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A Comparative Study of Cervical Cancer Among Indigenous Amerindian, Afro-Guyanese, and Indo-Guyanese Women in Guyana

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Walden University
2016

Abstract

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by

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MPH, Walden University, 2012

MA, New York University, 1997

BSc, York College, City University of New York, 1994

Dissertation Submitted in Partial Fulfillment

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Abstract

Cervical cancer is a major public health problem in developing countries. In Guyana, factors associated with increasing cervical cancer cases among Indigenous Amerindian women (IAW), Afro- women (AGW), and Indo-Guyanese women (IGW) have not been fully examined. In this comparative cross-sectional study, 5,800 cervical cancer cases were selected from Guyanese women age 13 and above for ethnicity (Indigenous Amerindian, Afro- and Indo Guyanese women), geographical region, marital status, and year and stage at diagnosis. Secondary data from Guyana Cancer Registry for the 2000-2012 study periods were analyzed using chi-square test, multinomial logistic regression, poisson regression, and relative risk. Geographical region was a strong predictor of cervical cancer cases for all three ethnic groups ($p < 0.05$). The relative risk for cervical cancer for IAW in Regions 2 (RR = 1.2) and 6 (RR = 1.07) was greater than for IAW in Region 4, the reference group for the study period. Comparatively, the relative risk for cervical cancer for AGW in Region 4 was greater than AGW in all other regions except Region 3 (RR = 1.05). Additionally, the relative risk for cervical cancer for IGW in Region 3 (RR = 1.03) was greater than that of IGW in all other regions. Single IAW (1.05) have a higher risk of getting cervical cancer than their married counterparts as compared to AGW (0.96) and IGW (1.00). Implications for social change include development of tailored programs which utilize a socio-ecological model to address cervical cancer issues at the individual, interpersonal, cultural, and community levels. Future research should focus on understanding the epidemiology of cervical cancer and the social factors among the ethnic groups of women.

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Dedication

This milestone achievement is dedicated to two most beautiful and amazing women in my life, to the memory of my dearest mother, Lucille Jones and to my sister and best friend, Marie Jones whose faith, courage and love have inspired and transformed my life to one of excellence. Thank you for always being there for me through the years, for believing in me when my faith failed, and for selflessly caring and loving me. Thank you for allowing me to see the beauty of Jesus in you.

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Chapter 1: Introduction to the Study

Introduction

Cervical cancer is a disease that occurs when precancerous or neoplastic cells of the cervix, also known as cervical intraepithelial neoplasia (CIN), are infected with the human papillomavirus (HPV; Adams & Carnright, 2013; Tran et al., 2011). Researchers have identified HPV, the most common type of sexually transmitted infection (STI; Adams & Carnright, 2013; Crosbie, Einstein, Franceschi, & Kitchener, 2013; Lewis-Bell et al., 2013; Warman, 2010) as the primary cause of cervical cancer worldwide (Adams & Carnright, 2013; Andall-Brereton et al., 2011; Dascau et al., 2012; Eze, Umeora, Obuna, Egwuatu, & Ejikeme, 2012; Franco et al., 2006; Khan et al., 2005; Lewis-Bell et al., 2013; Ragin et al., 2007; Tiffen & Mahon, 2006; Warman, 2010). It has been detected in 99% of all invasive cervical cancer (Adams & Carnright, 2013; Tiffen & Mahon, 2006). These viruses are transmitted through sexual contact (Adams & Carnright, 2013; Cutts et al., 2007) and have prevalence rates of 19-46% (Cuzick et al., 1995; Hildesheim et al., 1993; Ho, Bierman, Beardsley, Chang, & Burk, 1998). HPVs include many subtypes, some classified as high-risk types and others as low-risk types that are unlikely to cause invasive cervical cancer (Adams & Carnright, 2013; Andall-Brereton et al., 2011; Crosbie et al., 2013; Munoz, Castellsague, deGonzalez, & Gissman, 2006; Tiffen & Mahon, 2006). Anogenital cancers are high-risk types of cancers (Spitzer, 2006) that are associated with the progression of precancerous lesions to invasive cervical cancer (Adams & Carnright, 2013; Andall-Brereton et al., 2011; Ragin et al., 2007; Tiffen & Mahon, 2006). Low-risk types of cancers cause genital warts, recurrent respiratory

papillomatosis, infections that go unnoticed or eventually go away, and benign or low-grade cervical cell changes that can result in mild Papanicolaou (Pap) test abnormalities (Andall-Brereton et al., 2011; Spitzer, 2006; Tiffen & Mahon, 2006). HPV 16 and HPV 18 are two high-risk types of HPV that have been associated with over 70% of all cervical cancer cases worldwide (Crosbie et al., 2013; Lewis-Bell et al., 2013; Bruni et al., 2015).

The two most common types of cervical cancer, squamous cell carcinoma which takes place in the squamocolumnar junction or ectocervix, and adenocarcinoma which develops in the glandular cells of the endocervix, are responsible for 70% and 25% of cervical cancer respectively (Adams & Carnright, 2013). Squamous cell carcinomas of the ectocervix are also reportedly related to HPV infection (Dascau et al., 2012). HPV infection is not the only known risk factor that contributes to the development of cervical cancer. Many related research studies have also identified other factors associated with an increased risk of developing cervical cancer (Adams & Carnright, 2013; Castellsaguè, Bosch, & Muñoz, 2002; Crosbie et al., 2013; Eze et al., 2012; Lee, So, Piyathilake, & Kim, 2013; Luo et al., 2012; Tiffen & Mahon, 2006; Warman, 2010). These include first intercourse at an early age, trachomatis infection, herpes simplex virus, HIV/AIDS, diet, smoking, long-term use of oral contraceptives, multiple sex partners, multiple full-term pregnancies, poverty, family history of cervical cancer, multiparity, use of diethylstilbestrol (DES), and lack of regular Pap tests.

Background

Cervical cancer is a preventable disease. Since the introduction of the Papanicolaou (Pap) smear programs in 1941, deaths resulting from cervical cancer have declined by 70% in developed countries (Devesa et al., 1987; Richart, 1995). Pap smears help to detect cervical changes due to premalignant forms of squamous cell cervical cancer (Akers, Newman, & Smith, 2007). Cervical cancer, the third most common cancer that occurs among women in developing countries (Jemal, Center, DeSantis, & Ward, 2010; Pierce Campbell, Curado, Harlow, & Soliman, 2010), is responsible for premature death and cancer death among women in these countries (Correnti et al., 2011; Jemal et al., 2010). The highest incidences of cervical cancer in the world are found in Latin American and Caribbean countries (Almonte et al., 2008; Franco et al., 2008) whose mortality rates are seven times the cervical cancer mortality rates of North American countries (Luciani & Andrus, 2008), with an average regional estimate of 29.2 cases per 100,000 women based on the 2002 data (Almonte et al., 2008). This large regional variation in cervical cancer rates reflects geographic differences in HPV prevalence and/or the availability of Pap test screening (Jemal et al., 2010).

Cervical cancer is common in Guyana, the only English-speaking country in South America which lies on the northern Atlantic coast between Venezuela and Surinam (Best Plummer, Persaud & Layne, 2009. According to public health statistics from Guyana, women (272,382) who are 15 years and older are at risk of developing cervical cancer (Bruni et al., 2013). The impact of this disease is evident in the number of deaths relative to the annual number of cervical cancer cases diagnosed among these women.

Statistics on the estimated incidence and mortality of cervical cancer cases in Guyana indicated that for 2012, "about 161 new cervical cancer cases are diagnosed annually in Guyana" (Bruni et al., 2013, p. 6) and "about 71 cervical cancer deaths occur annually" (Bruni et al., 2013, p. 14). By the year 2025, these rates are expected to increase, with an annual rate of 201 new cases and 99 deaths resulting from cervical cancer in Guyana (WHO/ICO Information Centre, 2010).The Indigenous Amerindian women of Guyana who reside in the rural and remote parts of the country have a high prevalence of high-risk HPV and also suffer from a higher prevalence of cervical cancer as compared to other demographic groups in Guyana (Kightlinger et al., 2010). The reason for this high prevalence is unclear (Kightlinger et al., 2010); therefore, understanding the burden of HPV infection and the high prevalence of cervical cancer within this population is important. Data from population-based cancer registries could provide insight into understanding cervical cancer rates within geographically diverse areas (Pierce-Campbell et al., 2012). The geographic and sociodemographic data obtained from the cancer registry in Guyana could potentially lead to a better understanding of the high incidence of cervical cancer existing within this indigenous population of women.

Problem Statement

In developing countries, cervical cancer is a significant public health problem (Correnti et al., 2011; Jemal et al., 2010; Luciani & Andrus, 2008; Reynales-Shigematsu, Rodrigues, & Lazcano-Ponce, 2009; Watt et al., 2009; Winkler et al., 2008) because of a lack of adequate screening programs (Akers, Newman, & Smith, 2007; Garner, 2003;

Luciani & Andrus, 2008; Vaccarella, Lortet-Tieulent, Plummer, Franceschi, & Bray, 2013). Cervical cancer is the second most common cause of cancer occurring among women in the world (Anorlu, 2008; Jia et al., 2013; Khan et al., 2005; Qmichou et al., 2013; Sabir, Hassan, & Hussain, 2013; Tiffen & Mahon, 2006; Warman, 2010; World Health Organization, 2013a) and is responsible for 250,000 deaths and 500,000 newly diagnosed cases each year (Eze et al., 2012; Jia et al., 2013; Sabir et al., 2013). In developing countries, however, the rate of cervical cancer is reportedly very high (Adams & Carnright, 2013; Jia et al., 2013; Qmichou et al., 2013; Sabir et al., 2013) and is blamed for 80% of the incident of cervical cancer cases worldwide (Adams & Carnright, 2013; Eze et al., 2012; Sabir et al., 2013), and 85% of cervical cancer deaths annually (Eze et al., 2012; Tran et al., 2011; World Health Organization, 2013a).

While the incidence and mortality of cervical cancer in developed countries have reportedly decreased (Anorlu, 2008; McDougall & Andall, 2002; Pierce Campbell et al., 2012), the prevalence of this disease continues to have a serious impact in developing countries (Anorlu, 2008; Jemal et al., 2010; Pierce Campbell et al., 2012) with high rates reported in countries located in Central and South America, the Caribbean, sub-Saharan Africa, and Southern Asia (Almonte et al., 2008; Correnti et al., 2011; Luciani & Andrus, 2008; Pierce Campbell et al., 2012). In Guyana, the estimated incidence of cervical cancer in 2008 was 43.3 per 100,000 women per year, while the mortality rate was 19.9 per 100,000 women per year as compared to 11.2 per 100,000 women per year for other regions in South America, and 8.2 per 100,000 globally (WHO/ICO Information Centre, 2010, p. 6, 12).

Cervical cancer, if left untreated, could have serious consequences on women's health, possibly leading to death. Indigenous Amerindian women in Guyana have a high rate of cervical cancer and high-grade dysplasia (Kightlinger et al., 2010). The Kightlinger et al. (2010) study was limited to an assessment of 16 cervical cancer cases (out of the 2250 Indigenous Amerindian women screened). The total Indigenous Amerindian population within the regions of Kightlinger et al.'s (2010) study was less than 40,000 (Guyana Bureau of Statistics, 2015a). Factors such as low socioeconomic status, intercourse at a very early age, numerous childbirths, poverty, and limited access to health care are risk factors for cervical cancer among these Indigenous women (Best Plummer et al., 2009). Since these women reside in the remote and rural regions of Guyana, access to large-scale cytologic cervical cancer screening has been hampered by many factors such as insufficient funding needed to address the healthcare and routine screening needs of these women, lack of laboratory infrastructure, and geographic and logistic barriers to medical care in areas that are difficult to travel as a result of poor roadways (Kightlinger et al., 2010). Additionally, Goss et al. (2013) reported that the health ministries and healthcare systems in Latin American and Caribbean countries also experience many challenges in caring for patients with advanced cancer. These challenges include "inadequate funding; inequitable distribution of resources and services; inadequate numbers, training, and distribution of health-care personnel and equipment; and lack of adequate care for many populations based on socioeconomic, geographic, ethnic, and other factors" (Goss, et al., p. 391).

It is unclear whether HPV is sexually transmitted and causally associated with cervical cancer in Guyana. According to the WHO/ICO HPV Information Centre (2010), data on the burden of HPV in the general population of Guyana is not yet available, but in South America, the region that Guyana belongs to, the disease may be latent among 13.2% of the women in the general population (WHO/ICO HPV Information Centre, 2010). Very little research has been conducted to address the high incidence of cervical cancer among IAW, AGW, and IGW in Guyana, and researchers have indicated the need for further investigation of cervical cancer rates in these three ethnic groups (Best Plummer et al., 2009; Kightlinger et al., 2010). To address this gap in research regarding the high incidence of cervical cancer among IAW, AGW, and IGW, I conducted a review of the Guyana Cancer Registry's database, as well as examined studies focusing on the ethnic and site prevalence of cervical, prostate and breast cancers, and the prevalence of cervical cancer disease, human papillomavirus infection, and human papillomavirus (HPV) genotypes in indigenous villages of Guyana (Kightlinger et al., 2010). Both of these studies suggested that further investigation on the high incidence of cervical cancer among these three ethnic groups of women is necessary.

Nature of the Study

In this quantitative study, I measured variables pertaining to age, marital status, geographical regions, stage at diagnosis, and their association with the cervical cancer cases. This study targeted IAW, AGW, and IGW who live in Guyana. Cases included all three ethnic groups of Guyanese women who were diagnosed with invasive cervical cancer, cervical intraepithelial neoplasia I, II and III, high-grade squamous intraepithelial

lesions, and low-grade squamous intraepithelial lesions with laboratory confirmation. In addition, I included all IAW, AGW, and IGW ages 13 years and over who were diagnosed with cervical cancer between 2000 and 2012 and reported to the Guyana Cancer Registry. Exclusion from the study was based on age (<13 years), and previous diagnosis or treatment for cervical cancer. I discussed methodology and research design in Chapter 3 of this study.

Research Questions and Hypothesis

RQ1: Is there a difference in cervical cancer cases for Indigenous Amerindian women compared to Afro- and Indo-Guyanese women from 2000 through 2012?

H1: There will be a significant difference in cervical cancer cases for Indigenous Amerindian women when compared to Afro- and Indo-Guyanese women from 2000 through 2012.

$H_0$1: There is no significant difference in cervical cancer cases for Indigenous Amerindian women when compared to Afro- and Indo-Guyanese women from 2000 through 2012.

H_A1: There is a statistically significant difference in cervical cancer cases for Indigenous Amerindian women when compared to Afro- and Indo-Guyanese women from 2000 through 2012.

RQ2: Is there an association between cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women and their geographical regions?

H2: There will be a significant association between cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women and their geographical regions.

$H_0$2: There is no significant association between cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women and their geographical regions.

RQ3: Is there a relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their ages, marital status, and year of diagnosis?

H3A: There will be a significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their ages, marital status, and year of diagnosis.

H3B: There will be a significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their age.

$H_0$3B: There is no significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their age.

H3C: There will be a significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their marital status.

$H_0$3C: There is no significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their marital status.

H3D: There will be a significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to year of diagnosis.

$H_0$3D: There is no significant relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to year of diagnosis.

RQ4: Is there an association between the stage at diagnosis of cervical cancer and age, marital status, year of diagnosis, and geographical region among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women?

H4: There will be a significant association between the stage at diagnosis of cervical cancer and age, marital status, year of diagnosis, and geographical region among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H4A: There will be a significant association between the stage at diagnosis of cervical cancer and age among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H_{04A}: There is no significant association between the stage at diagnosis of cervical cancer and age among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H4B: There will be a significant association between the stage at diagnosis of cervical cancer and marital status among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H_{04}B: There is no significant association between the stage at diagnosis of cervical cancer and marital status among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H4C: There will be a significant association between the stage at diagnosis of cervical cancer and year of diagnosis among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H_{04}C: There is no significant association between the stage at diagnosis of cervical cancer and year of diagnosis among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H4D: There will be a significant association between the stage at diagnosis of cervical cancer and geographical region among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

H_{04}D: There is no significant association between the stage at diagnosis of cervical cancer and geographical region among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women.

Purpose of the Study

The purpose of this study was to use secondary data from the Guyana Cancer Registry to examine the demographic variables and their relationship to cervical cancer between Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese

women in Guyana. The dependent variable was cervical cancer and the independent variables were age, marital status, geographical regions, and stage at diagnosis of cervical cancer.

Conceptual Framework

I used the health belief model (HBM) as the theoretical framework in this study. The HBM is one of the oldest and most widely used theories to explain the change in health behavior (Schiavo, 2007). In this study, the premise of the HBM constructs were appropriate for addressing the following behavior change among IAW, AGW, and IGW: a) perceived susceptibility and perceived severity in relation to cervical cancer; b) perceived benefits in terms of their willingness to be screened for cervical cancer. Being screened can reduce the risk of acquiring cervical cancer, improve quality of life, and reduce the incidence and mortality of cervical cancer; c) perceived barriers in terms of lack of finance, fear in getting screened, language barrier, cultural beliefs, and transportation issues; d) cues to action such as health education messages through culturally appropriate channels to respond or take action for cervical cancer screening; and e) self-efficacy to build confidence in maintaining the behavior change (Schiavo, 2007). According to Glanz, Rimer, and Viswanath (2008), demographic variables may influence perception and thus indirectly influence health-related behavior. Glanz and colleagues (2008) further note that sociodemographic factors, for example, educational attainment, could have an indirect effect on behavior by influencing the perception of susceptibility, severity, benefits, and barriers.

In Guyana, ethnic groups who reside in the rural areas are disproportionately affected by limited access to health care, poverty, and poor health outcomes. As compared to other ethnic groups who live in urban areas and areas where better and easier transportation facilities are provided, the Amerindians who reside in the rural areas experience difficulty accessing health clinics because doing so requires extensive travel (Kightlinger et al., 2010). Poverty also disproportionately affects the Amerindians who reportedly experience the highest incidence of poverty when compared to other ethnic groups in urban areas (Pan American Health Organization [PAHO], 2013a). There are also marked differences in health outcomes between the different ethnic groups in Guyana. Ischemic heart disease is the major cause of death among individuals of Indo-Guyanese, Chinese, and Portuguese ethnicity, while mortality due to neoplasms and AIDS are major causes of death among Afro-Guyanese and Amerindian ethnicities (PAHO, 2013a). According to a study conducted on the racial differences in physical and mental well-being in Guyana, Indo-Guyanese were found to have significantly higher levels of impairment when compared to Afro-Guyanese (Wilson, Wilson, & Johnson, 2010). In addition, the Guyana Cancer Registry reported that cervical cancer incidence in Afro- and Indo-Guyanese women were similar, while cases of cervical cancer were significantly higher among Amerindian women as compared to Afro- and Indo-Guyanese women (Best Plummer et al., 2009).

Operational Definitions

Definitions of the key words used in this paper are:

Adenocarcinoma: Cancer that begins in glandular (secretory) cells (National Cancer Institute, n.d. a).

Amerindians: A race of Indians from South America who are descendants of the people who gradually inhabited the wild coast of the Guiana region (Menezes, 1979)

Cervical cancer: Cancer that forms in tissues of the cervix, the organ connecting the uterus and vagina (National Cancer Institute, n.d. b).

Cervical dysplasia: A condition that relates to the abnormal changes in the cells on the surface of the cervix (A.D.A.M. Medical Encyclopedia, 2013a).

Cervix: The lower part of the uterus (womb) that opens at the top of the vagina (A.D.A.M. Medical Encyclopedia, 2013b).

Cervical intraepithelial neoplasia: A condition caused by certain types of HPV (National Cancer Institute, n.d. c).

Distant stage or Stage IV: A designation for when the cancer has spread to other parts of the body (National Cancer Institute, 2015).

Dysplasia: A condition in which cells change from being normal cells to abnormal cells (National Cancer Institute, 2013a).

Ectocervix: The part of the cervix next to the vagina (American Cancer Society, 2013a).

Ethnicity: A social group characterized by a distinct social and cultural tradition maintained within the group from generation to generation, that has a common history and origin, and a sense of identification with the group (Porta, 2008).

Human papillomavirus (HPV): A type of virus that causes abnormal tissue growth and other changes to cells (National Cancer Institute, n.d. d).

Indigenous: People are considered indigenous either because they are descendants of those who lived in the area at the time of conquest or before colonization, or because they have maintained their own social, economic, cultural and political institutions since colonization and the establishment of new states (International Labor Organization, Convention 169, 2012).

In-situ (Stage 0): A designation for when abnormal cells are found in the innermost lining of the cervix (National Cancer Institute, 2015).

Invasive cervical cancer: A cancer that originates in but spreads beyond the cervix (American Cancer Society, 2013b).

Neoplasia: Abnormal new cell growth which can be benign or malignant (American Cancer Society, 2014a).

Papanicolaou (Pap) test: A test used as the main screening for cervical cancer and pre-cancerous changes (American Cancer Society, 2013a).

Precancerous conditions: Cellular conditions that may become cancer (National Cancer Institute, 2013b).

Race: A group or a person who belong(s) to as a result of a mix of physical features, such as skin color and hair texture, which are associated with ancestry and geographical origins (Porta, 2008).

Sexually Transmitted Infections (STIs): Infections that are transmitted through sexual contact including vaginal, oral, and anal sex (Lazarus, Sihvonen-Riemenschneider, Josten, Wong & Liljestrand, 2010).

Squamous cell carcinoma: A condition in which cancer begins in the squamous cells. Squamous cells are thin, flat cells that look like fish scales, and are found in the tissue forming the surface of the skin, the lining of the hollow organs of the body, and the lining of the respiratory and digestive tracts (National Cancer Institute, n.d. e).

Assumptions

In this study, I relied on the following assumption: Indigenous Amerindian women with HPV will require better access to cytologic cervical cancer screening, easier access to well-equipped medical care facilities, and increased awareness and understanding of HPV and cervical cancer.

Limitations

This research study was limited to existing data collected from the Guyana Cancer Registry between 2000 and 2012. Denominator data was not available to calculate incidence rates for the sample population. However, I used estimated incidence rates to calculate incidence rate ratios in this study. I collected information on Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women age 13 years of age and over who were diagnosed with cervical cancer. Age, marital status, geographical regions, year of diagnosis, and the stage at diagnosis of cervical cancer were the variables considered for the purpose of this study.

Delimitations

I used data from the Guyana Cancer Registry for the Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women. No other cervical cancer data were used.

Significance of the Study

Lack of screening programs or ineffective use of these programs in developing countries contributes to the increased risk of women developing cervical cancer (Akers, Newman & Smith, 2007; Franco et al., 2008; Vaccarella et al., 2013; Winkler et al., 2008). Failure to implement effective screening and detect, diagnose, and treat cervical cancer early could increase the incidence of cervical cancer among women and lessen their chance of living longer lives. The significance of my study was to examine age, marital status, geographic regions, year of diagnosis, and stage at diagnosis of cervical cancer in IAW, AGW, and IGW. Findings from this study could provide more insight for public health officials to develop and implement appropriate interventions to address cervical cancer among the three groups of women.

Implications for Social Change

The incidence and mortality rates of cervical cancer in Guyana are very high (Bruni et al., 2014). Women over 15 years old are vulnerable to getting cervical cancer (Bruni et al., 2013). The cervical cancer cases among IAW, AGW, and IGW were 140, 3140, and 2520 respectively for the study period, 2000 – 2012. A better understanding of the epidemiology of cervical cancer among these three ethnic groups would enable the design of more effective prevention programs. This study could contribute to positive

social change by raising awareness and knowledge about the importance of early detection and screening of cervical cancer among IAW, AGW, and IGW. Early recognition of the problem by the government and early implementation of cervical cancer prevention programs could have a positive impact in reducing the high incidence of and mortality from cervical cancer among these three ethnic groups of women. The information provided in this study could also influence how the Guyana government responds to cervical cancer health outcomes among Amerindian women living in remote and rural areas of the country, as well as for Afro-Guyanese and Indo-Guyanese women who live in the coastal and urban areas.

Chapter 2: Literature Review

Introduction

In this chapter, I discussed the literature on the prevalence of cervical cancer and HPV in developing countries. I reviewed the existing literature on the prevalence of cervical cancer and HPV among Indigenous Amerindian women in Guyana in order to identify gaps in the literature. Understanding the epidemiology of cervical cancer and the role of HPV among Indigenous women living in remote and rural areas is important in order to design more effective prevention programs.

I conducted the literature review using Walden University Library resources to access EBSCO, CINAHL, PubMed, ProQuest, and MedLine databases. I also used Google Scholar and publications from *the Lancet* and the *Journal of Obstetrics & Gynecology*. Key words used in this literature search include *cervical cancer*, *HPV, indigenous, Amerindian, human papillomavirus, Guyana, HPV and cervical cancer, incidence,* and *mortality*. In this chapter, I first offered a brief overview of the history of Guyana. Next, I reviewed relevant literature on cervical cancer epidemiology, the role of HPV, types of HPVs and their prevalence in developing countries, and risk factors associated with HPV. Finally, I offered a summary of the epidemiological literature on the incidence of cervical cancer and HPV infection among Indigenous populations, including studies that specifically addressed the incidence of cervical cancer and HPV among these populations.

Background of Guyana

Guyana, the only English-speaking country in South America, has an area of 215,000 square kilometers and is located on the northeastern coast of South America along the borders of Venezuela, Brazil, and Suriname (PAHO, 2013a). Guyana progressed from a colony of Britain to an independent country in 1966, and further to a republic in 1970, maintaining a democracy (PAHO, 2013a; World Health Organization and Ministry of Health Guyana, 2008). In 2010, Guyana's estimated population was 785,000 (PAHO, 2013a), and was composed of several ethnic populations with Indo-Guyanese accounting for 43.5% of the population, Afro- Guyanese 30.2%, Amerindians 9.2%, and people of mixed heritage 16.7%. People of other descents, including European and Chinese, accounted for 0.4% of the population (PAHO, 2013a; PAHO, 2012). Included in Guyana's natural resources are bauxite, gold, diamonds, fertile soil, and water resources from its many rivers and vast rainforests which cover almost 80% of its territory (PAHO, 2013a; PAHO, 2012). Despite its abundant resources, Guyana remains one of the poorest countries in South America and the Caribbean (PAHO, 2012; World Health Organization and Ministry of Health Guyana, 2008), and has a gross domestic product of 2.85 billion U.S. dollars (The World Bank, 2014). For many years, Guyana was rated as a low-income developing and heavily indebted poor country (PAHO, 2013a; PAHO, 2012), but today its status has been upgraded to a lower middle-income developing country (PAHO, 2013a).

Guyana is divided into ten administrative regions. The rural and remote regions known as the interior or hinterland are in regions 1, 7, 8, and 9; this is where 9.4% of the

population lives (PAHO, 2013a; World Health Organization and Ministry of Health Guyana, 2008). 85.1% of the population resides in the coastal regions of 2, 3, 4, 5, and 6. The capital city, Georgetown, is located in region 4 and accounts for 41.3% of the population. Region 10 has a moderate sized town and a large rural area (PAHO, 2013a; World Health Organization and Ministry of Health Guyana, 2008). The Indo-Guyanese (East Indian) population primarily dwells within regions 2, 3, 5, and 6, the Afro-Guyanese in region 10, and the Amerindians in regions 1, 8, and 9. Regions 4 and 7 have a mixed population (World Health Organization and Ministry of Health Guyana, 2008).

Guyana experiences many health challenges related to communicable and chronic non-communicable diseases. The highest burden of morbidity and mortality is as a result of chronic non-communicable diseases among which are cerebrovascular diseases, ischemic heart disease, diabetes, hypertension, and cancer (PAHO, 2012). According to the PAHO, 60% of all deaths in 2008 were as a result of chronic, noncommunicable diseases, with cancer attributing to 20% of these deaths (PAHO, 2013a). Breast, prostate, and cervical cancers are the most frequently occurring cancers in Guyana (PAHO, 2012). The incidence rate of breast, prostate, and cervical cancer in 2004 was 85, 72 and 64/100,000 population respectively, as compared to 54, 53, and 27/100,000 population in 2000 (PAHO, 2012). The incidence rate of cervical cancer in 2004 was more than double the incidence rate reported for 2000.

Biologic Characteristic of Cervical Cancer

The American Cancer Society (ACS; 2014b) has reported that most cervical cancers start in the cells lining the cervix where the normal cells slowly undergo

precancerous changes before developing into cancer. Cervical cancer occurs at the area of the cervical transformation zone, which is a ring of tissue where the squamous epithelium joins with the glandular epithelium (Schiffman et al., 2011). The most common types of cervical cancer are squamous cell which accounts for more than 70% of cervical cancers, and the adenocarcinoma, which makes up approximately 25% of cervical cancers (Morrison, Moody & Shelton, 2010). Cervical cancer grows slowly (Morrison et al., 2010; Schiffman et al., 2011), developing from HPV infection to cervical cancer through a series of four distinct steps (Schiffman et al., 2011; Vesco et al., 2011). The first step in this process involves HPV transmission, which progresses to acute HPV infection, and which is believed to be the primary cause of cervical cancer (Morrison et al., 2010; Schiffman et al., 2011). The next step in this cervical carcinogenesis process is persistent HPV infection, which leads to the development of cervical precancer and especially cervical intraepithelial neoplasia grade 3 (CIN3).This is followed by invasion that results in cancer (Schiffman et al., 2011; see Figure 1).

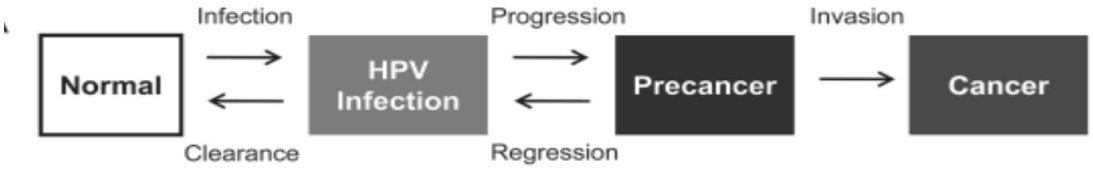

Figure 1. Model showing the progression of cervical cancer. From "Human Papillomavirus Testing in the Prevention of Cervical Cancer," by M. Schiffman, N. Wentzensen, S. Wacholder, W. Kinney, J. C. Gage, and P. E. Castle, 2011, *Journal of National Cancer Institute, 103*(5), p. 371. Copyright 2011 by Oxford University press. Reprinted with permission.

Cervical intraepithelial neoplasia (CIN) also known as the precancerous or neoplastic cells of the cervix, is caused by HPV infection (Morrison et al., 2010).

According to Morrison et al. (2010), HPV infections that persist beyond two years could lead to the development of CIN, and if not treated in a timely fashion may result in cervical cancer.

Cervical cancer could go unnoticed because there are usually no noticeable signs or symptoms present during the early stages of the disease (National Cancer Institute [NCI], 2014). However, during its late stages women may experience signs and symptoms such as pelvic pain, pain during sexual intercourse, vaginal bleeding, and unusual vaginal discharge, as well as hematuria or rectal bleeding that is secondary to tumor invasion through the bladder or rectal wall (Morrison et al., 2010; NCI, 2014). In addition, Morrison et al. (2010) noted that other nonspecific signs and symptoms of cervical cancer such as unexplained weight loss that is accompanied by nausea, vomiting, and loss of appetite should not go unnoticed. Screening for cervical cancer is, therefore, important in order to detect and treat the disease in its early stage so as to increase a woman's chance of survival.

Cervical cancer screening helps to detect precancerous lesions and could prevent women from getting cervical cancer (ACS, 2013c). The decrease in the incidence and mortality of cervical cancer can be attributed to the overall success of cervical cancer screening (Morrison et al., 2010; Saslow et al., 2012). Through cervical cancer screening, there has been an increase in the detection of invasive cervical cancer at early stages and treatment of pre-invasive lesions (Saslow et al., 2012). Thus, timely diagnosis and treatment could undoubtedly extend the length of life for women. The one- and five-year

relative survival rates for cervical cancer patients according to ACS (2013c) are 87% and 68% respectively.

For many years, screening has been the preferred method used to detect cervical cancer. However, the World Health Organization (WHO) has proposed a "screen-and-treat" approach to cervical cancer, in addition to screening and diagnosis by means of cytology, colposcopy, biopsy, and the histological confirmation of CIN (WHO, 2013b). According to the WHO (2013b), the "screen-and-treat" approach involves conducting screening tests such as HPV testing, visual inspection with acetic acid (VIA) which is carried out by staining the cervix with a 5% solution of vinegar where abnormal cervical tissue becomes white after 30 to 60 seconds (CDC, 2015), and cytology (Pap test). The treatment approach according to the WHO (2013b) involves using cryotherapy which is a technique involving the use of extreme cold to treat tumors (National Cancer Institute, 2003), large loop excision of the transformation zone (LEEP/LLETZ), and cold knife conization. Thus, the "screen-and-treat" approach could be beneficial to healthcare professionals in terms of making timely treatment decisions after a positive screening test is confirmed (WHO, 2013b). Cervical cancer screening for women who are younger than 20 years of age is not recommended because of its harmful effects (Vesco et al., 2011). However, cervical cancer screening is recommended for women who are at average risk of getting cervical cancer and are between the ages of 21 years and 65 years (ACS, 2013c). Women, on the other hand, who are older than age 65 and who have had adequate screening and are not deemed as high risk of getting cervical cancer should not continue to receive screening (Vesco et al., 2011).

Human Papillomavirus Link to Cervical Cancer

Introduction

HPV is a non-enveloped, double-stranded DNA virus that is known to cause cell abnormalities (Morrison et al., 2010; Nour, 2009). HPV infects the epithelium and produces new viral particles only in fully matured epithelial cells (Crosbie et al., 2013; Nour, 2009). Once infected, these cells become precancerous and could lead to CIN or adenocarcinoma in situ (AIS) (Nour, 2009). The causal link between HPV infection and cervical cancer was first discovered by Harald zur Hausen (Nobel Media AB, 2014). Based on his findings, zur Hausen concluded that patients infected with HPV types 16 and 18 were at increased risk of developing cancer (Nour, 2009).

HPV infection is the most common sexually transmitted infection worldwide and is predominantly spread through sexual contact (Nour, 2009; Warman, 2010). Several epidemiology studies have established that HPV infection causes cervical cancer (Andall-Brereton et al., 2011; Correnti et al., 2011; Gudlevičienė, Smilgevičiūtė-Ivshin, Vaitkuvienė, Šepetiene, & Didžiapetrienė, 2010; Garland et al., 2011; Mendes de Oliveira, Fregnani, Carvalho, Longatto-Filho, & Levi, 2013; Mendoza et al., 2013). In addition to being the cause of cervical cancer, HPV is also responsible for causing other cancers of the vagina, penis, vulva, anus, head and neck, as well as anogenital warts and recurrent respiratory papillomatosis (Bruni et al., 2014; Crosbie et al., 2013; Nour, 2009). There are over 100 known types of HPV which are classified as high-risk or low-risk depending on their oncogenicity (Morrison et al., 2010; Crosbie et al., 2013; Nour, 2009). High-risk HPV types are associated with the development of CIN and cancer while the

low-risk types cause low-grade intraepithelial neoplasia or condyloma (Morrison et al., 2010).

Epidemiology of HPV Infection

Prevalence

The prevalence of HPV infection has been documented worldwide for women with normal cytological findings (Bruni, Castellsagué, Ferrer, Bosch and de Sanjosé, 2010; Crosbie et al., 2013). The HPV virus has been identified in 99.7% of women with cervical cancer (Nour, 2009) while HPV types 16 and 18 are the most prevalent types and account for approximately 70% of all cervical cancer worldwide (Bruni et al., 2014; Crosbie et al., 2013; Li, Franceschi, Howell-Jones, Snijders and Clifford, 2011; Nour, 2009). Dames et al. (2014) note that high-risk HPV types 16 and 18 account for the majority of all invasive cervical cancers (56.5% and 16% respectively) in the world, while the other 27.4% of all invasive cervical cancers worldwide are attributed to the prevalence of HPV 58, 33, 45, 31, 52, 35, 59, 39, 51, and 56. The largest percentage of HPV 16 is found in western-central Asia (73%) and the smallest percentage in Africa (53%) (Guan et al., 2012). According to Nour (2009), the prevalence of HPV is highest in developing countries, especially Latin America and the Caribbean, sub-Saharan Africa, and Southeast Asia. DeMartel et al. (2012) also agree that HPV severely affects developing countries, particularly with all cervical cancer which consist of approximately 530,000 cases per year, and 88% (approximately 24,000 cases) of anal cancers per year.

The prevalence of HPV 16 and 18 occurring as the most common type of infection has been well documented in the literature. Bruni et al. (2010) conducted a

meta-analysis of 1,016,719 women with normal cervical cytology. Results showed an estimated global prevalence of 11.7% (95% CI, 11.6%-11.7%) with the highest prevalence recorded for sub-Saharan Africa (24%), Eastern Europe (21.4%), and Latin America (16.1%). The most common HPV types reported worldwide from this analysis were HPV 16 (3.2%), HPV 18 (1.4%), HPV 52 (0.9%), HPV 31 (0.8%), and HPV 58 (0.7%). It was noted that these HPV types were found mainly in younger women (< 25 years) while similar observations were made in older women (> 45 years) in Africa and the Americas (Bruni et al., 2010).

Other epidemiological studies have substantiated Bruni et al. (2010) findings as mentioned above. A study in Brazil found that HPV 16 (77.6%), HPV 18 (12.3%), HPV 31 (8.8%), HPV 33 (7.1%) and HPV 35 (5.9%) were the most frequent types found in women with invasive cervical cancer (Mendes de Oliveira et al., 2013). In Venezuela, HPV 16 and 18 (65%), followed by HPV 52, 33, 45, and 31 were detected in cervical carcinoma among women (Correnti et al., 2011). In Colombia, HPV 16 and 31 were the most prevalent types among a sample of 2110 women who were tested for the presence of HPV-DNA by polymerase chain reaction. The results showed distinct type-specific distribution among the regions and a high association between absence of pregnancies, indigenous ethnicity, and co-infection (Camargo et al., 2011). Another study on the prevalence of infection with high-risk HPV in Colombia, the investigators determined that HPV 18, HPV 39, HPV 45, HPV 59 and HPV 68 were associated with multiple infections. Of the 49.2% of women confirmed with HPV infection, 59.8% of these were infected with more than one viral type. Co-habitation without marriage and indigenous

ethnicity were statistically significant risk factors for HPV infection (Soto-DeLeon et al., 2009).

In South America and the Caribbean, the high rates of incidence and mortality of cervical cancer are complicated by the high prevalence of HPV. Because of lack of data on HPV in these countries and inability to track its pathways, HPV prevalence is underreported. In South America, 14.4% of women have cervical HPV infection (Bruni et al., 2014). In addition, the majority of invasive cervical cancers (72%) are attributed to HPV 16 or 18 (Bruni et al., 2014).This latter information is similar to that previously mentioned about HPV 16 and 18 being associated with cervical cancer. Many studies have thus emphasized the need to conduct further investigation into the epidemiology of HPV infections and the role of HPV testing in the screening, prevention, and control of cervical cancer (Andall-Brereton et al., 2011; Kightlinger et al., 2010; Lewis-Bell, 2013; Watt et al., 2009).

The prevalence of HPV types 16 and 18 appear to be uniform across countries with some variations occurring in other HPV genotypes. Cathro et al. (2009) conducted a cervical cancer screening including HPV genotyping among 463 women from the general population in Belize where cervical carcinoma is reported to be the most common cancer among women. Results of this study found a 15.6% prevalence of high-risk genotypes, with HPV types 16, 18, 56, and 52 being the most common types identified among the women. HPV 16 and 18 were recognized in women with normal cytology (10.1%), while the other HPV types mentioned above were found in women with high-grade squamous

intraepithelial lesion (HSIL). The authors suggested that their findings could augment the development and implementation of HPV vaccines in less developed countries.

In the Caribbean where HPV prevalence is very high, case-controlled studies have also linked invasive cervical cancer with HPV 16 and 18. Dames and colleagues (2014) carried out a study among HIV-positive women in the Caribbean to evaluate the frequency of high-risk HPV genotypes in this population. Participants included 167 non-pregnant, HIV positive women who were older than 18 years of age. Results reported in this study were similar and consistent to other findings from previous studies on HPV prevalence where HPV types 16 and 18 were the most commonly diagnosed types. In this study, HPV 52 and 58 were the most frequent infections reported. These authors recommended further investigation to determine the role of HPV 52 and 58 in the development of cervical cytological abnormalities. Another case-control study performed in Uganda to assess the risk of invasive cervical carcinoma associated with HIV and HPV types also found statistically significant odd ratios among women infected with HPV 16, 18 and 45 (Odida et al., 2011).

Not all studies conducted on HPV prevalence and incidence report HPV 16 and 18 as the most predominant types. Shrestha and colleagues (2010), in their study, observed an increased prevalence and incidence of HPV types 58, 53/66, 68/70, and 31/33/35 in African American, HIV-positive adolescents. This study was carried out to examine the effect of highly active antiretroviral therapy (HAART) on the incidence, persistence, and clearance of type-specific HPV among HIV-positive female adolescents.

Similarly, Watt and colleagues (2009) discovered a higher prevalence of HPV types 45 (2.17%) and 58 (18.8%) in their study to determine the presence of high-risk and multiple HPV infections in a population of cancer-free Jamaican women and its association with their lifestyle and sexual practices. Other high-risk types found in this study included HPV 16 (18.4%), HPV 35 (15.0%), HPV 18 (14.5%), HPV 52 (12.0%), and HPV 51 (11.1%). Findings from this study also identified 87.7% of HVP presence in this sample population, with pregnant women accounting for the higher prevalence, and with the highest prevalence attributed to high-risk HPV and multiple HPV infections. In contrast to a later study conducted in Jamaica, Lewis-Bell and colleagues (2013) reported a different HPV frequency distribution. The most frequently occurring types were HPV 16, 35, 62, 83, 61, 58, 84, 18, 66 and 81, with HPV prevalence being highest among single women ages 16-19 years old, who had had more than three sexual partners in their lifetime. These findings also detected oncogenic HPV in the 297 study participants (39.9%) and HPV 16 and 18 in 86 women (10.0%).

Two other studies conducted in Trinidad and Tobago also showed very high HPV prevalence and differences in HPV dominance. In the earlier study to estimate the prevalence of cervical HPV infection in a cohort of 310 sexually active women aged 18 to 65 years with no previous diagnosis of cervical cancer, Andall-Brereton and colleagues (2011) sought to determine HPV genotypes and their distribution within the sample. These authors observed a high prevalence of HPV within their study participants (40.6%), with 60% of infections considered as high-risk. Of the most common high-risk genotypes observed in this study, the results showed that HPV 52 (12.7%) and HPV 66

(10.3%) occurred more frequently than HPV 16 (9.5%) and HPV 18 (8.6%). This frequency was followed by HPV 58 (7.9%). In addition, this study also found an association between eleven high-risk genotypes and cytologic abnormalities. Conversely, in a later study to determine the relative contribution of known high-risk human papillomavirus genotypes to the occurrence of cervical cancers in Trinidad, Hosein, Mohammed, Zubach, Legall, & Severini (2013) observed HPV infection in 91.8% of the participants. Results showed a strong association between HPV 16 (66.1%) and HPV 18 (17.8%) with cases of invasive squamous cell carcinoma, followed by HPV 45 (8.9%) which is the third most frequent high-risk genotype. Based on these findings, these authors concur with other studies that women who have high-risk HPV 16 and 18 infections, develop cervical cancer at higher rates as compared with those infected with other high-risk HPV types or with low-risk types (Hosein et al., 2013; Rocha, Filho, de Queiroz and dos Santos, 2013).

HVP Prevalence in Indigenous Populations

Other studies conducted in indigenous populations also reveal a high prevalence of HPV infection with high-risk types. In a cross-sectional study, Mendoza et al. (2013) analyzed the frequency of HPV and other genital infections among indigenous women from Paraguay. 181 sexually active women without cervical lesions participated in the study. Results showed that HPV infection was the most frequent, with any-type HPV of 23.2% (n = 42; 95% CI: 17.3-30.0) and 16.1% of women positive for high-risk HPV types (n=29; 95% CI: 11.1-22.3). There was also a significant association observed between any-type HPV and *C trachomatis* (p = 0.004). The high prevalence observed in

this study was higher than the 13.2% (95% CI: 12.7-13.7) prevalence reported by Bruni et al. (2010) in the meta-analysis involving 17,500 urban women from South America who had normal cytology.

In another study to determine the prevalence of cervical disease, human papillomavirus infection, and human papillomavirus genotypes in indigenous villages of Guyana, Kightlinger et al., (2010) found invasive cervical carcinoma in 0.80% of the women, cervical intraepithelial neoplasia II and III in 5.07% of the women, and a high-risk HPV infection rate in 19.3% of the women. Sixteen genotypes were detected in women with high-grade dysplasia or cancer with HPV 31 (25.0%), HPV 16 (22.7%) and HPV 18 (13.6%) being the most common HPV types. The rate of HPV 16 and 18 in cervical cancer was 55.50%. Based on these findings, Kightlinger and colleagues (2010) concluded that Indigenous Guyanese women have a high rate of cervical cancer and high-grade dysplasia with HPV 16 and 18 being the leading cause of invasive cancer. These findings are not consistent with results from other studies which showed that other HPV types are more dominant than HPV 16 or 18 (Shrestha et al., 2010; Watt et al., 2009; Andall-Brereton et al., 2011).

In a quantitative study of Indigenous women in the Amazon region of Brazil, Rocha et al. (2013) found a high prevalence of HPV 16 (58.1%) and HPV 58 (20.0%) in their sample involving 361 sexually active women over 18 years of age. In addition, 13 more types of HPVs were detected, namely, HPV 33, 81, 6, 70, 31, 35, 45, 52, 53, 61, 68, 71, and 89. HPV 58 is considered the seventh most common type with precursor lesions and cervical cancer, and the sixth most common type of HPV in women without

cytological abnormalities (Rocha et al., 2013). According to Rocha and colleagues (2013), the prevalence rates of HPV 58 in other countries show marked differences exist between regions, especially in Latin America and Asia which account for the highest prevalence rate of this type of HPV. Additionally, other studies conducted in Brazil on the prevalence of HPV also established that HPV 16 is the most frequently common infection in women (Castro, Farias, Borborema-Santos, Correia, & Astolfi-Filho, 2011; Mendes de Oliveira et al., 2013).

Consistent with the high-risk of HPV in Indigenous populations in Central and South America and the Caribbean, a high prevalence of HPV has also been found among Indigenous women in North America. Women living in the Appalachian region of the United States experience severe cancer disparities and have the highest incidence and mortality rates of cervical cancer in the U.S. (Reiter et al., 2013). In examining the prevalence of genital HPV among 1116 Appalachian women in their case-control study, Reiter et al. (2013) detected a high prevalence of HPV among them. The prevalence of any HPV type in this sample was 43.1%, followed by 33.5% of high-risk HPV types, 23.4% of low-risk types, and 12.5% for vaccine-preventable HPV types. Younger age (18-26 years; OR = 2.09, 95% CI: 1.26-3.50), current smokers (OR = 1.86, 95% CI: 1.26-2.73), number of male sexual partners (at least five) during lifetime (OR = 2.28, 95% CI: 1.56-3.33), and multiple male sexual partners during the last year (OR = 1.98, 95% CI: 1.25-3.14) were associated with contracting HPV infection. Because of a deficiency of data on HPV prevalence among women from Appalachia, Reiter et al. (2013) suggest that

their findings could provide pertinent information relative to cervical cancer screening and prevention within the Appalachian region.

In another case controlled study among Indigenous and non-Indigenous Australian women to determine differences in the prevalence of HPV type by area of residence or ethnicity, Garland and colleagues (2011) reported that Indigenous women were at a higher risk of HPV prevalence especially from risk factors associated with it. Although HPV 16 and 18 was similar for both groups (HPV 16 was 9.4% and 10.5% respectively; and HPV 18 was 4.1% and 3.8% respectively) and not associated with place of residence, there was a significant difference in the prevalence of HPV 68 for both Indigenous and non-Indigenous women (OR = 3.8, 95% CI 1.9 to 7.5%; $p < 0.001$). HPV 16 was the most common genotype detected in both groups of women, followed by types 51, 52, 18 and 39. Age was a factor associated with the higher prevalence of HPV for Indigenous women, particularly in the 31 to 40 years age group category (35% versus 22.5%; $p < 0.001$) even though no association was observed in younger women on the prevalence of high-risk types. These authors, like others mentioned before, emphasize the importance of cervical cancer screening and obtaining data on HPV genotype prevalence to better target women who are at high risk of getting HPV infection and cervical cancer.

In Canada, Indigenous women residing in the Aboriginal populations reportedly have higher rates of cervical cancer than other Canadian women (Brassard et al., 2012). Geographic and ethnic variations in HPV prevalence exist among regions in Canada (Jiang et al. (2013). Studies conducted in the Northwest Territories of Canada report differences in the prevalence of type-specific HPV infections and the co-factors

associated with it (Brassard et al., 2012; Jiang et al., 2013; Jiang et al., 2011). In examining 5725 bio-samples to determine the prevalence of HPV infection on different virus types and their association with cervical dysplasia in the Northwest Territories of Canada, Jiang and colleagues (2011) reported a high prevalence of high-risk HPV in these regions, especially among Aboriginal women whose prevalence rate was approximately 50% more than non-Aboriginal women. The overall HPV prevalence reported in the sample was 24.2%. 89.5% of the cervical dysplasia cases were from HPV infection, and HPV 16 or 18 was responsible for 21.7% of the cases. Analysis of the HPV-positive samples also showed that 76.6% of the women harbored high-risk types, 35.2% had multi-type infections and 21.6% had HPV 16 or 18 infections.

Results of a later study by Jiang and colleagues (2013) to examine the prevalence of HPV infections and their association of different types with cervical dysplasia among women in Northern Canada, also showed that Aboriginal women had a higher prevalence rate of HPV infection (approximately 50%) than the non-Aboriginal population (27.6 vs. 18.5%). These results were similar to the one previously reported by Jiang and colleagues (2011) who also found a higher prevalence rate of HPV infection in Aboriginal women (approximately 50% higher) as compared to the non-Aboriginal population. Granted that HPV 16 was the most common type detected across the region, Jiang and colleagues (2013) reported no difference of HPV 16 or 18 infections among Aboriginal women and non-Aboriginal women. Younger age (<20 years) was a determining factor in the highest HPV prevalence.

Brassard et al. (2012) also support the findings of Jiang et al. (2011 and 2013) that Aboriginal women were more affected by high-risk HPVs than non-Aboriginal women. Determinants of high-risk HPVs found in this sample were younger age, single marital status, aboriginal background, current smoking, lifetime deliveries, use of hormonal contraceptives, and numbers of sexual partners in the previous year. These findings were also consistent with those reported by Demers et al. (2012b).

Risk Factors for HPV

Persistent infection with certain HPVs causes cervical cancer (ACS, 2013c). Lack of knowledge and awareness could be detrimental to women's health. Therefore, identifying the risk factors associated with cervical cancer is extremely important. Even though numerous epidemiological studies have identified certain risk factors as contributing to the development of cervical cancer, HPV infection is considered the most important factor in this process. An increased risk of HPV infection is linked to sexual behaviors such as first sexual intercourse at an early age, multiple sex partners, and the indiscriminate sexual behavior of the partner (Morrison et al., 2010; Louie et al., 2009; Warman, 2010). Age at first sexual intercourse and age at first pregnancy are significant risk factors for cervical cancer (Louie et al., 2009). In their pooled case-control studies on invasive cervical cancer from eight developing countries, Louie and colleagues (2009) reported a 2.4 fold risk among women, who were less than 16 years of age, and who initiated their first sexual intercourse, and who experienced their first pregnancy when compared to women who were over 21 years. In another study, age, ethnicity, and the number of sexual partners in the last year were identified as independent risk factors for

HPV infection (Demers et al., 2012b). This study examined a sample of 592 women to determine risk factors associated with HPV infections and to link the HPV types with the cervical cancer screening history of their participants. HPV infection was detected in 115 participants (19.4%), 89 of whom had a normal Pap test. HPV 16 was the most prevalent type found in this study (15/115: 13.0% of infections). Of the women who were HPV positive, 10.3% (61) had high-risk HPV.

Several other factors are thought to be associated with persistence of HPV infection and progression to cervical cancer. These include history of sexually transmitted diseases, number of child births, long-term use of oral contraceptives, smoking, immunodeficiency, exposure to HIV, low socioeconomic status, and lack of access to health (ACS, 2013c; Morrison et al., 2010; Carmargo et al., 2011; Gudlevičienė et al., 2010; Muñoz & Bravo, 2012; Warman, 2010). Carmargo and colleagues (2011) found that early initiation of sexual intercourse and uses of oral contraceptives put women at increased risk of HPV infection. These authors note that women without any history of previous pregnancies were at a greater risk of HPV infection than women who had more than four full-term pregnancies because of their likelihood to engage in risky sexual practices. In another study, statistically significant associations were found between high parity ($p = 0.04$), rural residence ($p = 0.03$), low socioeconomic status ($p = 0.01$) and illiteracy ($p = 0.07$) and high-risk HPV infection among a population of 769 cytologically negative women, aged 18-45 years (Gupta et al., 2009). Still, in their case controlled study to detect HPV, its type prevalence, and other risk factors associated with cervical cancer among a sample of Lithuanian cervical carcinoma patients, Gudlevičienė and

colleagues (2010) reported that socioeconomic status and the sexual history of women were the most important risk factors for the development of cervical cancer. In addition to these risk factors, smoking was considered a likely determinant for HPV infection. The odds ratio adjusted by the age showed that women who smoked were two times more likely to be at risk for cervical cancer than those who did not smoke (OR = 2.0, 95% CI 1.2-3.5). This result differed however, after the odds ratio adjustment by age and HPV positivity, where smoking did not increase the risk of cervical cancer. Similar results found by Garland and colleagues (2011) showed that smoking was strongly associated with any HPV type among Indigenous women who were twice as likely to smoke (45.9% versus 21.8%, $p < 0.001$). The result from this study also showed that Pap-test abnormalities and younger age especially among Indigenous women were associated with the risk for cervical cancer. Women were seven times as likely to have a current high-grade Pap test result (3.1% versus 0.4%, $p = 0.03$), or to have their first ever Pap test (n = 3 (3.2%) versus n = 1 (0.4%), $p = 0.03$).

Epidemiology of Cervical Cancer

Worldwide, cervical cancer ranks as the third most common cancer in women (Arbyn et al., 2011; Colantonio et al., 2009; Jemal, Center, DeSantis & Ward, 2010; Muñoz & Bravo, 2012; Oh et al., 2013; Pierce Campbell, Curado, Harlow & Soliman, 2012; Vaccarella et al., 2013) and is the fourth leading cause of death in women (International Agency for Research on Cancer (IARC), 2013; Jemal et al., 2011; Jemal et al., 2010). In 2012, worldwide statistics showed there were 266,000 deaths from cervical cancer that occurred in women, with approximately70% of the global burden affecting

under-developed countries (IARC, 2013). Very high rates of cervical cancer incidence exist in India where more than one fifth of all new cases are diagnosed (IARC, 2013). In addition, sub-Sahara Africa also has high incidences of cervical cancer with 34.8 new cases being diagnosed annually per 100,000 women, and 22.5 deaths per 100,000 annually (IARC, 2013). When these incidence and mortality rates are compared with those of North America (6.6 per 100,000 women and 2.5 per 100,000 women respectively), the lower rates in North America highlight the grim reality of the burden of cervical cancer in developing countries.

In developing countries, cervical cancer ranks as the second most common cancer, with 452,000 cases reported for these regions in comparison to developed countries where cervical cancer is ranked as the 10^{th} most common cancer with 76,000 reported cases (Ferlay et al., 2010; Munoz & Bravo, 2012). In 2008, the worldwide estimate of cervical cancer revealed there were 530,000 (9%) new cases and 275,000 (8%) deaths (ACS, 2011; Arbyn et al., 2011; Jemal et al., 2011; Muñoz & Bravo, 2012; Pierce Campbell et al., 2012; Vaccarella et al., 2013), with approximately 88% of these deaths occurring in developing countries (Jemal et al., 2011; Ferlay et al., 2010).

The marked differences in the morbidity and mortality rates associated with cervical cancer in developed and developing countries are significant. The reported mortality in 2008 for Asia was 159,800; followed by 53,000 in Africa and 31,400 in Latin America and the Caribbean (Ferlay et al., 2010). In 2008, the reported age-standardized incidence rates (ASIR) and age-standardized mortality rates (ASMR) were two to three times lower in developed countries than in developing countries (Arbyn et al., 2011). For

example, the ASIR for developing countries was 18/100,000 compared to 9/100,000 for more developed countries, while the ASMR for developing countries was 10/100,000 in contrast to an ASMR of 3/100,000 for developed countries (Arbyn et al., 2011). In addition, in 2008, 1.9% of women developed cervical cancer and 1.1% died of the disease before reaching the age of 75 in developing countries (Arbyn et al., 2011). Worldwide, there is a big difference in the incidence and mortality of cervical cancer especially in the subcontinents. The highest incidence and mortality rates are reported in Eastern Africa (ASIR = 34.5/100,000 and ASMR = 25.3/100,000), Western Africa ((ASIR = 33.7/100,000 and ASMR = 24.0/100,000), and Southern Africa (ASIR = 26.8/100,000 and ASMR = 14.8/100,000), followed by South-Central Asia (ASIR = 24.5/100,000 and ASMR = 14.0/100,000) and South America (ASIR = 24.1/100,000 and ASMR = 10.8/100,000) (Arbyn et al., 2011; Jemal et al., 2011). On the other hand, countries such as Australia/New Zealand (ASIR = 5.0/100,000 and ASMR = 1.4/100,000), North America ((ASIR = 5.7/100,000 and ASMR = 1.7/100,000), and in Western Europe (ASIR = 6.9/100,000 and ASMR = 2.0/100,000) have experienced the lowest incidence and mortality rates (Arbyn et al., 2011; Jemal et al., 2011) [See Figure 2].

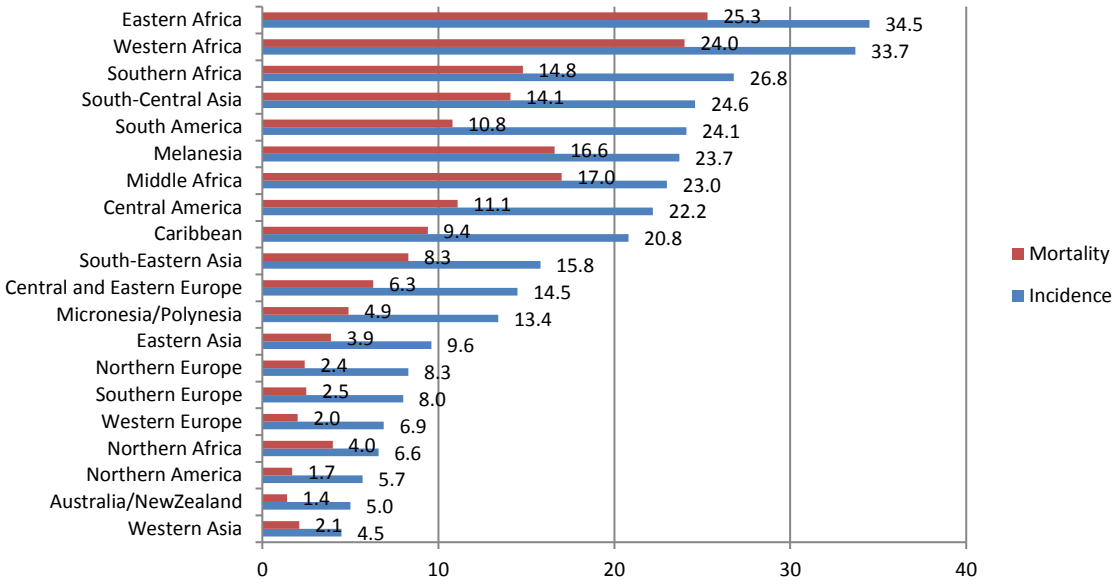

Figure 2. Age-standardized cervical cancer incidence and mortality rates by world area. Adapted from "Global Cancer Statistics," by A. Jemal, F. Bray, M. M. Center, J. Ferlay, E. Ward, and D. Forman, 2011, *Cancer Journal for Clinicians, 61*(2), p. 80.

The rising number of cases and deaths resulting from cervical cancer is perturbing, especially in developing countries. According to Forouzanfar et al. (2011), globally, the number of cervical cancer cases has increased by 0.6% annually and the number of deaths by 0.46% as a result of population sizes and population ageing. In 2010, the incidence rates of cervical cancer rose to 454,000 (318,000-620,000) cases per year as compared to 378,000 (256,000-489,000) cases per year in 1980 (Forouzanfar et al., 2011). Although there has been a decrease in cervical cancer deaths in nearly all countries between 1980 and 2010 (Forouzanfar et al., 2011), this disease however, continues to have an overall devastating effect. In 2010, cervical cancer death rates were reported at 200,000 (139,000-276,000). Of this number, 46,000 (33,000-64,000) women aged 15-49 years lost their lives as a result of cervical cancer (Forouzanfar et al., 2011).

The heterogeneity in cervical cancer mortality is evident between various countries. Malawi, 3.2(1.9-4.8), Ethiopia, 2.9(1.4-7.3), and Guyana, 3.0(2.0-4.3) had high mortality risks reported in 2010, while low mortality rates were reported for some countries in eastern and southern Africa, and some Latin American countries such as Mexico, Chile, and Panama who previously experienced high mortality rates between 1980 and 2010 (Forouzanfar et al., 2011).

Cervical Cancer Incidence in Developing Countries

Latin America

The incidence of cervical cancer and mortality in developing countries has far-reaching effects on its population. According to WHO/ICO HPV Information Centre (2010), 86% of the cervical cancer cases occur in developing countries. Several studies have highlighted the high rates of cervical cancer occurring in Latin American countries from Central and South America, and the Caribbean, as well as in sub-Saharan Africa, and Southern Asia (Correnti et al., 2011; Jemal et al., 2011; Pierce Campbell et al., 2012; Villa, 2012). Disparities in access to cervical cancer screening and treatment, and inadequate health care infrastructure are primarily responsible for the high burden of cervical cancer within developing countries (IARC, 2013; Jemal et al., 2011; Villa 2012). In Latin America and Caribbean countries, this high burden of cervical cancer disproportionately affects women (Luciani, Cabanes, Prieto-Lara & Gawryszewski, 2013). Research has shown that geographic variation plays a role in these disparities (Pierce Campbell et al., 2012; Villa 2012). Studies conducted in Latin America and the Caribbean show that age-adjusted incidence rates of cervical cancer could range from low

to high (Pierce Campbell 2012; Villa, 2012), from 20 to 80 per 100,000 women per year (Villa, 2012). In a study to examine the variation in cervical cancer incidence across Latin America and the Caribbean on invasive cervical cancers diagnosed from 1998-2002, results showed that variations in age-standardized incidence rates varied across countries, from a low incidence of 14.6 to a high incidence of 44.0 (Pierce Campbell et al., 2012). The age-standardized incidence rates were: Cuba (14.6/100,000); Argentina (16.0/100,000); Costa Rico (18.9/100,000); Ecuador (20.0/100,000); Colombia 927.9/100,000); Brazil (37.7/100,000), and Peru (44.0/100,000). Other findings on the variations of cervical cancer incidence in Latin America were also reported by the World Health Organization (Villa, 2012) where the highest incidence rates of cervical cancer were observed in Haiti (87/100,000), Bolivia (55/100,000), Peru (48/100,000), and Nicaragua (47/100,000), while the lowest incidence rates were in Argentina (23/100,000) and Uruguay (19/100,000).

In addition, Luciani et al. (2013) also reported on the differences of cervical cancer mortality rates in Latin America and North America. In a study to assess the burden of breast and cervical cancers in the Americas, these authors reviewed and analyzed mortality data from the PAHO Regional Mortality Database on both breast and cervical cancers in 33 countries from 2000-2009 and found that relatively high rates of death from breast cancer were found in the Bahamas, Trinidad and Tobago and Uruguay while El Salvador, Nicaragua and Paraguay had the highest rates of cervical cancer death, 17.9, 19.4 and 20.5 deaths per 100,000 females respectively as compared to Canada, Puerto Rico and the United States who show relatively low rates of 2.4, 3.4 and 3.1

deaths per 100,000 females, respectively (see Table 1 for mortality data on cervical cancer).

Findings from the above-mentioned studies are significant in terms of gaining a better understanding of cancer distribution and the disparities women with cervical cancer face in poor countries. Increasing awareness and knowledge of risks across geographic areas could provide region-specific recommendations on cancer control and prevention (Pierce Campbell et al., 2012; Villa, 2012).

Table 1

Mortality from Cervical Cancer in the Region of the Americas, 2000-2009

Country or territory	Mortality from cervical cancer					APC[c](95% CI)
	Deaths in 2000	ASMR[a] in 2000	Latest year[b]	Deaths in latest year[b]	ASMR[a] in latest year	
Northern America						
Canada	703	2.7	2007	730	2.4	-2.21(3.31 to -1.09)
United States of America	7460	3.3	2007	7786	3.1	-1.18(-1.52 to -0.83)
Mexico and Central America						
Belize	17	23.2	2008	16	15.5	-7.43 (-12.89 to -16.3)
Costa Rica	151	9.1	2009	117	5.1	-6.65 (-8.44 to -4.82)
El Salvador	611	23.6	2008	566	17.9	-3.01 (-4.01 to -2.0)
Mexico	4944	12.3	2009	4326	8.0	-4.86 (-5.17 to -4.56)
Nicaragua	380	24.1	2009	421	19.4	-3.73 (-4.76 to -2.68)
Panama	153	12.0	2009	147	8.5	-5.43 (-7.01 to -3.83)
South America						
Andean Area						
Colombia	2416	14.7	2008	2609	12.0	-3.05 (-3.54 to -2.56)
Ecuador	694	13.9	2009	885	13.3	-0.86 (-1.63 to -0.08)
Peru	2117	20.9	2007	2031	16.3	-1.15 (-1.85 to -0.44)
Venezuela	1548	15.9	2007	1856	14.9	-1.31 (-2.02 to -0.06)
Brazil	7965	10.1	2009	8920	8.4	-2.2 (-2.43 to -1.97)
Southern Cone						
Argentina	1861	8.4	2009	1955	7.6	-0.99 (-1.48 to -0.49)
Chile	771	8.9	2008	685	6.1	-4.02 (-4.91 to -3.12)
Paraguay	549	28.6	2009	537	20.5	-3.49 (-4.35 to -2.63)
Caribbean						
Cuba	531	7.2	2009	593	7.0	-0.16 (-1.18 to 0.87)
Guyana	72	22.8	2006	44	12.7	-4.88 (-9.77 to 0.27)
Puerto Rico	94	3.5	2007	106	3.4	-1.79 (-4.65 to 1.16)
Suriname	26	12.6	2007	21	8.3	-4.77 (-10.37 to 1.17)
Trinidad and Tobago	89	13.6	2007	95	12.9	-1.59 (-4.80 to 1.73)

Note. PC, annual percentage change; ASMR, age-standardized mortality rate; CI, confidence interval [a] Deaths per 100,000 females. [b] Latest year for which relevant data on mortality from cervical cancer were available; [c] In ASMR between 2000 and the latest year for which data were available. Adapted from "Cervical and female breast cancers in the Americas: current situation and opportunities for action," by S. Luciani, A. Cabanes, E. Prieto-Lara, and V. Gawryszewski, 2013, *Bulletin of the World Health Organization, 91*(9), 643.

The existence of the high incidence and mortality rates of cervical cancer in other developing countries has also been confirmed in the literature (Camargo, 2011; Correnti et al., 2011; Luciani et al., 2013; Muñoz & Bravo, 2010; Paz-Soldán, Hayer, Nussbaum & Cabrera, 2012). In Peru, cervical cancer ranks as the most common cancer and is the second cause of cancer-related deaths among women (Paz-Soldán et al., 2012). According to Paz-Soldán et al. (2012), the age-standardized incidence (34.5 per 100,000 women) and cause-specific mortality (16.3 per 100,000) rates from cervical cancer for Peru in 2008 were more than double the rates reported for the Americas. In addition, Correnti et al. (2011) reported that women in Venezuela also experience very high incidences of cervical cancer where it is the second most common cancer among women after breast cancer. According to Correnti and colleagues (2011), the age-standardized incidence of cervical cancer in 2008 for Venezuela was 31.4 per 100,000 women and the age-standardized mortality rate was 14.4 cases per 100,000 women. This mortality rate reflects a decrease from that reported in 2007 (14.9 per 100,000 women) (Luciani et al., 2013) {see Table1}. Overall, the rates for those countries mentioned above are considerably substantial when compared to those previously mentioned for Canada, Puerto Rico, and the United States (2.4, 3.4 and 3.1 deaths per 100,000 females, respectively).

Other Latin American countries such as Colombia, Mexico and Brazil also suffer from high incidences and mortalities of cervical cancer (Camargo et al., 2011; Luciani et al., 2013; Muñoz & Bravo, 2012). However, mortality rates are intermediate among those countries in comparison to the high rates occurring in El Salvador, Nicaragua and

Paraguay as previously mentioned. In Colombia, cervical cancer is the first cause of mortality and the second cause of cancer incidence among women (Muñoz & Bravo, 2012). Based on the GLOBOCAN 2008 estimates reported by Muñoz & Bravo (2012), there were 2,154 deaths and 4,736 cases that occurred in Colombia in 2008 (age-adjusted incidence rate of 21.5 per 100,000 and a mortality rate of 10.0 per 100,000) with the highest mortality rates occurring in poorer regions. Mexico's mortality rate from cervical cancer in 2009 was 8.0 deaths per 100,000 women, while Brazil's mortality rate was 8.4 deaths per 100,000 women (Luciana et al., 2013).

South America and the Caribbean

Like other countries in Latin America, the Caribbean countries are also seriously affected by the high incidence and mortality of cervical cancer. In the Caribbean, incidence and mortality of cervical cancer is considered the second most common cancer among women of all ages (PAHO/WHO, 2013b). Data on the incidence of cervical cancer in non-Latin Caribbean countries are scarce (PAHO/WHO, 2013b); therefore, information reported on the incidence and mortality rates might be more than what are being conveyed. However, an analysis conducted on the incidence and mortality of cervical cancer and HPV prevalence in non-Latin Caribbean countries for three different periods (2000-2002; 2003-2003; and 2006-2008) reveal that differences exist in the incidence and mortality rates. Incidence rates are highest in the Bahamas (60/100,000), Belize (54.9/100,000), Jamaica (17.4/100,000) and Trinidad and Tobago (16.5/100,000); and lowest in Bermuda (5.8/100,000) and Suriname (12/100,000 in the urban population and 10/100,000 in the rural population) (PAHO/WHO, 2013b) {see Table 2}.

Table 2

Summary of Cervical Cancer Incidence Data from non-Latin Caribbean Countries

Country (reference)	Year(s)	Number of new cervical cancer cases (age group)	Cervical cancer incidence rates (age group)
Grand Bahama, The Bahamas	1988 – 2002	58 (27 – 77 years)	60/100,000 (27 – 77 years)
Belize (survey)	2011	38 (21 – 55 years)	54.9/100,000 (21 to 55 years)
Bermuda	1991 – 2003, 2012	15	Caucasian 5.8/100,000 (n/a) Black 7.6/100,000 (n/a)
Cayman Islands (survey)	2005 – 2012	12 (n/a)	n/a
Dominica (survey)	2007 – 2011	81 (21 – 70+ years)	n/a
Guyana	2000 – 2007	573 (< 70 years)	n/a
Jamaica (Kingston & St. Andrews area)	2003 – 2007	302	17.4/100,000 (20 – 85+ years)
St. Kitts and Nevis (survey)	2011	14 (n/a)	n/a
Suriname	1980 – 2004	1138 (all ages)	Urban 12/100,000 (all ages) Rural 10/100,000 (all ages)
Trinidad and Tobago	2000 – 2002	324 (25 – 85+ years)	16.5/100,000 (25 – 85+ years)

Note: Adapted from "Situational analysis of cervical cancer prevention and control in the Caribbean," by Pan American Health Organization/World Health Organization, 2013b, p 11.

Mortality rates from cervical cancer also vary considerably within these Caribbean countries (see Table 3). From 2000 to 2002 and from 2003 to 2005, mortality

rates were highest in Belize (25.4/100,000; 20.5/100,000), St. Lucia (34.2/100,000; 34.6/100,000), and St. Vincent and the Grenadines (30.0/100,000; 20.2/100,000), as well as in Dominica from 2003-2005 (23.6/100,000). However, for the periods 2006-2008, Dominica, Guyana and St. Vincent and the Grenadines had the highest rates (21.7/100,000; 19.0/100,000 and 19.4/100,000 respectively). Overall, Bermuda had the lowest rates for all three periods, 2000-2002, 2003-2005 and 2006-2008 (see Table 3).

Table 3

Cervical Cancer Mortality in Selected non-Latin Caribbean Countries

	Cervical cancer mortality among women aged 15 years and older					
Country	2000 - 2002		2003 – 2005		2006 - 2008	
	No.	ASMR	No.	ASMR	No.	ASMR
Antigua and Barbuda	6	7.6	10	11.6	9	9.3
Aruba	14	10.7	[a]12	[a]12.4	12	7.2
Bahamas	44	14.5	[b]14	[b]13.8	33	8.9
Barbados	56	16.2	[c]34	[c]12.8	31	7.3
Belize	39	25.4	35	20.5	35	17.0
Bermuda	5	4.7	[d]1	[d]3.2	4	2.8
Dominica	n/a	n/a	14	23.6	17	21.7
Grenada	8	11.0	[e]8	[e]9.6	18	17.7
Guyana	108	19.5	112	20.8	107	19.0
St. Kitts and Nevis	4	8.4	6	10.0	4	7.4
St. Lucia	52	34.2	56	34.6	[f]10	[f]12.5
St. Vincent and the Grenadines	27	30.0	22	20.2	21	19.4
Suriname	70	16.3	76	16.7	89	17.7
Trinidad and Tobago	181	13.6	201	14.0	216	14.1

Note: a. Aruba is missing data for 2005; b. Bahamas is missing data for 2004-2005; c. Barbados is missing data for 2003 and for 2005; e. Grenada is missing data for 2005; f. St. Lucia is missing data for 2006-2007. Adapted from "Situational analysis of cervical cancer prevention and control in the Caribbean," by Pan American Health Organization/World Health Organization, 2013b, p 12.

Cervical Cancer in Guyana

The focus of this study was to estimate the incidence of cervical cancer among IAW, AGW, and IGW in Guyana. In Guyana, cervical cancer is the second cause of female cancer among women and the first most common cancer in women aged 15 to 44 years (Bruni et al., 2014). According to Bruni et al. (2014), there are 0.26 million women aged 15 years and older in Guyana who are at risk of developing cervical cancer. The incidence and mortality rates of cervical cancer in Guyana are excessive. Based on the 2013 estimates of the incidence of cervical cancer as reported by Bruni et al. (2014), 161 new cases of cervical cancer are diagnosed annually in Guyana with women between the ages of 40-64 years accounting for most of these cases. The current age-standardized incidence rate for cervical cancer is 46.9 per 100,000 women per year (see Table 4). This rate was similar to the age-standardized incidence rate for Brazil (47.7 per 100,000 women per year) (Bruni et al., 2014). Correspondingly, cervical cancer death in Guyana ranks as the first cause of female deaths and the first leading cause of cancer deaths in women aged 15 to 44 years (Bruni et al., 2014). There are 71 new cervical deaths that occur annually in Guyana; the current age-standardized mortality rate being 21.9 per 100,000 women per year. Comparing this statistic to the age-standardized mortality rate in 2006 (12.7 per 100,000; 95% CI: -4.88 {9.77 to 0.27}), the rate has almost doubled within a seven year span. These statistics are nevertheless grim, and they especially stand out against the current age-standardized mortality rates for South America (8.6 per 100,000) and the world (6.8 per 100,000) as a whole (Bruni et al., 2014) {see Table 5}.

Table 4

Incidence of Cervical Cancer in Guyana

Indicator	Guyana	South America	World
Annual number of new cancer cases	161	45,008	527,624
Crude incidence rate[a]	42.7	22.2	15.1
Age-standardized incidence rate[a]	46.9	20.3	14.0
Cumulative risk (%) at 75 years old[b]	4.9	2.0	1.4

Note. [a] Rates per 100,000 women per year; [b] Cumulative risk (incidence) is the probability or risk of individuals getting from the disease during ages 0-74 years. Adapted from "Human papillomavirus and related diseases in Guyana, Summary Report, " by L. Bruni, L. Barrionuevo-Rosas, G. Albero, M. Aldea, B. Serrano, S. Valencia,…X. Castellsagué, 2014, ICO Information Centre on HPV and Cancer (HPV Information Centre), p. 6.

Table 5

Cervical Cancer Mortality in Guyana

Indicator	**Guyana**	**South America**	**World**
Annual number of deaths	71	19,374	265,653
Crude mortality rate[a]	18.8	9.5	7.6
Age-standardized mortality rate[a]	21.9	8.6	6.8
Cumulative risk (%) at 75 years old[b]	2.5	0.9	0.8

Note: [a]Rates per 100,000 women per year, [b]Cumulative risk (mortality) is the probability or risk of individuals dying from the disease during ages 0-74 years. For cancer, it is expressed as the % of new born children who would be expected to die from a particular cancer before the age of 75 if they had the rates of cancer observed in the period in the absence of competing causes. Adapted from "Human papillomavirus and related diseases in Guyana. Summary Report, " by L. Bruni, L. Barrionuevo-Rosas, G. Albero, M. Aldea, B. Serrano, S. Valencia,…X. Castellsagué, 2014, ICO Information Centre on HPV and Cancer (HPV Information Centre), p. 14.

Literature Review on Indigenous Populations

Several studies have used a quantitative approach to assess the incidence of cervical cancer among Indigenous people. A study by the National Aboriginal Health Organization with First Nations people across Canada conducted a survey to measure the use of preventive health services (Demers et al., 2012a). Results showed similarity in rates of screening for cervical cancer between Aboriginal women (71.9%) and non-Aboriginal women (74.8%) within small communities in the Northwest Territories, but differences in another community where Aboriginal women had lower screening rates (71.7%) than non-Aboriginal women (92.0%). In Canada, the incidence and mortality rates of invasive cervical cancer among Aboriginal women are higher than for other groups (Demers et al., 2012a). Incidence rates for invasive cervical cancer for Aboriginal women are reportedly 1.7 to 3.5 times higher than the rates for non-Aboriginal women while mortality rates are 4 to 5 times higher for these women than for non-Aboriginal women (Demers et al., 2012a). Based on the findings, these authors recommended developing culturally appropriate educational materials and services related to sexual health, screening for cervical cancer and immunization against HPV. Added to these recommendations is the need for research to be done on HPV and related outcomes among the Aboriginal populations to assess the gaps in knowledge.

In Latin American, data on cervical cancer among Indigenous people is lacking (Goss et al., 2013; Moore et al., 2014). Moore and colleagues (2014) conducted a systematic review of peer-reviewed literature in academic databases and evidence from

cancer registries from 1980 to assess the cancer epidemiology among Indigenous people in Latin American countries of Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, and Peru. Results determined that Indigenous people had higher rates of cervical cancer in some parts of Brazil, Ecuador, and Guyana; higher stomach cancer rates in regions of Chile, and higher gallbladder rates in Chile and Bolivia. Based on the findings, the authors stressed the importance of obtaining cancer profiles as well as identifying and prioritizing cancer control measures for indigenous people.

In another study, Kightlinger and colleagues (2010) conducted a retrospective study in Guyana to determine the prevalence of cervical cancer disease and HPV among women who live in the indigenous villages. 2250 Amerindian women who participated in the study were screened for cervical cancer and HPV. Results showed that Indigenous Guyanese women, especially between the ages of 20-30 years, have a high prevalence of cervical cancer and high-grade dysplasia, and HPV infection. Based on the findings, the authors recommended ongoing HPV genotype analysis in women with high-grade neoplasia and cancer, as well as ongoing clinical care and epidemiologic studies in the indigenous villages.

Similar findings on the high incidence of cervical cancer in IAW were also reported in another study. Best Plummer et al. (2009) conducted a review of the Guyana Cancer Registry's database, focusing on the ethnic and site prevalence of breast, cervical, and prostate cancers. Results showed that the majority of cervical cancers cases were found among AGW (39%) but when the proportion of cervical cancer cases for all cancer in an ethnic group was analyzed, cervical cancer was significantly more prevalent among

IAW (p<0.0001). These authors recommended further investigation into the high incidence of cervical cancer to be carried out.

Another study using a cancer registry was conducted by Roue and colleagues (2012) to determine the incidence rate of cervical cancer in French Guiana. Data on cervical cancer between 2003 and 2005 were analyzed. The results indicated that women from rural areas had a significantly greater amount of lesions than women from urban areas (age-standardized rate of invasive cervical cancer was 30.3 per 100,000 women, 95% CI, 22.8-37.9). The incidence of invasive cervical cancer increased from age 25 years then showed a decline after 64 years. Roue and colleagues (2012) recommended more organized screening for women in the rural parts of French Guiana.

Shannon, Franco, Powles, Leng & Pashayan (2011) evaluated data to determine the difference in occurrence and case fatality of cervical cancer among Indigenous and non-Indigenous Australian women. Surveillance data was collected from the Australian Bureau of Statistics, Australian Institute of Health and Welfare, and State- or Territory-based Cancer Registries. Results showed that age-standardized incidence rates among Indigenous women (16.9 per 100,000 women) was higher than non-Indigenous women (7.1 per 100,000 women), and the age-standardized mortality rate was more than 5 times the rate for non-Indigenous population (9.9 per 100,000 women years; 95% CI 7.1-13.3). Based on these findings, these authors pointed out those Indigenous women were more likely to develop cervical cancer and have less survival rates than non-Indigenous women. They also conceded that the pattern of cervical cancer incidence and survival confirms the existence of health inequities in Australia.

Consistent with the above-mentioned findings, Vasilevska, Ross, Gesink, & Fisman (2012) conducted a systematic review and meta-analysis on both Indigenous and non Indigenous populations to identify whether Indigenous women in Australia, Canada, New Zealand, and the United States had higher risks of cervical dysplasia, cervical cancer, and cervical cancer-related mortality than the non-Indigenous population. Studies published in 1969-2008 were used. Results showed that Indigenous women have a significantly higher risk of cervical cancer morbidity (pooled RR=1.72) and mortality (pooled RR=3.45) than non-Indigenous women, but no increased risk of early-stage disease. These authors suggest that structural, social, or individual barriers to screening are possible factors that influence the poor health outcomes of Indigenous women and not baseline risk factors.

Epidemiology of Cervical Cancer among Indigenous Women in Guyana

In Guyana, the Indigenous Amerindians live in the forests and experience the poorest health outcomes (Francis, Liverpool and Chan, 2009) and have the highest poverty levels (PAHO, 2013a). Similar reports of Indigenous people living in poverty in Latin American countries have also been documented (Moore et al., 2014). Compared to Indigenous people in other parts of the world, Latin American countries (Central America and Mexico, and South America) have a higher percentage of poverty (Moore et al., 2014) {see Table 6}.

Table 6

Population of Indigenous People by Country or Region, with Percentage of those Living in Poverty

Country of origin	Indigenous peoples (millions)	Indigenous poor (%)
China	106	5
South Asia	95	44
Southeast Asia	30	50
Africa	22	77
Arabia	15	7
Central America and Mexico	12	75
South America	11	82
Rest of world	9	22
Total	299	33

Adapted from "Cancer in Indigenous People in Latin America and the Caribbean: A Review," by S. P. Moore, D. Forman, M. Piñeros, S. M. Fernández, M. de Oliveira, and F. Bray, 2014, *Cancer Medicine*, *3*(1), 76.

The health status of Indigenous people in Guyana is affected by the apparent marked disparities that exist between the coastal communities and those communities in the hinterland, namely where the Indigenous Amerindians live (PAHO, 2012). For instance, Indigenous Amerindians experience social exclusion and hardship in accessing healthcare services because most of them reside in the underdeveloped areas in the interior where the delivery and provision of healthcare services and other essential services is hampered by the difficulty in getting to them (PAHO, 2013a). Factors impacting the delivery of healthcare services to Amerindian communities include limited resources, poor health infrastructure, and lack of electricity (Francis et al., 2009; PAHO, 2012).

Cervical cancer and HPV-associated dysplasia are widespread among Indigenous women who live in remote areas (Goss et al., 2013; Kightlinger et al., 2010). Factors contributing to this increased prevalence are associated with limited access to Pap smear screening, HPV vaccination, and early treatment for cervical cancer (Kightlinger et al., 2010). IAW in Guyana are not screened for cervical cancer because of the unavailability of large-scale systematic cervical cancer screening (Francis et al., 2009). Some factors impacting the provision of cervical cancer screening among this population are related to insufficient funding and equipment to conduct cervical cytology, lack of trained medical personnel, and geographic and logistic barriers in providing medical care in its remote areas (Francis et al., 2009;Kightlinger et al., 2010).

Epidemiological data on the incidence of cervical cancer and HPV infection among Indigenous people in Guyana is limited. Indigenous people experience poorer health outcomes and higher mortality rates than non-Indigenous people (Demers et al., 2012a; Goss et al., 2013; Moore et al., 2014). Research indicates that the high rates of morbidity and mortality among this population are as a result of lack of access to adequate screening and prevention services, low socioeconomic status, geographic and financial barriers (Best Plummer et al., 2009; Demers et al., 2012a; Goss et al., 2013; Kightlinger et al., 2010; Moore et al., 2014). As a result of these factors, the survival rate from cervical cancer tends to be poor since diagnosis and initial treatment of cervical cancer is delayed because manifestation of the disease is diagnosed at later stages (Goss et al., 2013, Moore et al., 2014). Early diagnosis and treatment of cervical cancer is important. Indigenous women who are diagnosed and treated early for cervical cancer

will thus have a greater chance of being cured and living longer lives (Demers et al., 2012a).

Low reporting of cervical cases for IAW is a major issue. This problem is compounded by the poor infrastructure that prevents access from getting to the remote villages to areas where health services are monitored and delivered (Kightlinger et al., 2010; PAHO, 2012). Guyana has a cancer registry where data on the incidence rates of cervical cancer among IAW is limited or underreported. Figure 3 shows data on the number of cases by type and ethnicity as reported by the cancer registry. Cervical cancer cases for AGW (141) and IGW (137) are reported more than for IAW (31).

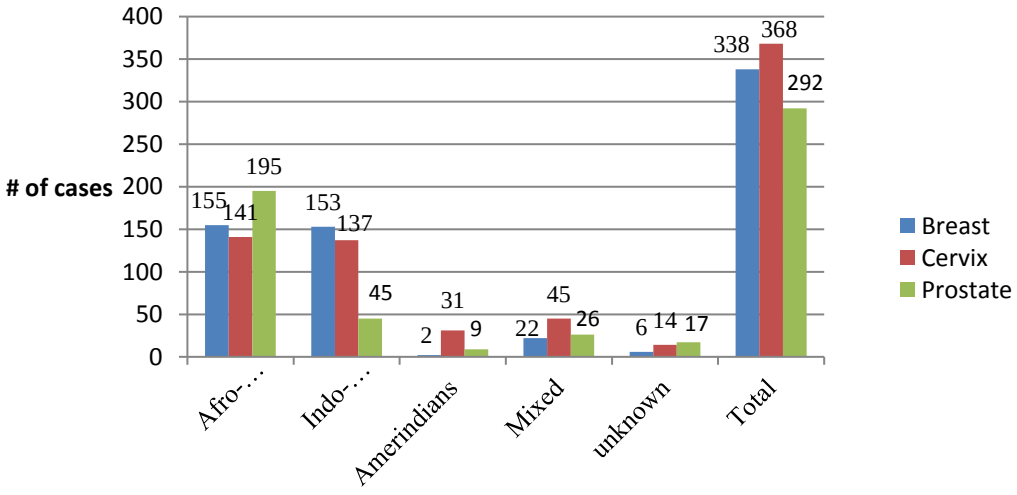

Figure 3. Reported cases of cancer in Guyana, January 2004–December 2007. Adapted from "Guyana Country Cooperation Strategy 2010-2015," by Pan American Health Organization, 2012, p. 19.

Summary

A review of the literature indicated that there is limited epidemiology data on the incidence of cervical cancer among indigenous populations. Indigenous women experience very high incidence and mortality rates of cervical cancer as compared to non-Indigenous women. It is therefore important to understand the epidemiology and prevalence of cervical cancer and HPV among women who are at high risk. Providing opportunities for cervical cancer screening for Indigenous women in remote regions as well as for women in urban areas, and improving data collection could go a very long way in reducing health disparities in developing countries. The study design and methods of this study are presented in Chapter 3.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study was to use secondary data from the Guyana Cancer Registry to examine the demographic variables and their relationship to cervical cancer among IAW, AGW, and IGW in Guyana. The dependent variable in the study was cervical cancer, and the independent variables were age, marital status, geographical regions, and stage at diagnosis this comparative cross-sectional study could help researchers better understand the association between the dependent variable and the independent variables. In this chapter I discussed the research design, study population and sample, sample size, data collection and data analysis methodology, and the ethical issues involved in the study.

Research Questions

My major aims in this study were to compare the cervical cancer cases among IAW, AGW, and IGW in Guyana and to use available risk factors from these data to answer the following research questions:

RQ 1: Is there a difference in cervical cancer cases for Indigenous Amerindian women compared to Afro- and Indo-Guyanese women from 2000 through 2012?

RQ 2: Is there an association between cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women and their geographical regions?

RQ 3: Is there a relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their ages, marital status, and year of diagnosis?

RQ 4: Is there an association between the stage at diagnosis of cervical cancer and age, marital status, year of diagnosis, and geographical region among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women?

Research Design

For this comparative cross-sectional study, I obtained preexisting data from the Guyana Cancer Registry from 2000 through 2012 and used them to assess demographic factors that were related to cervical cancer among IAW, AGW, and IGW. My reason for using this comparative study was to extrapolate findings from the reported cervical cancer cases and to apply these findings to these three ethnic groups of women.

Study Population

For this study, I studied data from the three main ethnic groups, IAW, AGW, and IGW which included a total of 5800 cervical cancer cases from the study regions during the period 2000 to 2012. The study population included women from the three ethnic groups, age 13 and older who were diagnosed with invasive cervical cancer, cervical intraepithelial neoplasia I, II and III, high-grade squamous intraepithelial lesions, and low-grade squamous intraepithelial lesions with laboratory confirmation between 2000 and 2012 from data reported to the Guyana Cancer Registry. I did not consider the total population in this study.

Guyana has a population of approximately 751,223 according to the 2002 census report (Bureau of Statistics, 2015b) and is made up of different ethnic groups including Indo-Guyanese, the largest group (43.5%), Afro-Guyanese (30.2%), mixed (16.7%), Amerindians (9.2%), and other groups (0.4%;PAHO, 2013a; Guyana Bureau of Statistics, 2015b). In Guyana, there are ten regions classified as either remote and rural, coastal, or townships or the capital city, Georgetown (PAHO, 2013a; World Health Organization and Ministry of Health Guyana, 2008). According to the Guyana Bureau of Statistics (2015a), the urban townships are found in Regions 2, 4, 6 and 10. The coastland areas are in Regions 2, 3, 4, 5, 6 and 10, while the hinterland areas are primarily located in Regions 1, 7, 8 and 9. Figure 4 below outlines the regional population distribution of Guyana, as of 2012. According to the Guyana Bureau of Statistics (2015a), the coastland regions which include the capital city have the higher percentage of the population (89.1%), while the population of the hinterland regions accounts for 10.9% of the total population. Additionally, Region 4 accounts for 41.9% of the population while Regions 6 and 3 have almost the same composition of the population (14.6% and 14.4% respectively).

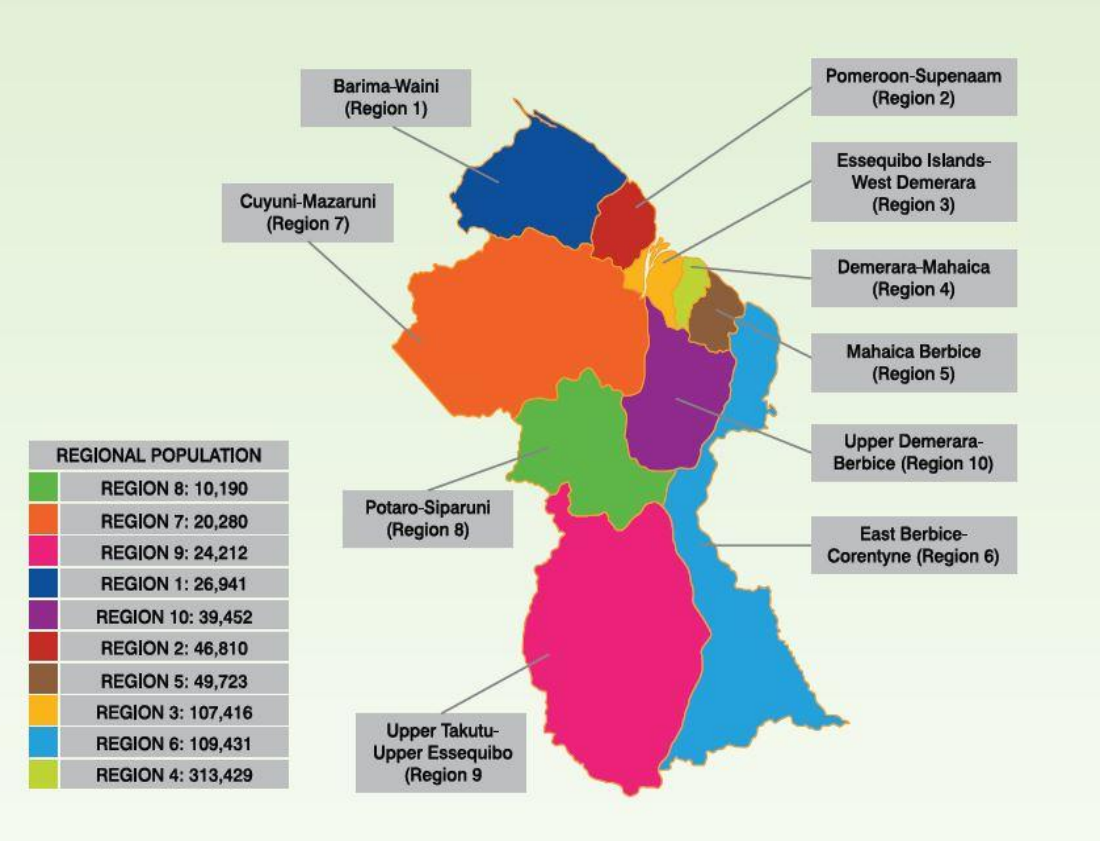

Figure 4. Regional Population Distribution for Guyana, 2012. Urban and Coastland Regions consist of Regions 2, 3, 4, 5, 6 and 10. The Hinterland Regions consist of Region 1, 7, 8 and 9. Adapted from "Guyana Population and Housing Census 2012, Preliminary Report," by the Guyana Bureau of Statistics, 2015a, VI.

However, almost every ethnic group is found within each of these regions. Figure 5 shows the regional population by nationality background and ethnicity. Afro-Guyanese are mainly concentrated in Region 4, while a higher percentage of Indo-Guyanese are primarily found in Regions 4, 6, and 3 respectively. Amerindians are found in Regions 1, 8, and 9 (Guyana Bureau of Statistics, 2015b).

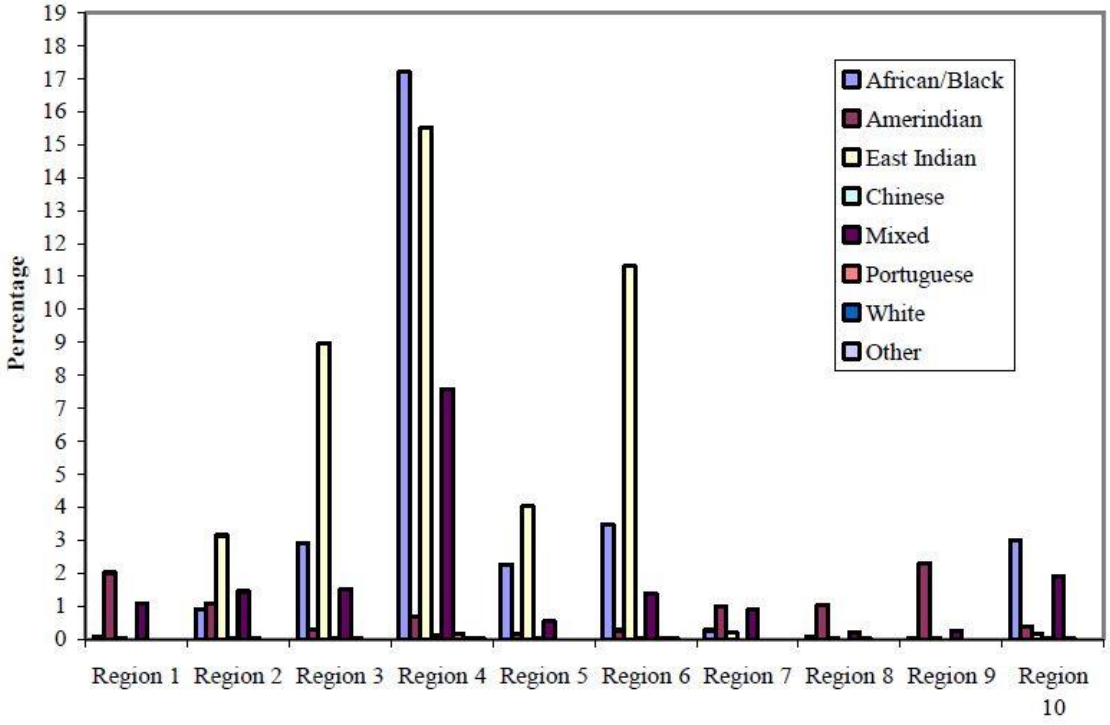

Figure 5. Population by Nationality Background/Ethnicity by Region of Residence, Guyana: 2002. Adapted from "2002 Population and Housing Census, Guyana National Report, Chapter II: Population Composition," by the Guyana Bureau of Statistics, 2015b, p. 30.

The percentage distribution for all ten regions based on the 2002 census is presented in Table 7. As seen in Table 7, Indigenous Amerindians account for more than three-quarters of the populations of Regions 8 and 9 (75.9% and 89.2% respectively) and two-thirds of the population of Region 1 (62.2%). Indo-Guyanese make up about one-half of the population in Regions 2 and 5, and more than two-thirds of the population of Region 3 (65.5%) and Region 6 (68.7%). Afro-Guyanese make up almost one-half of the populations of Regions 4 and 10 (Guyana Bureau of Statistics, 2015b).

Table 7

Percentage Distribution of Population within a Region by Nationality, Background/Ethnicity, Guyana 2002

Background	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Region 9	Region 10	Total
African/Black	2.29	13.41	21.23	41.67	32.55	21.06	11.61	7	1.22	54.98	30.21
Amerindian	62.24	16.27	2.01	1.69	1.95	1.63	41.69	75.91	89.2	7.1	9.14
Chinese	0.03	0.09	0.16	0.26	0.11	0.18	0.03	0.03	0.04	0.15	0.19
East Indian	1.40	47.91	65.47	37.54	57.76	68.68	8.89	2.16	0.5	3.08	43.43
Mixed	33.86	22.06	11.02	18.38	7.63	8.37	37.58	13.92	8.85	34.48	16.73
Portuguese	0.08	0.21	0.07	0.34	0	0.05	0.14	0.93	0.09	0.12	0.20
White	0.09	0.04	0.03	0.09	0	0.04	0.05	0.05	0.09	0.05	0.06
Other	0.01	0	0	0.03	0	0	0.01	0	0.01	0.03	0.01
Total	100	100	100	100	100	100	100	100	100	100	100
Number	24,275	49,254	103,061	310,320	52,428	123,694	17,597	10,094	19,388	41,114	751,223

Note: Only Regions 2, 3, 4, 5, 6 and 10 were included in this study Adapted from "2002 Population and Housing Census, Guyana National Report, Chapter II: Population Composition," by the Guyana Bureau of Statistics, 2015b, p. 31.

For this study, I only reviewed data for IAW, AGW, and IGW from Regions 2, 3, 4, 5, 6 and 10.The study regions with the three ethnic groups represented 75% of the national population. The Afro- and Indo-Guyanese representation in the study regions mirrored the overall national representation (30% and 43% respectively), while the Indigenous Amerindian represented only 3.74% of the study regions, a much smaller percentage than their overall national representation (9.14%).

As shown in Table 7, for the study population, Indo-Guyanese have the highest percentage of the population distribution (except for Region 4 where Afro-Guyanese

have the largest percentage distribution), followed by Afro-Guyanese and Indigenous Amerindians. Indigenous Amerindians represent more than three-quarters of the populations for Regions 8 and 9 (75.9% and 89.2% respectively) and two-thirds of the population for Region 1 (%). In contrast, Afro-Guyanese made up almost half of the populations of Regions 4 and 10 (41.67% and 54.98% respectively), while the Indo-Guyanese made up approximately one-half of the populations for Regions 2 and 5 (47.91% and 57.76%) and more than two-thirds of the populations for Regions 3 and 6 (65.5% and 68.7% respectively; Guyana Bureau of Statistics, 2015a}.

Rural and urban inequalities exist in relation to health care access, poverty, and health outcomes among the different ethnic groups in Guyana. My review of the literature however, revealed that there is very limited information related to the inequalities among the different ethnic groups in Guyana. Wilson et al. (2010) reported that although the Bureau of Statistics in Guyana publishes statistical information on mortality according to gender, disparity studies on the health of ethnic groups is either very limited or non-existent. In the rural areas where the Indigenous Amerindians reside, access to health centers is hindered by the extensive travel required to reach them as compared to the access of other ethnic groups who live in the urban areas where better and easier transportation facilities are provided (Kightlinger et al., 2010). Poverty is linked to transportation disparity in health care access. Amerindians living in rural areas have the highest prevalence of poverty when compared to other ethnic groups in urban areas (PAHO, 2013a). Also, marked differences are observed in health outcomes between the different ethnic groups in Guyana. Ischemic heart disease is the major cause of death

among those of Indo-Guyanese, Chinese, and Portuguese ethnicity, while mortality rates due to neoplasms and AIDS were highest among Afro-Guyanese and Amerindian ethnicities (PAHO, 2013a).According to Wilson et al.'s (2010) study on the racial differences in physical and mental well-being in Guyana, Indo-Guyanese have significantly higher levels of impairment when compared to Afro-Guyanese. In another study that used data from the Guyana Cancer Registry populations to examine the prevalence of breast, cervical, and prostate cancers within different ethnicities in Guyana (Best Plummer et al., 2009), results showed that there was no significant difference between cervical and breast cancer incidence among Afro- and Indo-Guyanese women, but the cervical cancer cases among Indigenous Amerindian women were significantly higher ($p<0.0001$) than the cervical cancer cases of the Afro- and Indo-Guyanese women (Best Plummer et al., 2009).

The coastland area of Guyana is home to approximately 90% of the population, as shown in Table 8, the highest population distribution is found in Region 4 which includes the capital city (Guyana Bureau of Statistics, 2015a). The hinterland regions, on the other hand, consist of 10.9% of the population and these are not densely populated (Guyana Bureau of Statistics, 2015a). The regional population distribution for the periods 2002 and 2012 is shown in Table 8 below. The population distribution was the same throughout years 2002 to 2012. In the ten-year period, there was very little change. Based on the average population statistics provided, in Regions 1, 2, 3, 4, and 5, the percentage change for each region was 3.4, 6.5, 14, 42, and 6.8 respectively, while for Regions 6, 7,

8, 9, and 10, the percentage change for each region was15.5, 2.5, 1.3, 2.9, and 5.4 respectively

Table 8

Regional Population Distribution (Male and Female), Guyana: 2002 and 2012

Region	Absolute Number		Percent	
	2002	2012	2002	2012
Region 1	24,275	26,941	3.2	3.6
Region 2	49,253	46,810	6.6	6.3
Region 3	103,061	107,416	13.7	14.4
Region 4	310,320	313,429	41.3	41.9
Region 5	52,428	49,723	7	6.6
Region 6	123,695	109,431	16.5	14.6
Region 7	17,597	20,280	2.3	2.7
Region 8	10,095	10,190	1.3	1.4
Region 9	19,387	24,212	2.6	3.2
Region 10	41,112	39,452	5.5	5.3
Guyana	751,223	747,884	100	100
Coastland	679,869	666,261	90.5	89.1
Hinterland	71,354	81,623	9.5	10.9

Note: The coastal regions are Regions 2, 3, 4, 5, 6 and 10, while the hinterland regions are Regions 1, 7, 8 and 9. Only Regions 2, 3, 4, 5, 6 and 10 were included in this study. Adapted from "Guyana Population and Housing Census 2012, Preliminary Report," by the Guyana Bureau of Statistics, 2015a, p. 45.

The gender distribution within the ten regions of Guyana varies (Guyana Bureau of Statistics, 2015a). In Table 9, the gender distribution and sex ratios for the periods 2002 and 2012 are shown. Very little change has occurred in the pattern of the gender distribution in the 2012 census when compared to the 2002 census. According to the 2012 census, females (375,337) slightly outnumbered the males (372,547), with an

estimated ratio of 99 males for every 100 females (Guyana Bureau of Statistics, 2015a). However, in the 2002 census report, there were an almost equal number of males and females (100.2). As seen in Table 9, the largest sex differentials where the men outnumber the women (male to female ratio greater than 100) were observed in Regions 1, 7, 8 and 9 in comparison to the coastland regions (Regions 2, 3, 4, 5, 6 and 10) where the sex ratio was low (96 males to every 100 females), especially in Region 4 (Guyana Bureau of Statistics, 2015a). This decrease might be attributed to male migration or other associated population factors such as population shift from the city to the city outskirt areas. According to the 2012 Guyana census report, male labor migration accounted for the higher sex ratio (more males than females) in the hinterland Regions (1, 7, 8 and 9) as compared to the coastland Regions (Guyana Bureau of Statistics, 2015a). According to the Guyana Bureau of Statistics, (2015a), this influx of male migration to the hinterland regions occurred as a result of the increased mining activities as well as opportunities for more economic gains. This high sex ratio within the hinterland regions however, has not been fully examined and further investigation is needed to assess this ongoing migration issue (Guyana Bureau of Statistics, 2015a).

Comparatively, other studies have also discussed the difference in sex ratio as a result of migration. According to Dyson (2012), sex selective migration could impact the sex ratio of a population in terms of employment opportunities. The availability of lucrative employment such as mining or construction could influence the movement of male migration both within the country or internationally (Dyson, 2012). This flow of

male migration in terms of employment opportunities has been reported in countries such as China, South Africa and Saudi Arabia (Dyson, 2012).

Table 9

Gender Distribution and Sex Ratios, Guyana: 2002 and 2012

Regions	Population/Census Year				Male-Female Ratios	
	2002		2012		2002	2012
	Male	Female	Male	Female	2002	2012
Region 1	12,815	11,460	14,150	12,791	111.8	110.6
Region 2	24,847	24,407	23,578	23,232	101.8	101.5
Region 3	51,944	51,117	53,595	53,821	101.6	99.6
Region 4	152,136	158,184	153,356	160,073	96.2	95.8
Region 5	26,207	26,221	24,761	24,962	99.9	99.2
Region 6	62,079	61,615	54,895	54,536	100.8	100.7
Region 7	9,373	8,224	10,701	9,579	114	111.7
Region 8	5,750	4,345	5,512	4,678	132.3	117.8
Region 9	10,009	9,378	12,426	11,786	106.7	105.4
Region 10	20,874	20,238	19,573	19,879	103.1	98.5
Guyana	376,034	375,189	372,547	375,337	100.2	99.3
Coastland	338,087	341,782	329,758	336,503	98.9	98
Hinterland	37,947	33,407	42,789	38,834	113.6	110.2

Note: The coastal regions are Regions 2, 3, 4, 5, 6 and 10, while the hinterland regions are Regions 1, 7, 8 and 9. Only Regions 2, 3, 4, 5, 6 and 10 were included in this study. Adapted from "Guyana Population and Housing Census 2012, Preliminary Report," by the Guyana Bureau of Statistics, 2015a, p. 47.

Table 10 shows the population distribution for the study regions which consisted of Regions 2, 3, 4, 5, 6, and 10 and based on the 2002 census information. There was no regional ethnic distribution in the 2012 census. All study-eligible cervical cancer cases were drawn from the study regions (Regions 2, 3, 4, 5, 6 and 10). The data from all ten

regions were not used in this analysis. The regions with low data (Regions 1, 7, 8 and 9) were excluded due to having a very low case count. The number of cases for regions 1, 7, 8 and 9 were 133, 136, 13 and 41 respectively compared to the case count in the study regions that exceeded more than 400 per region. The crude cervical cancer rate for these regions was calculated as follow:

$$\text{Crude case rate per 1000} = \frac{Average\ cancer\ cases\ /yr}{Women\ census\ Population(2002)} X\ 1000$$

Using the women 2002 population figures (Table 9), the crude cervical cancer rates were 0.892 for Region 1; 1.272 for Region 7; 0.23 for Region 8; and 0.336 for Region 9. Comparatively, data from the other regions had a crude case rate greater than 1.11 cases per 1,000 persons with each region having a case count greater than 400 cases. In the study region, the crude case rate per thousand for IAW was 1.01 ({140/13} /10643} x 1000) as compared to 2.16 for AGW ({3140/13} /111,757 x 1000) and 1.20 for IGW({2520/13} /162,033 x 1000).The computed numbers of women in the three ethnic groups for the study regions were 10,643 (IAW), 111,757(AGW) and 162,033(IGW) {Table 10 and Table 9 (male: female ratio equals approximately 1}.

Table 10

Population Distribution (Male and Female) for Study Regions, 2002

Ethnicity		REGIONS						Total
		Region 2	Region 3	Region 4	Region 5	Region 6	Region 10	
IAW	Pop.	8014	2072	5244	1022	2016	2919	21287
	%	1.41	0.36	0.92	0.18	0.35	0.51	3.74
AGW	Pop.	6605	21880	129310	17065	26050	22604	223514
	%	1.16	3.85	22.73	3	4.58	3.97	39.29
IGW	Pop.	23598	67474	116494	30282	84953	1266	324067
	%	4.15	11.86	20.45	5.32	14.93	0.22	56.97
Total		38217	91426	251048	48369	113019	26789	568868
		6.72	16.07	44.13	8.5	19.87	4.71	100

Note: The coastal regions are Regions 2, 3, 4, 5, 6 and 10, while the hinterland regions are Regions 1, 7, 8 and 9. Only Regions 2, 3, 4, 5, 6 and 10 were included in this study. Adapted from "Guyana Population and Housing Census 2012, Preliminary Report," by the Guyana Bureau of Statistics, 2015a, p. 47.

Sample Size Determination

For this study, the sample size determination was conducted using Epi Info 7. The sample was chosen randomly from the population of 8,682 cervical cancer cases from the Guyana Cancer Registry for the period, 2000 to 2012. A 95% confidence level with a confidence limit of 5% and a design effect of 1 was determined for the sample size. Using this sample estimation information, 368 cervical cancer cases were randomly drawn from the database of 5800 valid cervical cancer cases. A case was considered valid if it fell within the age group of the study. Cervical cancer cases were selected according to ethnicity, age (ages were categorized into groups of 13-18 years; 19-24 years; 25-30 years; 31-36 years; 37-42 years; 43-48 years; 49-54 years; 55-60 years; 61-66 years; and

67>years), marital status, geographical regions, year of diagnosis and stage at diagnosis for this study population. Figure 6 shows the sample size that was determined for the study population.

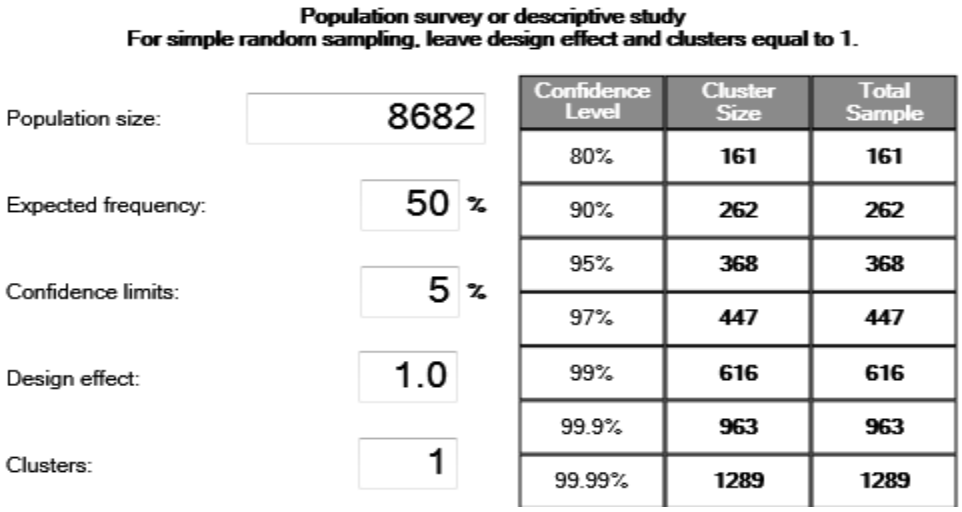

Figure 6. Epi Info 7. Sample Size Calculations

Study Variables

The independent variables in this study consisted of the following demographic variables: age (presented as ten groups: Group1 = 13-18 years; Group 2 =19-24 years; Group 3 =25-30 years; Group 4 = 31-36 years; Group 5 = 37-42 years; Group 6 = 43-48 years; Group 7 = 49-54 years; Group 8 = 55-60 years; Group 9 = 61-66 years; and Group 10 = 67>; marital status (categorized as single, married, divorced and unknown); and geographical regions. Guyana has ten regions which consist of the coastland and the hinterland regions (Guyana Bureau of Statistics, 2015a). Within the coastland regions (regions 2. 3, 4, 5, 6, and 10), the majority of Afro-Guyanese are primarily found in Regions 4 and 6, while the majority of Indo-Guyanese are located in Regions 3, 4, and 6.

In contrast, the Indigenous Amerindians are located in the hinterland regions (regions 1, 7, 8 and 9) with the majority living within Regions 1 and 9 (Guyana Bureau of Statistics, 2015b). For this study, samples were drawn from the study regions (Regions 2, 3, 4, 5, 6 and 10). The outcome variable is cervical cancer.

Other variables that were measured in this study included ethnicity, year of diagnosis and the stages of cervical cancer. These stages consist of: a) Stage 0 referred to as carcinoma in situ where the cells are confined to the cervix; b) Stage I where the cancer is localized and is found in the cervix only; c) Stage II or the regional stage where the cancer has spread from the cervix but is confined to the pelvic region; d) Stage III where the cancer has spread to the lower third of the vagina but not unto the pelvic wall; and e) Stage IV or distant stage where the cancer has spread to other parts of the body (National Cancer Institute, 2015). According to the World Health Organization (WHO) (2008), when the cancer is in its early stage it is classified as Stages I and II while cancer in its advanced stage is grouped into Stage III and Stage IV.

Guyana Cancer Registry Data Source

This probability sample was identified through data obtained from the Guyana Cancer Registry (2015) from 2000 through 2012. For this study, I used data on the cervical cancer cases for the study population (IAW, AGW, and IGW). I also examined the demographic factors such as age, marital status, geographical regions as well as ethnicity, year of diagnosis and stage at diagnosis in relation to the cervical cancer cases for the three ethnic groups.

Data Collection

A Data Use Agreement form was obtained from Walden's University Institutional Review Board (IRB) and signed between this researcher and the Guyana Cancer Registry in order to use the data from the Cancer Registry for this study.

Data Analysis

All data were analyzed by using predictive analytical statistics software, Statistical Package for the Social Sciences (SPSS) version 20. Data from 2000 through 2012 inclusive for cervical cancer cases of women aged 13 and above from the Guyana Cancer Registry were analyzed by means of descriptive statistics involving frequencies, and confidence intervals which described the dependent variable (cervical cancer) and the independent variables (ethnicity, age, marital status, geographical regions, year of diagnosis and stage at diagnosis). Two-way contingency tables were used to examine the relationship between the dependent and independent variables. In addition, Chi-square statistics, Poisson regression, Exp (B) value, odds ratio, estimated incidence rate ratios, estimated relative risk, and 95% confidence intervals were also calculated. There were no appropriate denominators for the population at risk. Therefore, the odds ratio was used as a condition to approximate the risk. In a similar study population, San Sebastian & Hurtig (2004) used population estimates to develop denominators in order to estimate incidence and relative risk of cancers among indigenous people in the Amazon Basin of Ecuador.

The exponential beta (Exp B) value which gives the odd ratio of the dependent variable (Statistics Solution, 2016) was used to interpret the impact of each independent variable on the dependent variable. Therefore, the coefficient was interpreted by looking

at the exponential of the coefficient on the independent variables and was interpreted in terms of the odds ratio. The Exp (B) for each category was estimated and divided by the Exp (B) of the reference category. These coefficients estimate the percentage difference in the absolute risk of cervical cancer cases for each region, relative to the reference category, Region 4. Also, the percentage difference in the absolute risk of cervical cancer cases for single/divorced, relative to the married category, and the younger age (by category) were calculated relative to the highest age category. Thus the Exp (B) coefficient was interpreted in terms of estimated incidence rate ratios which are exponentiated and are similar to the odds ratio (Statistics Solution, 2016).

Pearson Chi-Square test based on an alpha-level of 0.05 was conducted to assess the differences in proportion of cervical cancer cases between the three ethnic groups of women. The proportion of cervical cancer cases for the three ethnic groups of women was also calculated by year to examine these differences.

Poisson Regression Model was calculated separately for each ethnic group of women to assess whether geographical region, age, marital status, and year of diagnosis were related to the number of cervical cancer cases. Estimated incidence rate ratios were calculated to assess the association between region, age, marital status, and year of diagnosis on the differences in the count of cervical cancer cases, relative to the reference categories. For this analysis, Region 4 (the largest region), the age category 10 (67> years), and the marital status (married) were used as the reference categories.

Also, relative risk was calculated for geographical regions, age and marital status for the three ethnic groups. The intercept in the Poisson regression was exponentiated to

give the Exp (B) which is the expected number of cervical cancer cases. This same method was used to compare the relative risk between age and marital status among the three ethnic groups.

To assess the association between the stage at diagnosis of cervical cancer and age, marital status, year of diagnosis, and geographical region, a logistic regression model was developed. The statistical significance was based on a 0.05 alpha level. The stage at diagnosis of cervical cancer was used as the dependent variable, and the age, marital status, year of diagnosis, and geographical region were used as the independent variables. The in-situ stage was used as the reference category because it is the first indication of the presence of cervical cancer.

The rationale for choosing Logistic regression was to compare the cervical cancer rates between IAW to AGW and IGW as a combined group. Previous studies have shown that the incidence rate for Afro- and Indo-Guyanese is similar (Best Plummer, Persaud & Layne, 2009); therefore, it was plausible to combine the two groups in the analysis. According to O'Halloran & Econometrics (2008) and Anderson (2001), logistic regression assumptions assume: 1) the cases are independent; 2) the independent variables are not linear functions of each other; 3) the independent variables need not be interval levels; 4) normal distribution is not necessary or assumed for the dependent variable; and 5) the sample is 'large' – reliability of estimation declines when there are only a few cases. On the other hand, Poisson regression was used calculate odds ratio and relative risk in relation to the independent variables and the number of cervical cancer cases among each ethnic group of women. Poisson regression assumptions assume: 1) the

dependent variable consist of count data; 2) one or more independent variable can be measured on a continuous, ordinal or nominal/dichotomous scale; 3) there is independence of observations; 4) the distribution of counts follow a Poisson distribution; 5) the mean and variance of the model are identical (Laerd Statistics, 2013).

Data Analysis Plan

Study Aim 1

The primary aim of this study was to examine the difference in observed and expected cervical cancer cases for IAW compared to AGW and IGW from 2000 through 2012. Frequency distribution tables were used to quantify the cervical cancer cases among the two groups as well as two-way contingency tables. In addition, chi-square test was also used to test for the differences of cervical cancer cases between IAW, AGW, and IGW.

Study Aim 2

The secondary aim of this study was to examine the association between cervical cancer cases among IAW, AGW, and IGW by geographical regions. Poisson regression with 95% confidence intervals was used to compare the cervical cancer cases to geographical regions.

Study Aim 3

The third aim of this study was to compare the relationship in cervical cancer cases among IAW, AGW, and IGW again after adjustment for demographic characteristics including age, marital status, and year of diagnosis. Poisson regression

model was fitted to examine the associations between demographic characteristics and the estimated incidence rate ratio of cervical cancer cases.

Study Aim 4

Aim 4 investigated the association between the stages at diagnosis of cervical cancer and age, marital status, year of diagnosis, and geographical region among IAW, AGW, and IGW by both crude and adjusted analyses. The actual ages were provided in the database obtained from the Guyana Cancer Registry. Marital status was categorized as single, married, and divorced. Crude estimates were examined using Multinomial Logistic Regression to obtain adjusted estimates.

Tables were used for each of the statistical tests described in the data analysis plan.

Strengths of the Data Analysis Plan

This study used secondary data obtained from the Guyana Cancer Registry database. Using secondary data has its advantages in terms of being economical and less expensive to use; it can be replicated; and may improve measurement, sample size and representativeness (Frankfort-Nachmias & Nachmias, 2008). Another advantage of this study is that it is unique. No published studies were found which used data from the Guyana Cancer Registry to describe the relationship in cervical cancer cases among IAW, AGW, and IGW according to their age, marital status, geographical region, year of diagnosis, and stage at diagnosis. Being able to compare variables and to identify the

differences and relationships between variables by means of statistical tests are other strengths of this study.

Summary

Chapter 3 presented the research design, study population, sample size, data collection and the data analysis and data analysis plan. This study used data that were obtained from the Guyana Cancer Registry database to examine the variables, ethnicity, age, marital status, geographical region, year of diagnosis and stage of diagnosis and their relationship to cervical cancer cases among IAW, AGW, and IGW in Guyana. Chapter 4 provides a detailed description of the results of the findings of this study where each research question and its hypotheses are addressed.

Chapter 4: Results

Introduction

The purpose of this study was to examine the relationship between cervical cancer and age, marital status, geographical regions, year of diagnosis, and stage at diagnosis of cervical cancer cases among IAW, AGW, and IGW in Guyana. In this study, I examined whether cervical cancer cases for IAW were different from AGW and IGW, whether geographical region was a significant predictor of cervical cancer cases among the three ethnic groups, and whether age, marital status, and year of diagnosis were related to the cervical cancer cases among these three ethnic groups. In addition, I examined the stage at diagnosis of cervical cancer in relation to age, marital status, year of diagnosis, and geographical regions among these three ethnic groups of women.

Data Collection

This research study was approved by Walden's University Institutional Review Board, IRB Approval Number 12-18-14-0184632. A data use agreement was signed by me and a representative from the Guyana Cancer Registry. I secured data in a password-protected database for confidentiality, and conducted the analysis using the SPSS Statistical Software, Version 20.

Descriptive Statistics

Data provided by the Guyana Cancer Registry consisted of 8,682 cervical cancer cases ranging in ages 0 to 100 years old during the years 2000 through 2012. The study population consisted of 5,800 cervical cancer cases from the dataset that I used for this analysis. I did not use the remaining 2, 882 cases because these cases fell outside of the

age groups for this study (i.e. they were cases for individuals below age 13). In this chapter, I provide descriptive summaries of the cervical cancer cases within the study region by ethnicity, age, marital status, geographical regions, year of diagnosis, and stage at diagnosis. From the ten regions included in the dataset from the Guyana Cancer Registry, I only used data from regions 2, 3, 4, 5, 6, and 10. Regions 1, 7, 8, and 9 were not included because there was insufficient data to produce significant results.

The trend in cervical cancer cases within the study region from 2000 through 2012 for the three ethnic groups of women is presented in Figure 7.

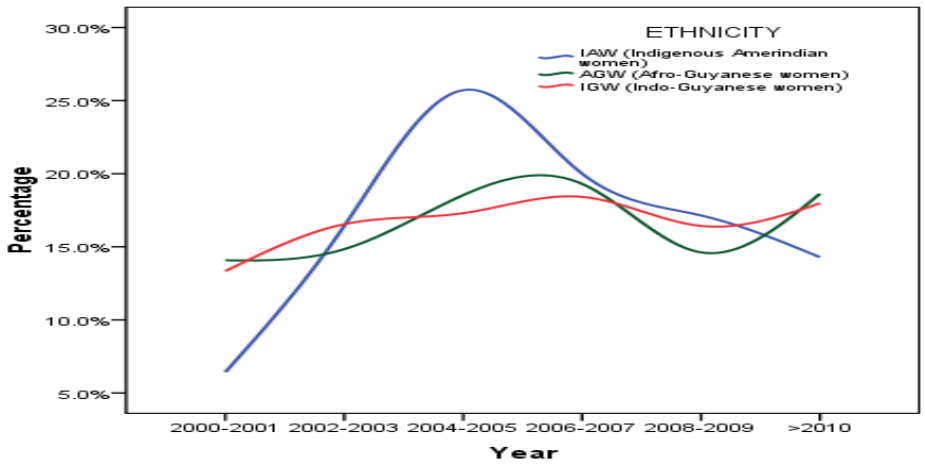

Figure 7. Trend in Cervical Cancer Cases Within the Study Region, 2000-2012

The results in Figure 7 show that the majority of the cervical cancer cases for the IAW group occurred between the years 2003 to 2005 (25%), and that after 2005 there was a decreasing trend (14%). In contrast, the trend curve for the AGW group was a bit different. From the year 2000 through 2004, there was a growing trend of cervical cancer cases for this group. From 2005 through 2007, the percentages of the cervical cancer cases from this group was at peak (approximately 20%), but then showed a decline. For

the years 2008 to 2009, there was a major decrease (15%). However, after 2009 to beyond 2010, the percentages of cervical cancer cases increased for the AGW group (approximately 19%). For the IGW group, there was a growing trend of cervical cancer cases from year 2000 onward. The peak occurred between the years 2006 to 2007 (approximately 18%), and then there was a decrease in the percentage of cases. However, after the year 2009 to beyond 2010, there was, again, an increase in the percentages of cervical cancer cases for the IGW group (approximately 18%).

Age Distribution

Table 11 shows the age distribution of the cervical cancer cases within the study region for IAW, AGW, and IGW. I categorized ages into ten groups in order to understand the ranges of the study population diagnosed with cervical cancer.

Table 11

Descriptive Summary of the Cervical Cancer Cases Within the Study Region by Ethnicity and Age Groups, 2000-2012

		Age										
		13-18 Years	19-24 Years	25-30 Years	31-36 Years	37-42 Years	43-48 Years	49-54 Years	55-60 Years	61-66 Years	67> Years	Total
ETHNICITY	IAW %	0.7	3.6	2.1	6.4	10.7	10.0	12.1	14.3	6.4	33.6	100
	Cases	1	5	3	9	15	14	17	20	9	47	140
	AGW %	0.6	1.0	2.1	3.2	6.1	8.7	10.8	11.2	11.8	44.5	100
	Cases	20	30	66	102	190	274	338	351	371	1398	3140
	IGW%	1.2	1.5	2.2	4.8	8.7	12.5	14.8	13.8	12.7	27.8	100
	Cases	30	38	55	121	220	315	373	348	320	700	2520
	Total Cases	51	73	124	232	425	603	728	719	700	2145	5800

The results showed that for all three ethnic groups, the highest percentages of cervical cancer cases were found in the 67 years and older age group. This indicates that nearly half of the women over 67 years were diagnosed with cervical cancer. I found that the second largest percentage of cervical cancer cases occurred in the 55 to 60 years old age group for IAW and IGW (14.3% and 13.8% respectively), followed by the 49-54 years age group where IAW (12.1%) and IGW (14.8%) accounted for the larger number of cases. The results showed that cervical cancer cases were more common in IAW age 37 years and older, and for the other ethnicities, in the age 49 and over age group.

Marital Status

Table 12 presents the descriptive statistics of the cervical cancer cases within the study region by marital status for the study period, 2000 through 2012. Marital status was categorized as single, married, divorced, and unknown.

Table 12

Descriptive Summary of Cervical Cancer Cases Within the Study Region by Marital Status, 2000-2012

		MARITAL STATUS				Total
		Single	Married	Divorced	Unknown	
ETHNICITY	IAW%	30	26.4	1.4	42.1	100
	Cases	42	37	2	59	140
	AGW %	25.4	22.6	1.8	50.3	100
	Cases	797	709	55	1579	3140
	IGW %	18.1	25.5	0.6	55.8	100
	Cases	456	643	16	1405	2520
Total		1295	1389	73	3043	5800

The results showed that the “unknown” status of cervical cancer cases for all three groups was dominant. The “unknown” group accounted for 52.5% of the 5800 cervical cancer cases (3,043). The second largest group of cervical cancer cases (1, 389) was in the “married” category (24%), followed by the “single” category with 1,295 cervical cancer cases (22.3%). The results showed there were only a few cervical cancer cases for the “divorced” category (73 cases = 1.3%). In addition, the results showed that the “single” and “married” statuses of cervical cancer cases of IAW were 30% and 26.4% respectively. For AGW there were 25.4% and 23% cases respectively, while for the IGW, there were 18% and 26% cases respectively.

Region

Table 13 shows the results of the distribution of cervical cancer cases by ethnicity and region for the study period, 2000 through 2012.

I derived the number of ethnic women for each study region from the equation:

$$\text{Number of women} = \frac{100}{100 + (Male - Female\ Sex\ Ratio)\ (Table\ 9)} \times Study\ Region\ Pop.$$

The total number of IAW women in the study region was 10714, while the total number AGW and IGW women were 112, 672 and 162,617 respectively.

In Table 13, the population of IAW, AGW, and IGW with regions 1, 7, 8 and 9 excluded were 568, 868 for 2002. The population percentage of IAW, AGW, and IGW for the study Regions, 2, 3, 4, 5, 6 and 10 were 3.74%, 39.29% and 56.97% respectively (See Table 10).The crude case rate per 1000$\left(\frac{Average\ cancer\ cases\ /yr}{Women\ census\ Population(2002)}\ X\ 1000\right)$ for IAW in the study region was 1 ([140/13/(10714)] x 1000) as compared to 2.14 for AGW ([3140/13/(112672)] x 1000), and 1.19 for IGW ([2520/13/(162617)] x1000).

Table 13

Descriptive Summary of Cervical Cancer Cases Within the Study Region by Ethnicity and Region, 2000-2012

		REGION													
		Region 2		Region 3		Region 4		Region 5		Region 6		Region 10		Total	
		Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
ETHNICITY	IAW	28	20.0	6	4.3	66	47.1	6	4.3	18	12.9	16	11.4	140	100
	AGW	125	4.0	251	8.0	1949	62.1	208	6.6	306	9.7	301	9.6	3140	100
	IGW	288	11.4	414	16.4	1051	41.7	189	7.5	562	22.3	16	.6	2520	100
Total		441	7.6	671	11.6	3066	52.9	403	6.9	886	15.3	333	5.7	5800	100

The results in Table 13 show that the majority of the cervical cancer cases were from Region 4 which comprised 44.13 % of the study population (see Table 10) and had 52.9% of the cervical cancer cases. In the study region, 0.92 % of the IAW resided in Region 4 (see Table 10) where 47.1% of all IAW cervical cancer cases were observed. The AGW and IGW populations for the Region 4 study population were 22.73% and 20.45% respectively (Table 10), and accounted for 62.1% and 41.7% respectively of the overall cervical cancer cases. For the IAW, the second largest share of cervical cancer cases were from Region 2 (20.0%), while for AGW and IGW, the second largest share of cervical cancer cases came from Region 6 (9.7% and 22.3% respectively).

Cancer Stages

Table 14 presents the results of the distribution of cervical cancer cases in the study region by ethnicity and stage at diagnosis for the study period, 2000 through 2012. The four stages of cervical cancer considered for this analysis were In situ, Localized, Regional, and Distant. Among these four stages, more than 70% of the cervical cancer cases were observed to be at the "Localized" stage, followed by the "Regional" stage which had the second largest share of cervical cancer cases. When compared to the "Localized" and "Regional" stages, the "Distant" stage had fewer cervical cancer cases but more than the In-situ stage where the lowest number of cervical cancer cases were diagnosed.

Table 14

Descriptive Summary of Cervical Cancer Cases Within the Study Region by Ethnicity and Stage at Diagnosis, 2000-2012

		STAGE									
		In situ		Localized		Regional		Distant		Total	
		Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
ETHNICITY.	IAW	1	1.22	58	70.73	12	14.63	11	13.41	82	100
	AGW	9	0.45	1451	72.84	304	15.26	228	11.45	1992	100
	IGW	8	0.44	1311	72.55	301	16.66	187	10.35	1807	100
Total		18	0.46	2820	72.66	617	15.90	426	10.98	3881	100

Note: The distribution of cases by stage was similar across the different ethnic groups.

The results of the analysis in Table 14 of the cervical cancer cases by ethnicity and stage of cancer followed an overall pattern. For IAW, AGW and IGW, the "Localized" stage had the largest share of cases (70.7%, 72.7% and 73.2% respectively), followed by the "Regional" stage which had the second largest share of cases (14.6%, 15.4%, 16.6% respectively).

Research Questions and Hypotheses

Research Question 1

Is there a difference in cervical cancer cases for Indigenous Amerindian women compared to Afro- and Indo-Guyanese women from 2000 through 2012?

The results showed that there is a significant difference in cervical cancer cases for IAW when compared to AGW and IGW from 2000 through 2012. The results of the analysis were statistically significant, Pearson $X^2(5, N = 5800) = 19.739$, $p < 0.05$). Therefore, the null hypothesis was rejected.

Table 15 presents the expected and observed counts of cervical cancer cases for IAW, AGW, and IGW from year 2000 through 2012.

Table 15

Pearson Chi-Square to Predict Differences in Percentages Between Cervical Cancer Cases Within the Study Region for Indigenous Amerindian Women When Compared to Afro-and Indo-Guyanese Women, 2000-2012

			Ethnicity and Year						
			2000-2001	2002-2003	2004-2005	2006-2007	2008-2009	>2010	
	IAW	Observed Count	9	23	36	28	24	20	140
	(Indigenous	Expected Count	19	22	25	27	22	26	217
	Amerindian	% Within							
Ethnicity	women) [1]	Ethnicity	6.4	16.4	25.7	20.0	17.1	14.3	100
(% in	AGW	Observed Count	442	466	582	606	459	585	3140
population)	(Afro-	Expected Count	426	491	571	594	486	573	2279
	Guyanese	% Within							
	women)[2]	Ethnicity	14.1	14.8	18.5	19.3	14.6	18.6	100
	IGW	Observed Count	336	417	436	464	414	453	2520
	(Indo-	Expected Count	342	394	458	477	390	460	3304
	Guyanese	% Within							
	women)[3]	Ethnicity	13.3	16.5	17.3	18.4	16.4	18.0	100
		Observed Count	787	906	1054	1098	897	1058	5800
Total		Expected Count	787	906	1054	1098	897	1058	5800
		% Within							
		Ethnicity	13.6	15.6	18.2	18.9	15.5	18.2	100

Note: [1]% of IAW in the study region = 3.74%; Observed number of cervical cancer cases = 140; [2]% f AGW in the study region = 39.29%; Observed number of cervical cancer cases = 3140; [3]% of IGW in the study region = 56.97%; Observed number of cervical cancer cases = 2520.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.739[a]	10	.032
Likelihood Ratio	20.607	10	.024
Linear-by-Linear Association	.004	1	.947
N of Valid Cases	5800		

Note: [a]0 cells (.0%) have expected count less than 5. The minimum expected count is 19.00.

The results in Table 15 showed that the percentage of cervical cancer cases for IAW for the years 2004-2005 was 25.7% as compared to 18.5% and 17.3% for AGW and IGW respectively. For the IAW, there was a notably decrease in the percentage of cervical cancer cases observed for the years 2008 and beyond. For AGW and IGW, there was an increase in the percentage of cervical cancers cases for 2002 through 2009. In addition, the results of the analysis showed that for IAW and IGW, the expected count of cervical cancer cases was greater than the observed count (217 vs. 140 for IAW) and (3304 vs. 2520 for IGW) while the expected count was less than the observed count for AGW (2279 vs. 3140).

Research Question 2

Is there an association between cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women and their geographical regions?

The results showed that there is a significant association between cervical cancer cases for IAW, AGW, and IGW and their geographical regions (p <0.05). This information therefore provides evidence to reject the null hypothesis.

Table 16 below presents the results from the Poisson Regression analysis of the cervical cancer cases for IAW and their geographical regions. The estimated incidence rate ratios of cervical cancer cases in Regions 2 and 5 were significant (p<0.05). IAW in Region 2 have a 20% greater chance of getting cervical cancer than IAW in Region 4. IAW in Region 5 have a 15% lower chance of getting cervical cancer than IAW in Region 4.

Table 16

Poisson Regression of Cervical Cancer Cases Within the Study Region for Indigenous Amerindian Women and Their Geographical Regions, 2000-2012

Independent Variable	p-value	*Exp(B)	95% Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0	69.955	60.854	80.416
[REGION=2]	0.136	1.2	0.944	1.526
[REGION=3]	0.536	0.848	0.504	1.428
[REGION=5]	0.137	0.636	0.35	1.155
[REGION=6]	0.674	1.065	0.794	1.429
[REGION=10]	0.307	0.838	0.597	1.176
[REGION=4] (REFERENCE)	.	1	.	.

Note. *IRR estimated based on the Poisson regression coefficient Exp (B). Each Exp (B) of each category was divided by the Exp (B) of the reference category. Model: (Intercept), Region. Absolute Risk (IAW/Region 4) = 1.21% (69.955/5800 x 100%).

Table 17 presents the results of the Poisson Regression analysis of the cervical cancer cases within the study regions for AGW and their geographical regions. The estimated incidence rate ratios of cervical cancer cases in Regions 2 and 5 were significant ($p<0.05$).

Table 17

Poisson Regression of Cervical Cancer Cases From the Study Region for Afro-Guyanese Women and Their Geographical Regions, 2000-2012

Independent Variable	p-value	*Exp(B)	95%Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0	1741.141	1701.036	1782.192
[REGION=2]	0.112	0.879	0.795	0.972
[REGION=3]	0.886	1.005	0.938	1.077
[REGION=5]	0.01	0.091	0.833	0.975
[REGION=6]	0.558	0.981	0.92	1.046
[REGION=10]	0.123	0.95	0.89	1.014
[REGION=4] (REFERENCE)	.	1	.	.

Note. *IRR estimated based on the Poisson regression coefficient Exp (B). Each Exp (B) of each category was divided by the Exp (B) of the reference category. Model: (Intercept), Region. Absolute Risk (AGW/Region 4) = 30.01% (1741.141/5800 x 100%).

Table 18 presents the results of the Poisson Regression analysis of the cervical cancer cases within the study regions for IGW and their geographical regions. The results showed that the approximated incidence rate ratio of cervical cancer cases for IGW in Regions 5 was significant ($p < 0.05$). IGW in Region 5 have a 2.5% less chance of getting cervical cancer.

Table 18

Poisson Regression of Cervical Cancer Cases Within the Study Region for Indo-Guyanese Women and Their Geographical Regions, 2000-2012

Independent Variable	p-value	*Exp(B)	95%Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0	4549.782	4505.954	4594.036
[REGION=2]	0.965	1	0.98	1.022
[REGION=3]	0.71	1.003	0.985	1.022
[REGION=5]	0.047	0.975	0.951	1
[REGION=6]	0.79	0.998	0.982	1.014
[REGION=10]	0.267	0.955	0.881	1.036
[REGION=4] (REFERENCE)	.	1	.	.

Note. *IRR estimated based on the Poisson regression coefficient Exp (B). Each Exp (B) of each category was divided by the Exp (B) of the reference category. Model: (Intercept), Region. Absolute Risk (IGW/Region 4) = 78.44% (4549.782/5800 x 100%).

The results in Table 19 showed the expected risk of cervical cancer cases by geographical region and the ethnic groups. The expected risk of cervical cancer cases for the AGW and IGW was less than that in the reference Region 4 for all regions (2, 5, 6, and 10) except Region 3 where it was greater than that of the reference region (1.05 and 1.03 respectively). The results also showed that Regions 2 and 4 were predictors of cervical cancer cases for IAW while Region 4 was a predictor of cervical cancer cases for AGW. Geographical region was not a significant predictor of cervical cancer cases for IGW.

Table 19

Expected Risk of Cervical Cancer Cases by Study Region and Ethnic Groups

Regions	IAW			AGW			IGW		
	Relative Risk	95% CI		Relative Risk	95% CI		Relative Risk	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
2	1.2	0.944	1.526	0.88	0.795	0.972	1	0.98	1.022
3	0.85	0.504	1.428	1.05	0.938	1.077	1.03	0.985	1.022
5	0.64	0.35	1.155	0.9	0.833	0.975	0.98	0.951	1
6	1.07	0.794	1.429	0.9	0.92	1.046	0.98	0.982	1.014
10	0.84	0.597	1.176	0.95	0.89	1.014	0.96	0.881	1.036

Note. *Reference category = Region 4

Research Question 3

Is there a relationship in cervical cancer cases among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women according to their ages, marital status, and year of diagnosis?

The results from the Poisson Regression analysis showed there was a statistically significant relationship in cervical cancer cases among IAW, AGW, and IGW according to their ages ($p < 0.00$; 95% CI). Therefore, the null hypothesis was rejected.

Table 20 presents the results of the Poisson Regression analysis within the study region for the cervical cancer cases among AGW according to age, marital status, and year of diagnosis. The results in Table 20 showed that age ($p < 0.001$) and being single ($p < .05$) were significant predictors for cervical cancer cases but the year of diagnosis was not significant ($p > 0.05$) relative to the cervical cancer cases among AGW. The results also showed that AGW, 30 years or younger (OR ≥ 3.822) have a greater chance of being

diagnosed with cervical cancer compared to AGW, 55 years and older (OR ≤ 2.483). AGW who are married have a greater chance of being diagnosed earlier for cervical cancer than single AGW (OR = .962; $p < 0.05$).

Table 20

Poisson Regression to Predict the Relationship Between Cervical Cancer Cases and Age, Marital Status, and Year of Diagnosis Among Afro-Guyanese Women Within the Study Region, 2000-2012

Independent Variable	p-value	*Exp(B))	95% Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0.183	26.106	0.214	3177.899
Age Group1 = 13-19 years	0	3.949	3.665	4.255
Age Group2 = 19-24 years	0	3.892	3.66	4.14
Age Group 3 = 25-30 years	0	3.822	3.659	3.993
Age Group 4 = 31-36 years	0	3.71	3.575	3.85
Age Group 5 = 37-42 years	0	3.537	3.432	3.645
Age Group 6 = 43-48 years	0	3.257	3.169	3.347
Age Group 7 = 49-54 years	0	2.887	2.811	2.965
Age Group 8 = 55-60 years	0	2.483	2.415	2.552
Age Group 9 = 61-66 years	0	2.049	1.991	2.109
Age Group 10 = 67> years	.	1	.	.
[marital status=Single]	0.002	0.962	0.94	0.986
[marital status=Divorced]	0.369	0.971	0.912	1.035
[marital status=Unknown]	0.314	0.989	0.969	1.01
[marital status=Married]	.	1	.	.
Year	0.155	1.002	0.999	1.004

Note. *IRR estimated based on the Poisson regression coefficient Exp (B). Each Exp (B) of each category was divided by the Exp (B) of the reference category (Married). Model: (Intercept), Region. Absolute Risk (AGW Age Group 10 & Married) = 0.45% (26.106/5800 x 100%).

The results in Table 21 showed that age ($p < 0.001$), being single ($p < .05$), and the year of diagnosis ($p < .05$) are significant predictors of cervical cancer cases among

IGW. The results also showed that IGW 30 years or younger (OR ≥ 1.571) have a greater chance of being diagnosed with cervical cancer as compared to IGW who are 55 years and older (OR ≤ 1.232).

Table 21

Poisson Regression to Predict the Relationship Between Cervical Cancer Cases and Age, Marital Status, and Year of Diagnosis Among Indo-Guyanese Women Within the Study Region, 2000-2012

Independent Variable	p-value	*Exp(B)	95% Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0	1421.236	684.07	2952.783
(Intercept)	0	1.597	1.58	1.613
Age Group1 = 13-19 years	0	1.584	1.569	1.598
Age Group2 = 19-24 years	0	1.571	1.559	1.584
Age Group 3 = 25-30 years	0	1.547	1.539	1.556
Age Group 4 = 31-36 years	0	1.5	1.493	1.507
Age Group 5 = 37-42 years	0	1.426	1.42	1.432
Age Group 6 = 43-48 years	0	1.332	1.326	1.337
Age Group 7 = 49-54 years	0	1.232	1.227	1.237
Age Group 8 = 55-60 years	0	1.14	1.135	1.145
Age Group 9 = 61-66 years	0.049	0.996	0.992	1
Age Group 10 = 67> years	.	1	.	.
[marital status=Single]	0.594	0.996	0.981	1.011
[marital status=Divorced]	0.803	1	0.997	1.003
[marital status=Unknown]	.	1	.	.
[marital status=Married]	.	1	.	.
Year	0.012	1	1	1.001

Note. *IRR estimated based on the Poisson regression coefficient Exp (B). Each Exp (B) of each category was divided by the Exp (B) of the reference category (Married). Model: (Intercept), Region. Absolute Risk (IGW Age Group 10 & Married) = 24.5% (1421.236/5800 x 100%).

The results in Table 22 showed that age was a statistically significant predictor of cervical cancer among IAW ($p < 0.001$) but not year and marital status. IAW 30 years or

younger (OR ≥ 5.479) have a greater chance of being diagnosed with cervical cancer as compared to IAW who are 55 years and older (OR ≤ 2.797).

Table 22

Poisson Regression to Predict the Relationship Between Cervical Cancer Cases and Age, Marital Status, and Year of Diagnosis Among Indigenous Amerindian Women Within the Study Region, 2000-2012

Independent Variable	p-value	*Exp(B)	95% Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0.899	0.158	7.41E-14	3.39E+11
Age Group1 = 13-19 years	0	5.713	4.191	7.788
Age Group2 = 19-24 years	0	5.681	4.81	6.711
Age Group 3 = 25-30 years	0	5.479	4.484	6.695
Age Group 4 = 31-36 years	0	5.309	4.601	6.127
Age Group 5 = 37-42 years	0	4.798	4.213	5.463
Age Group 6 = 43-48 years	0	4.163	3.631	4.772
Age Group 7 = 49-54 years	0	3.566	3.115	4.081
Age Group 8 = 55-60 years	0	2.797	2.429	3.22
Age Group 9 = 61-66 years	0	2.183	1.812	2.631
Age Group 10 = 67> years	.	1	.	.
[marital status=Single]	0.359	1.048	0.948	1.159
[marital status=Divorced]	0.563	0.906	0.648	1.266
[marital status=Unknown]	0.279	1.052	0.96	1.153
[marital status=Married]	.	1	.	.
Year	0.731	1.002	0.988	1.017

Note. *IRR estimated based on the Poisson regression coefficient Exp (B). Each Exp (B) of each category was divided by the Exp (B) of the reference category (Married). Model: (Intercept), Region. Absolute Risk (IAW Age Group 10 & Married) = 0.0027% (0.158/5800 x 100%).

Table 23 presents the relative risk of cervical cancer cases by age and marital status for IAW, AGW, and IGW. The results showed that single IAW (1.05) have a higher

risk of getting cervical cancer than their married counterparts as compared to AGW (0.96) and IGW (1.00).

Table 23

Relative Risk of Cervical Cancer Cases by Age and Marital Status Among Indigenous Amerindian, Afro- and Indo-Guyanese Women Within the Study Region, 2000-2012

Ethnicity	Age	Single Exp(B)	Married Exp(B)	Relative Risk Single vs. Married (%)	95% Confidence Interval For Exp(B)	
					Lower	Upper
IAW	13-18	0.949	0.906	1.05	0.996	1.101
	19-24	0.945	0.900	1.05	0.996	1.101
	25-30	0.910	0.868	1.05	0.996	1.101
	31-36	0.882	0.841	1.05	0.996	1.101
	37-42	0.797	0.760	1.05	0.996	1.101
	43-48	0.691	0.656	1.05	0.996	1.101
	49-54	0.592	0.565	1.05	0.996	1.101
	55-60	0.464	0.443	1.05	0.996	1.101
	61-66	0.362	0.346	1.05	0.996	1.101
AGW	13-18	99.19	103.03	0.96	0.915	1.011
	19-24	97.81	101.59	0.96	0.915	1.011
	25-30	96.06	99.78	0.96	0.915	1.011
	31-36	93.22	96.83	0.96	0.915	1.011
	37-42	88.85	92.29	0.96	0.915	1.011
	43-48	81.85	85.03	0.96	0.915	1.011
	49-54	72.53	75.34	0.96	0.915	1.011
	55-60	62.36	64.78	0.96	0.915	1.011
	61-66	51.52	53.52	0.96	0.915	1.011
IGW	13-18	2259.73	2268.77	1.00	0.946	1.046
	19-24	2241.72	2250.71	1.00	0.946	1.046
	25-30	2223.86	2232.77	1.00	0.946	1.046
	31-36	2188.56	2197.33	1.00	0.946	1.046
	37-42	2121.76	2130.30	1.00	0.946	1.046
	43-48	2018.28	2026.37	1.00	0.946	1.046
	49-54	1883.71	1891.26	1.00	0.946	1.046
	55-60	1744.11	1751.10	1.00	0.946	1.046
	61-66	1613.24	1619.71	1.00	0.946	1.046

Research Question 4

Is there an association between the stage at diagnosis of cervical cancer and age, marital status, year of diagnosis, and geographical region among Indigenous Amerindian women, Afro-Guyanese women, and Indo-Guyanese women?

The results showed that there is a statistically significant association between the stage at diagnosis of cervical cancer and age ($p<.05$); marital status ($p<.05$); year of diagnosis ($p<.05$); and geographical region ($p<.05$) among IAW, AGW, and IGW. The year of diagnosis for the localized, regional, and distant stages is less than expected, whilst the marital status for the distant stage is less than expected. This information provides evidence to reject the null hypothesis.

The statistical results of the multinomial logistic regression are presented in Table 24.

Table 24

Multinomial Logistic Regression of the Association Between the Stage at Diagnosis of Cervical Cancer and Year of Diagnosis, Age, Marital Status, Ethnicity, and Region, 2000-2012

STAGE[a]		p-value	Exp(B) [odds ratio]	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Localized	Intercept	0.001			
	Year	0.001	0.72	0.592	0.876
	Age	0.004	1.338	1.1	1.628
	Mstatus	0.181	0.717	0.441	1.167
	ETHNICITY	0.167	1.844	0.774	4.395
	REGION	0.018	1.753	1.102	2.789
Regional	Intercept	0.049			
	Year	0.049	0.82	0.674	0.999
	Age	0.006	1.319	1.082	1.608
	Mstatus	0.069	0.635	0.389	1.036
	ETHNICITY	0.123	1.995	0.829	4.802
	REGION	0.013	1.803	1.131	2.873
Distant	Intercept	0.011			
	Year	0.011	0.773	0.634	0.942
	Age	0.003	1.356	1.11	1.657
	Mstatus	0.003	0.47	0.288	0.769
	ETHNICITY	0.222	1.737	0.717	4.211
	REGION	0.018	1.754	1.099	2.8

Note. Reference category = In situ

The results in Table 24 showed that compared to the reference in situ stage, early diagnosis is likely to decrease the chances of getting to the localized, regional, and distant stages. This indicates that for one unit increase in the year of diagnosis, there would be a 28% reduction of going to the localized stage, an 18% reduction of going to the regional stage, and a 23% reduction of possibly going to the distant stage.

With regards to the age of women, the results of the multinomial logistic regression showed that when compared with the in situ stage (which was the reference category), as age increased, there was less likelihood of the cases being localized, and cases for the older age group were more likely to be in the in situ stage. There was a 1.228 times more probability of getting to the localized stage; 1.319 times more probability of getting to the regional stage; and 1.356 times more probability of getting to the distant stage. Cervical cancer cases that were diagnosed later were more likely to be in the in situ stage.

With regards to the marital status in comparison to the distant stage, the results of the multinomial regression analysis showed that as a single woman's marital status was changed to married or divorced status, she had a 53% less chance of moving to the distant stage when compared to the in-situ stage.

In addition, the results of the multinomial regression analysis showed that with regards to region when compared to the in-situ stage, as the population density increases, there is a likelihood for the women to be diagnosed at the localized, regional, and distant stages (OR = 1.753; OR = 1.803; and OR = 1.754 respectively), particularly for each cervical cancer case in the in-situ stage where there would be about 1.75 times more cases for those women who are in the localized, regional, and distant stages.

Summary

The results from this study showed that there was a statistically significant association between cervical cancer cases and the age, marital status, geographical region, and stage at diagnosis for IAW, AGW, and IGW. Based on the results, IAW have

proportionally higher cervical cancer cases than both AGW and IGW. In addition, the results showed that geographical region was a strong predictor of cervical cancer cases when comparing the different ethnic groups of women. Remote and dense urban areas were most likely to contribute to the higher cervical cancer rates. There was a statistically significant relationship between age and marital status of getting cervical cancer among IAW, AGW and IGW. The number of cervical cancer cases for married women exceeded that of single women (24% to 22.3%) but yet the single women were more likely to be diagnosed with cervical cancer. Women in the 13-18 age groups had a high risk of being diagnosed with cervical cancer and this age group appears to be a driver for cervical cancer in single women. Divorce was not a predictor of cervical cancer cases among the three ethnic groups of women. The year of diagnosis was only an important predictor of cervical cancer cases among IGW. Cervical cancer cases among IGW tend to increase over time. This may be as a result of migration to high risk or remote areas. In addition, the results showed that among all three ethnic groups, the women are more likely to develop later stage cervical cancer as they progress in age.

The findings, social implications, and recommendation for future study are discussed in Chapter 5.

Chapter 5: Discussion, Recommendations, and Conclusion

Discussion

The findings from this study showed that IAW, AGW, and IGW in Guyana were affected by cervical cancer. In this study, I examined the relationship between cervical cancer cases and age, marital status, geographical regions, year of diagnosis, and stage at diagnosis of cervical cancer cases among IAW, AGW, and IGW in Guyana. I used Pearson's chi-square, multinomial logistic regression, and Poisson regression to examine: (a) whether there were differences in the cervical cancer cases for IAW compared to AGW and IGW from 2000 through 2012; (b) whether cervical cancer cases among IAW, AGW, and IGW were associated with geographical regions; (c) whether there was a relationship between cervical cancer cases among IAW, AGW, and IGW and their ages, marital status, and year of diagnosis; and (d) whether the stage at diagnosis of cervical cancer was associated with age, marital status, year of diagnosis, and geographical region among IAW, AGW, and IGW. In this chapter, I present interpretations of the findings, discuss the strengths and limitations of this research study, and conclude with a discussion of the social change implications and future research recommendations for these three ethnic groups of women in Guyana.

Interpretation of the Findings

In this study, I addressed four research questions in an attempt to determine the relationship between cervical cancer cases and age, marital status, geographical region, year of diagnosis, and stage at diagnosis of cervical cancer among three ethnic groups of women in Guyana.

Findings for Research Question 1 indicated that there were significant differences in cervical cancer cases by ethnicity. IAW had a lower case rate (cases per thousand persons) of cervical cancer as compared to AGW and IGW women. The crude cervical cancer case rate per thousand was 1.01 for IAW, 2.16 for AGW, and 1.20 for IGW. These rates suggest that the IAW are less likely to be diagnosed with cervical cancer when compared with the women in the other ethnic groups in the study regions 2, 3, 4, 5, 6, and 10. Regions 1, 7, 8, and 9 (which I excluded from the study) have about 60% of the Indigenous population, but no significant data was available for these regions. The data from the Guyana Cancer Registry covered regions where more than 98.5% of AGW and IGW reside. AGW were more likely to be affected by cervical cancer than the IGW, while IAW may not have been proportionally represented in the data collection. Most Amerindians tend to live in areas remote from population centers where access to healthcare centers is limited, thereby also impacting data acquisition for this population.

Previous researchers have also shown that Indigenous women have higher rates of cervical cancer when compared to non-Indigenous women (Moore et al., 2013; San Sebastian, & Hurtig, 2004). Risk factors related to this high incidence of cervical cancer among Indigenous Amerindian include numerous childbirths, sexual intercourse at an early age, low socioeconomic status, and limited access to health care services (Best Plummer et al., 2009).

For Research Question 2, the expected risk of cervical cancer cases for Indigenous Amerindian women in Regions 2 and 6 was greater by 20% and 6.5% respectively, as compared to the reference Region 4. This indicates that diagnosis of

cervical cancer was more likely to occur in urban areas than in the rural areas. Comparatively, the expected risk of cervical cancer cases for IAW was less in Regions 3, 5, and 10. This result may be indicative of lack of access to healthcare facilities for IAW in Region 2 and 6. The geography of Amerindian villages in these study regions, as well in those regions (1, 7, 8, and 9) that were not included in this study, often isolates them from population centers where healthcare facilities are more likely to be present. In addition, although Indigenous Amerindians comprise of 9.14% of the total population of Guyana, a total of 59.1% of this population did not reside in the study regions as per the 2002 population census. Comparatively, the AGW and IGW were overrepresented in the study regions by about 30% and 31% respectively. This overrepresentation suggests that there was underreporting of cervical cancer cases for IAW, and that the majority of the Afro- and Indo-Guyanese populations most likely resided in areas that were closest to healthcare facilities. Region 4, which consists of the capital city and other large urban centers, had the majority of the cervical cancer cases for each ethnic group, which is reflective of the presence of easily accessible health care facilities.

Additional findings from this study showed that AGW in Region 4 were at a higher risk of getting cervical cancer as compared to AGW in the other study regions (Regions 2, 3, 5, 6, and 10). There was no regional significance of cervical cancer cases for IGW. Thus, the findings of this study which showed that geographical region is a predictor of cervical cancer cases are consistent with previous studies from some developing countries (Best Plummer et al., 2009; Moore et al., 2014; Shannon et al., 2011). This regional variation can be explained by marked disparities related to poverty,

access to goods and services, employment, and income that exist between the coastal/urban regions and the hinterland regions of Guyana. The coastal areas are located in Regions 2, 3, 4, 5, 6, and 10, while the urban areas are found in Regions 2, 4, 6 and 10, and the hinterland areas are in Regions 1, 7, 8 and 9 (Guyana Bureau of Statistics, 2015a). Indigenous Amerindians primarily reside in Regions 1, 7, 8, and 9 (regions not included in this study), but few are located in Regions 2 and 4. Afro-Guyanese reside mainly in Regions 3, 4, 6, and 10, with few in Region 5. Indo-Guyanese are primarily found in Regions 3, 4, and 6, but not many are found in Regions 2 and 5 (CARICOM Secretariat, 2009).

Marked disparities relating to poverty, access to goods and services, employment opportunities, and income levels disproportionately affect the coastal/urban and hinterland communities (PAHO, 2012). The differences I observed in the incidence rate ratios of cervical cancer cases among the three ethnic groups of women in Regions 2, 3, 5, 6, and 10 could be explained by contextual, sociodemographic, and environmental factors. Indigenous Amerindians have the highest poverty levels (PAHO, 2012) and also experience the poorest health outcomes (Francis et al., 2009). Additionally, IAW are disproportionately affected by limited access to healthcare services, limited resources, and geographic barriers including poor infrastructure, transportation difficulties, and difficult terrains (PAHO, 2012). Furthermore, while better qualified health workers are found within the coastal/urban regions, the hinterland regions experience a shortage of skilled professionals and have poor referrals and communication systems that impact the

provision of adequate cervical cancer screening among IAW (Francis et al., 2009; Kightlinger et al., 2010; PAHO, 2012).

For Research Question 3, additional findings showed that IAW, AGW, and IGW who are 30 years or younger (IAW = OR ≥ 5.479; AGW = OR ≥ 3.822; IGW = OR ≥ 1.571; respectively) have a greater chance of being diagnosed with cervical cancer as compared to older women from the same ethnic group who are 55 years and older (IAW = OR ≤ 2.797; AGW =OR ≤ 2.483; IGW = OR ≤ 1.232 respectively). This seems to indicate that the younger women in each ethnic group have a greater chance of being diagnosed with cervical cancer as compared to older women in the same ethnic group. These findings are consistent with the results from previous studies that showed a relationship between increased age and increased incidence of cervical cancer (Pierce Campbell et al., 2012; Roue et al., 2012) as well as a higher age-standardized incidence of cervical cancer among Indigenous women (Shannon et al., 2011). Guyana has a mixed healthcare system consisting of universal healthcare and private practices. Healthcare is primarily practiced as treatment-based rather than preventative, which could be understood in the context of limited financial and healthcare worker resources. At the start of the Guyana Cancer Registry, data was mostly collected through visits to healthcare facilities. My finding that showed younger women were more likely to be diagnosed with cervical cancer than older women indicates that in the absence of any voluntary cervical cancer screening program, younger women would have been more likely to visit health facilities than older women. Visits might have included prenatal care, which would have enabled testing. Older women on the other hand, were not likely

to be seeking such care. It is also possible that physician bias could lead to low levels of diagnosis for older women. Physician bias occurs when a physician assumes that older women who may not be sexually active would not need to be screened for STDs. Cervical cancer may take 10-15 years from onset to become invasive (Anderson et al., 2015). Older women are also more likely to associate early symptoms of cervical cancer with the process of aging and other co-morbid conditions; hence they are not inclined to seek medical attention. This possibly explains the findings from this study that older women were more likely to be diagnosed with later stage cervical cancer. Comparative studies of breast cancer in developing countries also showed that older age has been associated with the delay of patients seeking treatment (Ramirez et al., 1999).

With regards to the marital status, my findings from this study showed that married AGW have a greater chance of being diagnosed earlier for cervical cancer than single AGW (OR = .962; $p < 0.05$). All single IAW are more likely to have higher rates of cervical cancer when compared to their married counterparts. The relative risk of developing cervical cancer for single IAW is greater than married IAW. This information indicates that factors such as younger age, single marital status, number of sexual partners, and co-habitation without marriage, as well as high parity, rural residence, low socioeconomic status and lack of access to healthcare facilities might be responsible for the increased risk of HPV infection which contributes to the development of cervical cancer.

Findings from other researchers show that for the Indigenous population, the number of sexual partners in the previous year (at least 5 during their lifetime), younger

age (18-26 year age group, and 31-40 year age group), cohabitation without marriage, and current smoker (Brassard et al., 2010; Garland et al., 2011; Reiter et al., 2013; Soto-DeLeon et al., 2009) were associated with a higher prevalence of HPV among Indigenous women. Additionally, other studies have reported that Indigenous women have higher risks of developing cervical cancer and less chance of survival rates than non-Indigenous women (Roue et al., 2012; Shannon et al., 2011; Vasilevska et al., 2012). For the AGW discussed in my study, the relative risk between single and married AGW was not significant. This is more likely because Afro-Guyanese live in areas where healthcare facilities are easily accessible and their socioeconomic status is relatively the same between the single and married women. Additionally, in all three ethnic groups discussed in my study, divorced women appeared less likely to develop cervical cancer when compared to married and single women. Currently, no other research study has examined the marital status among IAW, AGW, and IGW in Guyana. These findings could have future implications for addressing the incidence of cervical cancer among these three ethnic groups of women.

Marital status was only significant for the distant stage as compared to the in-situ stage. Findings from this study found that for the distant stage, as a single woman's marital status was changed to married or divorced, she had a 53% less chance of moving to the distant stage when compared to the in-situ stage. This information implies that single women are more likely to be in the distant stage when compared to married or divorced women. Among the three ethnic groups of women discussed in this study, most cervical cancer cases were found in the localized stage (72.9%), followed by the regional

stage (15.8%), and then the distant stage (10.9%). These results indicate that diagnosis of cervical cancer was made late. Relative to the increased age of the women, there was less likelihood of the cervical cancer cases being localized, with cervical cancer cases for the older age group more likely to be in situ stage. Cervical cancer cases that were diagnosed later were more likely to be in the in situ stage. There was a 1.228 times more probability of getting to the localized stage; 1.319 times more probability of getting to the regional stage; and 1.356 times more probability of getting to the distant stage. These findings suggest that with increasing age, there is an increased likelihood of women moving into the critical stages and being diagnosed late.

Previous studies which examined the association between late stage diagnosis of cervical cancer and insurance and age found similar results (Printz, 2012). Risk factors that were identified by Printz (2012) as being associated with late stage diagnosis of cervical cancer were socioeconomic status, race, marital status, and geographic location Therefore, women are more likely to advance to the distant stages of cervical cancer as they become older.

Compared to married or divorced women, my finding showed that being single was associated with the distant stage at diagnosis of cervical cancer. As a single woman's marital status was changed to married or divorced, she had a 53% less chance of moving to the distant stage when compared to the in-situ stage. This information implies that single women are more likely to be in the distant stage when compared to married or divorced women. The association between marital status and the stage at diagnosis of cervical cancer among single IAW indicates that these women have a higher risk of

contracting cervical cancer. Previous studies have shown that being single, marital status and aboriginal background were risk factors associated with high-risk HPVs (Brassard et al., 2012).

With regards to geographical regions, as the regions become denser with the number of cervical cancer cases, the stage at diagnosis is also a critical factor. My finding showed that compared to the in-situ stage, as the population density increases, women are more likely to be diagnosed at the localized, regional, and distant stages (OR = 1.753; OR = 1.803; and OR = 1.754 respectively), particularly for each cervical cancer case in the in-situ stage, where there would be about 1.75 times more cases for those women who are in the localized, regional, and distant stages. These findings provide evidence-based information for primary prevention such as early detection for cervical cancer for all women within their geographical regions, especially among the IAW who reside in rural areas and do not have the quality of care or adequate access to healthcare care services.

Limitations of the Study

This study was limited to the use of existing data that were obtained from the Guyana Cancer Registry between 2000 and 2012. Data completeness and quality were not assessed during this study period; therefore the quality of the data could impact the validity of the estimates and sampling errors. The current reporting requirements to the Guyana Cancer Registry is not bound by a legal mandate (P. Layne, personal communication, March 30, 2016), hence the likelihood of underreporting of data. Not having sufficient information on the data collection process might have produced biases in my study. Another potential limitation of this study relates to the representativeness of

cervical cancer data coverage in the rural areas of the study region. Although data from the cancer registry were provided for all the regions, the combined case counts (both the crude case count and case rate)of the cervical cancer cases for some regions (Regions 1, 7, 8 and 9) were very low(<4%), and were therefore excluded from the data analysis. My findings might not reflect the true magnitude of the cervical cancer cases within the study area. It is therefore assumed that the cervical cancer case counts might have been higher within the rural areas and underreported for IAW due to the geographical barriers that exist in reaching this population. The cultural and religious practices which could impact how IAW seek medical help were not addressed in this study. Additionally, crude case rate used in this study was only based on the 2002 census data. Using only cervical cancer cases instead of incidence rates for IAW, AGW, and IGW limited the analysis on these three ethnic groups of women. Denominator data was not available to calculate incidence rates from the data provided by the Guyana Cancer Registry. Also, the regional ethnic distribution data was not available for 2012. The female population count per ethnic group and region, as well as the ethnic regional distribution for the 2012 census were not available. Although my findings could provide meaningful information for program planning, incidence rates would have enabled a better understanding of the disease where the populations differ in size as well as to compare disease occurrence during different time periods (Gregg, 2008).

Implications for Social Change

This study has important implications for the Guyana Ministry of Health, the Guyana Cancer Registry, health care providers, and public health researchers. My

findings showed that IAW had a higher risk of getting cervical cancer as compared to AGW and IGW. Similarly, the results from previous researchers also showed that IAW in Guyana have a high rate of cervical cancer (Kightlinger et al., 2010). In contrast, other researchers found that Indigenous women had a significantly lower risk for cervical cancer than non-Indigenous women and which might have occurred as a result of the underreporting of cervical cancer rates especially among the Indigenous women (San Sebastian & Hurtig, 2004). These findings of San Sebastian & Hurtig (2004) are similar to the finding from my study, which showed that the lower rates of cervical cancer for IAW were due to underreporting. The data obtained from the Guyana Cancer Registry for IAW who were sampled, were small (one-third of the Amerindian population) and thus, indicate that IAW are disproportionately affected by cervical cancer. More reporting of data for IAW in Guyana could mirror the high rates as reported in Kightlinger and colleagues (2010) findings.

The differences in the sociodemographic, environmental, contextual, and cultural factors, in addition to the findings from my study showed there were significantly higher cervical cancer cases among IAW. Geographic variations of cervical cancer cases among the three groups of women are avenues that should be further explored. Public health interventions are necessary to address the existing disparities among IAW, AGW, and IGW within the urban/coastal and hinterland regions. The design of effective cervical cancer prevention programs to ensure monitoring and surveillance should be considered.

Findings from this study could also be used to guide program planners in developing tailored programs by utilizing a socio-ecological model that would address

cervical cancer issues at the individual, interpersonal, cultural, and community levels. To assess the accuracy of cervical cancer case reporting among the ethnic groups of women discussed in this study, a national cancer registry should be implemented to track all cervical cancer cases in Guyana. Legislation is needed to enable mandatory reporting to the cancer registry for all cervical cancer cases from both public and private health facilities. This would close reporting gaps and enable a more accurate cancer registry. Recommendation for further study to assess the overall performance of the Guyana Cancer Registry in relation to the acquisition of data from both public and private health care facilities where cervical cancer is diagnosed and treated is needed. In the future, data from a viable cancer registry could be used for extensive research and treatment plans for cervical cancer.

In addition, appropriate measures to enhance the data collection process, as well as increased cervical cancer programs and better health services, are warranted. Appropriate telecommunication technology, especially in areas where infrastructure is limited, should be addressed. Personnel would have to be trained on its use. However, drawbacks to this implementation could occur as a result of lack of financial expenditure to install and administer this technology, and security issues relating to personal data because wireless data is not considered a secured mode of telecommunication. Another measure that could be utilized is the establishment of mobile clinics to execute programs and to increase awareness of cervical cancer through education, as well as to improve data collection. However, these clinics would have to be appropriately staffed. The language and cultural barriers should also be taken into consideration. Training is

recommended for Indigenous Amerindians to become healthcare practitioners to work in the remote areas. Providing adequate incentives could be a means of attracting more healthcare workers to the remote regions. The training of healthcare workers to avoid physician bias should also be conducted and incorporated into the training of all healthcare personnel. Also, larger scale Visual Inspection with Acetic Acid (VIA) screening programs to include older, post-menopausal women is recommended.

Recommendations for Future Research

The data presented in this study suggest that IAW are disproportionately affected by cervical cancer outcomes compared to AGW and IGW. The Guyana Cancer Registry data excluded more than 50% of the Indigenous Amerindian population. The Cancer Registry should extend its surveillance capability by conducting periodic surveys as well as to conduct HPV immunizations earlier among the IAW. It may also be beneficial to assess the completeness of the cervical cancer reporting and HPV immunization rates among the IAW, and to find ways to improve the reporting requirements for this population. The results from this study should guide future research in exploring geographical variations in the incidence rates of cervical cancer in Guyana among IAW, AGW, and IGW. Epidemiological research which includes geospatial analyses could further provide a better understanding of the distribution patterns of cervical cancer within the ten regions.

This study provides insight on cervical cancer among three ethnic groups of women in Guyana. Findings on the study variables (adjusted age, marital status, geographical region, year of diagnosis, and stage at diagnosis of cervical cancer) indicate

that further research is necessary to address the contributing factors related to the increasing cervical cancer cases in Guyana.

Recommendations for future research should include: (a) an assessment of underreporting to enable a more accurate profile of cervical cancer in Guyana. This could serve as a basis for mandatory reporting to facilitate future cancer research; (b) stratifying cervical cancer incidence in order to create the insights needed from more detailed analyses and geospatial considerations within the ten regions of Guyana; (c) implementing screening programs to test for HPV, HIV, HBV and HCV throughout the ten regions, particularly in those rural and urban regions that experience cervical cancer disparities; (d) conducting research on the cultural norms of IAW, AGW, and IGW to address lack of knowledge about cervical cancer among these three group of women, and for healthcare providers and community public health workers to develop culturally appropriate cervical cancer prevention programs; (e) examining evidence-based cervical cancer intervention and control strategies for IAW, AGW, and IGW throughout the regions of Guyana; (f) engaging leaders from the Indigenous Amerindian communities to discuss the health needs of their people and to use this information to guide program planning to address these needs in culturally, appropriate ways; and (g) obtaining more resources to reach underserved areas, and conducting outreaches and special surveys within these areas in order to gain insight into the health needs of the underrepresented population.

Conclusion

In conclusion, this is the first study to use cancer registry data from Guyana to examine the relationship between cervical cancer cases and demographic factors among IAW, AGW, and IGW. My study provides several distinct key findings: First, differences exist between the observed and expected cervical cancer cases between AGW when compared to IAW and IGW. The expected count of cervical cancer cases for AGW was less than the observed count, while for IGW and IAW, the expected counts were greater than the observed counts. This suggests there was a possible underreporting of cervical cancer diagnosis for both IGW and IAW, where the populations are larger in the remote areas, and with minimal access to health care facilities (See Table 7).There were also differences in the case rate between these groups of women in the study region; IAW had the lowest case rate (1.2 per 1000 as compared to 2.55 and 1.41 per 1000 for AGW and IGW respectively). Second, geographical region was a strong predictor of cervical cancer when comparing the different ethnic groups of women. Third, age was a strong predictor of cervical cancer among the three groups of women. Younger women have a greater chance of being diagnosed with cervical cancer because of the likelihood of migrating to areas where access to healthcare is available. Migration trends in Guyana from remote rural to urban areas would enable more access to health service centers. Most of this migration is likely to occur among the younger, mobile population than the older women. This indicates that younger women may have had more reported diagnosed cervical cancer cases into the Cancer Registry than older women. Marital status was only significant for single women as compared to divorced women. The year of diagnosis

beyond 2010, was an important predictor of cervical cancer among IGW. This indicates there was an increase in health expenditures among the IGW. However, there is no census data relating to health expenditure capita for ethnic groups or geographic regions. According to the World Bank (2016a), in Guyana, the health expenditure as a percentage of GDP decreased between the years 2011 to 2014, while health expenditure per capita rose from $232 million US dollars in 2011 to $247 million in 2012. In 2014, however, there was a decrease in health expenditure per capita of $222 million in 2014 (World Bank, 2016b). Fourth, my findings showed that older women were more likely to be diagnosed with late stage cervical cancer.

Cervical cancer is a preventable disease. My findings could provide further insights to address the burden of cervical cancer cases among IAW, AGW, and IGW. The high rates of cervical cancer in Region 4 indicate there is a need to develop better health education programs and improved health services. Overtime, with the development of better infrastructure, the Guyana cancer registry would be able to have more extensive data. Also, a better reporting system would enable a more accurate profile of the cervical cancer cases and facilitate future cancer research in Guyana.

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Appendix A: Author Permission to Use Cervical Cancer Progression Model

Carol Jones-Williams <carol.jones-williams@waldenu.edu> Fri, May 2, 2014
To: schiffmm@mail.nih.gov
Bcc: Carol Jones-Williams <carol.jones-williams@waldenu.edu>

Dear Dr. Schiffman:

I am a PhD student in the Public Health Program at Walden University. I am currently writing my dissertation on the Incidence of cervical cancer among HPV-infected Amerindian women in Guyana. I am writing to ask your permission to allow me to use the cervical cancer progression model that was listed in your article "Human Papillomavirus Testing in the Prevention of Cervical Cancer" and published in the Journal of National Cancer Institute.

Full credit will be given to you for use of this model. Thank you and I look forward to hear from you soon.

Sincerely,

Carol Jones-Williams

carol.jones-williams@waldenu.edu

Schiffman, Mark (NIH/NCI) [E] <schiffmm@exchange.nih.gov> Fri, May 2, 2014
To: Carol Jones-Williams <carol.jones-williams@waldenu.edu>

Sure, feel free.

Appendix B: Data Use Agreement

DATA USE AGREEMENT

This Data Use Agreement ("Agreement"), effective as of December 3, 2014 ("Effective Date"), is entered into by and between Carol Jones-Williams ("Data Recipient") and Penelope Layne ("Data Provider"). The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set ("LDS") for use in research **in accord with laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program.** In the case of a discrepancy among laws, the agreement shall follow whichever law is more strict.

1. Definitions. Due to the study's affiliation with Laureate, a USA-based company, unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the USA "HIPAA Regulations" and/or "FERPA Regulations" codified in the United States Code of Federal Regulations, as amended from time to time.

2. Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program.

3. Data Fields in the LDS. **No direct identifiers such as names may be included in the Limited Data Set (LDS).** In preparing the LDS, Data Provider shall include the **data fields specified as follows**, which are the minimum necessary to accomplish the research: Incidence rates of cervical cancer, stage of diagnosis, age groups, ethnicity, geographic regions, and marital status from the Guyana Cancer Registry.

4. Responsibilities of Data Recipient. Data Recipient agrees to:

    a. Use or disclose the LDS only as permitted by this Agreement or as required by law;

    b. Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;

    c. Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;

    d. Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and

    e. Not use the information in the LDS to identify or contact the individuals who are data subjects.

5. Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS **for its Research activities only.**

6. Term and Termination.

   a. Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.

   b. Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.

   c. Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

   d. For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

   e. Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

7. Miscellaneous.

   a. Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

   b. Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

   c. No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

d. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

e. Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA PROVIDER

Signed: _____

Print Name: PENELOPE LAYNE

Print Title: REGISTRAR

DATA RECIPIENT

Signed: _____

Print Name: Carol Jones-Williams

Print Title: PhD Student