD = adenocarcinoma; ASC = adenosquamous carcinoma; ECT = endocervical type; EMC = endometroid carcinoma; K= keratinizing; MI = microinvasive; NK = nonkeratinizing; NOS = not otherwise specified; R/E = race/ethnicity; SCC = squamous cell carcinoma; W = White.

Table 27

Chi-Square Tests for Histological Type

	Value	*df*	Asymptotic significance (2-sided)
Pearson chi-square	712.697 [a]	8	<.001
Likelihood ratio	785.245	8	<.001
Linear-by-linear association	69.656	1	<.001
N of valid cases	56,388		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 152.42.

Table 28

Symmetric Measures for Histological Type

		Value	Approximate significance
Nominal by nominal	Phi	.112	<.001
	Cramer's V	.112	<.001
N of valid cases		56,388	

Table 29

Race/Ethnicity of Participants and the Stage of Disease at Diagnosis Crosstabulation

			Stage of disease at diagnosis				
			Localized	Regional	Distant	Unstaged	Total
Race/Ethnicity of participants	White	Count	20,084	15,003	4,959	7,361	47,407
		% within Race/Ethnicity of participants	42.4%	31.6%	10.5%	15.5%	100.0%
		Adjusted residual	14.7	-10.0	-5.6	-2.4	
	African American	Count	3,055	3,324	1,119	1,483	8,981
		% within Race/Ethnicity of participants	34.0%	37.0%	12.5%	16.5%	100.0%
		Adjusted residual	-14.7	10.0	5.6	2.4	
Total		Count	23,139	18,327	6,078	8,844	56,388
		% within Race/Ethnicity of participants	41.0%	32.5%	10.8%	15.7%	100.0%

Table 30

Chi-Square Tests for Stage of Disease at Diagnosis

	Value	*df*	Asymptotic Significance (2-sided)
Pearson chi-square	227.773 [a]	3	<.001
Likelihood ratio	230.796	3	<.001
Linear-by-linear association	100.035	1	<.001
N of valid cases	56,388		

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 968.05.

Table 31

Symmetric Measure for Stage of Disease at Diagnosis

		Value	Approximate significance
Nominal by nominal	Phi	.064	<.001
	Cramer's V	.064	<.001
N of valid cases		56,388	

Chi-Square Test for Research Question 3

For RQ3, no expected cell frequency was less than 5 for all the variables. The chi-square test for independence (with Yates' Continuity Correction) indicated a significant association between race/ethnicity (CV) and treatment-related factors (IV), therefore, rejected the null hypothesis. For surgical treatment, $\chi 2$ (1, n = 56,388) = 701.102, p = <.001, and phi = -.112 (see Tables 33, 34) with a 2 by 2 table (see Table 32). Radiation therapy showed, $\chi 2$ (1, n = 56,388) = 186.354, p = <.001, and phi = .058 (see Tables 36, and 37), and chemotherapy revealed $\chi 2$ (1, n = 56,388) = 59.327, p = <.001, and phi = .032 (see Tables 39, and 40) with a 2 by 2 table (see Tables 35, and 38). Also, surgery and radiation therapies administered indicated $\chi 2$ (1, n = 56,388) = 52.886, p = <.001, and phi = -.031 (see Tables 45, and 46), systemic therapy and surgical procedure administered showed $\chi 2$ (1, n = 56,388) = 22.457, and p = <.001, phi = -.020 (see Tables 42, and 43), and patient status after treatment had $\chi 2$ (1, n = 56,388) = 557.464, p = <.001, and phi = -.099 (see Tables 48, and 49) with a 2 by 2 table (see Tables 41, 44, and 47). The phi coefficient values (for all the treatment-related variables) detected a small effect, using Cohen's criteria of .10 for a small effect, .30 for a medium effect, and .50 for a large effect.

Table 32

Race/Ethnicity of Participants and Surgical Treatment Crosstabulation

			Surgical treatment		
			No surgery	Surgery performed	Total
Race/Ethnicity of participants	White	Count	19,578	27,829	47,407
		% within Race/Ethnicity of participants	41.3%	58.7%	100.0%
		Adjusted residual	-26.5	26.5	
	African American	Count	5,067	3,914	8,981
		% within Race/Ethnicity of participants	56.4%	43.6%	100.0%
		Adjusted residual	26.5	-26.5	
Total		Count	24,645	31,743	56,388
		% within Race/Ethnicity of participants	43.7%	56.3%	100.0%

Table 33

Chi-Square Tests for Surgical Treatment

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	701.716 [a]	1	<.001		
Continuity correction [b]	701.102	1	<.001		
Likelihood ratio	695.972	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	701.704	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 3925.25. [b] Computed only for a 2x2 table.

Table 34

Symmetric Measures for Surgical Treatment

		Value	Approximate significance
Nominal by nominal	Phi	-.112	<.001
	Cramer's V	.112	<.001
N of valid cases		56,388	

Table 35

Race/Ethnicity of the Participants and Radiation Therapy Crosstabulation

			Radiation therapy		
			No radiation	Radiation performed	Total
Race/Ethnicity of participants	White	Count	23,201	24,206	47,407
		% within Race/Ethnicity of participants	48.9%	51.1%	100.0%
		Adjusted residual	13.7	-13.7	
	African American	Count	3,690	5,291	8,981
		% within Race/Ethnicity of participants	41.1%	58.9%	100.0%
		Adjusted residual	-13.7	13.7	
Total		Count	26,891	29,497	56,388
		% within Race/Ethnicity of participants	47.7%	52.3%	100.0%

Table 36

Chi-Square Test for Radiation Therapy

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	186.669 [a]	1	<.001		
Continuity correction [b]	186.354	1	<.001		
Likelihood ratio	187.760	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear Association	186.666	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 4282.97.

[b] Computed only for a 2x2 table.

Table 37

Symmetric Measures for Radiation Therapy

		Value	Approximate significance
Nominal by nominal	Phi	.058	<.001
	Cramer's V	.058	<.001
N of valid cases		56,388	

Table 38

Race/Ethnicity of Participants and Chemotherapy Crosstabulation

			Chemotherapy		
			No chemotherapy	Had chemotherapy	Total
Race/Ethnicity of participants	White	Count	26,799	20,608	47,407
		% within Race/Ethnicity of participants	56.5%	43.5%	100.0%
		Adjusted residual	7.7	-7.7	
	African American	Count	4,681	4,300	8,981
		% within Race/Ethnicity of participants	52.1%	47.9%	100.0%
		Adjusted residual	-7.7	7.7	
Total		Count	31,480	24,908	56,388
		% within Race/Ethnicity of participants	55.8%	44.2%	100.0%

Table 39

Chi-Square Tests for Chemotherapy

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	59.506 [a]	1	<.001		
Continuity correction [b]	59.327	1	<.001		
Likelihood ratio	59.273	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	59.505	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 3967.13.

[b] Computed only for a 2x2 table.

Table 40

Symmetric Measures for Chemotherapy

		Value	Approximate significance
Nominal by nominal	Phi	.032	<.001
	Cramer's V	.032	<.001
N of valid cases		56,388	

Table 41

Race/Ethnicity of Participants and Systemic Therapy/Surgical Procedure Administered Crosstabulation

			Systemic therapy and surgical procedure administered		
			No	Yes	Total
Race/Ethnicity of participants	White	Count	24,010	23,397	47,407
		% within Race/Ethnicity of participants	50.6%	49.4%	100.0%
		Adjusted residual	-4.8	4.8	
	African American	Count	4,794	4,187	8,981
		% within Race/Ethnicity of participants	53.4%	46.6%	100.0%
		Adjusted residual	4.8	-4.8	
Total		Count	28,804	27,584	56,388
		% within Race/Ethnicity of participants	51.1%	48.9%	100.0%

Table 42

Chi-Square Tests for Systemic Therapy/Surgical Procedure Administered

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	22.567[a]	1	<.001		
Continuity correction[b]	22.457	1	<.001		
Likelihood ratio	22.586	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	22.566	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 4393.34.

[b] Computed only for a 2x2 table.

Table 43

Symmetric Measures for Systemic Therapy/Surgical Procedure Administered

		Value	Approximate significance
Nominal by nominal	Phi	-.020	<.001
	Cramer's V	.020	<.001
N of valid cases		56,388	

Table 44

Race/Ethnicity of Participants and Surgery/Radiation Therapies Administered Crosstabulation

			Surgery and radiation therapies administered		
			No	Yes	Total
Race/Ethnicity of participants	White	Count	36,545	10,862	47,407
		% within Race/Ethnicity of participants	77.1%	22.9%	100.0%
		Adjusted residual	-7.3	7.3	
	African American	Count	7,237	1,744	8,981
		% within Race/Ethnicity of participants	80.6%	19.4%	100.0%
		Adjusted residual	7.3	-7.3	
Total		Count	43,782	12,606	56,388
		% within Race/Ethnicity of participants	77.6%	22.4%	100.0%

Table 45

Chi-Square Tests for Surgery/Radiation Therapies Administered

	Value	*df*	Asymptotic significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	53.087 [a]	1	<.001		
Continuity correction [b]	52.886	1	<.001		
Likelihood ratio	54.541	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	53.086	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 2007.78.

[b] Computed only for a 2x2 table.

Table 46

Symmetric Measures for Surgery/Radiation Therapies Administered

		Value	Approximate significance
Nominal by nominal	Phi	-.031	<.001
	Cramer's V	.031	<.001
N of valid cases		56,388	

Table 47

Race/Ethnicity of Participants and Patient Status After Treatment Crosstabulation

			Patient status after treatment		
			Dead	Alive	Total
Race/Ethnicity of participants	White	Count	17,300	30,107	47,407
		% within Race/Ethnicity of participants	36.5%	63.5%	100.0%
		Adjusted residual	-23.6	23.6	
	African American	Count	4,466	4,515	8,981
		% within Race/Ethnicity of participants	49.7%	50.3%	100.0%
		Adjusted residual	23.6	-23.6	
Total		Count	21,766	34,622	56,388
		% within Race/Ethnicity of participants	38.6%	61.4%	100.0%

Table 48

Chi-Square Tests for Patient Status After Treatment

	Value	*df*	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	558.022 [a]	1	<.001		
Continuity correction [b]	557.464	1	<.001		
Likelihood ratio	546.442	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	558.012	1	<.001		
N of valid cases	56,388				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 3466.70.

[b] Computed only for a 2x2 table.

Table 49

Symmetric Measures for Patient Status After Treatment

		Value	Approximate significance
Nominal by nominal	Phi	-.099	<.001
	Cramer's V	.099	<.001
N of valid cases		56,388	

The chi-square test for independence (with Yates' Continuity Correction) indicated a significant association between the variables race/ethnicity and cervical cancer survival rate, $\chi 2$ (1, n = 56,045) = 143.711, p = <.001, and phi = -.051 with a 2 by 2 table (see Tables 51, and 52), therefore, rejected the null hypothesis. The phi coefficient value of -.05 detected a small effect, using Cohen's criteria of .10 for a small effect, .30 for a medium effect, and .50 for a large effect.

Table 50

Race/Ethnicity of Participants and Cervical Cancer Survival Rate Crosstabulation

			Cervical cancer survival rate (dichotomous)		
			under 60 months	>60 months	Total
Race/Ethnicity of participants	White	Count	26,085	21,049	47,134
		% within Race/Ethnicity of participants	55.3%	44.7%	100.0%
		Adjusted residual	-12.0	12.0	
	African American	Count	5,544	3,367	8,911
		% within Race/Ethnicity of participants	62.2%	37.8%	100.0%
		Adjusted residual	12.0	-12.0	
Total		Count	31,629	24,416	56,045
		% within Race/Ethnicity of participants	56.4%	43.6%	100.0%

Table 51

Chi-Square Tests for Cervical Cancer Survival Rate

	Value	*df*	Asymptotic significance (2-sided)	Exact sig. (2-sided)	Exact sig. (1-sided)
Pearson chi-square	143.990 [a]	1	<.001		
Continuity correction [b]	143.711	1	<.001		
Likelihood ratio	145.475	1	<.001		
Fisher's exact test				<.001	<.001
Linear-by-linear association	143.988	1	<.001		
N of valid cases	56,045				

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 3882.08.

[b] Computed only for a 2x2 table.

Table 52

Symmetric Measures for Cervical Cancer Survival Rate

		Value	Approximate significance
Nominal by nominal	Phi	-.051	<.001
	Cramer's V	.051	<.001
N of valid cases		56,045	

I conducted binary logistic regression analyses to investigate whether there was a significant association between sociodemographic, histopathologic, and treatment-related factors on racial/ethnic disparities in cervical cancer survival outcomes among African Americans and White women in the United States. The RQs and corresponding hypotheses were evaluated in this study using binary logistic regression. However, to make sense of the results, it was essential to set up the coding of responses. The dichotomous DV (Cervical cancer survival rate) was recoded as 0 = under 60 months and

1 = >60 months. Race/ethnicity of the participants was recoded as 0 for White, and as 1 for African Americans. The marital status at diagnosis was recoded to become dichotomous, where 2, 3, and 4 were recoded as 0 = not married and 1 = legally married. Also, the diagnostic method of confirmation was recoded into 0 = No, and 1 = Yes values (microscopically confirmed = 1, not microscopically confirmed = 0 and unknown = 0). Surgical treatment was recoded as 1 = surgery performed, 0 = no surgery performed. Radiation therapy was recoded as 1 = radiation performed, 0 = no radiation performed. Chemotherapy was recoded as 1 = had chemotherapy, and 0 = had no chemotherapy. Surgery and radiation therapies administered, and systemic therapy and surgical procedure administered were recoded as dichotomous variables (0 = No, and 1 = Yes). For the variable patient status after treatment, Alive = 1 and Dead = 0. The logistic regression model was used to compute the odds ratio (OR), the exponentiated β (Exp [β]), for the relationship between each independent categorical variable and the categorical DV. I presented the results of the binary logistic regression analysis for each RQ. The values of the variables are shown in Table 53.

Table 53

The Codebook of the Variables for Chi-Square Test and Binary Logistic Regression

Variable	Measurement	Values recoded from SEER*Stat Variable	Variable role
Cervical Cancer Survival Rate	Nominal	MMMM	Dependent variable
Cervical Cancer Survival Rate (dichotomous)	Nominal	0 = under 60 months 1 = >60 months	
Race/Ethnicity of Participants	Nominal	0 = White 1 = African American	Covariate variable
Age at diagnosis	Ordinal	1 = Under 18 years 2 = 19-45 years 3 = 46-55 years 4 = 56-65 years 5 = 66-75 years 6 = 76+ years	Independent variable
Year of diagnosis	Nominal	1 = 2002 or earlier 2 = 2003-2007 3 = 2008-2012 4 = 2013-2017	Independent variable
Marital status at diagnosis (dichotomous)	Nominal	0 = Not married 1 = Legally married	Independent variable
Geographical location	Nominal	1 = Alaska Natives 2 = California 3 = Connecticut 4 = Detroit (Metropolitan) 5 = Georgia 6 = Hawaii 7 = Iowa 8 = Kentucky 9 = Louisiana 10 = New Jersey 11 = New Mexico 12 = Seattle (Puget Sound) 13 = Utah	Independent variable
Diagnostic method of confirmation (dichotomous)	Nominal	0 = No 1 = Microscopically Confirmed	Independent variable

Variable	Measurement	Values recoded from SEER*Stat Variable	Variable role
Grade of tumor at diagnosis	Nominal	1 = Well differentiated/Grade I 2 = Moderately differentiated/Grade II 3 = Poorly differentiated/Grade III 4 = Undifferentiated, anaplastic/Grade IV 5 = Unknown	Independent variable
Histological type	Nominal	1 = Squamous cell carcinoma, NOS 2 = Adenocarcinoma 3 = Squamous cell carcinoma nonkeratinizing, NOS 4 = Squamous cell carcinoma keratinizing, NOS 5 = Adenosquamous carcinoma 6 = Squamous cell carcinoma, microinvasive 7 = Adenocarcinoma, endocervical type 8 = Endometroid carcinoma 9 = Other types	Independent variable
Stage of disease at diagnosis	Nominal	1 = Localized 2 = Regional 3 = Distant 4 = Unstaged	Independent variable
Surgical Treatment (dichotomous)	Nominal	0 = No Surgery performed 1 = Surgery performed	Independent variable
Radiation Therapy (dichotomous)	Nominal	0 = No radiation performed 1 = Radiation performed	Independent variable
Chemotherapy (dichotomous)	Nominal	0 = Had no chemotherapy 1 = Had chemotherapy	Independent variable
Systemic therapy and surgical procedure administered (dichotomous)	Nominal	0 = No 1 = Yes	Independent variable

Variable	Measurement	Values recoded from SEER*Stat Variable	Variable role
Surgery and radiation therapies administered (dichotomous)	Nominal	0 = No 1 = Yes	Independent variable
Patient status after treatment	Nominal	0 = Dead 1 = Alive	Independent variable

Binary Logistic Regression Analysis for Research Question 1

RQ1: Is there a statistically significant association between the independent categorical variables (race/ethnicity, the age at diagnosis, the year of diagnosis, marital status, and geographical location) and the cervical cancer survival rate (categorical DV) among African Americans and White women?

The variable race/ethnicity was a CV for the study and includes two categories (White and African American). The age, year of diagnosis, and geographical location were categorized into 6, 4, and 12 groups, respectively. I conducted a binary regression analysis to determine a statistically significant association between the predictor variables (race/ethnicity, the age at diagnosis, the year of diagnosis, marital status, and geographical location) and the cervical cancer survival rate (outcome variable) among African Americans and White women. The sample size included in the case processing summary table (n = 56,045; 99.4%) and the missing cases (n = 343; 0.6%) for the logistic regression analysis comprised the total cases included in the study (n = 56,388). The DV was coded using 0 and 1 for cervical cancer survival rates under 60 months and >60 months. The Omnibus Tests of Model Coefficients was a 'Goodness of Fit' test and had a

significant value of .000 (p <.05). The chi-square ($\chi 2$) statistic from the result was $\chi 2$ (21, n = 56,045) = 25672.586, p < .001 (see Table 57), meaning that the full model containing the sociodemographic factors were statistically significant and were able to distinguish the respondent's disparity in cervical cancer survival rate.

For the Hosmer-Lemeshow Goodness of Fit Test, the chi-square ($\chi 2$) statistic was 26.084 with a significance level of .001 (see Table 58). The value was smaller than .05, indicating no support for the model, and there was evidence of the lack of model fit based upon the Hosmer-Lemeshow Goodness of Fit Test. A value larger than .05 (p >.05) indicated support for the model. The -2Log likelihood, Cox and Snell R^2, and Nagelkerke R^2 were 51091.388, .367, and .493, respectively, indicating the variation amount in the DV explained by the model (see Table 59). Thus, the two values, .367 (Cox and Snell R^2) and .493 (Nagelkerke R^2), suggested that the sociodemographic variables explained the variability between 36.7% and 49.3%. The model correctly classified 74.8% of the cases, and its sensitivity and specificity rates for predicting the cervical cancer survival rate were 84% (>60 months) and 67.7% (under 60 months), respectively. The positive predictive value was 66.72% which was the percentage of cases that the model classified as having the characteristics observed in the group for cervical cancer survival rate 60 months and above. The negative predictive value was 84.53% which was the percentage of cases that the model classified as not having the characteristics observed in the group (cervical cancer survival rate less than 60 months).

The logistic regression model for predicting cervical cancer survival rate (see Table 54) showed that being African American was a negative and significant (p <.001)

predictor of the odds of having a disparity in cervical cancer survival rate and surviving less than 60 months. The odds of African American women surviving less than 5 years were 0.8 times more likely than the odds for White women (*OR* = .773; 95% CI = .728-.821; $p < .05$) who survived 60 months or more. The odds that White women had a cervical cancer survival rate of more than 60 months were 1.3 times more likely than those for African American women. The percentage of women who lived less than 5 years (84.86%; *n* = 21,405) were 52% greater than women who lived more than 5 years (33.28%; *n* =10,224). The age at diagnosis was negative and significant ($p <.001$) for all the categories; however, women aged 19 to 45 years old were 0.6 times ($p <.001$, *OR* = .612, 95% CI = .483-.777) more likely to have cervical cancer survival rate less than 5 years.

As the age increased, the odds of having disparity in cervical cancer survival decreased, especially for ages 66 to 75 years ($p <.001$, *OR* = .157, 95% CI = .123-.202) and 76 years and older ($p <.001$, *OR* = .053, 95% CI = .040-.069). Increasing age was associated with a decreased likelihood of having cervical cancer survival rate more than 60 months. Being legally married was a positive and significant ($p <.001$) predictor of cervical cancer survival rate of 60 months or more, keeping all other predictors constant. Hence, being legally married was associated with an increased likelihood of having cervical cancer rate >60 months. Thus, compared to the odds of having a cervical cancer survival rate of fewer than 60 months by the reference group (not legally married), those who were legally married had a cervical cancer survival rate of >60 months which was 1.395 times greater.

The estimated odds of being legally married (p <.001, OR = 1.395, 95% CI = 1.337-1.457) was 1.4 times higher than participants who were not legally married. The predictor variable (year of diagnosis) was a negative and significant (p <.001) predictor of disparities in cervical cancer survival rate, except for the years 2013-2017, p =.945 (>.05). Thus, increasing year of diagnosis was associated with a decreased likelihood of cervical cancer survival rate of >60 months. The geographical location was a significant (p <.001) predictor of disparities in cervical cancer survival rate for all geographical locations, except for Detroit (Metropolitan), Georgia, Hawaii, Louisiana, and New Mexico. Thus, race/ethnicity, the age at diagnosis, the year of diagnosis, marital status, and geographical location made unique contributions to predicting cervical cancer survival rate disparities in the full model. Therefore, I rejected the null hypothesis in RQ1 with the evidence of a significant association between the independent categorical variables (race/ethnicity, the age at diagnosis, the year of diagnosis, marital status, and geographical location) and the cervical cancer survival rate (outcome variable) among African Americans and White women.

Table 54

Binary Logistic Regression for Predicting Cervical Cancer Survival Rate for Research Question 1

	B	S.E.	Wald	*df*	Sig.	Odds Ratio	95% C.I. for Odds Ratio	
							Lower	Upper
Race/Ethnicity of participants								
White (Reference)								
African American	-.258	.031	70.579	1	<.001	.773	.728	.821
Age at diagnosis								
Under 18 years (Reference)			2781.026	5	.000			
19-45 years	-.491	.121	16.334	1	<.001	.612	.483	.777
46-55 years	-1.112	.123	82.208	1	<.001	.329	.259	.418
56-65 years	-1.350	.124	119.166	1	<.001	.259	.204	.330
66-75 years	-1.849	.126	214.848	1	<.001	.157	.123	.202
76+ years	-2.941	.136	465.075	1	<.001	.053	.040	.069
Marital Status at diagnosis								
Not married (Reference)								
Legally married	.333	.022	230.698	1	<.001	1.395	1.337	1.457
Year of diagnosis								
2002 or earlier (Reference)			144.611	3	<.001			
2003-2007	-.112	.028	16.193	1	<.001	.894	.847	.944
2008-2012	-.316	.028	130.103	1	<.001	.729	.690	.770
2013-2017	-21.853	318.960	.005	1	.945	.000	.000	1.019E+262
Geographical location								
California (Reference)			98.171	11	<.001			
Connecticut	.131	.057	5.216	1	.022	1.140	1.019	1.275
Detroit (Metropolitan)	.083	.049	2.866	1	.090	1.087	.987	1.197
Georgia	-.024	.035	.444	1	.505	.977	.911	1.047

	B	S.E.	Wald	*df*	Sig.	Odds Ratio	95% C.I. for Odds Ratio	
							Lower	Upper
Hawaii	.067	.167	.158	1	.691	1.069	.770	1.483
Iowa	.243	.062	15.274	1	<.001	1.275	1.129	1.441
Kentucky	.161	.045	12.762	1	<.001	1.175	1.075	1.284
Louisiana	.000	.045	.000	1	.995	1.000	.916	1.092
New Jersey	.097	.034	8.050	1	.005	1.102	1.031	1.179
New Mexico	-.135	.072	3.543	1	.060	.874	.759	1.006
Seattle (Puget Sound)	.421	.057	55.314	1	<.001	1.523	1.363	1.701
Utah	.244	.082	8.878	1	.003	1.276	1.087	1.499
Constant	1.326	.123	116.445	1	<.001	3.765		

Note. CI = confidence interval.

Table 55

Case Processing Summary for Research Question 1

Unweighted cases [a]		*N*	Percent
Selected cases	Included in analysis	56,045	99.4
	Missing cases	343	.6
	Total	56,388	100.0
Unselected cases		0	.0
Total		56,388	100.0

[a] If weight is in effect, see classification table for the total number of cases.

Table 56

Dependent Variable Encoding for Research Question 1

Original value	Internal value
under 60 months	0
>60 months	1

Table 57

Omnibus Tests of Model Coefficients for Research Question 1

		Chi-square	*df*	Sig.
Step 1	Step	25672.586	21	.000
	Block	25672.586	21	.000
	Model	25672.586	21	.000

Table 58

Hosmer and Lemeshow Test for Research Question 1

Step	Chi-square	*df*	Sig.
1	26.084	8	.001

Table 59

Model Summary for Research Question 1

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	51091.388 [a]	.367	.493

[a] Estimation terminated at iteration number 20 because maximum iterations has been reached.

Final solution cannot be found.

Table 60

Classification Table [a] for Research Question 1

		Predicted		
		Cervical cancer survival rate (dichotomous)		
Observed		under 60 months	>60 months	Percentage Correct
Cervical cancer survival rate (dichotomy)	under 60 months	21,405	10,224	67.7
	>60 months	3,918	20,498	84.0
Overall Percentage				74.8

[a] The cut value is .500.

Binary Logistic Regression Analysis for Research Question 2

RQ2: Is there a statistically significant association between the independent categorical variables (race/ethnicity, the diagnostic method of confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis) and the cervical cancer survival rate (categorical DV) among African Americans and White women?

The variable race/ethnicity was a CV for the study, and the diagnostic method of confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis were categorized into 2, 5, 9, and 4 groups. I conducted binary logistic regression analysis to determine a statistically significant association between the predictor variables (race/ethnicity, the diagnostic method of confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis) and the cervical cancer survival rate (outcome variable) among African Americans and White women. The case processing summary table showed that the selected cases included in the regression analysis were, n = 56,045, 99.4%, and the missing cases were n = 343, 0.6%. The Omnibus Tests of Model Coefficients was a 'Goodness of Fit' test and had a significant value of .000 (p <.05). The chi-square ($\chi 2$) statistic from the result was $\chi 2$ (17, n = 56,045) = 13522.766, p < .001 (see Table 64), meaning that the full model containing the histopathological characteristics were statistically significant and were able to distinguish between respondent's disparity in cervical cancer survival rate.

For the Hosmer-Lemeshow Goodness of Fit Test, a value larger than .05 (p >.05) indicated support for the model, but the chi-square ($\chi 2$) statistic was 73.741 with a

significance level of <.001 (see Table 65). The value was smaller than .05, indicating no support for the model, and there was evidence of the lack of model fit based upon the Hosmer-Lemeshow Goodness of Fit Test. The -2Log likelihood, Cox and Snell R^2, and Nagelkerke R^2 were 63241.207, .214, and .287, respectively (see Table 66), indicating the variation amount in the DV explained by the model. Thus, the two values, .214 (Cox and Snell R^2) and .287 (Nagelkerke R^2), suggested that the histopathologic variables explained the variability between 21.4% and 28.7%. The model correctly classified 71.1% of the cases, and its sensitivity and specificity rates for predicting the cervical cancer survival rate were 64.3% (>60 months) and 76.3% (under 60 months), respectively (see Table 67). The positive predictive value was 67.68% which was the percentage of cases that the model classified as having the characteristics observed in the group for cervical cancer survival rate 60 months and above. The negative predictive value was 73.47% which was the percentage of cases that the model classified as not having the characteristics observed in the group (cervical cancer survival rate less than 60 months).

The logistic regression model for predicting cervical cancer survival rate (see Table 61) showed that being African American was a negative and significant (p <.001) predictor of the odds of having disparities in cervical cancer survival rate and surviving less than 60 months. The *OR* (.833) indicated that the odds of African American women having a disparity in cervical cancer survival and surviving less than 60 months were also 0.8 times more likely than the odds for White women (95% CI = .791-.878). The odds that White women have a cervical cancer survival rate of fewer than 60 months were 1.2

times those for African American women who had a cervical cancer rate of 60 months or fewer. The percentage of women who lived less than 60 months (73.47%; *n* = 24,131) was 41% greater than women who lived more than 60 months (32.32%; *n* =7,498). The odds that the diagnostic methods of cervical cancer were microscopically confirmed were .882 times the odds that they were not microscopically confirmed. Also, the diagnostic method of confirmation was negative and not significant, *p* =.213 (>.05).

The analysis showed that 11% of the grade of the tumor that had a cervical cancer survival rate of fewer than 60 months were the Unknown grade of the tumor (*p* <.001, *OR* = 1.111, 95% CI = 1.033-1.194). The Unknown grade tumor was positive and significant out of all the tumor grades. All other tumor grades were negative and significant, except for moderately differentiated tumor (Grade II) *p* = .187 (>.05), *OR* = .953, 95% CI = .887-1.024. The odds that the tumor grade was moderately differentiated and had a cervical cancer survival rate of fewer than 60 months was .953 times the odds that they were well differentiated. All categories for histological types, except for those with Adenocarcinoma (Endocervical type), and Others, were negative. The *OR* (.810) and (.960) showed that for every unit of increment for histological factors, the odds of having cervical cancer survival rate of fewer than 60 months decreased (.810 < 1) and (.960 < 1). Hence, African American women with these histological types were more likely to have a cervical cancer survival rate of fewer than 60 months than more than 60 months.

Furthermore, all categories for histological types, except squamous cell carcinoma, keratinizing type, *p* =.127 (>.05), and other types, *p* =.213 (>.05), were not significant (*p* >.05). All categories for the stage of the disease were negative and

significant (p <.001) predictors of the disparities in cervical cancer survival rate, keeping all other predictors constant. The $OR < 1$ for all categories meant that as the stage of disease increased, the odds of having a cervical cancer survival rate of fewer than 60 months decreased. Thus, race/ethnicity, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis (except for the diagnostic method of confirmation) made unique contributions to predicting cervical cancer survival rate disparities in the full model. Consequently, I rejected the null hypothesis in RQ2 with the evidence of a significant association between race/ethnicity, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis with the cervical cancer survival rate among African Americans and White women. However, I failed to reject the null hypothesis in RQ2 that there was no association between the diagnostic method of confirmation and cervical cancer survival rate amongst African Americans and White women. However, statistically significant evidence against the null hypothesis in RQ2 indicated a significant association between some of the histological characteristics and cervical cancer survival rate.

Table 61

Binary Logistic Regression for Predicting Cervical Cancer Survival Rate for Research Question 2

Predictors	B	S.E.	Wald	*df*	Sig.	Odds Ratio	95% C.I.for Odds Ratio	
							Lower	Upper
Race/Ethnicity of participants								
White (Reference)								
African American	-.182	.027	46.285	1	<.001	.833	.791	.878
Diagnostic method of confirmation								
No (Reference)								
Microscopically confirmed	-.125	.101	1.552	1	.213	.882	.724	1.075
Grade of tumor at diagnosis								
Well differentiated/Grade I (Reference)			165.379	4	<.001			
Moderately differentiated/Grade II	-.048	.037	1.739	1	.187	.953	.887	1.024
Poorly differentiated/Grade III	-.207	.038	29.839	1	<.001	.813	.755	.876
Undifferentiated, anaplastic/Grade IV	-.379	.073	26.672	1	<.001	.684	.593	.790
Unknown	.105	.037	7.979	1	.005	1.111	1.033	1.194
Histological type								
Squamous cell carcinoma, NOS (Reference)			189.636	8	<.001			
Adenocarcinoma	.067	.031	4.773	1	.029	1.069	1.007	1.135
Squamous cell carcinoma nonkeratinizing, NOS	.071	.034	4.289	1	.038	1.074	1.004	1.148
Squamous cell carcinoma keratinizing, NOS	.058	.038	2.333	1	.127	1.060	.984	1.141

Predictors	B	S.E.	Wald	*df*	Sig.	Odds Ratio	95% C.I.for Odds Ratio	
							Lower	Upper
Adenosquamous carcinoma	.149	.052	8.096	1	.004	1.161	1.047	1.286
Squamous cell carcinoma, microinvasive	.694	.060	135.196	1	<.001	2.002	1.781	2.251
Adenocarcinoma, endocervical type	-.211	.063	11.107	1	<.001	.810	.715	.917
Endometroid carcinoma	.365	.075	23.686	1	<.001	1.441	1.244	1.669
Other types	-.041	.033	1.550	1	.213	.960	.900	1.024
Stage of disease at diagnosis								
Localized (Reference)			8546.782	3	.000			
Regional	-1.091	.022	2546.941	1	.000	.336	.322	.350
Distant	-2.707	.044	3859.369	1	.000	.067	.061	.073
Unstaged	-2.814	.039	5337.861	1	.000	.060	.056	.065
Constant	.850	.108	61.900	1	<.001	2.341		

Note. CI = Confidence interval.

Table 62

Case Processing Summary for Research Question 2

Unweighted Cases [a]		*N*	Percent
Selected Cases	Included in analysis	56,045	99.4
	Missing cases	343	.6
	Total	56,388	100.0
Unselected Cases		0	.0
Total		56,388	100.0

[a] If weight is in effect, see classification table for the total number of cases.

Table 63

Dependent Variable Encoding for Research Question 2

Original value	Internal value
under 60 months	0
>60 months	1

Table 64

Omnibus Tests of Model Coefficients for Research Question 2

		Chi-square	*df*	Sig.
Step 1	Step	13522.76	17	.000
	Block	13522.76	17	.000
	Model	13522.76	17	.000

Table 65

Hosmer and Lemeshow Test for Research Question 2

Step	Chi-square	*df*	Sig.
1	73.741	8	<.001

Table 66

Model Summary for Research Question 2

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	63241.207 [a]	.214	.287

[a] Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 67

Classification Table [a] for RQ 2

		Predicted		
		Cervical cancer survival rate (dichotomous)		
Observed		under 60 months	>60 months	Percentage correct
Cervical cancer survival rate (dichotomous)	under 60 months	24,131	7,498	76.3
	>60 months	8,713	15,703	64.3
Overall ercentage				71.1

[a] The cut value is .500.

Binary Logistic Regression Analysis for Research Question 3

RQ3: Is there a statistically significant association between the independent categorical variables [race/ethnicity, the mode of treatment (surgery, radiation therapy, chemotherapy, and combination therapies), and treatment outcome/status] and the cervical cancer survival rate (categorical DV) among African Americans and White women?

The variable race/ethnicity (White = 0, and African American = 1) was a CV for the study, and all the treatment-related variables were dichotomized. Surgical treatment was dichotomized into surgery performed and no surgery performed, radiation therapy into radiation performed and no radiation performed, and chemotherapy into had chemotherapy and had no chemotherapy. Likewise, 'systemic therapy and surgical procedure administered' and 'surgery and radiation therapies administered' were dichotomized into yes and no. Patient status after treatment was recoded as Dead = 0 and Alive = 1. I conducted a binary logistic regression analysis to determine a statistically significant association between the predictor variables (race/ethnicity, surgical treatment,

radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) and the cervical cancer survival rate (outcome variable) among African Americans and White women. The case processing summary table showed that the selected cases included in the regression analysis were n = 56,045, 99.4%, and the missing cases were n = 343, 0.6%.

The Omnibus Tests of Model Coefficients was a 'Goodness of Fit' test and had a significant value of .000 ($p < .05$). The chi-square ($\chi 2$) statistic from the result was $\chi 2$ (7, n = 56,045) = 19250.610, $p < .001$ (see Table 71), meaning that the full model containing the treatment-related characteristics were statistically significant and distinguished respondent's disparity in cervical cancer survival rate. For the Hosmer-Lemeshow Goodness of Fit Test, a value larger than .05 ($p > .05$) indicated support for the model, but the chi-square ($\chi 2$) statistic was 587.604 with a significance level of $p < .001$ (see Table 72). The value was smaller than .05, indicating no support for the model, and there was evidence of the lack of model fit based upon the Hosmer-Lemeshow Goodness of Fit Test. The -2Log likelihood, Cox and Snell R^2, and Nagelkerke R^2 were 57513.363, .291, and .390, respectively (see Table 73), indicating the variation amount in the DV explained by the model. Thus, the two values, .291 (Cox and Snell R^2) and .390 (Nagelkerke R^2) suggested that the treatment-related variables explained the variability between 29.1% and 39%. The model correctly classified 72.5% of the cases, and its sensitivity and specificity rates for predicting the cervical cancer survival rate were 72.5% (>60 months) and 72.4% (under 60 months), respectively (see Table 74).

Furthermore, positive predictive value of 67.01% was the percentage of cases that the model classified as having the characteristics observed in the group for cervical cancer survival rate 60 months and above. The negative predictive value of 77.35% was the percentage of cases that the model classified as not having the characteristics observed in the group (cervical cancer survival rate less than 60 months). The logistic regression model for predicting cervical cancer survival rate (see Table 68) showed that being African American was a positive and insignificant ($p > .05$) predictor of the odds of having disparities in cervical cancer survival rate and surviving less than 60 months. Thus, race/ethnicity was not a significant predictor of cervical cancer survival rates (*OR* = 1.045; 95% CI = .988-1.106). Surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment were significant predictors of cervical cancer survival rate, $p < .05$.

Surgical treatment was a significant contributor to the model, $p < .05$. Survivors who had surgery performed had 2.8 times higher odds of cervical cancer survival rate of more than 60 months than those who had no surgery performed (*OR* = 2.796; 95% CI = 2.601-3.006) of cervical cancer survival rate of fewer than 60 months. Also, cervical cancer survivors who had radiation therapy had 2.9 times higher odds of cervical cancer survival rate of more than 60 months than those who had no radiation therapy (*OR* = 2.869; 95% CI = 2.631-3.128) of cervical cancer survival rate of fewer than 60 months. However, the predictor (surgery with radiation therapies administered and chemotherapy) was negative and significant ($p < .001$). Also, patients had 10.3 times the odds of cervical

cancer survival rate for more than 60 months than those who survived 60 months or fewer (*OR* = 10.327; 95% CI = 9.798-10.884) after treatment.

Cervical cancer survivors who had combination therapy (systemic therapy and surgical procedure) had 6.0 times the odds of cervical cancer survival rate of more than 60 months than their counterparts with 60 months or fewer (*OR* = 6.042; 95% CI = 5.746-6.354). From the analysis, race/ethnicity was an insignificant predictor of the DV as a CV; therefore, the null hypothesis was not rejected. Thus, surgical treatment, radiation therapy, chemotherapy, combination therapy (systemic therapy and surgical procedure administered, surgery and radiation therapies administered), and patient status after treatment made unique contributions to predicting cervical cancer survival rate disparities in the full model. Therefore, I rejected the null hypothesis in RQ3 with the significant evidence against the null hypothesis indicated by the significant association between the treatment-related factors (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) and the cervical cancer survival rate (categorical DV) among African Americans and White women.

Table 68

Binary Logistic Regression for Predicting Cervical Cancer Survival Rate for Research Question 3

Predictors	B	S.E.	Wald	*df*	Sig.	Odds ratio	95% C.I. for Odds ratio	
							Lower	Upper
Race/Ethnicity of participants								
White (Reference)								
African American	.044	.029	2.382	1	.123	1.045	.988	1.106
Surgical Treatment								
No surgery performed (Reference)								
Surgery performed	1.028	.037	774.079	1	<.001	2.796	2.601	3.006
Radiation therapy								
No radiation performed (Reference)								
Radiation performed	1.054	.044	569.775	1	<.001	2.869	2.631	3.128
Chemotherapy								
Had no chemotherapy (Reference)								
Had chemotherapy	-.929	.031	915.843	1	<.001	.395	.372	.420
Systemic therapy and surgical procedure administered								
No (Reference)								
Yes	1.799	.026	4912.436	1	.000	6.042	5.746	6.354

Predictors	B	S.E.	Wald	*df*	Sig.	Odds ratio	95% C.I. for Odds ratio Lower	Upper
Surgery and radiation therapies administered								
No (Reference)								
Yes	-1.396	.046	931.542	1	<.001	.248	.226	.271
Patient status after treatment								
Dead (Reference)								
Alive	2.335	.027	7574.534	1	.000	10.327	9.798	10.884
Constant	-3.172	.042	5671.574	1	.000	.042		

Note. CI = confidence interval.

Table 69

Case Processing Summary for Research Question 3

Unweighted Cases [a]		*N*	Percent
Selected Cases	Included in analysis	56,045	99.4
	Missing cases	343	.6
	Total	56,388	100.0
Unselected Cases		0	.0
Total		56,388	100.0

[a] If weight is in effect, see classification table for the total number of cases.

Table 70

Dependent Variable Encoding for Research Question 3

Original value	Internal value
under 60 months	0
>60 months	1

Table 71

Omnibus Tests of Model Coefficients for Research Question 3

		Chi-square	*df*	Sig.
Step 1	Step	19250.610	7	.000
	Block	19250.610	7	.000
	Model	19250.610	7	.000

Table 72

Hosmer and Lemeshow Test for Research Question 3

Step	Chi-square	*df*	Sig.
1	587.604	7	<.001

Table 73

Model Summary for Research Question 3

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	57513.363 [a]	.291	.390

[a] Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 74

Classification Table [a] for Research Question 3

		Predicted		
		Cervical cancer survival rate (dichotomous)		
Observed		under 60 months	>60 months	Percentage correct
Cervical cancer survival rate (dichotomous)	under 60 months	22,914	8,715	72.4
	>60 months	6,710	17,706	72.5
Overall percentage				72.5

[a] The cut value is .500.

Assumptions for Binary Logistic Regression Analyses for the Research Questions

For the logistic regression, a minimum of 166 cases were needed to detect a small effect at $R^2 = 0$, and there were 56,388 participants eligible for the study. The sociodemographic independent categorical predictors included in the study were race/ethnicity of participants, the age at diagnosis, marital status at diagnosis, the year of diagnosis, and geographical location. The histopathological independent categorical predictors were race/ethnicity, the diagnostic method of confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis. The treatment-related predictors include race/ethnicity, surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment.

Furthermore, I ran diagnostic tests to identify correlated predictors and the presence of multicollinearity between them (i.e., Variance Inflation Factor, VIF $\geq$ 10 and Tolerance value < 0.1). The predictors of cervical cancer survival rates were not highly correlated with each other, and there was no evidence of multicollinearity (VIF < 10 and Tolerance > 0.1) between them. I also checked for high inter-correlations (> 0.70 bivariate correlation) between the predictors (see Tables 33, 34, and 35). There was no inter-correlation between the sociodemographic, histopathological, and treatment-related predictors because the correlation coefficients for RQ1, RQ2, and RQ3 values are < 0.70. Thus, the preliminary analysis suggested that the assumption of multicollinearity was not met. Also, an inspection of the standardized residual values revealed that there was no presence of outliers, or cases that were not well explained by the logistic regression

model. The P-P plot of standardized residuals fell within the ±3 criterion for the outliers, as shown in figures 18, 20, and 22. Also, the scatterplot of the residuals fell within the ±3 margins, as shown in figures 19, 21, and 23.

Table 75

Coefficients for Research Question 1

	Collinearity statistics	
	Tolerance	VIF
Race/Ethnicity of participants	.973	1.028
Age at diagnosis	.976	1.024
Marital status at diagnosis	.956	1.046
Year of diagnosis	.998	1.002
Geographical location	.996	1.004

Table 76

Coefficients for Research Question 2

	Collinearity statistics	
	Tolerance	VIF
Race/Ethnicity of participants	.996	1.005
Diagnostic method of confirmation	.930	1.075
Grade of tumor at diagnosis	.971	1.030
Histological type	.960	1.042
Stage of disease at diagnosis	.971	1.030

Table 77

Coefficients for Research Question 3

	Collinearity statistics	
	Tolerance	VIF
Race/Ethnicity of participants	.983	1.017
Surgical treatment	.368	2.721
Radiation therapy	.287	3.489
Chemotherapy	.491	2.035
Systemic therapy and surgical procedure administered	.801	1.248
Surgery and radiation therapies administered	.350	2.857
Patient status after treatment	.804	1.244

Table 78

Coefficient Correlations for Research Question 1

		Geographical location	Marital status at diagnosis	Year of diagnosis	Age at diagnosis	Race/Ethnicity of participants
Correlations	Geographical location	1.000	-.001	-.011	-.010	-.064
	Marital status at diagnosis	-.001	1.000	.033	.145	.143
	Year of diagnosis	-.011	.033	1.000	-.015	.009
	Age at diagnosis	-.010	.145	-.015	1.000	-.027
	Race/Ethnicity of participants	-.064	.143	.009	-.027	1.000
Covariances	Geographical location	.000	.000	.000	.000	.000
	Marital status at diagnosis	.000	.000	.000	.000	.000
	Year of diagnosis	.000	.000	.000	.000	.000
	Age at diagnosis	.000	.000	.000	.000	.000
	Race/Ethnicity of participants	.000	.000	.000	.000	.000

Table 79

Coefficient Correlations for Research Question 2

		Stage of disease at diagnosis	Race/Ethnicity of participants	Histological type	Grade of tumor at diagnosis	Diagnostic method of confirmation
Correlations	Stage of disease at diagnosis	1.000	-.040	-.022	-.056	.138
	Race/Ethnicity of participants	-.040	1.000	.042	-.035	.001
	Histological type	-.022	.042	1.000	-.060	.171
	Grade of tumor at diagnosis	-.056	-.035	-.060	1.000	.124
	Diagnostic method of confirmation	.138	.001	.171	.124	1.000
Covariances	Stage of disease at diagnosis	.000	.000	.000	.000	.000
	Race/Ethnicity of participants	.000	.000	.000	.000	.000
	Histological type	.000	.000	.000	.000	.000
	Grade of tumor at diagnosis	.000	.000	.000	.000	.000
	Diagnostic method of confirmation	.000	.000	.000	.000	.000

Table 80

Coefficient Correlations for Research Question 3

		Patient status after treatment	Surgery and radiation therapies	Race/ Ethnicity	Chemo	Systemic therapy and surgical procedure	Surgery	Radiation therapy
Correlations	Patient status after treatment	1.000	.090	.060	-.050	.149	-.338	-.014
	Surgery and radiation therapies administered	.090	1.000	.008	-.012	-.222	-.651	-.648
	Race/Ethnicity of participants	.060	.008	1.000	.023	.006	.045	-.024
	Chemotherapy	-.050	-.012	.023	1.000	-.171	.165	-.457
	Systemic therapy and surgical procedure administered	.149	-.222	.006	-.171	1.000	-.113	.079
	Surgical treatment	-.338	-.651	.045	.165	-.113	1.000	.524
	Radiation therapy	-.014	-.648	-.024	-.457	.079	.524	1.000
Covariances	Patient status after treatment	.000	.000	.000	.000	.000	.000	.000
	Surgery and radiation therapies administered	.000	.000	.000	.000	.000	.000	.000
	Race/Ethnicity of participants	.000	.000	.000	.000	.000	.000	.000
	Chemotherapy	.000	.000	.000	.000	.000	.000	.000
	Systemic therapy and surgical procedure administered	.000	.000	.000	.000	.000	.000	.000
	Surgical treatment	.000	.000	.000	.000	.000	.000	.000
	Radiation therapy	.000	.000	.000	.000	.000	.000	.000

Figure 18

Normal P-P Plot Showing the Sociodemographic Predictors for Research Question 1

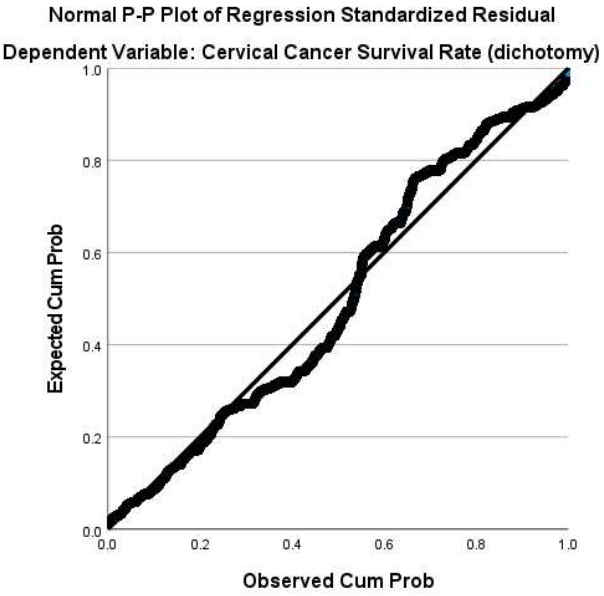


Figure 19

Scatterplot Showing the Sociodemographic Predictors for Research Question 1

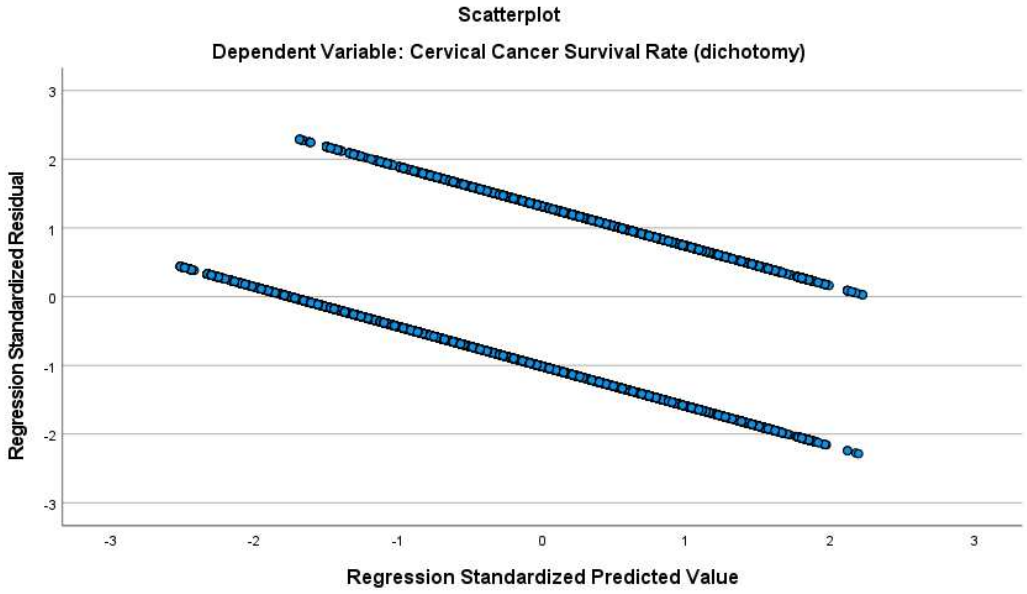


Figure 20

Normal P-P Plot Showing the Histopathological Predictors for Research Question 2

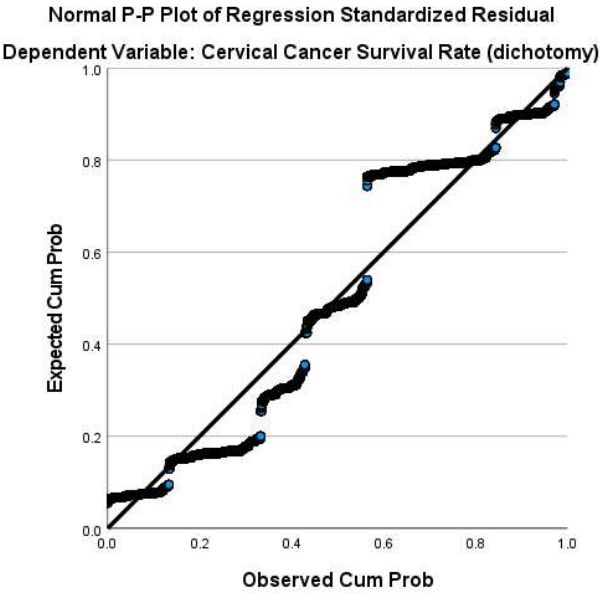


Figure 21

Scatterplot Showing the Histopathological Predictors for Research Question 2

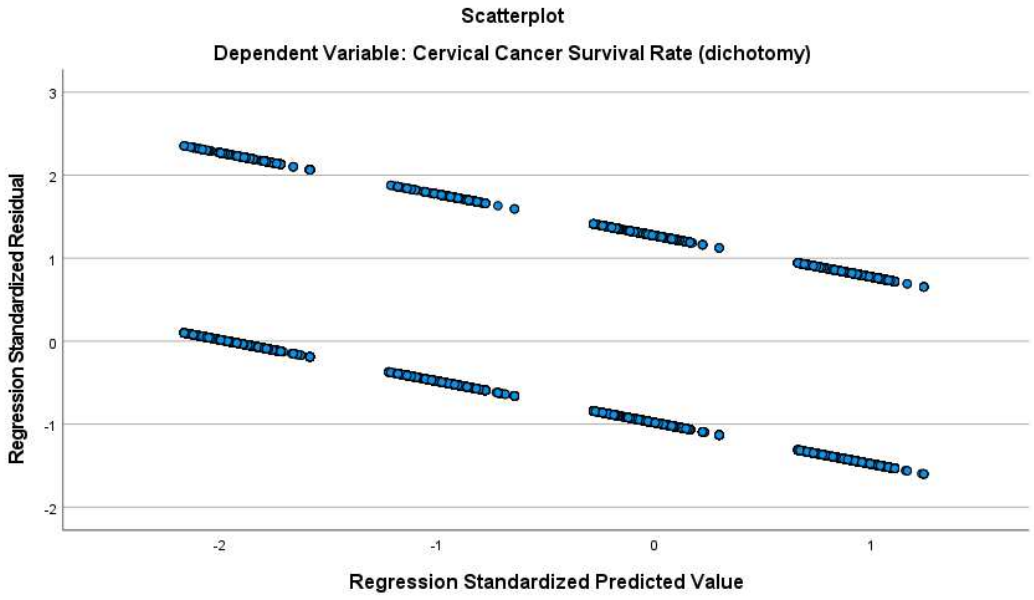


Figure 22

Normal P-P Plot Showing the Treatment-Related Predictors for Research Question 3

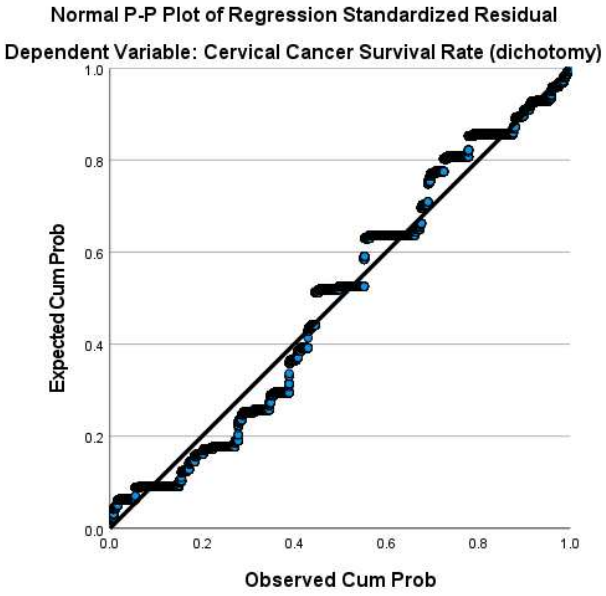
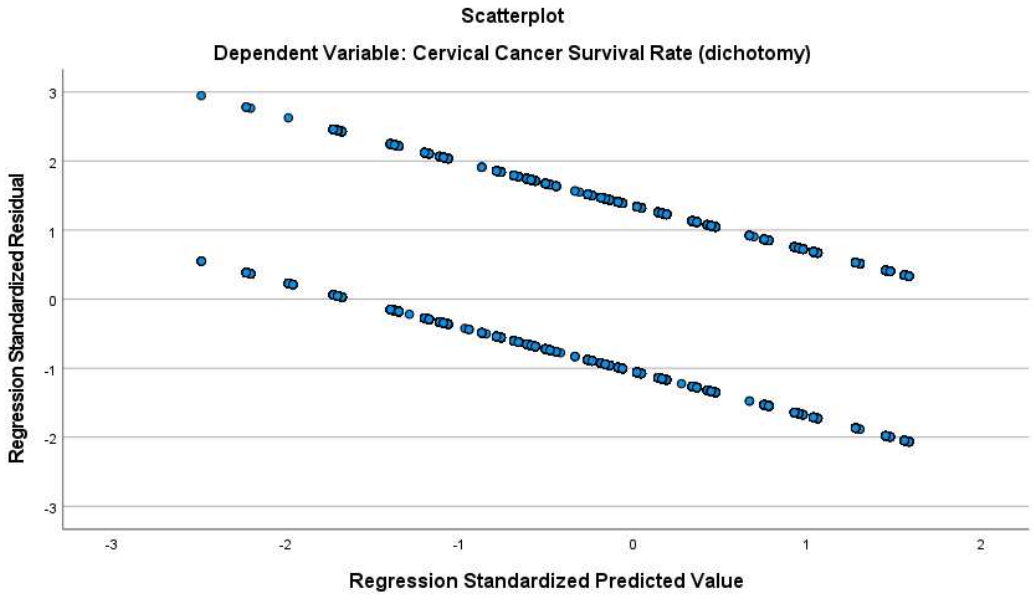


Figure 23

Scatterplot Showing the Treatment-Related Predictors for Research Question 3



Summary

I conducted chi-square for descriptive statistics and binary logistic regression to investigate the relationship between disparities in the sociodemographic (in RQ1), histopathological (in RQ2), and treatment-related factors (in RQ3) and cervical cancer survival rate amongst Whites and African American women. I presented the results, summarized the findings, and presented the conclusions from each result. In the study, 54% of the participants aged 19-45 years correlate with the study by Pan et al., where women aged 20 to 39 years in the United States were mostly affected by cervical cancer. Rejected the null hypotheses since the chi-square tests were significant ($p < .05$) for all the independent categorical variables, however, failed to reject the null hypotheses for the year of diagnosis, $\chi 2$ (3, n = 56,388) = 2.266, p = .519 (>.05), phi = .006 and diagnostic method of confirmation, $\chi 2$ (1, n = 56,388) = 3.648, p = .062 (>.05), phi = -.008 (with Yates' Continuity Correction). The phi coefficient values detected a small effect size using Cohen's criteria; however, the value of Cramer's V indicated weak associations between the categorical variables.

The first RQ examined the potential association between race/ethnicity-related disparities in age at diagnosis, marital status, the year of diagnosis, and geographical location (sociodemographic independent categorical variables) and the cervical cancer survival rates (dependent dichotomous variable) amongst Whites and African American women. The logistic regression model showed a statistically significant association between race/ethnicity, age at diagnosis, year of diagnosis (except for 2013-2017), marital status, and geographical location (except for Detroit, Georgia, Hawaii, Louisiana,

and New Mexico) and cervical cancer survival rates among African Americans and White women. Therefore, rejected the null hypothesis in RQ1 with the evidence of a significant relationship between the independent categorical variables (race/ethnicity, the age at diagnosis, the year of diagnosis, marital status, and geographical location) and the cervical cancer survival rates (outcome variable) amongst Whites and African American women.

The second RQ examined the potential association between race/ethnicity-related disparities in the diagnostic method of confirmation, grade of tumor at diagnosis, histological type, and cancer stage at diagnosis (histopathologic independent categorical variables) and the cervical cancer survival rates (dependent dichotomous variable) amongst African Americans and White women. The logistic regression model showed a significant relationship between race/ethnicity, tumor grade at diagnosis (except for moderately differentiated/Grade II), histological type (except for Squamous cell carcinoma, keratinizing, NOS and Other Types), and cancer stage at diagnosis and the cervical cancer survival rate among African Americans and White women. Though there was no relationship between the diagnostic method of confirmation and cervical cancer survival rates amongst Whites and African American women; however, there was a statistically significant association between some histological characteristics and cervical cancer survival rate. Therefore, statistically significant evidence against the null hypothesis in RQ2 indicated a significant association between some of the histopathological characteristics and cervical cancer survival rate.

The third RQ examined the potential association between race/ethnicity-related disparities in treatment-related characteristics (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) and cervical cancer survival rates (dependent dichotomous variable) among African Americans and White women. The logistic regression model showed a statistically significant association between treatment-related factors (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) and cervical cancer survival rates among African Americans and White women. Race/ethnicity did not significantly predict the DV as a CV; therefore, the null hypothesis was not rejected. However, there was a statistically significant association between all treatment-related characteristics (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) and cervical cancer survival rates. Therefore, statistically significant evidence against the null hypothesis in RQ3 indicated a significant association between the treatment-related factors and cervical cancer survival rates among African Americans and White women. In Section 4, I will interpret the key findings, recommend future research, and provide the potential implications for positive social change of the findings.

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

Introduction

In Section 3, I presented the results and findings of the statistical analyses and described the data collection methods of the secondary data set, the time frame for data collection, and the sample's demographic characteristics. Additionally, I presented the tables and figures to illustrate the results, reported the baseline descriptive and inferential statistics that appropriately characterized the sample, and summarized the statistical analyses to test the RQs and corresponding hypotheses by providing the answers to each RQ. Therefore, in this section (Section 4), I interpret these findings within the SEM framework, discuss the study's limitations, propose future research recommendations, describe implications for professional practice and social change, and provide conclusions that capture the essence of the study.

The purpose of this quantitative study was to understand and fill the gaps in the scientific knowledge about the predictive association of race/ethnicity-related disparities in the sociodemographic, histopathological, and treatment-related factors and cervical cancer survival outcomes between African American and White women in the United States. I designed the study as a secondary analysis of the Incidence SEER Research Plus data 18 Registries (2000–2017) cross-sectional dataset. The quantitative correlational design measured the association between race/ethnicity-related disparities in age at diagnosis, year of diagnosis, marital status, geographical location, diagnostic confirmation, grade of tumor at diagnosis, histological type, cancer stage at diagnosis, surgical treatment, radiation therapy, chemotherapy, surgery and radiation therapies

administered, systemic therapy and surgical procedure administered, and patient status after treatment and the cervical cancer survival rate. The SEER surveyors used standardized data collection and nonprobability sampling methods to provide rich information about the target population in the United States to ensure generalizability. Additionally, the quantitative research approach was used to address the three RQs.

The study was conducted due to the disparate outcomes in cervical cancer survival amongst White and African American women leading to significant racial health disparities, thus posing a challenge to disease management, despite an overall decrease in cervical cancer rates in the United States. I used a correlational study design and conducted chi-square for descriptive statistics and binary logistic regression analyses to investigate the relationship between disparities in the sociodemographic (in RQ1), histopathologic (in RQ2), and treatment-related (in RQ3) factors and the cervical cancer survival rate amongst Whites and African American women in the United States. The result showed that 54% of the participants aged 19–45 years were most affected by cervical cancer. I also rejected the null hypotheses because the chi-square tests were significant ($p < .05$) for all the independent categorical variables; however, due to insignificance, I did not reject the null hypotheses for the year of diagnosis, $\chi 2$ (3, n = 56,388) = 2.266, p = .519 (> .05), phi = .006 and diagnostic method of confirmation, $\chi 2$ (1, n = 56,388) = 3.648, p = .062 (> .05), phi = -.008 (with Yates's continuity correction). The phi coefficient values (for an association between race/ethnicity and marital status, diagnostic method of confirmation, the treatment-related variables, and cervical cancer survival rates with the 2-by-2 tables) detected a small effect size using Cohen's criteria.

However, the value of Cramer's V indicated weak associations between the categorical variables.

Moreover, there was a statistically significant association between race/ethnicity, age at diagnosis, year of diagnosis (except for 2013–2017, $p = .945$), marital status, and geographical location (except for Detroit $p = .090$, Georgia $p = .505$, Hawaii $p = .691$, Louisiana $p = .995$, and New Mexico $p = .060$), and cervical cancer survival rates among African American and White women. Cervical cancer diagnosis reduced by 0.5% from 2013 to 2017, and the incidence decreased by about 0.1% per year between 2003 and 2017. There were significant associations between race/ethnicity-related tumor grade at diagnosis (except for moderately differentiated/Grade II, $p = .187$ ($> .05$), $OR = .953$; 95% CI = .887-1.024), histological type (except for squamous cell carcinoma, keratinizing, NOS, $p = .127$ ($> .05$), $OR = 1.060$; 95% CI = .984-1.141, and other types, $p = .213$ ($> .05$), $OR = .960$; 95% CI = .900-1.024), and cancer stage at diagnosis and the cervical cancer survival rate. However, there was no association between the diagnostic method of confirmation and cervical cancer survival rate amongst White and African American women.

Furthermore, treatment-related factors (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) were significant predictors ($p < .05$) of cervical cancer survival rates among African Americans and White women, hence rejecting the null hypotheses. However, race/ethnicity $p = .123$ ($> .05$), $OR = 1.045$; 95% CI = .988-1.106, did not significantly predict the disparate outcome in

cervical cancer survival amongst White and African American women; thus, the null hypothesis was not rejected.

Interpretation of the Findings

The key findings from the study advanced an understanding of the scientific knowledge about the gaps in the predictive association of race/ethnicity-related disparities in sociodemographic, histopathological, and treatment-related factors and cervical cancer survival amongst White and African American women in the United States. The RQs illuminate the findings.

RQ1: Is there a statistically significant association between the categorical variables (race/ethnicity [CV], age at diagnosis [IV], year of diagnosis [IV], marital status at diagnosis [IV], and geographical location [IV]) and the cervical cancer survival rate (DV) amongst White and African American women?

The study sample included White (n = 47,407; 84.1%) and African American (n = 8,981; 15.9%) participants, out of which less than 1% were aged less than 18 years, 54% (n = 30,448) were aged 19–45 years, 19.6% (n = 11,065) were aged 46–55 years, 13.3% (n = 7,486) were aged 56–65 years, 7.6% (n = 4,310) were aged 66–75 years, and 4.6% (n = 2,597) were 76 years of age and older. Previous studies confirmed that despite the decline in incidence and mortality, more than 13,000 diagnosed cases of invasive cervical cancer and almost 4,300 deaths in 2020 disproportionately affected survival (Andersson et al., 2017; Campos et al., 2017b; Fontham et al., 2020; Liverani et al., 2020). According to epidemiologic studies, an increasing number of young women under 40 years old were

most affected and comprised an estimated 30% of newly diagnosed cervical cancer cases in the United States (Pan et al., 2021; Steiner et al., 2021). Hence, it is crucial to explore the clinicopathological characteristics and to predict the prognosis of young women with cervical cancer in future studies. The current study revealed that 48.5% (n = 4,358) African Americans and 55% (n = 26,090) Whites aged 19 to 45 years were most affected. Compared to Whites (n = 20,922; 44.2%), the incidence of women above 45 years with cervical cancer included in the study was higher for African American women (n = 4,535; 50.5%). In line with previous studies, African American women experienced significant disease burden and cancer survival disparities compared to Whites (Liverani et al., 2020; Zhang et al., 2019).

Furthermore, the quantitative data were compared using the chi-square ($\chi 2$) and binary logistic regression analysis. The chi-square test for independence (with Yates' continuity correction) indicated a significant association between race/ethnicity and cervical cancer survival rate, $\chi 2$ (1, n = 56,045) = 143.711, p = <.001, phi = -.051. the phi coefficient (-.05) detected a small effect, the overall 5-year survival rate was 55.3% for Whites and 62.2% for African Americans, and the overall 10-year survival rates were 44.7% and 37.8%, respectively. Additionally, the binary logistic regression model showed that African American women had negative and significant ($p < .001$) odds of having disparities in the cervical cancer survival rate and surviving less than 5 years and were 0.8 times more likely than White women (OR = .773; 95% CI = .728-.821; $p < .05$) to survive less than 60 months. Moreover, White women were 1.3 times more likely than African American women to survive 5 years or more. Regardless of race or ethnicity, the

age at diagnosis was negative and significant ($p < .001$); however, women aged 19 to 45 years were 0.6 times ($p < .001$, $OR = .612$, 95% CI = .483-.777) more likely to have survived less than 60 months. However, Pfaendler et al. (2018) reiterated that race was not an independent predictor of survival after controlling for equal access to equal care and had no differences in 5- and 10-year survival.

The use of oral contraceptives, high parity, smoking, obesity, young age at first pregnancy, and early marriage influence HPV infections and are traditional risk factors for developing cervical cancer (Egli-Gany et al., 2019; Kirubarajan et al., 2021). However, marital status associated with young age, African American/Hispanic ethnicity, Western U.S. residence, uninsured status, high-grade tumor, squamous histology, and increased infectious mortality in advanced-stage cervical cancer were independent prognostic factors for advanced-stage disease and significant predictors of morbidity and mortality (Alyabsi et al., 2021). Compared to married women, unmarried women had increased cumulative risk of all-cause mortality (5-year rate: 32.9% vs. 29.7%, $p < 0.001$) and infectious mortality (0.5% vs. 0.3%, $p < 0.001$; Machida et al., 2017). From the study, less than 42% were not legally married ($n = 2,2911$; 40.6%), 10.5% ($n = 5,900$) were widowed, 42.8% ($n = 24,155$) were legally married, and the marital status of 3,422 participants (6.1%) was unknown.

The chi-square test for independence (with Yates' continuity correction) showed a significant association between the race/ethnicity and marital status at diagnosis, $\chi 2$ (1, $n = 56,388$) = 1243.548, $p = < .001$, phi = -.148, and the phi coefficient value of -.148 (~-.15) detected a small to medium effect, using Cohen's criteria of .10 for a small effect,

.30 for a medium effect, and .50 for a large effect. Additionally, being legally married ($p < .001$, $OR = 1.395$, 95% CI = 1.337-1.457) was 1.4 times higher to survive cancer for more than 5 years than for individuals not legally married. Cervical cancer incidence and mortality decreased by 0.2%/year and 0.7%/year, respectively (Vengaloor et al., 2021), but in the current study, incidence decreased by about 0.1% per year. Findings from this study revealed that morbidity from 2003 to 2007 ($n = 15,683$; 27.8%) plunged by 0.5% from 2008 to 2012 ($n = 15,389$; 27.3%). The proportion of cervical cancer diagnosed from 2013 to 2017 declined by 0.5%. From 2008 to 2012d (African Americans [$n = 2,458$; 27.4%] and Whites [$n = 12,931$; 27.3%]), and from 2013 to 2017 (African Americans [$n = 2,372$; 26.4%] Whites [$n = 12,740$; 26.9%]), the incidence was almost the same.

Previous studies revealed that in 2018 and 2019, there were ($n = 13,240$ and $n = 13,170$) cases and ($n = 4,170$ and $n = 4,250$) deaths, respectively (Olusola et al., 2019; Vengaloor et al., 2021). However, there was an insignificant association between race/ethnicity and year of diagnosis, $\chi 2$ (3, $n = 56,388$) = 2.266, $p = .519$ (> .05), and phi = .006, which detected a small effect size using Cohen's criteria of 0.06 for a small effect, .17 for a medium effect, and .29 for a large effect. Additionally, Cramer's V (.006) indicated no association between the two variables. The binary logistic regression showed that the year of diagnosis was associated with a decreased likelihood of 5-year survival and a negative and significant ($p < .001$) predictor of disparities in cancer survival, except for the years 2013–2017, $p = .945$ (> .05).

Geographical location as a sociodemographic factor affects women who reside in medically underserved and rural communities, which are significantly impacted by distance, the stage at presentation, and survival outcomes in Appalachia, the South Atlantic, and the lower Mississippi Valley (Dunyo et al., 2018; Powell et al., 2018). There is an association between race (African American women) and the South region (geographical location) with increased incidence and mortality among African Americans (race) and the South region (geographical location), leading to regional and racial disparities (Yoo et al., 2017). The current study showed that in the Appalachia region, the percentage of African Americans with cervical cancer was higher than that of Whites in Georgia (n = 2,395, 26.7%: n = 4,670, 9.9%), Kentucky (n = 301, 34%: n = 3,450, 7.3%), and Louisiana (n = 1,593, 17.7%, n = 2,286, 4.8%), respectively.

Furthermore, there was a significant association between race/ethnicity and geographical location, $\chi 2$ (11, n = 56,388) = 6556.930, p = .000, and phi = .341 and the Cramer's V of .006 detected a small effect size. The binary regression analysis conducted revealed significant ($p < .001$) disparities in cervical cancer survival rate for all geographical locations, except for Detroit (Metropolitan), Georgia, Hawaii, Louisiana, and New Mexico. The current study supported earlier research about the widening disparity in sociodemographic determinants of increased barriers to prevention, treatment, and survival identified by Benard et al. (2017) and the geographical disparities for minorities significantly impacted by distance in obtaining and completing high-quality care (Kweon et al., 2017).

RQ2: Is there a statistically significant association between the categorical variables (race/ethnicity [CV], diagnostic method of confirmation [IV], grade of tumor at diagnosis [IV], histological type [IV], and stage of disease at diagnosis [IV]) and the cervical cancer survival rate (DV) amongst White and African American women?

The diagnostic method of confirmation was a negative and insignificant, $p = .213$ ($> .05$) predictor of cervical cancer survival rate. However, researchers have stated that cervical cancer screening practices and HPV vaccination uptake influenced a decline in the disease burden in the United States (Karuri et al., 2017; Lei et al., 2020). The trend further revealed that widespread Pap smear screening for prevention reduced racial disparity, and there was a significantly decreased incidence among African Americans from 26.9 to 9.7 cases per 100,00 women ($p < .001$) in both the early and late stages (Yang et al., 2018). Besides, older women were more likely to have an increased risk of HPV infection and risk of cervical cancer and were diagnosed with high-grade tumors, poor histology, and advanced disease (Fontham et al., 2020).

Furthermore, the chi-square test for independence indicated an insignificant association and perfectly negative relationship between race/ethnicity and diagnostic method of confirmation, $\chi 2$ (1, $n = 56{,}388$) = 3.648, $p = .062$, phi = -.008. The phi coefficient value of -.008 detected a small effect size. Studies have demonstrated that African Americans in Appalachia, the South Atlantic, and the Mississippi Delta were more likely than Whites to be significantly impacted by disparities in screening and access to care resulting in overall high incidence, mortality, and survival (Gibson et al.,

2019; Fontham et al., 2020; Powell et al., 2018). The current study enhanced the scientific understanding of the impact of cervical cancer early detection programs on the incidence, mortality, and survival rates amongst White and African American women and closed the gap by Singh and Jemal (2017). The negative relationship may be explained by many factors such as cost, lack of access, place of residence, underuse of the healthcare system, anxiety, discomfort with the screening procedure, fear of cancer, poor health literacy, sociodemographic factors, structural barriers, health perceptions, and cultural beliefs that influence participation in cervical screening and poor outcomes for cervical cancer (Alyabsi et al., 2021; Ebu, 2018; Machida et al., 2017).

The binary logistic regression model showed significant associations between histopathological factors and cervical cancer survival rate amongst White and African American women. In a previous study, there was an association between more than 50% of the squamous cell carcinoma keratinizing subtype with a higher likelihood of advanced-stage disease and a lower overall 5-year survival (Saleem et al., 2019). However, I did not find a statistically significant relationship between Grade II/moderately differentiated tumors, $p = .187$ (> .05), $OR = .953$; 95% CI = .887-1.024), squamous cell carcinoma, keratinizing, NOS, $p = .127$ (> .05), $OR = 1.060$; 95% CI = .984-1.141, and other types, $p = .213$ (> .05), $OR = .960$; 95% CI = .900-1.024), and the cervical cancer survival rate. Several studies revealed that Whites were less likely to be diagnosed with advanced stages of the disease than with early stages and were more likely to survive than African Americans (Abdalla et al., 2020; Gibson et al., 2019; Singh & Jemal, 2017). Therefore, Whites had better prognoses than African Americans

diagnosed with squamous cell carcinoma; squamous cell carcinoma, keratinizing type, NOS, and other types; and low-grade (Grade I or Grade II) tumors at diagnosis than for other histological types and high-grade (Grade III or IV) tumors at diagnosis.

HPV infections infect immature basal epithelial cells (Gearhart, 2020), while adenocarcinoma and squamous cell carcinoma comprise 25% and 69% of cervical cancers (Benoit et al., 2018a, p. 39; Saleem et al., 2019). In the study, squamous cell carcinoma (n = 25,269; 44.8%) and adenocarcinoma (n = 7,682; 13.6%). African Americans were more likely than Whites (n = 4,848; 54% vs. n = 20,421; 43.1%) to develop squamous cell carcinoma, and less likely than Whites (n = 684; 7% vs. n = 6,998; 14.8%) to develop adenocarcinoma. Whites (n = 20,084; 42.4%) were more likely than African Americans (n = 3,055; 34%) to develop localized stages of disease at diagnosis but were less likely to develop regional (31.6% vs. 37%), distant (10.5% vs. 12.5%), and unstaged types (15.5% vs. 16.5%). The study filled gaps in the literature on the molecular landscape, multifactorial etiology, pathogenesis, and predicting the prognosis (Chen et al., 2021; Powell et al., 2018).

RQ3: Is there a statistically significant association between the categorical variables (race/ethnicity [CV], surgical treatment [IV], radiation therapy [IV], chemotherapy [IV], systemic therapy and surgical procedure administered [IV], surgery and radiation therapies administered [IV], and patient status after treatment [IV]) and the cervical cancer survival rate (DV) amongst White and African American women?

Several studies examined that disparities in treatment exist for underrepresented populations, especially in clinical trials and approaches to cancer care and follow-up studies, thereby limiting the targeted safety and effectiveness of novel treatments (Yates et al., 2020). Regardless of sociodemographic, histopathological, and treatment-related factors, the binary logistic regression analysis showed that race/ethnicity (CV) was an insignificant predictor of cervical cancer survival rate (DV). Treatment depends on the patient's age, fertility, general well-being, primary lesion size, stage, histology, tumor differentiation, and metastases (ACS, 2020e; Šarenac & Mikov, 2019; WHO, 2020). In the study, White women (*n* = 27,829; 58.7%) received surgical treatment more than African American women (*n* = 3,914; 43.6%). However, more than 50% of African Americans (*n* = 5,067; 56.4%) and less than 50% of White women (*n* = 19,578; 41.3%) did not receive surgical treatment.

Higher percentages of African American women had radiation therapy (58.9%; *n* = 5,291 vs. 51.1%; *n* = 24,206) and chemotherapy (47.9%; *n* = 4,300 vs. 43.5%; *n* = 20,608) compared to White women. Additionally, less than 50% had no radiotherapy (48.9%; *n* = 23,201 vs. 41.1%; *n* = 3,690), and more than 50% had no chemotherapy (56.5%; *n* = 26,799 vs. 52.1%; *n* = 4,681) for Whites and African Americans respectively. A higher percentage of White women had more combination therapy than African American women for Chemotherapy + Surgery (49.3%; *n* = 23,397 vs. 46.7%; *n* = 4,187) and Surgery + Radiation (22.9%; *n* = 10,862 vs. 19.4%; *n* = 1,744).

In the quantitative study, the Chi-square ($\chi 2$) test indicated a significant association between race/ethnicity (CV) and treatment-related factors. Surgical treatment, $\chi 2$ (1, n = 56,388) = 701.102, p = <.001, phi = -.112, radiation therapy, $\chi 2$ (1, n = 56,388) = 186.354, p = <.001, phi = .058, and chemotherapy revealed $\chi 2$ (1, n = 56,388) = 59.327, p = <.001, phi = .032. Also, surgery and radiation therapies administered $\chi 2$ (1, n = 56,388) = 52.886, p = <.001, phi = -.031, systemic therapy and surgical procedure administered $\chi 2$ (1, n = 56,388) = 22.457, p = <.001, phi = -.020, and patient status after treatment $\chi 2$ (1, n = 56,388) = 557.464, p = <.001, phi = -.099 indicated significance. The phi coefficient values for all the treatment-related variables detected a small effect size. Though surgery presented a survival advantage over radiotherapy or chemotherapy as primary treatment for early-stage cervical cancer, African Americans had an increased risk of dying from cervical cancer (Pfaendler et al., 2018). In the study, almost 50% of African Americans (49.7%; n = 4,466, p <.001) and 37% of Whites (36.5%; n = 17,300, p <.001) did not survive after treatment, while 50.3% (n = 4,515) and 63.5% (n = 30,107) of African Americans and Whites survived, respectively. Thus, treatment-related factors for African Americans and White women made unique contributions to predicting cervical cancer survival rate disparities in the full model.

Application of the Socio-Ecological Model

The SEM explained the relationship between sociodemographic, histopathologic, treatment-related factors and cervical cancer survival rate. Socioeconomic deprivations provide nuances for understanding the major risk factors at the intrapersonal,

intrapersonal, organizational, community, and public policy levels. However, the SEM provides a framework for understanding the clinicopathological characteristics and predicting the prognosis of young women with cervical cancer. The lack of HPV vaccination, lack of cervical screening, poor adherence to the screening program, and lack of regular gynecological follow-up are consequences of disparities in social determinants of health. At the interpersonal level, the SEM addressed the associations between the patient's marital status (married vs. unmarried), age, and African American vs. White ethnicity, with the increased cumulative risk of all-cause mortality in advanced-stage cervical cancer as an independent prognostic factor for advanced-stage disease, and a significant predictor of morbidity and mortality.

Also, due to the disadvantaged SES, significant evidence suggests that the persistence of racial differences was associated with almost an increased risk of cervical cancer development. The SEM also explained that geographic disparities exist in disadvantaged geographical locations (e.g., Appalachia region) in the study at the community and public policy level, as explained by the association between race (African American women) and the South region (geographical location) with increased incidence and mortality among African Americans (race) and the South region (geographical location), leading to regional and racial disparities. The negative and significant diagnostic method of confirmation, p =.213 (>.05) as a predictor of cervical cancer survival rate affects cervical cancer screening practices and HPV vaccination uptake and may be explained by barriers like poor knowledge, time constraints, location of the physician's office, rate of female patients enlisted with the doctor, the size of the office,

physician's gender, interactions with healthcare providers, and the practice of Pap-smears by the doctor and location (urban or rural) of the office (Kirubarajan et al., 2021).

The SEM also addressed the significant associations between histopathological factors and cervical cancer survival rate amongst Whites and African American women; however, there was no association between Grade II/moderately differentiated tumors, squamous cell carcinoma, keratinizing, and Other Types, and the cervical cancer survival rate. The organizational level barriers may be cultural (physician vs. patient), lack of trust, unfavorable attitudes in the workplace, late detection, and lack of health insurance (not available as a variable for the study). The significant association between race/ethnicity treatment-related factors and cervical cancer survival disparities illuminates the concerted efforts by healthcare providers, stakeholders, navigators, and community leaders to educate women and young girls about cervical cancer screening as a public health initiative campaign.

The public policy level ensures culturally competent communication strategies for populations demographically characterized by a lower cervical cancer screening rate and a more disadvantaged socioeconomic environment. It is crucial to provide an organized screening program that is culturally competent (sociodemographic), universally accessible, enables quality care (based on histopathologic factors), and treatment (surgery, radiation therapy, chemotherapy, and combined therapy) for early diagnosis to lower incidence and mortality from cervical cancer (Meira et al., 2020). Hence, the study examined the predictive association of sociodemographic, histopathologic, and treatment-

related factors on the cervical cancer survival rate among Whites and African American women, using the SEM as a theoretical framework.

Limitations of the Study

The cross-sectional, correlational study design utilized the SEER Research Plus Data, 18 registries for secondary analysis. Due to the cross-sectional study design, I drew conclusions based on the null hypotheses; hence, I did not use descriptive research. Also, the limitations of the correlation study were that the results demonstrated associations and not causality demonstrated by experimental studies. The cross-sectional design effectively described the relationships between sociodemographic, histopathological, and treatment-related factors and the cervical cancer survival rate amongst Whites and African American women. However, the dichotomization of the independent and dependent variables for the analyses limited the study—the quantitative cross-sectional study used non-probability sampling and is representative of the general population (Yang et al., 2020).

Also, cervical cancer survival rate (DV) for the study sample had 343 (0.6%) missing data; however, excluding these participants had minimal effect on the statistical power and the analysis. The SEER database for the sociodemographic variables did not include data on health insurance status, family poverty level, level of education, employment status, or distance from the hospital; however, sociodemographic variables made unique contributions to predicting disparities in cervical cancer survival rate for the study. Participants may have had a recall and social desirability bias, and medical surveillance bias may have resulted when one group of participants was followed more

closely than the other groups (Bero et al., 2018; Lash et al., 2021). The threats to reliability influenced the generalizability of the findings from the study. However, the rigor of the statistical analyses controlled the confounders, or any systemic errors attributed to insignificant associations of some histopathologic types (squamous cell carcinoma, keratinizing, and Other Types).

Recommendations

Race/ethnicity-related disparities in socioeconomic, histopathologic, and treatment-related factors and cervical cancer survival rates among Whites and African Americans exist. The current study showed a statistically significant association between race/ethnicity, age at diagnosis, year of diagnosis (except for 2013-2017), marital status, and geographical location (except for Detroit, Georgia, Hawaii, Louisiana, and New Mexico), and cervical cancer survival rates among African Americans and White women. Also, race/ethnicity-related tumor grade at diagnosis (except for moderately differentiated/Grade II), histological type (except for Squamous cell carcinoma, keratinizing, NOS, and Other Types), and cancer stage at diagnosis showed significance. However, there was no relationship between the diagnostic method of confirmation and cervical cancer survival rates. Also, treatment-related characteristics (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) are significant; however, race/ethnicity did not significantly predict the DV as a CV.

More studies are needed to fully assess how to study race/ethnicity-related disparities in cancer survival as a critical metric of the effectiveness and quality of health

care and cancer management systems. The study focused on African Americans and Whites in the United States; hence, future studies should focus on minority subpopulations in the United States. The study is vital for cervical cancer elimination and the need for improved collaboration between stakeholders, policymakers, healthcare systems, providers, Physicians, health workers, and communities using the SEM as the theoretical model. Future research regarding the contribution of the current study on the association between race/ethnicity-related disparities in diagnostic and clinical biomarkers to predict the course of the disease and survival and to better understand the continuum in the cervical cancer survival disparities.

Future studies can expand to understand how the association between race/ethnicity and advanced cervical cancer disease is disproportionately affected by the COVID-19 pandemic in underserved women to accelerate the elimination of cervical cancer. Researchers opined that disruption in cervical cancer screenings during lockdowns in June 2020, cervical cancer screenings in the United States were 35% lower than their pre–COVID-19 levels. As a result of the pandemic, the barriers to cervical screening disproportionately impact socioeconomically disadvantaged and minority women worldwide, resulting in higher cervical cancer incidence and cancer-related deaths and lower rates of participation in guideline-based screening and treatment (Lozar et al., 2021). Therefore, given that socioeconomically disadvantaged and minority women insignificantly predicted cervical cancer survival rates, future research should understand infertility and cancer survival in advanced stage disease.

Implications for Professional Practice and Social Change

Future implications for professional practice include ways to eliminate race/ethnicity-related disparities in survival, expand on the effectiveness of available and emerging elimination strategies, provide a mechanism for visualizing the multilevel effects of cervical cancer disparities using the SEM framework, and highlight gaps in evidence to propose research priorities for addressing these gaps and accelerate progress toward elimination (Shin et al., 2021). Despite public health interventions aimed at prevention, early diagnosis, and effective screening for all women to contain the cervical cancer burden, disparities continue to exist, leading to increased mortality (Desta et al., 2021). Public health programs should be available for minorities and underserved populations at no cost (Desta et al., 2021). Health inequities and inequalities result in disparities in healthcare, which pose significant moral and ethical dilemmas. Also, geographic disparities in cervical cancer incidence exist among individuals living in high- and low-poverty counties in the United States (Spencer et al., 2021). Those living in higher poverty areas experience higher morbidity and mortality from numerous preventable cancers and are twice as likely to be diagnosed with cervical cancer as those in low-poverty areas (Spencer et al., 2021).

The positive social change implications for the study include providing available scientific evidence of the needed intervention on race/ethnicity-related sociodemographic, histopathological, and treatment-related factors and cervical cancer survival disparities needed to reduce and eliminate racial inequities in health. There is a need to create and maintain opportunities that facilitate social determinants of health at

the local community level, with emphasis at the institutional level to address primary care, preventive care, and early management of social risk factors and needs to ensure high-quality care and to inform the public and policymakers about the nature and extent of racial inequities in health for enhancing individual and community capacity building (Williams & Cooper, 2019). The strategies for reducing inequities in health require dismantling the societal institutions that initiate, sustain, and drive inequities in health (Williams & Cooper, 2019).

Furthermore, there is a need to implement policies in the long-term to improve economic well-being by reducing childhood poverty which elevates the risks of reduced SES (Williams & Cooper, 2019). Also, racial residential segregation eliminates racial differences in income, education, and unemployment and improves economic well-being, reducing gaps in single motherhood at the interpersonal level of the SEM (Williams & Cooper, 2019). Higher neighborhood quality is associated with improved health and economic outcomes, which reduce disparities to improve the quality of the neighborhood and housing environments in the United States (Williams & Cooper, 2019). It is essential to provide access to equal comprehensive preventive screenings and treatment to all persons in the United States, reducing and eliminating population-level inequities in health (Williams & Cooper, 2019). Also, addressing the patient's social and behavioral factors and needs will improve health outcomes and address healthcare disparities (Williams & Cooper, 2019). Diversifying the healthcare workforce enhances patient-provider communication, especially in a culturally competent healthcare system, which

fosters better relationships and improves overall health outcomes (Williams & Cooper, 2019).

Conclusion

African Americans historically have worse health outcomes than Whites; hence, racial inequities in health highlight the need for renewed efforts to effectively reduce and eliminate them (Williams & Cooper, 2019). Despite efforts to reduce inequities and eliminate disparities in cervical cancer over time through HPV vaccination and screening, the cancer burden remained significant (Egli-Gany et al., 2019). It remained the fourth most common gynecological cancer globally and the third most common malignancy affecting women in the United States (Ferrall et al., 2021; Sung et al., 2021). Studies revealed that persistent high-risk infection with HPV types 16 and 18 in the basal epithelium occurs in more than 70% of cases but provides an insufficient etiological factor for cervical cancer (Egli-Gany et al., 2019; Ferrall et al., 2021).

The quantitative correlational study utilized the Incidence-SEER Research Plus Data 18 Registries, November 2019, Submission 2000-2017 cross-sectional dataset. The study examined the relationships between sociodemographic, histopathological, and treatment-related factors and the cervical cancer survival rate amongst Whites and African American women. The SEM addressed the association between sociodemographic, histopathologic, treatment-related factors and cervical cancer survival rate at the intrapersonal, interpersonal, organizational, community, and public policy levels. In the study, 54% of the participants aged 19-45 correlate with Pan et al., where women aged 20 to 39 years in the United States were affected mainly by cervical cancer.

The chi-square test was significant ($p < .05$) for all the independent categorical variables except for the year of diagnosis and diagnostic method of confirmation. The phi coefficient values detected a small effect size using Cohen's criteria; however, the value of Cramer's V indicated weak associations between the categorical variables.

Therefore, rejected the null hypothesis in RQ1 with the evidence of a significant association between the independent categorical variables (race/ethnicity, the age at diagnosis, the year of diagnosis, marital status, and geographical location) and the cervical cancer survival rates (outcome variable) amongst Whites and African American women. Also, in RQ2, there were significant associations between histopathological factors and cervical cancer survival rate amongst Whites and African American women; however, there was no association between moderately differentiated/Grade II tumors, squamous cell carcinoma, keratinizing, and other types, and the cervical cancer survival rate. Moreover, in RQ3, there was a statistically significant association between all treatment-related characteristics (surgical treatment, radiation therapy, chemotherapy, systemic therapy and surgical procedure administered, surgery and radiation therapies administered, and patient status after treatment) and cervical cancer survival rates. But race/ethnicity $p = .123$ (>.05), $OR = 1.045$; 95% CI = .988-1.106, did not significantly predict the disparate outcome in cervical cancer survival amongst Whites and African American women. Therefore, future research must close the gaps in understanding disparities in cervical cancer survival in minority subpopulations in the United States to understand racial inequities, inequalities, and disparities in population health.

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