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Differences in Breast Cancer Tumor Size, Stage, and Survival by Socioeconomic Position in Young Women

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has been found to be complete and satisfactory in all respects,
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Dissertation Submitted in Partial Fulfillment

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Abstract

Although the incidence of breast cancer in women under 40 years of age is somewhat rare, young women tend to present with cancer that is more advanced and with poorer prognostic characteristics. This research will be important to providers, women and their families and those seeking to clarify screening guidelines. The purpose of this quantitative, retrospective, cohort study was to evaluate differences in prognostic characteristics by socioeconomic position (SIP). The cohort was comprised of females aged 18 to 39 with a primary diagnosis of breast cancer. Data were obtained from the Surveillance, Epidemiology and End Results registry for all primary breast cancers reported between 2001 and 2006 (n = 14,696). Hierarchical regression analysis was performed to assess to what extent SEP had an independent effect on tumor size and cancer summary stage upon diagnosis, and overall survival. SEP was found to be a significant predictor of tumor size and summary stage at the time of diagnosis. As cancer summary stage increases by 1 unit, women were .14 times as likely to have a tumor size of less than 2 cm versus a tumor size of greater than 5 cm. As SEP increases by 1 unit, the likelihood of having a tumor size of less than 2 cm versus greater than 5 cm increases by a factor of 1.14. SEP was not a significant predictor of survival time. The results of this study have the potential to promote positive social change by advancing the understanding of breast cancer in young women, as well as raise awareness of socioeconomic, racial and clinical inequalities. In addition, it may assist researchers and policy makers clearly defined formal screening guidelines for young women in higher-risk subgroups based on socioeconomic position.

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Dedication

This dissertation is dedicated to my remarkable family. First and foremost to my loving, encouraging, and extraordinarily patient husband Milan, who has supported me through these years of research, as well as two subsequent military deployments. To our two amazing sons, Milan and Eliaš, who have endured all the same, while reminding me to smile and have fun along the way.

I would also like to thank my parents Marsh and Mary Kay, for always encouraging me to keep going, and for all of the extra help they gave us at each and every turn. A special thank you to my wonderful friends who offered endless advice and encouragement and support when things got tough, and to my extended family in Slovakia who have also been encouraging me from afar.

Finally, I dedicate this work to my beautiful sister Malia who was diagnosed with, and subsequently beat breast cancer at age 31, to my friend Molly who finished her course of treatment this very day at the age 32, and to Cassie who is currently enduring her second battle with breast cancer at age 26. I also dedicate this work in memory of Karie who lost her courageous 4-year battle with IBC at the age of 35, leaving behind two young children and a loving husband. All of you have continued to amaze me with your strength, humor, grace, and positive outlook on life, in the midst of it all.

Acknowledgments

I would like to express my deepest gratitude to my chair Mary Lou Gutierrez, PhD. This dissertation would never have been possible without her expertise, mentoring, and remarkable patience. I would also like to thank my committee member, Donald Goodwin, PhD, and my URR Amany Refaat, MD, PhD, for playing an integral part in guiding me through the dissertation process with their excellent feedback and support at each step. Last but not least, I would like to thank Michael Kuskowski, PhD, for his assistance in refining my model and his overall statistical guidance throughout the dissertation process.

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Chapter 1: Introduction to the Study

Background of the Study

Breast cancer is the second leading cause of cancer death among women in the United States and the first cause of cancer related deaths globally (Kohler et al., 2011; World Health Organization [WHO], 2010). Although the incidence of breast cancer in women under 40 years of age is somewhat rare, young women tend to present with cancer that is more advanced, and with poorer prognostic characteristics—such as tumor size and how far the cancer has spread within the body (Fisher et al., 2001; Rapiti et al., 2005; Rosenberg, Chia, & Plevritis, 2005). On national and global scales, there are apparent socioeconomic, racial and ethnic health disparities in breast cancer incidence, and survival (Baquet, Mishra, Commiskey, Ellison, & DeShields, 2008; Harper et al., 2009). Between 2001 and 2005, African-American women with breast cancer had a 37% higher mortality rate than European-American women (Ries et al., 2008).

Additionally, barriers to care have been identified as factors that impede early detection of breast cancer in minorities, thus contributing to this disparity. Researchers of a study performed in 2006 (Lantz et al., 2006) noted that approximately 66.6% of European-American women had detected their breast cancer through screening mammography, in comparison to 54.6% of African-American women, and 48.5% of Hispanic women (p <.001). In 1996, Weiss et al. found that in women under the age of 35, 30% had detected their breast cancer through mammography, 6% through a physical exam, and 5% due to clinical symptoms such as breast pain, swelling, dimpling, mastitis, nipple discharge, or bleeding.

In a study performed in 2003, found that patients who resided in low income neighborhoods were significantly more likely to present with Stage IIIB breast cancer or higher in comparison to patients who lived in neighborhoods of a higher income (33% vs. 24%; O'Malley, Le, Glaser, Shema, & West, 2003). Additionally, O'Malley et al. (2003) found that the women presenting with late-stage disease were more likely to live in the low education (30%) and blue-collar neighborhoods (29%).

Table 1
Frequencies for Newly Diagnosed Breast Cancer Cases Taken from the SEER 17 Registry Matching the Criteria for This Proposed Study

	Age 18-39 (n = 14,936)		Age 40-80 (n = 217,653)	
	n	(%)	*n*	(%)
Caucasian	8,524	(57.07%)	161,036	(73.99%)
African-American	2,037	(13.64%)	19,453	(8.94%)
American Indian/Alaska Native	101	(0.68%)	951	(0.44%)
Asian or Pacific Islander	1,517	(10.16%)	15,110	(6.94%)
Spanish-Hispanic-Latino	2,622	(17.55%)	19,624	(9.02%)
Other / Unspecified	24	(0.16%)	236	(0.11%)
Other / Unspecified-with Hispanic Surname	9	(0.06%)	77	(0.04%)
Unknown	90	(0.60%)	1,089	(0.50%)
Unknown-with Hispanic Surname	12	(0.08%)	77	(0.04%)

Problem Statement

It is projected that approximately 1 out of 8 American women will develop invasive breast cancer during their lifetime (Altekruse et al., 2010). It was estimated that in the year 2010, there were 207,090 new cases of invasive breast cancer and 54,010 cases of in situ breast cancer diagnosed among women (ACS, 2010a). Breast cancer is the second leading cause of cancer death among women in the United States, with an estimated 39,840 deaths in the year 2010 (ACS, 2010a).

There are approximately 250,000 or more women living in the United States who were diagnosed with breast cancer under the age of 40, and an expected 10,000 more young women will be diagnosed over the next year (Young Survival Coalition [YSC], 2010). Although the incidence of breast cancer in young women (under the age of 40) is somewhat rare, young women (under the age of 45) tend to present with cancer that is more aggressive and with poorer prognostic characteristics (Anders et al., 2008; Brinton, Sherman, Carreon, & Anderson, 2008; Hartley et al., 2006; Yankaskas, 2006). Breast cancer is the leading cause of cancer related deaths among women ages 15 to 54 (National Cancer Institute [NCI], 2006a).

Between the years 2003-2006 the median age of all adult women newly diagnosed with breast cancer was 61; women under 40 accounted for approximately 6% of new cases (Horner et al., 2009). During that same time period, the overall age-adjusted incidence rate was 122.9 per 100,000 women per year (Altekruse et al., 2010). Subsequent age-specific incidence rates were 0.0% for girls and women under age 20, 1.9% for women between 20 and 34, 10.5% between 35 and 44, 22.6% between 45 and

54; 24.1% between 55 and 64; 19.5% between 65 and 74; 15.8% between 75 and 84; and 5.6% for women aged 85 or above (Altekruse et al., 2010).

Until recently, women were encouraged to begin breast self-exams (BSEs) at age 20 and yearly mammograms at age 40 (ACS, 2009b; NCI, 2009b). However, in 2009, the United States Preventative Task Force (USPSTF; 2010) released recommendations stating that women aged 50-74 should receive biennial mammography screenings and added that screenings prior to the age of 50 should be based on each individual patients risks and benefits of early screening (USPTF, 2010).

In most cases mammography is viewed as the most accurate tool for screening, but this method may not be appropriate for young women who have denser breast tissue in comparison to their older counterparts. The accuracy of screening tests such as mammograms is measured in terms of both sensitivity and specificity. Sensitivity refers to the percentage of patients who receive positive breast cancer results from a diagnostic test among women with breast cancer. In respect to sensitivity, false positives occur when a patient receives a negative test result despite having the disease (NCI, 2010a). Specificity refers to the percentage of patients who receive a negative test result from a diagnostic test among patients who do not have the disease. In respect to specificity, false positives occur when patients receives a positive result although they do not have the disease (NCI, 2010c).

A study of age-related accuracy of mammograms and ultrasounds found that mammography had a low sensitivity, detecting 76% of 25 cancers in women under the age of 35 and 69% of cancers in women between the ages of 36 and 40 (Houssami et al.,

2003). A further study which investigated screening and diagnostic mammography use specifically in women under 40 found that both sensitivity and specificity varied across age groups as well as across diagnostic methods (Yankaskas et al., 2010). Screening mammography is a routine mammogram performed at a predesignated interval in time (i.e., yearly) when the patient does not present with any signs or symptoms, whereas diagnostic mammography is a mammogram performed when a women presents with clinical symptoms such as a lump or other symptoms of breast cancer (NCI, 2010c).

Screening mammography in women aged 35-39 years (n = 73,335), sensitivity was 76.1% and specificity, 87.5%; in women aged 30-34 years (n = 10,527) sensitivity was 81.5% and specificity, 85.8%; in women aged 25-29 years (n = 2,282), sensitivity was 66.7% and specificity, 83.0%; and no cancers were detected in the women aged 18-24 (n = 637). Diagnostic mammography in women aged 35-39 years had a sensitivity of 82.5% and specificity of 88.9%; in women aged 30-34 years sensitivity was 86.3%, and specificity was 89.5%; in women aged 25-29 years sensitivity was 89.5%, and specificity was 88.4%; and in women aged 18-24 sensitivity was 100%, and specificity was 83.8%. The overall age-adjusted rates across all age groups were sensitivity, 85.7%; specificity, 88.8%, positive predictive value (*PPV*) of 14.6%, and cancer detection rate of 14.3 cancers per 1,000 mammograms (Yankaskas et al., 2010).

Due to the recommended age guidelines and the aforementioned methods of screening, women under the age of 40 do not benefit from population screenings and commonly consult a physician when they are presenting with a palpable mass or other symptoms. Moreover, young women are largely underrepresented in cancer treatment

trials due to the lower incidence of breast cancer versus their older counterparts. In addition, there is a lack of literature and clinical research of breast cancer among women under 40 years of age when compared to their older counterparts. A basic keyword search of *breast carcinoma and women* or *breast carcinoma and over 40* in PubMed yielded 46,598 and 984 results respectively, whereas a basic search of the keywords *breast carcinoma, and young women* or *breast carcinoma and under 40* yielded 251 and 228 results respectively. To address this inadequacy within the literature, this study aimed to the discuss differences in prognostic characteristic within this population based on socioeconomic position. It has done so by evaluating differences in tumor size, tumor stage, and survival by socioeconomic position in women under 40 years of age upon primary diagnosis of breast cancer. Furthermore, the implications for social change include clearly defining formal screening guidelines for young women in higher-risk subgroups based on socioeconomic position.

Purpose of the Study

The purpose of this quantitative, retrospective, cohort study was to evaluate differences in tumor size, cancer stage, and survival by socioeconomic position in women under 40 years of age diagnosed with breast cancer. Current studies of breast cancer in young women have varied in the definition of *young*. being between 40 and 50 years of age; as a result there are conflicting results regarding stage upon diagnosis, course of treatment, and life expectancy (Anderson, Chu, & Devesa, 2004; Hall, Moorman, Millikan, & Newman, 2005; Swanson, Haslam, & Azzouz, 2003). Research has shown that cancer in young women is more advanced with poorer prognostic characteristics

(Brinton, Sherman et al., 2008; Gajdos, Tartter, Bleiweiss, Bodian, & Brower, 2000; Yankaskas, 2006), and, in some cases, is considered a biologically different disease than that found in their older counterparts (Anders et al., 2008; Colleoni et al., 2007; Fisher et al., 2001; Fredholm et al., 2009; Rapiti et al., 2005). Other research has illustrated that breast cancer in young women is more aggressive based on the combined effects of familial history, genetic mutations, and hormonal responsiveness (Antoniou et al., 2003; Begg et al., 2008; Czene, Reilly, Hall, & Hartman, 2009; McAree et al., 2010). Breast cancer is also the leading cause of cancer related deaths among women ages 15 to 54 (NCI, 2006a). This study addressed breast cancer among young women (under 40 years of age) in relation to differences in tumor size, cancer stage, and survival by socioeconomic position.

Nature of the Study

This study was a quantitative, retrospective, cohort study of newly diagnosed female breast cancer patients between the ages of 18 and 40. Participants were drawn from the SEER database (2009). More details about the SEER data are found in chapter 3. The independent variable was socioeconomic position (SEP). Dependent variables included SEER summary stage, tumor size, and survival time. These variables were utilized to analyze differences in tumor size, cancer stage, and survival by socioeconomic position in women under 40 years of age diagnosed with breast cancer, the following research questions and hypotheses were utilized for this study.

1. What is the independent effect of socioeconomic position on tumor size at the time of breast cancer diagnosis in women under 40?

H_0:. There is no association between socioeconomic position and tumor size at diagnosis.

H_1: There is an association between socioeconomic position and tumor size at diagnosis.

2. What is the independent effect of socioeconomic position on the stage of cancer at the time of breast cancer diagnosis in women under 40?

H_0: There is no association between socioeconomic position and the stage of cancer at the time of breast cancer diagnosis in women under 40.

H_1: There is an association between socioeconomic position and the stage of cancer at the time of breast cancer diagnosis in women under 40.

3. What is the independent effect of socioeconomic position on survival in women under 40 diagnosed with breast cancer?

H_0:There is no association between socioeconomic position and survival.

H_1: There is an association between socioeconomic position and survival.

Theoretical Base

The theoretical base for this study was driven by the association of the independent and dependent variables being investigated. The conceptual model shown in Figure 1 outlines the relationship between socioeconomic position, cancer stage, tumor size, and survival. In order to investigate if socioeconomic position has an effect on the biologic makeup of breast cancer in young women, variables such as tumor size and cancer summary stage and size were analyzed.

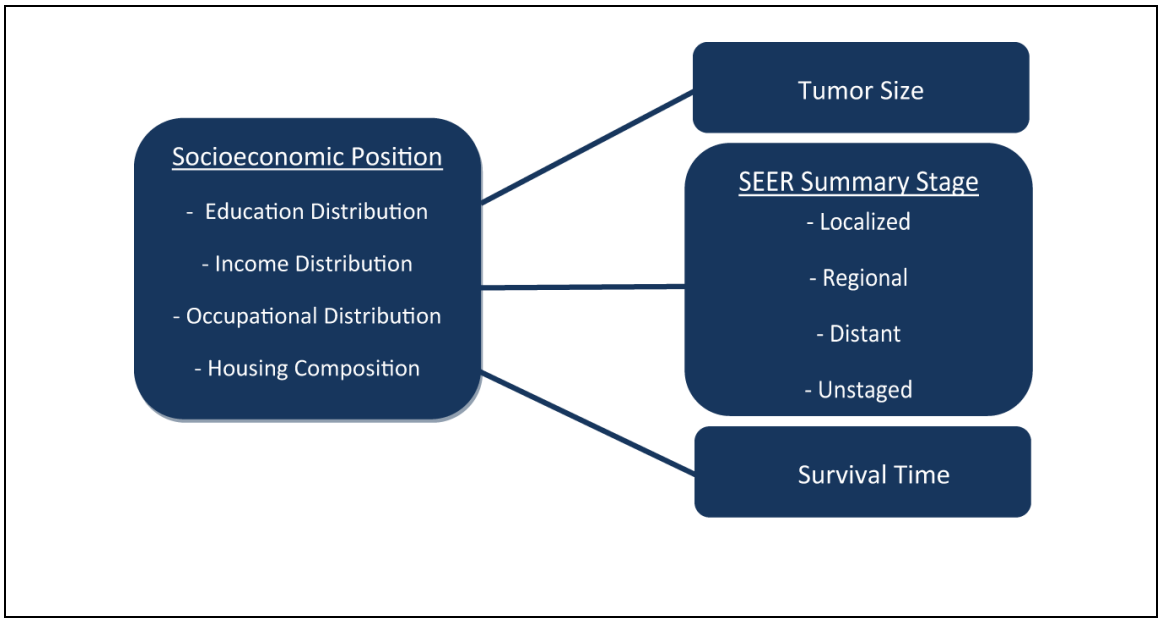

Figure 1. Study conceptual model.

Although breast cancer is the most common type of cancer among women regardless of race or ethnicity, there are measureable disparities across these groups when looking at incidence, prevalence, and survival (Baquet et al., 2008; Brinton, Sherman et al., 2008; Hall et al., 2005; Joslyn, Foote, Nasseri, Coughlin, & Howe, 2005). African-American women also typically present with poorer prognostic characteristics, which

have been found to be strong indicators for decreased survival (Curtis, Quale, Haggstrom, & Smith-Bindman, 2008; Wong, Ettner, Boscardin, & Shapiro, 2009). The mortality rate of African-American women under the age of 35 is 3 times higher than that of age matched European-American women. Also, the age specific incidence rates among African-American women in this age group are more than twice the rate of European-Americans (Shavers, Harlan, & Stevens, 2003). Along with race and ethnicity, another characteristic that has effect on breast cancer risk is socioeconomic status (SES). SES is also associated with access to care, age at diagnosis, and more aggressive tumor characteristics (Byers et al., 2008; Koh, 2009; O'Malley et al., 2003; Roetzheim et al., 2000; Smith-Bindman et al., 2006; Wallington, Brawley, & Holmes, 2009; Watlington, Byers, Mouchawar, Sauaia, & Ellis, 2007).

Another factor that may contribute to breast cancer risk is environmental exposures. Although it is not specifically known exactly how environmental exposures interact with genetic and hormonal factors, research has associations between certain organic solvents, and polycyclic aromatic hydrocarbons (PAHs) in occupational settings (Hansen, 1999). Identifying an association within population studies is more complex due to the lack of exposure assessment tools, latency, and variations in susceptibility.

Definition of Terms

Benign: Non cancerous - the majority of benign breast conditions are fibroadenomas, which are not considered to be cancer (ACS, 2009c).

Biopsy: For the purpose of this study refers to the removal of cells or tissues from the breast area or lymph nodes, for the purpose of an examination by a pathologist. The

three main types of breast biopsies are: (a) incisional biopsy, where tissue is removed, (b) excisional biopsy, where an entire lump is removed, and (c) needle biopsy, where either fluid or tissue is removed for examination (NCI, 2010c).

Breast density: Relates to different types of tissue present in the breast. Dense breasts are made up of more glandular and connective tissue rather than fat. Standard mammography films of dense breasts are more difficult to read in comparison to breasts that are less dense (NCI, 2010c).

Chemotherapy: Treatment with drugs that kill cancer cells (NCI,2010c).

Cyst: For the purpose of this study refers to a fluid filled sac or capsule within the breast (NCI, 2010c).

Diagnostic mammogram: A mammogram performed when a women presents with clinical symptoms such as a lump or other symptoms of breast cancer (NCI, 2010c).

Distant Cancer: A cancer which has spread from the primary tumor to distant tissue, lymph nodes or, organs. This is also referred to as distant metastasis (NCI, 2010c).

Duct: A thin tube within the breast that carries milk from the breast lobules to the nipple; also called *milk duct* (NCI, 2010c).

Estrogen: A hormone produced by the body that assists in developing and maintaining female sex characteristics. Lab-created estrogen is created for use in birth control medicine and to treat osteoporosis, side effects of menopause, and other menstrual disorders (NCI, 2010c).

Lifetime risk: The probability of developing or dying from breast cancer during an individual's lifetime(NCI, 2010c).

Lobe: A portion of an organ, such as the breast (NCI, 2010c).

Lumpectomy: A surgical procedure performed in order to remove abnormal tissue from the breast, as well as a small sample surrounding the area of concern. A lumpectomy is considered to be a type of breast conservation surgery (NCI, 2010c).

Malignant: Cancerous; tumors which are malignant can invade and destroy surrounding tissue as well as spread to lymph nodes, distant tissue, and organs (NCI, 2010c).

Mammogram: An x-ray of the breast; a way to find breast cancers that are not palpable (NCI, 2010b).

Magnetic resonance imaging (MRI): For the purpose of this study, an MRI is a breast cancer screening procedure used to differentiate between normal and diseased tissue within the breast. An MRI utilizes radio waves and a powerful magnet to obtain detailed images of the breast (NCI, 2010c)

Mastectomy: A surgical procedure used to remove the breast, nipple, or as much of the breast tissue surrounding as necessary to eradicate cancerous tissue within the breast (NCI, 2010c)

Older women: For the purpose of this study, women aged 40 or older.

Prognosis: The potential outcome or course of breast cancer; expressed in the terms of course of treatment, chance of recovery or recurrence, and projected survival time (NCI, 2010b).

Regional cancer: Breast cancer that has spread or grown beyond the primary tumor to nearby tissue, lymph nodes, or organs (NCI, 2009a).

Regional lymph node: A lymph node that drains lymphatic fluid from the region surrounding a tumor (NCI, 2010c).

Screening mammography: A routine mammogram performed at a pre designated interval in time (i.e., yearly), when the patient does not present with any signs or symptoms (NCI, 2010c).

SEER Summary Stage: Another system used to categorize cancer staging within the SEER registry. Summary staging is the most basic way of categorizing how far a cancer has spread from its point of origin. Cancer is staged as localized, regional or distant using this staging model.

Sensitivity: For the purpose of this study refers to the percentage of patients who receive positive breast cancer results from a diagnostic test among women with breast cancer. False positives occur when a patient receives a negative test result despite having the disease (NCI, 2010a).

Specificity: For the purpose of this study refers to the percentage of patients who receive a negative test result from a diagnostic test among patients who do not have the disease. False positives occur when patients receive a positive result although they do not have the disease (NCI, 2010c).

Socioeconomic Position (SEP): Is comprised of measures including education attainment, income, and occupation (Galobardes, Lynch, & Smith, 2007).

Socioeconomic status (SES): Comprised of measures such as geographic location, education, occupation, and income that may indicate specific health care choices, potential environmental exposures, and access to adequate medical services (Koh, 2009).

Staging: For the purpose of this study, refers to the extent of cancer within the body. It is based on tumor size, lymph node involvement, and whether the cancer has spread beyond the primary tumor to distant tissue, and organs (NCI, 2010b).

Tumor: Abnormal cells combine to create a lump or mass within the breast, tumors can be either benign (non cancerous) or malignant (cancerous; NCI, 2010c).

Younger women: For the purpose of this study, women under 40 years of age.

Assumptions, Limitations, Scope and Delimitations of the Study

For the purpose of the study, the SEER 17 registry was utilized. The study was based on one main assumption-that participating cancer registries followed the National Comprehensive Care Network cancer registry guidelines which standardized registry reporting as of 2000 (SEER, 2000). The SEER dataset has several limitations. Currently the SEER registry dataset is limited to 26% of the United States population. This coverage includes 23% of African-Americans, 23% of European-Americans, 40% of Hispanics, 42 % of American Indians and Alaska Natives, 53% of Asians, and 70% of Hawaiian/Pacific Islanders (SEER, 2000). The SEER program has a special focus on minority racial and ethnic groups as well as urban populations; this focus, in turn, equates to an overrepresentation of minorities within the data set. The overrepresentation of racial and ethnic groups within SEER is done to ensure sufficient population sizes for the purpose of statistical analysis. While the SEER dataset is limited to 26% of the population (see Figure 2), it does not account for patient migration. The concurrent migration of patients in and out of SEER registry counties can cause patients' subsequent malignancies to go unrecorded. This study focused on a patients' first reported

malignancy; however losing a patient to follow-up opportunities may influence calculations such as survival, which is dependent on long-term follow up of individual patients.

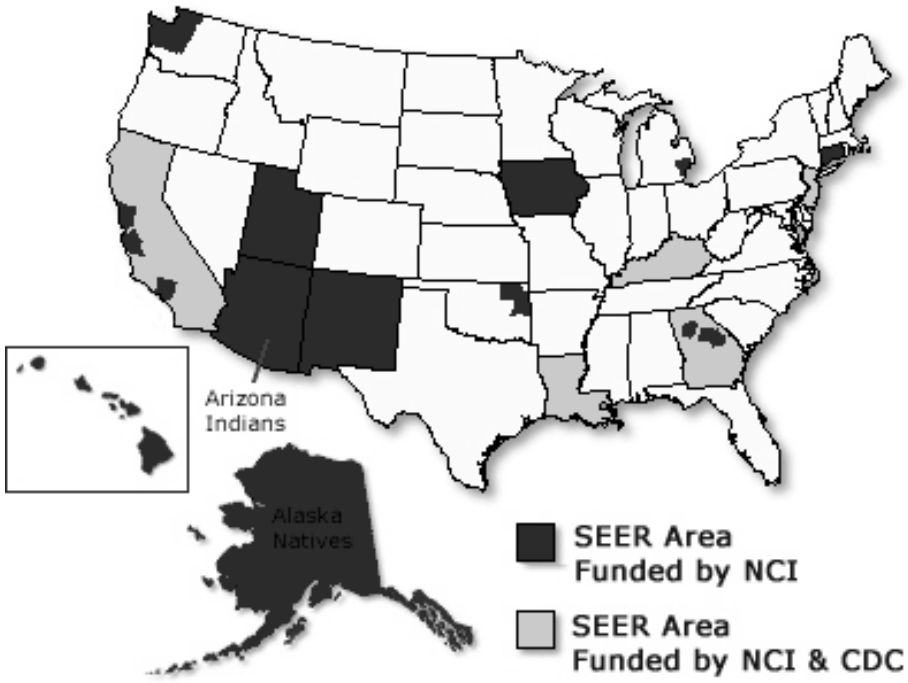

Figure 2. Map of SEER Registry location coverage across the United States.
Source is public domain, permission not required to reproduce: http://seer.cancer.gov/registries/

Another limitation of the dataset is the impact of Hurricanes Katrina and Rita on Louisiana's population from July-December 2005. Louisiana cases diagnosed during those 6 months were excluded from the limited-use database. Although the SEER 17 registry does include one record for each of the 2,601,686 tumors diagnosed during this time period (July-December 2005), they are considered supplemental data (SEER, 2007). Cases for Louisiana in 2005 are only included in SEER's 1973-2007 research database if they were diagnosed in the first half of 2005 (SEER, n.d.). For incidence rate

calculations, SEER excludes Louisiana cases diagnosed for the 6-month period, July-December 2005. For all prevalence calculations, Louisiana cases are entirely excluded. Although each SEER research database includes a file for a Katrina/Rita Population Adjustment, these adjustments are only applicable to the SEER 17 Registries data, which includes the state of Louisiana. Within SEER 17, a separate dummy state was created that represents displaced individuals. It is labeled *Hurricane Katrina/Rita Evacuees—Populations Only—2005* and is included by default in rate calculations over the total U.S. population. As previously noted, there is no population adjustment for prevalence databases; therefore, Louisiana cases are entirely excluded during the identified timeframe.

The design for this study was a non experimental in that the causal relationship between socioeconomic position, tumor size, cancer stage, and survival cannot be identified based upon the possible findings. The study was limited to assessing the potential effect of socioeconomic position on tumor size, cancer stage, and survival among women under 40 newly diagnosed with breast cancer. The study population was limited to women aged 18 to 39 years of age who received a primary diagnosis of breast cancer between the years of 2001-2006. The scope of this study was not to examine all identified risk factor associated with breast cancer. SEER does not collect data on health habits such as smoking, sedentary lifestyle, breast feeding behaviors, or obesity; therefore, these confounding factors were not controlled for during the data analysis, and this lack of control is a limitation of this study.

Significance of the Study

The significance of this study stems from the fact that breast cancer is the number one leading cause of death in women ages 15-54 (NCI, 2006a). Across all ages, breast cancer is the number one cause of cancer related deaths among Hispanic women and the second leading cause of cancer related deaths among European-American, African-American, Asian/Pacific Islander, and American Indian/Alaska Native women (Centers for Disease Control and Prevention [CDC], 2010). There are inequalities in both clinical research and current literature pertaining to young women with breast cancer in comparison to their older counterparts. A basic keyword search of *breast carcinoma and women* or *breast carcinoma and over 40* in PubMed yielded 46,598 and 984 results, respectively; whereas a basic search of the keywords *breast carcinoma and young women* or *breast carcinoma and under 40* yielded 251 and 228 results, respectively.

To address this inadequacy in the literature, this study aimed to explore differences in prognostic characteristic within this population based on socioeconomic position. It has done so by evaluating differences in tumor size, cancer stage, and survival by socioeconomic position in women under 40 years of age upon primary diagnosis of breast cancer. Furthermore, another implication for social change may include clearly defined formal screening guidelines for young women in higher-risk subgroups based on socioeconomic position.

Summary

Chapter 1 introduced the study and explained the background, assumptions, limitations; defined terminology used, and outlined the importance of this study. Chapter

2 provides an overview of the current literature and research related to breast cancer in women under 40. It presents a discussion of the natural history of breast cancer, prevention and screening methods, clinical characteristics, and issues surrounding socioeconomic position within this population. Chapter 3 describes the research questions, research design, inclusion criteria, and data analysis. Chapter 4 presents the results of the study, and chapter 5 interprets and discusses the results.

Chapter 2: Literature Review

This chapter presents the different facets of breast cancer, including the basic definition, epidemiology, causation, and detection methods based on the current literature. The literature summarized in this chapter focuses on breast cancer among women under the age of 40 at the time of primary diagnosis. To understand the history of breast cancer as a disease and prognostic characteristics in relation to age, a compilation of journal articles was utilized. Medline, PubMed, NCI, and OVID databases were used.

The search was limited to sources published between 1980 and 2010, and the following keywords were used: *breast cancer, breast carcinoma, epidemiology, race/ethnicity, young women, premenopausal, morbidity, mortality, socioeconomic status, socioeconomic position, screening, environment, genetics*, and *prognostic characteristics*. The majority of the literature operationally defines *young women* as those who are 50 years of age or younger; for the purpose of this study, the term referred to women under the age of 40. Within the current literature, it remains unclear whether the division at age 50 is due to a convenience of sample size breakdown (under 50, over 50) or the association with the initial mammography screening recommendations for women 50 and older only. In other words, breast cancer among women 40 and under may possibly be a biologically different cancer in comparison to women over 40 years of age (Anders et al., 2008; Colleoni et al., 2007; Fisher et al., 2001; Fredholm et al., 2009; Rapiti et al., 2005). This difference in age categorization has further increased the gap in the literature addressing this age group in relation to breast cancer diagnosis.

Because many studies define young women as being between 40 and 50 years of age, there are conflicting results regarding stage upon diagnosis, course of treatment, and life expectancy (Anderson et al., 2004; Hall et al., 2005; Swanson et al., 2003). Although these factors are difficult to compare due to varying age ranges and prognostic characteristics being investigated (Newman et al., 2002), this study focused on the evidence due to a biologically aggressive etiology (Anders et al., 2008; Colleoni et al., 2007; Fisher et al., 2001; Fredholm et al., 2009; Rapiti et al., 2005) based on tumor size and stage. As previously noted, other research has illustrated that breast cancer in young women may be more aggressive in nature based on the combined effects of familial history, genetic mutations, and hormonal responsiveness (Antoniou et al., 2003; Begg et al., 2008; Czene et al., 2009; McAree et al., 2010). These individual factors, such as genetics and family history, are beyond the scope of this study.

Anatomy of the Breast

In order to comprehend the pathophysiology of breast cancer and overall breast health, it is beneficial to understand the basic anatomy of the breast. The breast is a glandular organ located on the chest, which is made up of connective tissue, fat, and breast tissue that contains the glands that can make milk (NCI, 2010b; see Figures 3 and 4).

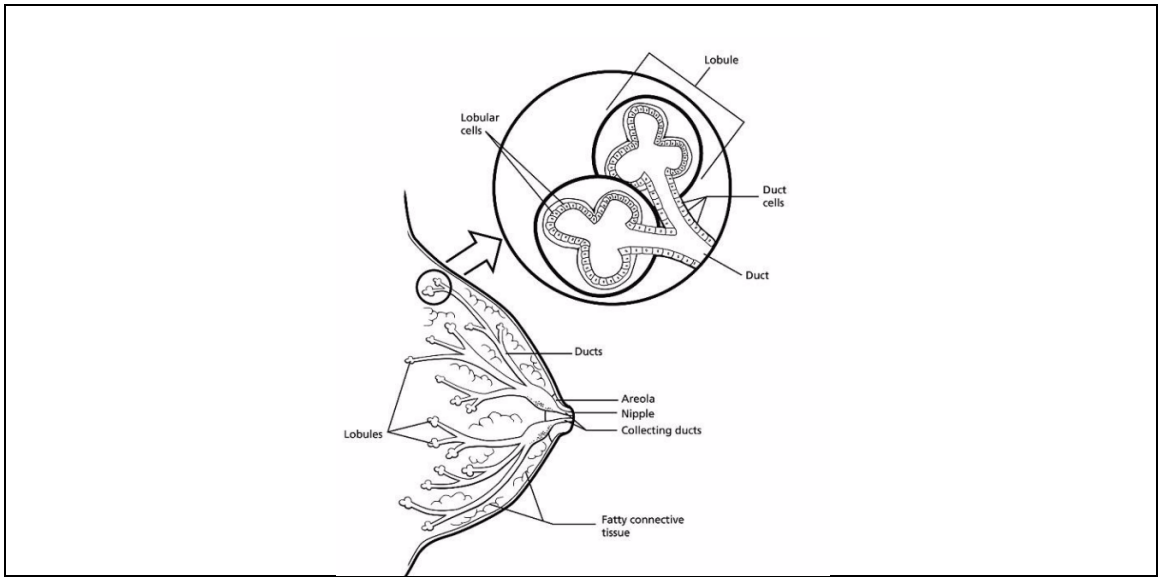

Figure 3. A diagram of the anatomy of the normal breast.

Note. Reprinted from "Breast Cancer: What is Breast Cancer," by The American Cancer Society, 2009, *Breast Cancer: The Detailed Guide*, p. 3. Source is public domain, no permission required.

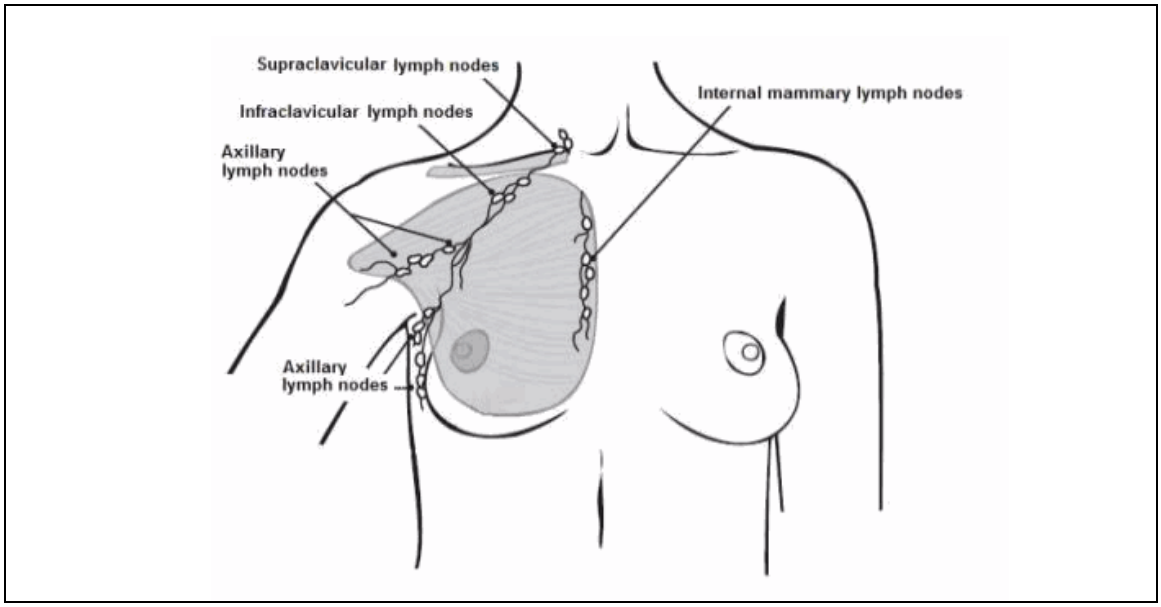

Figure 4. A diagram of the lymph (lymphatic) system of the breast.

Note. Reprinted from "Breast Cancer: What is Breast Cancer," by The American Cancer Society, 2009b, *Breast Cancer: The Detailed Guide*, p. 4. Source is public domain, no permission required.

History of Breast Cancer

The mental and physical implications of a breast cancer diagnosis are vast regardless of the stage in which a woman is diagnosed (Deshields, Tibbs, Fan, & Taylor, 2006; Kroenke et al., 2004; Sammarco, 2009). However, early detection can have a significant impact on a woman's treatment and survival (Chan, Pintilie, Vallis, Girourd, & Goss, 2000; Lin et al., 2002; Newman et al., 2002).

Numerous determinants contribute to this disease; some can be changed, and some cannot. Lifestyle choices such as not having children, taking hormone replacement therapy, abstaining from breastfeeding, consuming alcohol, being obese, eating high-fat diets, and having a sedentary lifestyle, can be changed. Determinants that cannot be changed include race, age, family cancer history, early menstruation, previous chest radiation, and genetics. Although various cosmetics and personal hygiene products are thought to be associated with breast cancer, to date there is no solid evidence linking personal products and breast cancer (Witorsch & Thomas, 2010). This area of concern warrants further research; therefore, it was not discussed in the context of this study. The aforementioned determinants are discussed in detail in chapter 2.

Cancer occurs when abnormal cells grow at an uncharacteristic rate. These cells may also form into a lump or a mass called a *tumor*. If left undetected, these abnormal cells or tumors may spread to other areas of the body. Within the breast, there are different types of cancer; the most common types are ductal and lobular carcinoma (CDC, 2009). Breast cancer is defined by the American Cancer Society (ACS; 2009d) as a malignancy that begins in the cells of the breast. Ductal carcinoma begins in the cells

that line the milk ducts; if the cancer has not spread beyond this area it is called *ductal carcinoma in situ (DCIS)*. DCIS makes up approximately 85% of the in situ breast cancers diagnosed (ACS, 2009a). Ductal carcinoma can also spread beyond the ducts and into surrounding tissue; this type of cancer is called *invasive ductal carcinoma*.

Lobular carcinoma (LCIS) begins in the breast lobe cells; the lobes, or lobules are the actual glands that produce milk within the milk ducts (CDC, 2009). Lobular carcinoma typically does not spread to the surrounding tissue except in cases of invasive lobular carcinoma. Another indicator of predisposition for breast cancer is called *atypical hyperplasia*. Atypical hyperplasia is a condition in which the cells of the breast appear abnormal and increased in number when inspected under a microscope (NCI, 2010c). Research has shown that women with biopsy confirmed atypical hyperplasia are approximately 5.3 times more likely to develop breast cancer compared to women with breast lesions that have not spread (Dupont & Page, 1985).

A rare yet highly invasive form of breast cancer is *inflammatory breast cancer (IBC)*. IBC makes up only 1-3% of breast cancers diagnosed within the United States (ACS, 2009c). This type of cancer tends to spread at a rapid rate and be diagnosed at a more advanced stage. Typically when IBC is diagnosed it is already advanced to Stage III cancer (ACS, 2009c). Unlike typical breast cancer, IBC does not form a lump that can be found during an exam. Instead, the breast appears to be red and inflamed and is warm to the touch; this coloring and inflammation is due to the cancer cells blocking the lymph vessels in the skin (NCI, 2006b). In addition to different presenting symptoms, IBC also tends to occur in younger women and African-American women. Whereas the incidence

of all other types of breast cancer occur more frequently in European-American women, IBC is 2 to 3 times more likely to occur among African-American women (NCI, 2006b).

Another rare form of breast cancer is Paget disease, which affects the nipple. The cancer cells initially begin to form in the ducts but then spread to the skin of the nipple and areola. Paget disease accounts for approximately 1% of breast cancer; if caught in an early stage, the prognosis for survival can be excellent (NCI, 2006c).

According to the NCI (2010a) in 2010, there will be an estimated 207,090 new cases diagnosed and 39,840 deaths among women that will be attributed to breast cancer. Additionally, the CDC (2010) reported that, with the exception of skin cancer, breast cancer is the most commonly diagnosed type of cancer among American women. It is also the leading cause of cancer death among Hispanic women, and the second leading cause of cancer related death among European-American, African-American, Asian/Pacific Islander, and American Indian/Alaska Native women.

To understand the impact of a breast cancer diagnosis, it is necessary to understand the stages of breast cancer. Different stages are utilized in the diagnosis of breast cancer; these stage qualifications assist in planning a woman's course of treatment. The National Breast Cancer Foundation (2009) defines the first stage of breast cancer as *Stage 0,* where atypical cells have not spread outside of the milk-producing organs (called *ducts* or *lobules*) into the surrounding breast tissue. This stage is referred to as carcinoma in situ, and it is classified into two different types. The first type is DCIS, early cancer which, if detected and treated, has a high survival rate. If DCIS is not detected and treated at an early stage, it can spread beyond the ducts or lobules to surrounding breast tissue.

The second type is LCIS, which is not cancer itself, but rather an indicator that a woman has an increased risk of developing breast cancer in her lifetime.

The second stage of breast cancer, called *Stage I,* refers to the early stage of invasive breast cancer. In Stage I breast cancer, the cancer is no larger than 2 centimeters and has not spread to beyond the breast to surrounding tissue or lymph nodes. The next stage of breast cancer is *Stage II.* Stage II breast cancer is classified into two types according to the size of the tumor and the level of lymph node involvement. In Stage II A breast cancer, the tumor is less than 2 centimeters and has spread to at least three lymph nodes. Tumors in Stage II A may be larger than 2 centimeters but no larger than 5 centimeters and have not spread to surrounding lymph nodes. In Stage II B breast cancer, the tumor is between 2 and 5 centimeters and has spread to up to three lymph nodes. Tumors in Stage II B may also be larger than 5 centimeters but have not spread to the surrounding lymph nodes.

The next stage of breast cancer is *Stage III*, which is also classified into two types according to the size of the tumor and the level of lymph node involvement. In Stage IIIA breast cancer, the tumor is larger than 2 centimeters but smaller than 5 centimeters and has spread to up to nine lymph nodes. In Stage III B breast cancer, the cancer has spread beyond the breast to surrounding tissues such as skin, chest wall, ribs, muscles, or lymph nodes within the chest wall or collarbone. The final stage of breast cancer is *Stage IV*. In Stage IV breast cancer, the cancer has spread beyond the breast to other organs and tissues, such as the liver, lungs, brain, and skeletal system.

Although Stage 0 is noted as being precancerous, stages I and II are considered to be the early stages of developing breast cancer, Stage III is considered late-stage cancer, and Stage IV is advanced breast cancer. According to the American Joint Committee on Cancer (AJCC), there are three types of staging; clinical staging, pathologic staging, and restaging (American Joint Committee on Cancer, 2010). Clinical staging is used to determine how much cancer is in the body based on physical examination, imaging tests, and biopsies of affected areas (ACS, 2009c; AJCC, 2010). Clinical staging is performed at the time of diagnosis and assists in planning a woman's course of treatment. Pathologic staging is performed following a procedure to extract tissue and combines clinical staging with the results from the surgical procedure (ACS, 2009c; AJCC, 2010). The pathological stage offers more precise information that can then be used to calculate possible treatment response and outcomes (prognosis). The final type of staging, called *restaging*, is not common. Restaging may be performed if the cancer reoccurs following the initial course of treatment (ACS, 2009c; AJCC, 2010). This type of staging would be done in order to reassess the current extent of the cancer and plan the appropriate course of treatment.

Along with cancer staging itself, there are various systems or tools in place that assist medical professionals in the actual staging process. These systems aim to standardize cancer staging and reporting based on selected criteria. One of the most common systems to date was created by the AJCC and International Union Against Cancer (UICC; AJCC, 2010). The TNM Staging System is based on *(T)* the tumor size, *(N)* lymph node involvement, and *(M)* if the cancer has metastasized (see Table 2).

Table 2
TNM Staging Guidelines

Stage	T (tumor)	N (lymph nodes)	M (metastasis)
Stage 0	Tis: Carcinoma in situ (DCIS, LCIS, or Paget disease of the nipple).	N0: Cancer has not spread to nearby lymph nodes.	M0: No distant metastases
Stage 1	T1: Tumor size no larger than 2 centimeters.	N0: Cancer has not spread to nearby lymph nodes.	M0: No distant metastases
Stage 1B	T0: No evidence of primary tumor. T1: Tumor size no larger than 2 centimeters.	N1mi: Micrometastases in 1 to 3 lymph nodes under the arm.	M0: No distant metastases
Stage 2A	T0: No evidence of primary tumor. T1: Tumor size no larger than 2 centimeters.	N1a: Cancer has spread to 1 to 3 lymph nodes under the arm sized greater than 2 mm across. N1b: Cancer has spread to internal mammary lymph nodes.	M0: No distant metastases
	OR		
	T2: Tumor is bigger than 2 centimeters but smaller than 5 centimeters.	N0: Cancer has not spread to nearby lymph nodes.	M0: No distant metastases
Stage 2B	T2: Tumor is bigger than 2 centimeters but smaller than 5 centimeters.	N1: Cancer has spread to 1 to 3 axillary lymph nodes, and/or tiny amounts of cancer are found in internal mammary lymph nodes.	M0: No distant metastases
	OR		
	T3: Tumor is more than 5 cm across.	N0: Cancer has not spread to nearby lymph nodes.	M0: No distant metastases
Stage 3A	T2: Tumor is bigger than 2 centimeters but smaller than 5 centimeters.	N2: Cancer has spread to 4 to 9 lymph nodes under the arm, or has enlarged the internal mammary lymph nodes.	M0: No distant metastases
	OR		
	T3: Tumor is more than 5 cm across.	N1: Cancer has spread to 1 to 3 axillary lymph nodes, and/or tiny amounts of cancer are found in internal mammary lymph nodes. N2: Cancer has spread to 4 to 9 lymph nodes or has enlarged the internal mammary lymph nodes.	M0: No distant metastases
Stage 3B	T4: Tumor of any size growing into the chest wall or skin. This includes inflammatory breast cancer.	Any N: Cancer may or may not have spread to nearby lymph nodes.	M0: No distant metastases
Stage 3C	Any T: The tumor is any size.	N3: Cancer has spread to 10 or more axillary lymph nodes, under or over the collar bone, or has enlarged the internal mammary lymph nodes.	M0: No distant metastases
Stage 4	Any T: The tumor is any size.	Any N: Cancer may or may not have spread to the lymph nodes.	M1: Distant metastases
Unstaged	TX: Primary tumor cannot be evaluated.	NX: Regional lymph nodes cannot be evaluated.	MX: Distant metastasis cannot be evaluated

Note. Adapted from "How is breast cancer staged? A detailed guide to breast cancer staging," American Cancer Society, 2010, Source is public domain, permission not required to reproduce; and "Cancer staging," National Cancer Institute, 2010, Source is public domain, permission not required to reproduce.

Another system used to categorize cancer staging within SEER is called *SEER Summary Staging*. Summary staging is the most basic way of categorizing how far a cancer has spread from its point of origin. The 2000 version of the Summary Stage Manual, which was used in this study, encompasses all of information submitted to the registry and is a combination of the most precise clinical and pathological documentation of the extent of disease (SEER, 2000).

SEER describes cancer in five stages: in situ, localized, regional, distant, and uncategorized. In situ cancer is early cancer that is present only in the layer of cells in which it began, and would encompass Stage 0 cancers. Localized cancer that is restricted to the site of origin without evidence of spreading would encompass Stage I cancer. Regional cancer that has grown beyond the original (primary) tumor to nearby lymph nodes or organs and tissues would encompass Stage II cancer. Distant stage cancer refers to cancer that has spread from the original (primary) tumor to distant organs or distant lymph nodes; this includes stages III and IV. Unstaged refers to cancers for which there is not enough information to indicate a stage (SEER, 2010). Previous studies have suggested that the highest proportions of unstaged cancer cases are among the elderly, minority populations, and those living in rural areas (Worthington, Koroukian, & Cooper, 2008).

Worthington et al. (2008) examined the characteristics of unstaged colon and rectal cancer cases to identify which stage components were missing, and to characterize and identify predictors of unstaged cancer. The population was comprised of 128,418 colon and 44,616 rectal cancer patients. The researchers utilized SEER data to look at

which staging components were missing, including tumor size *(T)*, number of lymph nodes *(N)*, and metastases *(M)*. The stage component *M* was missing most frequently across both age and cancer groups. Worthington et al. attribute this finding to the patients possible refusal to undergo diagnostic testing, the discovery of an inoperable tumor, being treated with endoscopic therapy, or receiving treatment outside of the SEER reporting area (2008). Identified predictors for having unstaged cancer were African-American descent and advanced age (65 years or older; Worthington et al., 2008).

Klassen et al. (2006) analyzed missing prostate stage and grade data in Maryland, and the potential effects on research and policy. Prostate Cancer Surveillance Data were obtained from the Maryland Cancer Registry ($N = 22{,}217$), logistic regression was then used to examine potential patterns across demographic and socioeconomic variables. The researchers looked at both missing stage and grade individually. Older age (65-74 and 75-106), African-American race, missing grade, and a higher county-level median income increased the probability of missing stage. While having a more recent diagnosis, higher blockgroup-level median income, and living in a rural county decreased the probability of missing stage. When looking at factors influencing missing tumor grade, older age, missing or later stage, and a higher blockgroup-level median income increased the probability of missing tumor grade. Whereas having a more recent diagnosis, higher county-level median income, and living in a rural county decreased the likelihood of missing tumor grade.

Although there was no noted difference in the proportion of unstaged cases across racial groups, African-American men were more likely to have missing tumor grade

(84% vs. 86%, $p = 0.007$; Klassen et al., 2006). The proportions of both unstaged and ungraded tumors increase with decreasing income, however, it is noted that despite the positive association between the two (Pearson correlation coefficient $r = 0.32$), they are influenced by different factors (Klassen et al., 2006). Klassen et al. (2006) found that the absence of staging (*OR,* 4.55), increased age (*OR,* 1.12), the ratio of urologists to patients (*OR,* 1.13), and later stage (*OR*, 1.16), were significant predictors of ungraded tumors. Significant predictors of ungraded tumors were missing grade (*OR*, 4.73) increased age (*OR*, 1.98), and African-American race (*OR*, 1.12; Klassen et al., 2006).

Incidence and Mortality Trends

Breast cancer incidence and mortality rates have increased over time which can be attributed to a range of lifestyle and healthcare behaviors. According to a collaborative report from ACS, CDC, NCI, and the North American Association of Central Cancer Registries (NAACCR; Edwards et al., 2010) there have been five distinct phases in breast cancer incidence trends since 1975: (a) between 1975 and 1980, incidence was constant; (b) between 1980 and 1987, incidence increased by 4.0% per year; (c) between 1987 and 1994, incidence was constant, (d) between 1994 and 1999, incidence rates increased by 1.6% per year; and (e) between 1999 and 2006, incidence rates decreased by 2.0% per year, except among Asian American/Pacific Islander women. Also, during 1997-2006 there was a slight decrease in breast cancer related death rates among European-American; African-American and Hispanic women (Edwards et al., 2010). Figure 5 represents these trends among specific racial/ethnic groups during this time period (1975-2006). Data were available for European-Americans and African-Americans for the

entire period of time; however, specific data were not available within SEER for Hispanic, Asian American/Pacific Islander, and American Indian/Alaska Native women until 1992.

Slight increases and decreases in incidence rates can be due to lifestyle choices such as a shift in reproductive patterns (Sweeny et al., 2008; Ursin et al., 2004), increased obesity rates (Brody et al., 2007; Daling et al., 2001; Reeves et al., 2007), and the use of menopausal hormone replacement therapy (Brinton et al., 2008; Lacey et al., 2009). The large increase noted between 1980 and 1987 (4.0% per year) is due to an increased use of mammography in population screenings (Garfinkel, Boring, & Heath, 1994). During these years, incidence rates of smaller tumors (2.0 cm or less) more than doubled, while rates of larger tumors (3.0 cm or more) decreased 27% (Garfinkel et al., 1994). It is noted that a sharp decrease in incidence rates (2.0% per year) between 2002 and 2003 in women aged 50-69 was attributed to a rapid drop in hormone use following lower usage of combined hormone replacement therapy (Edwards et al., 2010). The slight decrease noted around the year 2000 may be related to a reported decrease or stabilization in mammography use in women over 40. Also, the slight decline noted in 2000 can be attributed to the lower prevalence of mammography use (Breen et al., 2007; Miller, King, Ryerson, Eheman, & White, 2009; Ryerson, Miller, Eheman, Leadbetter, & White, 2008). The slight decline noted, gives the appearance of a continued decline in incidence rates, whereas it actuality it reflects the under diagnosis or delayed diagnosis, and is not a true decrease in breast cancer occurrences (ACS, 2009a).

Trends in breast cancer incidence and mortality across racial/ethnic groups have also been noted. Incidence and prevalence data for African-American and European-American women are readily available since the year 1973 within SEER; at that time race was categorized into *White*, *Black*, and *Other*. The *Other* race category used includes American Indian/Alaska Native and Asian/Pacific Islander's combined (SEER, 2009). After 1992, SEER categorized race into four groups: White, Black, American Indian/Alaska Native, Asian/Pacific Islander, and Hispanic origin. Figures 4 and 5 illustrate trends in both incidence and death rates by race and ethnicity between 1975 and 2006 in the United States. Between the early 1970s and 1987, breast cancer incidence increased rapidly for both African-American and European-American women. This rapid increase was due to the introduction of mammography (Garfinkel et al., 1994).

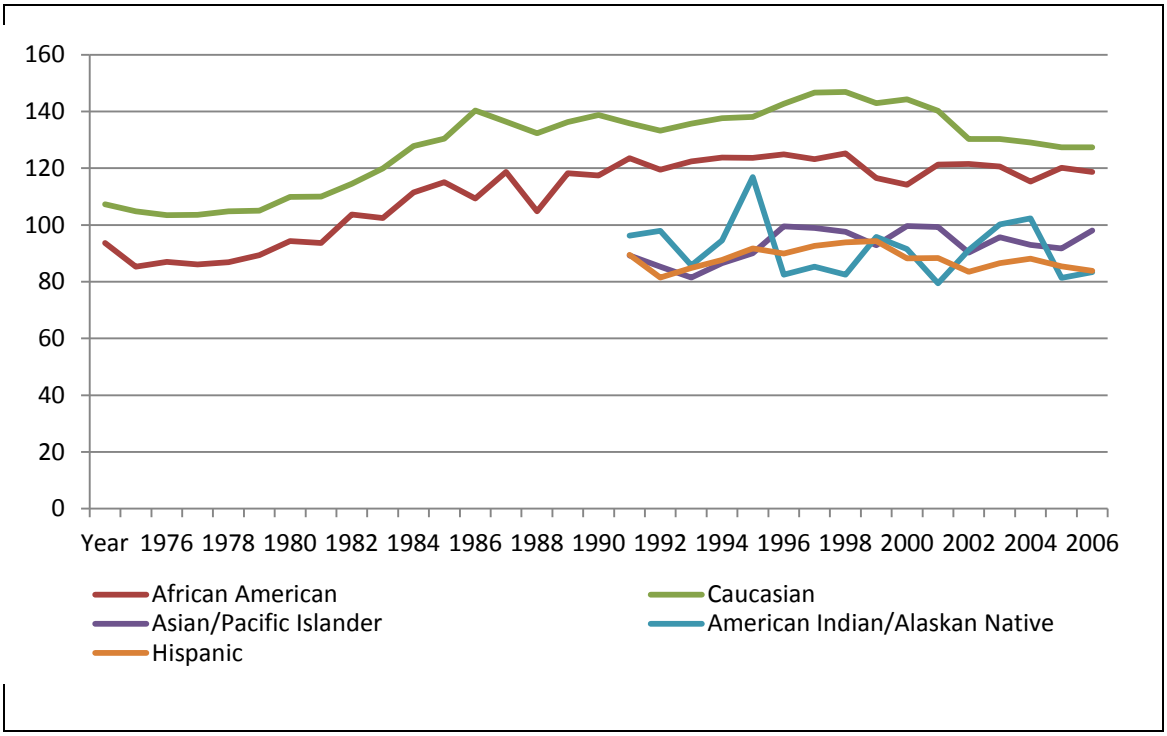

Figure 5. Trends in female breast cancer incidence rates* by race and ethnicity, U.S., 1975-2006.

Data Source: Rates are per 100,000 and are age-adjusted to the 2000 U.S. Std Population. Cancer sites include invasive cases only unless otherwise noted. Mortality source: U.S. Mortality Files, National Center for Health Statistics, CDC. Incidence source: Data for African-Americans and European-Americans are from the SEER 9 registries, data for Asian/Pacific Islander, Hispanic, and American Indian/Alaska Native are from the SEER 13 registries. Hispanics and Non Hispanics are not mutually exclusive from whites, blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives. Incidence data for Hispanics and Non Hispanics are based on NHIA and exclude cases from the Alaska Native Registry. Rates for American Indian/Alaska Native are based on the CHSDA (Contract Health Service Delivery Area) counties.

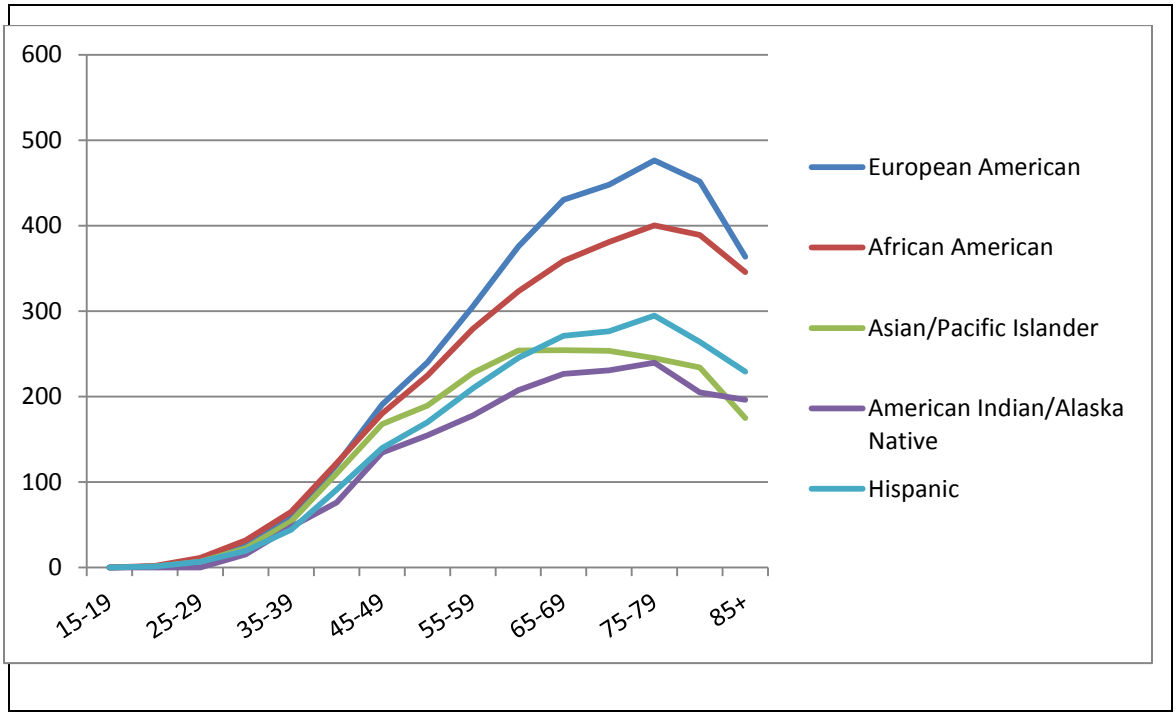

Figure 6. Age-specific (crude) SEER incidence rates by race/ethnicity female breast all ages 2000-2007.

Data Source: Rates are per 100,000 and are age-adjusted to the 2000 U.S. Standard Population. Cancer sites include invasive cases only unless otherwise noted. Mortality source: U.S. Mortality Files, National Center for Health Statistics, CDC. Incidence source: Data for African-Americans and European-Americans are from the SEER 9 registries, data for Asian/Pacific Islander, Hispanic, and American Indian/Alaska Native are from the SEER 13 registries. Hispanics and Non Hispanics are not mutually exclusive from whites, blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives. Incidence data for Hispanics and Non Hispanics are based on NHIA and exclude cases from the Alaska Native Registry. Rates for American Indian/Alaska Native are based on the CHSDA (Contract Health Service Delivery Area) counties.

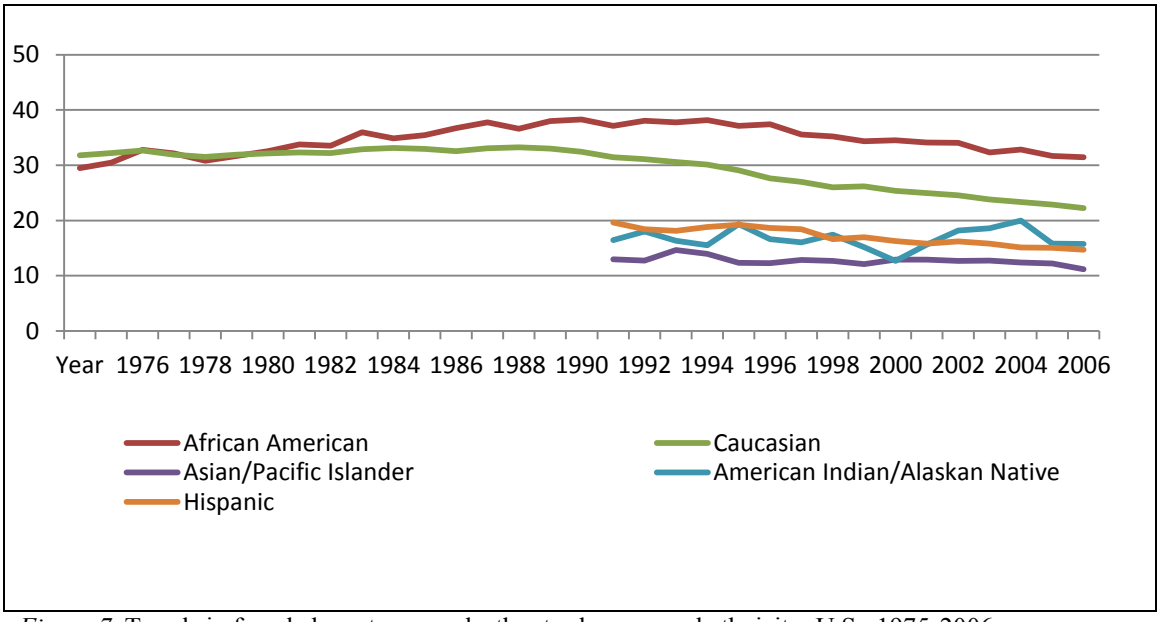

Figure 7. Trends in female breast cancer death rates by race and ethnicity, U.S., 1975-2006.

Data Source: Rates are per 100,000 and are age-adjusted to the 2000 U.S. Std Population. Cancer sites include invasive cases only unless otherwise noted. Mortality source: U.S. Mortality Files, National Center for Health Statistics, CDC. Incidence source: Data for African-Americans and European-Americans are from the SEER 9 registries, data for Asian/Pacific Islander, Hispanic, and American Indian/Alaska Native are from the SEER 13 registries. Hispanics and Non Hispanics are not mutually exclusive from whites, blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives. Incidence data for Hispanics and Non Hispanics are based on NHIA and exclude cases from the Alaska Native Registry. Rates for American Indian/Alaska Native are based on the CHSDA (Contract Health Service Delivery Area) counties.

Breast Cancer in Young Women

Between 2001-2006 the median age of women newly diagnosed with breast cancer was 61; women under 40 accounted for approximately 6% of newly diagnosed cases (Horner et al., 2009), and women over 40 years of age accounted for approximately 95% of newly diagnosed cases (ACS, 2010a).

Although the occurrence of breast cancer in women under 40 is somewhat rare, this group tends to present with cancer that is more advanced along with poorer prognostic characteristics (Yankaskas, 2006). As shown in Table 3, young women were diagnosed with breast cancer at a distant stage at a higher rate than their older

counterparts. The 5-year relative survival rate is slightly lower among women diagnosed with breast cancer before age 40 (83%) compared to women diagnosed at ages 40 or older (90%; ACS, 2010a). The same factors that put older women at an increased risk of cancer also effect young women. These factors include family history, African-American race, lack of physical activity, later age at menarche, genetic factors, and later age at first birth (Anders et al., 2008; Baquet et al., 2008; Yankaskas, 2006). Risk factors specifically associated with young women include genetics, oral contraceptive use, multiparity, history of miscarriages, smoking, and treatment for Hodgkin's Lymphoma (Althuis et al., 2003; Hall et al., 2005; Yankaskas, 2006).

Table 3
Stage Distribution (SEER Summary Stage 2000) percent by Age at Diagnosis/Death, Female Breast Cancer (2000-2007)

	European-American*		African-American*		American Indian/ Alaska Native*		Asian/Pacific Islander*	
	Age		Age		Age		Age	
Stage at Diagnosis	<50	50+	<50	50+	<50	50+	<50	50+
Localized	54.8	64.3	47.0	53.7	50.8	61.6	56.6	65.0
Regional	39.8	28.3	43.6	34.3	40.0	29.7	38.7	28.9
Distant	3.8	4.7	6.9	8.7	6.3	6.2	3.6	4.4
Unstaged	1.6	2.8	2.4	3.4	2.9	2.5	1.2	1.7

Data Source: Based on the SEER 17 areas (San Francisco, Connecticut, Detroit, Hawaii, Iowa, New Mexico, Seattle, Utah, Atlanta, San Jose-Monterey, Los Angeles, Alaska Native Registry, Rural Georgia and California, excluding SF/SJM/LA, Kentucky, Louisiana, and New Jersey). California excluding SF/SJM/LA, Kentucky, Louisiana, and New Jersey contribute cases for diagnosis years 2000-2006. The remaining 13 SEER Areas contribute cases for the entire period 1999-2006. Based on follow-up of patients into 2007. Cancer sites include invasive cases only unless otherwise noted.* Includes Hispanic race.

Overall, breast cancer incidence and death rates increase with age. During the years 2002-2006, approximately 95% of new cases and 97% of cancer deaths were among women aged 40 or older (Copeland et al., 2010). After the age of 80, there is a decrease in incidence rates. This decrease may reflect lower incidence of population screenings, detection of cancers before age 80, and/or incomplete detection (ACS, 2010a).

Prevention and Screening

There are many different risks associated with breast cancer; some can be changed and some cannot. Determinants that cannot be changed include race, age, family cancer history, early menstruation, previous chest radiation, and genetics (BRCA1 or BRCA2 mutations). Lifestyle choices that can also increase the risk are the use of oral contraceptives, not having children, taking hormone replacement therapy, abstaining from breastfeeding, consuming alcohol, being obese, eating high-fat diets, and having a sedentary lifestyle.

Although breast cancer is the most common type of cancer among women regardless of race or ethnicity (ACS, 2010a), and is the leading cause of cancer related deaths among women aged 15-54 (NCI, 2006a), there continues to be contrasting information regarding breast cancer among young women (YSC, 2008). Until recently, women were typically encouraged to begin breast self-exams (BSE) at age 20; and yearly mammograms at age 40. However, in 2009, the United States Preventative Task Force (USPTF) released recommendations stating that women aged 50-74 should receive biennial mammography screenings, and also adds that screenings prior to the age of 50

should be based on each individual patients risks and benefits of early screening (U.S. Preventive Services Task Force [USPSTF], 2010).

Conversely, according the ACS (2009c), women who are considered to be at a higher risk of breast cancer (greater than 20% lifetime risk) should include yearly breast MRIs beginning at the age of 30. Lifetime risk, which is the probability of developing or dying from breast cancer during an individual's lifetime; can be calculated using risk assessment tools such as the Breast Cancer Risk Assessment Tool, which is based on the Gail Model (Gail et al., 1989), and is discussed below. Also, women in this age group do not benefit from population screenings as only a small percentage of the population is affected by this cancer, and the mammography technology does not detect tumors in young breast tissue due to its density. The overall age adjusted *PPV* of screening mammography within this age group is 1.3%, and the age adjusted *PPV* of diagnostic mammography is 14.6% (Houssami et al., 2003).

Weiss et al. (1996) performed a population based case control study among women aged 20-44, who were newly diagnosed with breast cancer between 1990 and 1992, within the SEER registries of Atlanta, Seattle, and New Jersey. Control subjects were chosen through random digit dialing and matched by geographic location. A total of 1.616 breast cancers were analyzed. The method of detection among this population varied across stage of disease and age (see Table 4), however, the most common method of detection in all age groups was detection by the woman herself, or by her partner (Weiss et al., 1996).

Table 4
Method of Detection of Breast Cancer by Age and Stage at Diagnosis

	Stage at Diagnosis[a]							
	InSitu (*n* = 214)		Local (n = 784)		Regional/Distant (n = 602)		Total (n = 1600)	
Method of Detection	n	%	n	%	n	%	n	%
Age < 35								
Mammogram	8	30	1	1	3	2	12	4
Self/partner[b]	8	30	112	85	88	88	208	80
Physical	6	22	12	10	5	5	23	9
examination Other[c]	5	19	6	5	5	5	16	6
Age 35-39								
Mammogram	35	65	36	16	12	6	83	18
Self/partner[b]	15	28	171	74	150	80	336	71
Physical	3	6	20	9	15	8	38	8
examination Other[c]	1	2	5	2	10	5	16	3
Age 40-44								
Mammogram	81	61	105	25	32	10	218	25
Self/partner[b]	32	24	256	61	233	74	521	60
Physical	9	7	37	9	25	8	71	8
examination Other[c]	11	8	23	5	24	8	58	7

Note. [a]Data on methods of detection were not available for 14 in situ cases and two regional/distant cases. [b]Includes breast self-examination and accidental discovery by the patient or by her partner. [c]Includes pain, infection, mastitis, swelling, dimpling and nipple discharge, or bleeding. Adapted from "*Epidemiology of in situ and invasive breast cancer in women aged under 45*," Weiss, H. A., Brinton, L. A., Brogan, D., Coates, R. J., Gammon, M. D., Malone, K. E., Schoenberg, J. B., & Swanson, C. A., 1996, *British Journal of Cancer*, *73,* p. 1298-1305. Copyright 1996 Stockton Press. Adapted with permission.

Currently, no uniform guidelines exist concerning screening procedures for women under the age of 40 who are at an elevated risk. Additionally, cancer risk assessment tools such as the Breast Cancer Risk Assessment Tool, which is based on the Gail Model (Gail et al., 1989) are designed to estimate the lifetime risk for women aged 35 or older, and have been found to be ineffective to estimate risk in young women (Mackarem, Roche, & Hughes, 2001; Spiegelman, Colditz, Hunter, & Hertzmark, 1994).

The Gail model calculates both a 5-year and lifetime risk estimation for developing breast cancer. This calculation is based on the current age, race/ethnicity, age at menarche, age at the first live birth of a child, number of biopsies, and breast cancer history amongst first degree relatives (Gail et al., 1989). Although the Gail Model has been validated for European-American women, it has been found to underestimate risk among African-American women (Gail et al., 2007), and has not been thoroughly validated in Hispanic, Asian, or American Indian/Alaska Native women (Kaur, Roubidoux, Sloan, & Novotny, 2004). In 2007, the CARE model was created in order to more thoroughly ascertain risk among African-American women. The CARE model was structured around the original the Gail model constructs, and was based on updated incidence and mortality data among African-American women (Gail et al., 2007).

Consequently, it is essential for women to understand their actual breast cancer risk in order to have an open discussion with their doctor about proper screening methods based on this risk. In most cases mammography is viewed as the most accurate tool for screening in older women, but this method may not be appropriate for young women who have denser breast tissue in comparison to their older counterparts. A study on age-related accuracy of mammographies and ultrasounds found that mammography had a low sensitivity, detecting 76% of 25 cancers in women under the age of 35 and 69% of cancers in women between the ages of 36 and 40 (Houssami et al., 2003). When ultrasounds were utilized in the presence of a palpable mass, however, sensitivity increased to 84% for women under the age of 40 (Houssami et al., 2003). The overall age adjusted positive predictive value (*PPV*) of screening mammography was 1.3%, the *PPV*

increased with age 1.0% in women aged 25-29, 1.5% in women aged 30-34, and 1.3% in women aged 35-39. When looking at the overall age adjusted *PPV* of diagnostic mammograms (*PPV* 14.6%), there was a more pronounced increase with age. In women aged 18-24 the *PPV* was 2.3%, 8% in women aged 25-29, 13.8% in women aged 30-34, and 18.6% in women aged 35-39 (Houssami et al., 2003).

An additional study which investigated screening and diagnostic mammography use specifically in women under 40, found that both sensitivity and specificity varied across age groups as well as across diagnostic methods (Yankaskas et al., 2010). Screening mammography in women aged 35-39 years (n = 73,335) sensitivity was 76.1% and specificity was 87.5%; in women aged 30-34 years (n = 10,527) sensitivity was 81.5% and specificity was 85.8%, in women aged 25-29 years (n = 2,282) sensitivity was 66.7% and specificity was 83.0%; and no cancers were detected in the women aged 18-24 (n = 637). Diagnostic mammography in women aged 35-39 years had a sensitivity was 82.5% and specificity was 88.9%; in women aged 30-34 years sensitivity was 86.3% and specificity was 89.5%, in women aged 25-29 years sensitivity was 89.5% and specificity was 88.4%; and in women aged 18-24 sensitivity was 100% and specificity was 83.8%. The overall age-adjusted rates across all age groups were: sensitivity of 85.7%, specificity of 88.8%, *PPV* of 14.6%, and cancer detection rate of 14.3 cancers per 1000 mammograms (Yankaskas et al., 2010).

The researchers found that although younger women have very low breast cancer rates, their recall rates to receive additional screenings were high. This high recall rate can be due in part to younger women having dense parenchymal tissue which may also

mask tumors, as well as contribute to the lower performance of mammography in young women overall (see Table 5).

Table 5
Characteristics of Young Women Having Their First Mammography, Either Screening or Diagnostic, at Ages 18-39 Years: Breast Cancer Surveillance Consortium

	Screening Mammography				Diagnostic Mammography			
	Mammograms		Cancers		Mammograms		Cancers	
Characteristics	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Total	86781		188		30956		526	
Age Group								
18-24	637	(0.7)	0	(0.0)	1552	(5.0)	5	(1.0)
25-29	2282	(2.6)	6	(3.2)	4240	(13.7)	38	(7.2)
30-34	10527	(12.1)	27	(14.4)	11361	(36.7)	168	(31.9)
35-39	73335	(84.5)	155	(82.4)	13803	(44.6)	315	(59.9)
Race								
White	58137	(67.0)	121	(64.4)	20726	(66.0)	345	(65.6)
African-American	5994	(6.9)	22	(11.7)	2604	(8.4)	72	(13.7)
Other	13910	(16.0)	21	(11.2)	4746	(15.3)	71	(13.5)
Missing	8740	(10.1)	24	(12.8)	2880	(9.3)	38	(7.2)
Breast Density								
Almost entirely fat	3069	(3.5)	3	(1.6)	1012	(3.3)	9	(1.7)
Scattered fibroglandular densities	20172	(23.2)	41	(21.8)	6413	(20.7)	92	(17.5)
Heterogeneously dense	26837	(30.9)	70	(37.2)	10193	(32.9)	194	(36.9)
Extremely dense	8957	(10.3)	22	(11.7)	4596	(14.8)	80	(15.2)
Missing	27746	(32.0)	52	(27.7)	8742	(28.2)	151	(28.7)
Self-reported breast lump								
Yes	4302	(5.0)	49	(26.1)	20392	(65.9)	455	(86.5)
No	78924	(90.9)	127	(67.5)	8884	(28.7)	61	(11.6)
Missing	3555	(4.1)	12	(6.4)	1680	(5.4)	10	(1.9)

Note. Adapted from "Performance of first mammography examination in women younger than 40 Years," Yankaskas, B., Haneuse, S., Kapp, J. M., Kerlikowske, K., Geller, B., & Buist, D., 2010, *Journal of the National Cancer Institute, 102,* p. 692-701. Copyright 2010 by Yankaskas, B. Adapted with permission.

Although breast cancer screenings are necessary to confirm the presence of cancer, there are noted limitations and risks such as false negatives, false positives, and radiation exposure. False negatives occur when mammograms appear normal, but miss breast cancer that is present at the time of the screening, whereas false positives occur when a mammogram appears to be abnormal when there is no actual cancer present at the time of screening. Houssami et al. (2003) found that among the women in their study that did not have cancer, approximately 9% received one true-negative result, while the opposite test (mammography or sonography) produced a false-positive.

As discussed above, these limitations can occur in women that have dense breasts in which mammography has been shown to have lower sensitivity (Houssami et al., 2003; Yankaskas et al., 2010). Similarly, false positives can occur when a mammogram is deemed to be abnormal, when in fact no breast cancer is present at the time of the screening. As previously mentioned, the overall age adjusted positive predictive value (*PPV*) of screening mammography was 1.3%, the *PPV* increased with age 1.0% in women aged 25-29, 1.5% in women aged 30-34, and 1.3% in women aged 35-39 (Houssami et al., 2003). The low PPVs among this population due to issues such as breast density (Tamimi, Byrne, Colditz, & Hankinson, 2007) may potentially lead to unnecessary biopsies and testing in women (Yankaskas et al., 2010).

A possible risk associated with mammography is radiation exposure. Mammograms use very low levels of radiation; although it is not definitively known, contradictory reports discuss repeated low-dose medical radiation exposure and breast cancer risk (John et al., 2007; Ma, Hill, Bernstein, & Ursin, 2008).

Another noted issue linked to screening is interval cancer. Interval cancer is cancer that occurs in the time period between screening tests such as between recommended annual mammograms. Interval cancers have a tendency to be larger, and have a higher grade and stage at the time of diagnosis in comparison to cancers that are detected at an initial screening. This suggests that interval cancers may be biologically different and more aggressive than screen-detected cancers (Raja, Hubbard, & Salman, 2001). Lowery et al. (2011) utilized a population-based mammography program in Colorado (1994-2001) to examine the risk factors for interval breast cancer among women. The overall risk for interval cancer was analyzed in terms of the incidence per 10,000 negative screenings and the proportion of all breast cancers positively diagnosed. Among the 208,667 women aged 40 and older that were screened, the researchers identified both interval ($N = 557$) and screen-detected cancers ($N = 1,545$; Lowery et al., 2011). Lowery also noted that the risk of interval cancer was 29.5 per 10,000 women screened.

Lowery et al. (2011) investigated interval cancer by calculating both the incidence per 10,000 normal mammograms and the proportion of interval versus screen-detected cancers diagnosed among all women screened. The authors speculate that by assessing risk using a dual approach, it may assist in defining variables that are important in calculating risk based on etiology as well as identifying women that are high-risk and would benefit from increased surveillance in-between regular screenings (Lowery et al., 2011). The researchers found that incidence rates were elevated for women >50 (*OR,* 2.28), that had a family history of cancer (*OR*, 2.23), women with dense breasts (*OR*,

3.84), and women who had used or were currently using hormones (*OR*, 1.54; see Table 6). Hispanic women had lower incidence than European-Americans (*OR,* 0.52). Overall, interval cancers represented 26% of all newly diagnosed cancers. This proportion was higher in women <50 (*OR*, 1.41) and in women with dense breasts (*OR*, 2.95; Lowery et al., 2011). Extreme breast density was found to predict more than a threefold increase in incidence of interval cancer in both younger women (*OR*, 3.66) and older women (*OR*, 3.79). Density also disproportionately predicted occurrence of interval versus screen-detected cancer but only in older women (*OR*, 3.53; Lowery et al., 2011).

The researchers note that there was not a significant difference in proportion of interval cancer identified across racial and ethnic groups. Although there was a somewhat increased proportion of breast cancers diagnosed in African-American women when compared to European-American women (31% vs. 27%), this was not found to be significant (Lowery et al., 2011).

The researchers conclude that the incidence of interval cancer tends to increase with age, breast density, hormone use, and family history. Based on these findings, efforts to reduce the occurrence of interval cancers among these subgroups of women should be made. The increased proportion of interval cancers associated with young age and breast density indicate that interval cancers result from difficulties in detection due to dense breasts and rapid growth of the cancer itself. Women within the identified high-risk subgroups may benefit from more intense screening and from tailored breast health education outreach.

Table 6
Risk of Interval Versus Screen-detected Breast Cancer According to Age, Ethnicity, Family History, Current Hormone Use, and Breast Density Within 12 Months of a Screening Mammogram

Characteristic	Number of interval breast cancers *N*	(%)	Number of screen-detected cancers *N*	(%)	Odds ratio-interval vs. screen-detected crude	(95% *CI*)	Odds ratio adjusted (95% *CI*)	
Total	557	(26%)	1,545	(74%)				
Age								
40-49	125	(33%)	256	(66%)	1.58	(1.19-2.10)	1.41	(1.04-1.90)
50-59	160	(27%)	432	(78%)	1.20	(0.92-1.55)	1.04	(0.79-1.37)
60-69	130	(25%)	398	(75%)	1.06	(0.80-1.39)	0.95	(0.72-1.26)
70+	142	(24%)	459	(76%)	1.00		1.00	
Ethnicity								
African-American	17	(31%)	37	(69%)	1.27	(0.71-2.27)	1.24	(0.68-2.26)
Hispanic	21	(20%)	83	(80%)	0.70	(0.43-1.14)	0.70	(0.43-1.15)
Non Hispanic White	508	(27%)	1,400	(73%)	1.00		1.00	
Family History								
FDR* dx<50	19	(37%)	32	(63%)	1.75	(0.98-3.13)	1.70	(0.94-3.06)
FDR* (any age)	150	(30%)	343	(70%)	1.29	(1.03-1.61)	1.24	(0.98-1.56)
No Family Hx	407	(25%)	1,202	(75%)	1.00		1.00	
Current Hormones								
Yes	150	(27%)	398	(73%)	1.36	(1.02-1.80)	1.32	(0.99-1.76)
No	111	(22%)	400	(78%)	1.00		1.00	
Breast Density								
Extremely dense	54	(43%)	71	(57%)	3.31	(2.20-4.97)	2.95	(1.94-4.48)
Heterogeneous dense	183	(32%)	394	(67%)	2.02	(1.54-2.64)	1.87	(1.42-2.46)
Entirely fat/ scattered fibrodensities	113	(19%)	491	(81%)	1.00		1.00	

Note. *FDR = First Degree Relative. Adapted from "Complementary approaches to assessing risk factors for interval breast cancer," J. Lowery et al., 2011, *Cancer Causes and Control*, 22, p. 23-31. Copyright 2010 by Springer Science Media. Adapted with permission.

Health Behavior Risks

Numerous determinants contribute to this disease; some can be changed, and some cannot. Lifestyle choices such as not having children, taking hormone replacement

therapy, abstaining from breastfeeding, consuming alcohol, being obese, eating high-fat diets, and having a sedentary lifestyle, can be changed.

Smoking

The link between smoking and breast cancer has been highly debated in the literature among both young and older women (Ahern, Lash, Egan, & Baron, 2009; Band, Le, Fang, & Deschamps, 2002; Hamajima et al., 2002). Multiple studies have found no significant association between smoking and breast cancer risk (Al-Delaimy, Cho, Chen, Colditz, & Willet, 2004; Lash &Aschengrau, 2002; Prescott, Ma, Bernstein, & Ursin, 2007), whereas multiple studies have identified an increased risk (Band et al., 2002; Kropp & Chang-Claude, 2002; Palmer et al., 1991).

Al-Delaimy et al. (2004) followed a group of 112,844 women, most of which were premenopausal aged 25-42. The women were followed for 10 years to investigate the possible association between smoking and breast cancer incidence based on estrogen receptor status. During the course of follow-up, there were 1,009 cases of breast cancer diagnosed (Al-Delaimy et al., 2004). However, the Al-Delaimy et al. (2004) found no significant increase in overall breast cancer risk associated with smoking status, as the relative risk for *never smokers* was (*RR,* 1.00), *past smokers* (*RR*, 1.18), and *current smokers* (*RR*, 1.12). Covariates included age, BMI, height, alcohol consumption, age at menarche, use of oral contraceptives, age at first live birth, parity, personal history of benign breast disease, family history of breast cancer, and menopause status (Al-Delaimy et al., 2004).

In contrast to the findings of Al-Delaimy et al. (2004), Gram et al. (2005) followed a similarly aged group of women with the opposite result. A group of 102,098 women, ages 30-50, were observed over a time period of 8 years. During the course of the study, 1,240 women were diagnosed with breast cancer (Gram et al., 2005). Covariates included age at enrollment, age at menarche, menopause status, age at first live birth, parity, BMI, alcohol consumption, use of oral contraceptives, and family history of breast cancer (Gram et al., 2005). Non smoking women were utilized as the comparison group (*RR*, 1.0), an increased risk was identified among women who had smoked for at least 20 years, and over 10 cigarettes per day (*RR*, 1.34), women who began smoking prior to their first live birth (*RR,* 1.27), women who began smoking prior to menarche (*RR*, 1.39), and women who began smoking before age 15 (*RR*, 1.48; Gram et al., 2005). This same increase in risk however, was not noted in women who had smoked for at least 20 years following their first live birth. Another important finding from this cohort was that the researchers did not find that family history of breast cancer, menopause status, or any other previously established risk factor for breast cancer modified the association found with smoking (Gram et al., 2005).

Breast feeding

The protective effects of breast feeding in reducing breast cancer risk has been observed among women of all ages and ethnicities (Ursin et al., 2005). There are multiple mechanisms which are thought to be associated with this protective effect against breast cancer; postponing ovulation, decreasing estrogen levels in the breast, changing the composition of breast tissue (Ursin et al., 2005). Lactation following pregnancy

postpones ovulation, which in turn reduces the fluctuation of hormones throughout each menstrual cycle (Russo & Russo, 1994; Ursin et al., 2005). The composition of breast tissue changes across a woman's pregnancy, these changes can lead to permanent physiological changes within the breast which are thought to offer a protective effect against breast cancer (Petrakis et al., 1987; Russo & Russo, 1994; Ursin et al., 2005).

Ursin et al. (2004) evaluated if the number of full-term pregnancies, a woman's age at first full-term pregnancy, and total duration of breastfeeding were associated with comparable relative risk across both European-American and African-American women.

The study population was comprised of 4,567 women (2,950 European-American women and 1,617 African-American women) 35-64 years old, who had been newly diagnosed with invasive breast cancer between 1994 and 1998. The control participants included 4,668 women (3,012 European-American women and 1,656 African-American women). During the final data analysis, women were dichotomized into two age groups, women under 50 and women over 50 years old. This method was used to look at how these variables effected women that were either premenopausal versus postmenopausal. The study analyzed the reproductive variables of gravidity, parity, number of pregnancies, number of full-term pregnancies, age at first full-term pregnancy, and years since last full-term pregnancy. Associated breastfeeding variables analyzed were; ever breastfed versus never breastfed, ever breastfed for more than 2 weeks versus never breastfed, total duration of breastfeeding (in months), and total duration of breastfeeding without providing supplemental feedings (in months; Ursin et al., 2004).

In both European-American and African-American women, a reduction in risk was identified with each full-term pregnancy across a woman's lifetime. In European-American women, the reduction in risk was 13% among younger women (ages 35-49 years) and 10% among older women (ages 50-64 years); among African-American women there was a 10% reduction in young women and a 6% reduction in older women (Ursin et al., 2004). Overall risk also decreased significantly with each additional full-term pregnancies across both races and age categories. It was also noted that although African-American women tended to have more children than European-American women, breast feeding rates were much lower in younger African-American women versus younger European-American women (see Table 7). The duration of lactation was inversely associated with breast carcinoma risk among younger European-American (trend $p = 0.0001$) and African-American (trend $p = 0.01$) women (Ursin et al., 2004). Based on these findings, the researchers note that if young African-American women are giving birth to fewer children than in the past, and there is not a significant increase in breastfeeding, breast cancer incidence will continue to rise at a rapid rate among this population compared to their European-American counterparts (Ursin et al., 2004).

Table 7
Distribution of Parity and Breastfeeding Practices among Control Patients by Age and Race Characteristic

	European-American		African-American	
Characteristic	35-49 yrs	50-64 yrs	35-49 yrs	50-64 yrs
No. of parous women (% of all women)	1130 (74.7)	1307 (87.2)	698 (83.7)	730 (88.8)
Mean no. of live births among parous women ±*SE*	2.2 ± 0.03	2.9 ± 0.04	2.5 ± 0.05	3.4 ± 0.08
No. of women (% of all women) with first live birth at age <19 yrs	126 (8.3)	170 (11.3)	235 (28.2)	276 (33.6)
No. of women (% of all women) with >3 live births	120 (7.9)	343 (22.9)	132 (15.8)	293 (35.6)
No. breastfeeding (% of all parous women)	848 (75.0)	770 (58.9)	338 (48.4)	376 (51.5)
Mean no. of months breastfeeding (among women who breastfed) ±*SE*	15.0 ± 0.62	9.0 ± 0.47	9.4 ± 0.76	10.8 ± 0.73

Note. SE: standard error. Adapted from "Reproductive Factors and Risk of Breast Carcinoma in a Study of White and African-American Women," Ursin, G., Bernstein, L., Wang, Y., Lord, S. J., Deapen, D., Liff, J. M., Norman, S. A., Weiss, L. K., Daling, J. R., Marchbanks, P. A., Malone, K. E., Folger, S. G., McDonald, J. A., Burkman, R. T., Simon, M. S., Strom, B. L., & Spirtas, R., 2004, *Cancer, 101, p.* 353-362. Copyright 2010 by American Cancer Society. Adapted with permission.

Body Mass Index

The relationship between obesity and breast cancer risk is a complex issue. Studies have found that premenopausal women exhibit an inverse relationship between body mass index (BMI) and breast cancer risk (John, Sangaramoorthy, Phipps, Koo, & Horn-Ross, 2011; Peacock, White, Daling, Voigt, & Malone, 1999; Swanson et al., 1996). However, breast cancer risk among postmenopausal women increases as BMI increases (Lacey et al., 2009; Morimoto et al., 2002). Obesity has been linked to an increased risk of cancer as well as other health conditions such as diabetes, stroke, heart

disease, high-cholesterol, hypertension, and arthritis (Flegal, Carroll, Ogden, & Curtin, 2010; Malnick & Knobler, 2006). High BMI has also been found to increase mortality rates among women with breast cancer across all ages and ethnicities (Dal Maso et al., 2008; Daling et al., 2001; Ewertz et al., 2011).

Daling et al. (2001) conducted a study investigating survival in relation to body mass index (BMI) among women who were diagnosed with breast cancer before the age of 45 (n = 1,177). The researchers found that women who were in the highest quartile of BMI ($\geq$25.847 kg/m^2) were 2.5 times more likely to die from breast cancer related illness, when compared to women who were in the lowest BMI quartile (<20.639 kg/m^2; Daling et al., 2001).

Genetic Risks

As previously discussed genetic mutations such as BRCA1 or BRCA2 can considerably increase a woman's risk for breast cancer. BRCA1 and BRCA2 are tumor suppressor genes. In normal cells, BRCA1 and BRCA2 stabilize the cell's genetic material and prevent uncontrolled cell growth (the formation of a tumor). Although the actual percentage of breast cancer that is found to be due to BRCA1 and BRCA2 mutations is relatively low at 5-10% (ACS, 2009a); the gene-disease association itself has been found to be strong (Evans, Skrzynia, Susswein, & Harlan, 2006). Although an overrepresentation of the mutations among a specific racial or ethnic group has not been identified, women from Ashkenazi Jewish ancestry have been noted to have a slightly higher risk of carrying the mutations (Petrucelli, Daly, Bars Culver, & Feldman, 2007). Over 800 deleterious mutations have been identified that are related to BRCA1 and

BRCA2. These mutations within the DNA can be due to things such as exposure to natural and medical radiation or environmental contaminants (Campeau, Foulkes, & Tischkowitz, 2008; Petrucelli et al., 2007).

Antoniou et al. (2003) performed a meta-analysis utilizing pooled pedigree data from 22 studies involving 8,139 index case patients including 500 patients who carried BRCA1 or BRCA2 mutations. The average cumulative risks in BRCA1 carriers by age 70 years were 65% (95% confidence interval 44%-78%) for breast cancer, the average cumulative risk in BRCA2 carriers were 45% (31%-56%) and 11% (2.4%-19%). It was also found that the relative risk of breast cancer significantly declined with age for BRCA1 carriers, but not with BRCA2 carriers. As previously discussed, women that carry BRCA1 and BRCA2 mutations are encouraged to consider preventative measures due to their increased risk of breast cancer. These preventative measures are complex and involve various levels of risk; therefore it is imperative that women understand their actual risk and what each option entails in order to make an informed decision.

Environmental Risk

Another factor that may contribute to breast cancer risk is environmental exposures. Although it is not specifically known exactly how environmental exposures interact with genetic and hormonal factors, research has associations between certain endocrine disrupting compounds, organic solvents, and polycyclic aromatic hydrocarbons (PAHs) in occupational settings (Hansen, 1999; Labrèche, Goldberg, Valois, & Nadon, 2010; Peplonska et al., 2010; Zota, Aschengrau, Rudel, & Brody, 2010). Identifying an association within population studies is more complex due to the lack of exposure

assessment tools, latency, and variations in susceptibility, and differentiation between direct and indirect exposures (Laden & Hunter, 1998).

A prospective, nested case-control study was performed in 2007 (Cohn, Wolff, Cirillo, & Sholtz) to investigate whether DDT (dichloro-diphenyl-trichloroethane) exposure in young women predicted breast cancer. DDT was a pesticide that was used to control insect pests on crop and forest lands, in homes and gardens, and for industrial and commercial purposes. It was heavily used from the 1940s until its ban in 1972 (Environmental Protection Agency, 2010). The researchers utilized blood samples obtained from young women between 1959-1967. The women were participating in the Child Health and Development Studies, Oakland, California. Blood samples were provided 1-3 days after giving birth (mean age, 26 years). Cases (n = 129) had developed breast cancer before the age of 50 years, and controls (n = 129) were matched to cases on birth year.

All subjects tested had detectable levels of DDT (≥ 0.8 μg/L), 65% had measurements of above the minimum detectable level (0.4 μg/L). The researchers found a 5-fold increase in the association between breast cancer and DDT among women born after 1931; these women were between 14 and 20 years of age when DDT usage peaked. Women who were not exposed DDT before 14 years of age (born prior to 1931) showed no association between DDT and breast cancer (p = 0.02 for difference by age). It was also noted that approximately 78% of cases and 74% of controls reported no residence on a farm, which suggests that the majority of DDT exposure occurred in an urban environment, through diet and direct contact with the compound being used for

household pest control. Although there are noted limitations within the study; such as sample size and confounding factors, the researchers feel that this illustrates that exposure to DDT in early life may increase breast cancer risk.

The Cape Cod Breast Cancer and Environment Study investigated whether the use of household cleaners and pesticides increases breast cancer risk. This study investigated women's exposures to contaminants in tap water, to include endocrine disrupting chemicals and chemicals known to cause mammary cancer in animals (Zota et al., 2010). Cases (n = 787) were diagnosed with breast cancer between 1988 and 1995, and controls (n = 721) were matched to cases on decade of birth and vital status. Participants self-reported product use and measured their beliefs about what causes breast cancer, or increases a woman's risk for breast cancer. In order to address potential recall bias in self-reporting, the researchers stratified product-use odds ratios by beliefs about how contaminants may contribute to breast cancer. These results were then compared with odds ratios for family history of breast cancer, stratified by beliefs and conceptions about heredity breast cancer.

The researchers found that breast cancer association increased two-fold in the highest quartile of self-reported combined cleaning product use (adjusted OR = 2.1), and combined air freshener use (adjusted OR = 1.9) in comparison to the lowest quartile. Respective odds ratios for women reporting *ever use* of air freshener spray (OR = 1.2), solid air freshener (OR = 1.7), and mold or mildew control (OR = 1.7) was also associated with an increased risk. The researchers also noted positive dose responses linked to solid air freshener and mold or mildew control with bleach. There were no

significant findings associated with pesticide use across all quartiles. The researchers also noted that cleaning products odds ratios were elevated among participants who believed pollutants contribute *a lot* to breast cancer and moved towards the null among participants who felt pollutants contributed *a little* or *not at all*. Among women who believed that that heredity contributes *a lot* to breast cancer, the odds ratio was higher (*OR* = 2.6), than other women within the study (*OR* = 0.7). Zota et al. (2010), conclude that the results of the study suggest that cleaning product use contributes to increased breast cancer risk.

The authors note that their results contradict those from Teitelbaum et al. (2007), which was a case-control study investigating the association between self-reported residential pesticide use and breast cancer risk among women living in Long Island, New York. The study population was comprised of 1,508 women who were diagnosed with breast cancer between 1996 and 1997; and 1,556 randomly selected, age-matched controls. Participants were interviewed in detail about pesticide use in and around their homes, insect repellant use, lice control product use, and the use of flea and tick control products on their pets. The researchers calculated overall pesticide use based on the sum of the lifetime reported applications across all of the identified categories. Two groups consisting of combined products were also analyzed; this included a lawn and garden grouping and nuisance pest grouping. Unlike the study by Zota et al.(2010), the authors found that among the women who were in the highest quintiles of pesticide use, there was a 30% increased risk of breast cancer in comparison to those women who were in the lowest quintiles of pesticide use (Teitelbaum et al., 2007). It is important to note

however, that the results of both studies further illustrates the complexity of retrospective self-report studies when attempting to base valid associations while controlling for the potential of recall bias.

Breast Cancer Risk Reduction

A woman who has an average risk of breast cancer can reduce her probability of getting breast cancer by various lifestyle and behavior modifications. These modifications can include quitting smoking (Cui, Miller, & Rohan, 2007), adopting a low-fat diet (Prentice et al., 2006), and increasing physical activity (Brody et al., 2007; Reeves et al., 2007; Speck, Schmitz, Lee, & McTiernan, 2011). These targeted health behavior modifications can decrease the overall risk of breast cancer as well as improve a woman's basic health (Speck et al., 2011).

In addition to behavior modification, the prevention choices for high risk women who have a genetic mutation such as BRCA1 or BRCA2 can include preventative mastectomy, chemoprevention, or preventative Oophorectomy (removal of the ovaries). These preventative measures are complex and involve various levels of risk; therefore it is imperative that women understand their actual risk and what each option entails in order to make an informed decision. Another less invasive option may be to participate in intensive preventative screenings in lieu of chemoprevention or surgical intervention; however, this alternative does not guarantee an improved survival rate when compared to more aggressive surgical interventions (Anderson et al., 2006).

Racial and Ethnic Disparities

Although breast cancer is the most common type of cancer among women regardless of race or ethnicity, there are measureable disparities across these groups when looking at incidence, prevalence, and survival (ACS, 2009d; Hall et al., 2005; Joslyn et al., 2005). Currently, breast cancer is the second leading cause of cancer related deaths among European-American and African-American women, and is the first leading cause of cancer related deaths among Hispanic women (ACS, 2009e).

Among Hispanic women, breast cancer is the most common type of cancer diagnosed, with an estimated 14,200 new cases being diagnosed, and 2,200 deaths in 2009 (ACS, 2009e). Young Hispanic women can be at an increased risk of breast cancer for many of the same reasons as their older counterparts. Specific risk factors that cannot be modified include family history, later age at menarche, late menopause, and genetic factors (BRCA1 or BRCA2 mutations; Anders et al., 2008; Baquet et al., 2008; Yankaskas, 2006). Whereas factors such as multiparity, postmenopausal obesity, use of postmenopausal hormones, alcohol consumption, diet, and lack of physical activity are modifiable. The overall incidence rate of breast cancer in Hispanic women is 27% lower than that of non Hispanic European-American women (ACS, 2009e). Approximately 7% of this difference in incidence may be attributed to the protective effect of reproductive patterns among Hispanic women such as lower age at first birth and multiparity (Sweeny et al., 2008). Other possibilities include less use of hormone replacement therapy following menopause or under utilization of diagnostic services (Shavers et al., 2003; Smith-Bindman et al., 2006).

Another area that has been found to have racial/ethnic disparities is follow-ups after an abnormal mammogram. Press, Carrasquillo, Sciacca, and Giardina (2008) investigated possible disparities in follow-up after an abnormal mammogram. The cohort was made up of 6,722 women who had an abnormal mammogram, which had been performed at an academic medical facility in New York. The cohort included 2,143 (32%) European-American women, 915 (14%) African-American women, 3,291 (49%) Hispanic women, and 373 (6%) women from Asian or other racial/ethnic groups. The outcome measure was the number of days between the abnormal mammogram and follow-up appointment. The authors (2008) defined five factors that may contribute to disparities found in the steps between detection and diagnosis:

> (a) African-American and Hispanic women seek medical help at a later stage of breast cancer; (b) minority women experience delays in the initiation and completion of treatment; (c) there are differences in the type of treatment received by African-American and Hispanic women; (e) African-American women are more likely to receive fewer cycles of the expected treatment compared with European-American women; and (f) African-American women present with a more aggressive form of breast cancer. (Press et al., 2008)

Both African-American and Hispanic women had a significantly greater time to diagnostic follow-up when compared to European-American women. The median time for diagnostic follow-up was 21 days for Hispanic women, 20 days for African-American women, and 14 days for European-American women. After 30 days, 75% of African-American and 74% of Hispanic women received follow-up, compared to 86% of

European-American women. At the 60 day mark, 90% of women across all of the groups had received follow-up care, although some women were still less likely to have received follow-up imagining in conjunction with an office visit ($p < 0.01$ for Hispanic vs. European-American women).

As previously noted, many of the same factors that put older women at an increased risk of cancer also effect young women. One such factor is African-American race (Anders et al., 2008; Baquet et al., 2008; Yankaskas, 2006). Breast cancer is the most common type of cancer diagnosed in African-American women; with an estimated 19,540 new cases being diagnosed, and 6,020 deaths in 2009 (ACS, 2009d). The overall incidence of breast cancer in African-American women is 10% lower than European-Americans; however, when adjusting for age, African-American women under 40 have a higher incidence rate (Joslyn et al., 2005; ACS, 2009d). The age-specific incidence rates among African-American women under 40 as compared to European-American women during the same time period are listed in Table 8.

Table 8
Age-Specific (Crude) SEER Incidence Rates by Cancer Site, African-American, European-American, American Indian/Alaska Native, and Asian/Pacific Islander, Female, (2000-2007)

	African-American*		European-American*		American Indian/ Alaska Native*		Asian/Pacific Islander*	
Age at Diagnosis	Female Breast	Breast (In Situ)	Female Breast	Breast (In Situ)	Female Breast	Breast (In Situ)	Female Breast	Breast (In Situ)
20-24	2.2179	**	1.4351	0.1538	**	**	1.2064	**
25-29	11.329	0.9311	7.7173	0.7171	**	**	6.8086	**
30-34	31.8878	2.6573	25.1645	2.4238	15.6355	**	22.678	2.6933
35-39	65.2024	9.2325	58.8596	10.3118	47.7134	**	54.0119	9.6021

Note. Rates are per 100,000. Data source: SEER 17 areas (San Francisco, Connecticut, Detroit, Hawaii, Iowa, New Mexico, Seattle, Utah, Atlanta, San Jose-Monterey, Los Angeles, Alaska Native Registry, Rural Georgia, California excluding SF/SJM/LA, Kentucky, Louisiana, and New Jersey). * Includes Hispanic race. ** Statistic not displayed due to less than 16 cases.

Despite the lower overall incidence of breast cancer among African-American women, they continue to have a higher mortality rate than European-American women. Breast cancer mortality rates for African-American and European-American women were approximately the same in the 1980s, but during the period of 2001-2005, the mortality rate for African-American was 37% higher than European-American women. This difference in mortality accounted for more than one-third of the overall cancer mortality disparity between African-American and European-American women (ACS, 2009d). Possible factors that contribute to this disparity include race, aggressive tumor characteristics, as well as socioeconomic factors such as access to care, treatment choices, and health behaviors (Hall et al., 2005; Shavers et al., 2003; Yankaskas, 2006).

The 5-year survival rate refers to the percentage of patients who live at least 5 years after being diagnosed with cancer (ACS, 2010b). Many individuals live far beyond

the 5 years following initial diagnosis. The 5-year relative survival rates also take into consideration the fact that some patients with cancer die from other unrelated causes. As shown in Table 9, 5-year survival rates are considered to be a more accurate and concise way to describe the outlook for patients with a particular type and stage of cancer. The overall 5-year relative survival for 1999-2006 from 17 SEER geographic areas was 89.0% for women of all ages. The overall 5-year relative survival by race was 90.2% for European-American women; 77.5% for African-American for women of all ages (Altekruse et al., 2010).

Table 9
Percent Stage Distribution and 5-year Relative Survival by Stage at Diagnosis for 1999-2006, Females

	European-American		African-American	
Stage at Diagnosis	Ages <50	Ages 50+	Ages <50	Ages 50+
Localized	96.6	99.3	91.6	93.7
Regional	85.2	84.9	72.3	72.0
Distant	33.5	22.6	14.5	15.4
Unstaged	77.6	53.1	52.3	45.2

Note. Based on the SEER 17 areas (San Francisco, Connecticut, Detroit, Hawaii, Iowa, New Mexico, Seattle, Utah, Atlanta, San Jose-Monterey, Los Angeles, Alaska Native Registry, Rural Georgia, and California, excluding SF/SJM/LA, Kentucky, Louisiana, and New Jersey). California excluding SF/SJM/LA, Kentucky, Louisiana, and New Jersey contribute cases for diagnosis years 2000-2006. The remaining 13 SEER Areas contribute cases for the entire period 1999-2006. Based on follow-up of patients into 2007.

Socioeconomic Status and Socioeconomic Position

Census data are commonly used in public health research; it allows researchers to take specific socioeconomic status (SES) variables into consideration when investigating a health concern. Specific SES measures such as geographic location, education,

occupation, and income may indicate specific health care choices, potential environmental exposures, and access to adequate medical services (Baquet & Commiskey, 2000; Koh, 2009; Roetzheim et al., 2000; Smith-Bindman et al., 2006; ACS, 2009d). When investigating breast cancer; race, ethnicity, and SES are difficult concepts to define in theory and practice. Each concept encompasses specific health behaviors, treatment choices, comorbid conditions, as well as overall health status (Krieger, Emmons, & Williams, 2009; O'Malley et al., 2003; Wallington et al., 2009). In discussing SES, it is important to also understand the function of socioeconomic position (SEP) and its effect on SES. SEP is mainly comprised of measures including education attainment, income, and occupation (Galobardes et al., 2007; Sorensen, Sembajwe, Harley, & Quintiliani, 2009). SEP plays an integral part in influencing SES and therefore also has an influence on lifestyle, housing choices, health behaviors, income, and cancer outcomes (Galobardes et al., 2007). For the purpose of this study, I. referred to these variables and functions of SEP as the broader category of SES.

As previously discussed, although European-American women have the highest incidence rates of breast carcinoma; African-American women continue to have the highest mortality rates (Hall et al., 2005; Newman et al., 2002). African-American women also typically present with poorer prognostic characteristics which have been found to be a strong indicator for decreased survival (Shavers et al., 2003; Yankaskas, 2006). SES is also associated with access to care, age at diagnosis, and more aggressive tumor characteristics (Krieger et al., 2009; O'Malley et al., 2003; Roetzheim et al., 2000; Smith-Bindman et al., 2006; Wallington et al., 2009).

Clinical Characteristics

Various differences in clinical characteristics—such as stage distribution, tumor size and grade, lymph node status, and hormone receptor status—have also been noted within ethnic/racial groups (Baquet et al., 2008; Biffl, Myers, Franciose, Gonzalez, & Darnella, 2001; Newman et al., 2002; Shavers et al., 2003; Swanson et al., 2003). In 2003, Shavers et al. performed a multivariate logistic regression analysis in order to examine racial/ethnic variations in diagnosis, treatment, and survival of breast cancer in women under 35. After examination of clinical presentation at diagnosis, the researchers identified differences in stage distribution across various racial/ethnic groups. They found that both Hispanic women (*RR*, 0.5), and African-American women (*RR*, 0.8), were less likely than European-American women to be diagnosed with in situ breast cancer. Also, African-American women (*RR*, 0.96) and Hispanic women (*RR*, 0.97), were slightly less likely to be diagnosed with Stage I-II disease than European-American women. The researchers also found differences in tumor size across racial/ethnic groups. Both African-American and Hispanic women were significantly less likely that European-American women to be diagnosed with a tumor < 1 cm (*RR*, 0.6; Shavers et al., 2003).

When investigating differences in standards of care and treatment, variations were documented across all racial/ethnic groups. Both African-American (78.7%) and Hispanic (77%) women received axillary lymph node examinations less frequently than European-American women (81.4%), even though African-American and Hispanic women were more likely to have positive lymph nodes than European-American women (Shavers et al., 2003). Differences were also noted in course of treatment following breast

conservation treatment. In comparison to European-American women, both African-American (*RR*, 1.8) and Hispanic (*RR*, 1.7) women were almost twice as likely not to receive cancer-directed surgery for invasive breast cancer. Following cancer-directed surgery, African-American (*RR*, 0.8) and Hispanic (*RR*, 0.8) women were significantly less likely to receive adjuvant radiation therapy (Shavers et al., 2003). The researchers note that these differences can be due to a variety of factors such as lack of insurance status and fear and fatalism surrounding the utilization of breast cancer screening.

Another analysis performed by Baquet et al. (2008) found when looking at women of all ages, that African-American women were significantly more likely than European-American women (9.0% vs. 5.3%, $p<0.0001$) to be diagnosed with breast cancer at an advanced stage. Also, 34.2% of African-American women were diagnosed with breast cancer at a regional stage at an increased rate in comparison to European-American women (27.8%). The analysis performed by Baquet et al. (2008) utilized the SEER database in order to calculate specific age-adjusted incidence, mortality, relative survival rates, tumor grade, histology and receptor status, and treatment patterns for invasive breast cancer among African-American and European-American women of all ages. The researchers found that in women under the age of 40, both African-American women (44.6%, $p<0.05$) and European-American women (41.6%, $p<0.05$) were more likely to be diagnosed at a regional stage than their older counterparts (40-49 [38.9% of African-American women and 35.2% of European-American women, $p<0.0001$] and women aged 50 or older [31.1% of African-American women and 25.4% of European-American women, $p<0.0001$]; Baquet et al., 2008).

Racial/ethnic disparities have also been noted in tumor size upon primary diagnosis. In patients under 35 a difference in median tumor size was found; African-American women were found to be significantly less likely than European-American women have a primary tumor measuring < 1 cm (*RR*, 0.6), 95% *CIs* [0.4, 0.8] as were Hispanic women (*RR*, 0.6), 95% *CIs* [0.4, 0.8; Shavers et al., 2003]. The median sizes of primary breast cancer tumors were 2.5 cm for European-American women, 2.8 cm for African-American women, and 3.0 cm for Hispanic women (Shavers et al., 2003). Swanson et al. (2003) analyzed SEER statistics from 1973-1997 and found that younger African-American women (under the age of 45) were presenting with tumors sized 2.0 cm and larger. Miller, Hankey, and Thomas (2002), analyzed breast cancer in 106,000 women in order to investigate ethnic differences in tumor stage and size.

Table 10
Distribution of Tumor Size by Percentage Among a Selected Population of Female Breast Cancer Patients Diagnosed Between 1992-1996

Tumor Size (cm)	European-American (*n* = 84,355)	African-American (*n* =9,025)	Hispanic (*n*=7,068)	Chinese (*n* = 1,385)	American Indian (*n* = 136)
<1.0	19.0	11.2	12.6	15.3	17.2
1.0-1.9	38.5	30.5	29.8	36.6	32.8
≥ 2.0	42.5	58.3	57.7	48.1	50.0
Unknown	8.9	11.8	8.6	8.5	5.9

Note. Adapted from "Impact of sociodemographic factors, hormone receptor status, and tumor grade on ethnic differences in tumor stage and size for breast cancer in U.S. women," Miller, B. A., Hankey, B. F., & Thomas, T. L., 2002, *American Journal of Epidemiology, 155, p.* 534-545. Copyright 2002 by Johns Hopkins Bloomberg School of Public Health. Adapted with permission.

African-American women under 45 also had a higher rate of lymph node-positive tumors smaller than 2.0 cm (34.2% vs. 28.5%) compared to their older counterparts (Swanson et al., 2003). Also, 57.2% of African-American women versus 54.4% of European-American women were more likely to have lymph node-positive tumors (Swanson et al., 2003). Shavers et al. (2003) found that European-American women (*RR*, 1.0) were less likely to have positive lymph nodes upon dissection than both African-American women (*RR*, 1.2) and Hispanic women (*RR*, 1.3). Also, European-American women (44.5%) had a lower percentage of multiple positive lymph nodes ($\geq$4) than African-American women (53.1%) and Hispanic women (57%; Shavers et al., 2003).

Literature Review of Methods

O'Malley et al. (2003) investigated survival patterns, based on the effect of SES and disease stage on racial/ethnic differences in California breast cancer patients. The researchers used data from SEER within the Greater San Francisco Bay Area. The clinical covariates included were histology, grade, estrogen receptor (ER) status, progesterone receptor (PR) status, radiation, and surgical procedures. The surgical procedures covariate was then categorized as: breast-conserving (segmental mastectomy, lumpectomy, quadrantectomy, tylectomy, wedge resection, excisional biopsy, and partial mastectomy), mastectomy, or none. The study population was comprised of 13,634 females who were newly diagnosed with breast cancer between 1988 and 1992. The population was made up of 10,414 European-American women, 940 African-American women, 1,100 Hispanic women, and 1,180 Asian/Pacific Islanders.

To adequately measure SES, O'Malley et al. (2003) used census block groups to create dichotomous variables for

> (a) low education versus not low education (a cut point of 25% of residents older than age 25 not receiving a high school diploma were used as low education), (b) low income versus not low income (a cut point of 20% of residents living below the poverty line was used as low income), and (c) *blue collar* was used if 66% or more of the residents within the block were employed in blue-collar jobs (O'Malley et al., 2003). This cut point method has been validated in previous breast cancer research within the San Francisco Bay Area; therefore the researchers duplicated this method in order to further build on current research rather than utilizing Census track data which are comprised of larger geographic units of measurements than Census blocks. (United States Census Bureau, 2000)

O'Malley et al. (2003) found that although each patient and disease characteristics varied significantly by race/ethnicity, the characteristics themselves were not only associated with one specific racial/ethnic group. European-Americans were found to be older upon diagnosis with a mean age of 61.8 years old, when compared to African-American women (56.7 years), Hispanic women (56.8 years), and API women (55.5 years). Across all ethnic groups, the majority of women were diagnosed in the early stages of the disease, 76% were stages I and IIA, however, the actual stage upon diagnosis varied across ethnic groups. Approximately 64% of African-American women, 70% of Hispanic women, 71% of API women, and 78% of European-American women were diagnosed at a Stage I or IIA disease.

The analyses using the census block SES variables identified that 8% of patients lived in poor neighborhoods, 20% lived in low education neighborhoods, and 30% lived in blue-collar neighborhoods. When factoring in race, there was a significant association with each of the SES variables being utilized. African-American (49.6%), Asian American/Pacific Islander (35.8%), and Hispanic (66.3%) patients were more likely to live in low-education neighborhoods in comparison to European-Americans (10.4%). The percentage of individuals living in low-income neighborhoods was also lower for European-Americans (2.7%) in comparison to Asian American/Pacific Islander (14.8%), Hispanics (20.3%), and African-Americans (42.7%). The researchers also identified a significant association between the SES variables and stage of disease at primary diagnosis. The patients residing in low-income neighborhoods (33%) presented with Stage IIB or higher than those who lived in higher-income neighborhoods (24%). It was also noted that the women living in low education (30%) and blue-collar neighborhoods (29%) were the most likely to present with late-stage disease than the other patients (23%).

The main objective of this study was to investigate survival patterns, based on the effect of SES and disease stage on racial/ethnic differences. O'Malley et al., (2003) notedthat although the unadjusted risk of death within their study was 1.8 times higher for African-Americans than European-Americans, the majority of the excess risk identified, could be explained by disease stage at diagnosis. When the researchers controlled for disease stage at diagnosis, the excess risk was decreased considerably. Upon further analysis controlling for other clinical and SES factors, the researchers

identified a significant (22%) excess risk of death for African-Americans, consistent with previous studies on racial differences in breast cancer survival (Joslyn & West, 2000; O'Malley et al., 2003; Roetzheim et al., 2000). The researchers do note a limitation of the study based on categorization methods within the SEER database. The categorization of patients into four basic racial/ethnic groups leaves room for misclassification. This miscategorization can lead to a loss of precision, which has been shown to obscure pertinent differences regarding cancer incidence and survival across racial/ethnic populations (Lin et al., 2002).

The Public Health Disparities Geocoding Project (Krieger et al., 2002), was performed in order to ascertain which census based area-measure was best suited to monitor health disparities tied to geocoded public health data. The authors investigated various socioeconomic measures at census tract, census block group, and zip code level for Rhode Island (1990 population: 1,003,464), and Massachusetts (1990 population: 6,016,425), the researchers then connected these socioeconomic variables to the state's primary invasive cancer incidence and mortality rates. Krieger et al. (2002) defined two main conditions that are required in order to effectively measure SES: (a) important aspects of the geographic areas socioeconomic conditions must be adequately and accurately summarized and (b) the socioeconomic data being utilized must be relatively and legitimately generalizable across geographic regions as well as measures of time. Based on these central criteria, the researchers then created an area-based socioeconomic measure for six domains of SEP; occupational class, income, poverty, wealth, education, and crowding. The six domains translated into 11 single-variable measures, and eight

composite-variable measures. The six domains and 11 single-variable measures are shown in Table 11.

Following the analyses of all-cause and cause-specific mortality rates, as well as all-cause and site-specific cancer rates, the findings indicated that census tract poverty measures:

> (a) consistently detected expected socioeconomic gradients in health across a wide range of health outcomes, among both the total population and diverse racial/ethnic-gender groups, (b) yielded maximal geocoding and linkage to area-based socioeconomic data (compared to the block group and Zip code data), (c) was readily interpretable to and could feasibly be used by state health department staff. (Krieger et al., 2009)

During the course of the project it was also discovered that considerable bias could occur due to spatiotemporal mismatches between ZIP codes and census data. These mismatches occur when ZIP codes are added or deleted between census years, as well as changes in the ZIP code geography or physical population.

Table 11
Constructs and Operational Definitions for Area-based Socioeconomic Measures, Massachusetts and Rhode Island, 1988-1992*

Construct	Variable
Occupational Class	
Working Class	Percentage of persons employed in predominantly working-class occupations, (i.e., nonsupervisory employees). Operationalized as percentage of persons employed in the following 8 of 13 census-based occupational groups: administrative support; sales; private household service; other service (except protective); precision production, craft, and repair; machine operators, assemblers, and inspectors; transportation and material moving; handlers, equipment cleaners, and laborers.
Unemployment	Percentage of persons aged 16 years or older in the labor force who are unemployed (and actively seeking work).
Income	
Median household income	Median household income in the year prior to the decennial census ($30,056 for the United States in 1989).
Low income	Percentage of households with an income <50% of the U.S. median household income (i.e., <$15,000 in 1989).
High income	Percentage of households with an income ≥400% of the U.S. median household income (i.e., ≥$150,000 in 1989).
Gini coefficient	A measure of income inequality regarding the share of income distribution across the population. Calculated using the standard algorithm employed by the U.S. Bureau of the Census to extrapolate the lower and upper ends of the income distribution.
Poverty	
Below U.S. poverty line	Percentage of persons below the federally defined poverty line, a threshold that varies by the size and age composition of the household; on average, it equaled $12,647 for a family of four in 1989.
Wealth	
Expensive homes	Percentage of owner-occupied homes worth ≥$300,000 (400% of the median value of owned homes in 1989).
Educational Level	
Low: less than high school	Percentage of persons aged ≥25 years with less than a 12th-grade education.
High: ≥4 years of college	Percentage of persons aged ≥25 years with at least 4 years of college.
Crowding	
Crowded Households	Percentage of households containing more than one person per room.

Note. Adapted from "Geocoding and Monitoring of U.S. Socioeconomic Inequalities in Mortality and Cancer Incidence: Does the Choice of Area-based Measure and Geographic Level Matter?," Krieger, N., Chen, J. T., Waterman, P. D., Soobader, M. J., Subramanian, S. V., & Carson, R., 2002, *American Journal of Epidemiology*, *156*, p. 471-482. Copyright by 2002 Johns Hopkins Bloomberg School of Public Health. Adapted with permission.

Following the Public Health Disparities Geocoding Project, Singh, Miller, Hankey, Feuer, and Pickle (2002) developed a similar construct to be specifically utilized for cancer surveillance practices within the United States. The researchers developed an area socioeconomic index to examine patterns in all-cancer mortality among men between 1950 and 1998, based on socioeconomic position. Eleven census variables were analyzed and used to develop an area based socioeconomic position index which was then used to stratify the U.S. counties into five dichotomous SEP groups. As shown in Table 12, the 11 census variables were education distribution (two variables: percentage of population with less than 9 years of education and percentage of population with at least 12 years of education), median family income, income disparity (measured as a logged ratio of the number of households with less than $10,000 income to those with at least $50,000), occupational composition (percentage with a white collar occupation), unemployment rate, family poverty rate, median home value, median gross rent, percentage of households without access to phone, and percentage of households without complete plumbing. The estimated factor loadings for the 11 variables, in the order listed above, were -0.83, 0.86, 0.90, -0.84, 0.71, -0.57,-0.87, 0.66, 0.80, -0.80, and -0.65.

The researchers note that the utilized scale was a standard normal scale, had a mean of 0 and a standard deviation of 1. In order to transform the scale into a standardized index, the mean was set to 100, and the standard deviation was set to 20 (Singh, Miller, & Hankey, 2002). Following this adjustment, the index scores ranged from a low of -7.74 to a high of 172.65 (Singh, Miller, & Hankey, 2002). When interpreting this scale, a high index score indicates high levels of socioeconomic

status/position and low levels of deprivation. Respectively, a low index score indicates low levels of socioeconomic status/position and high levels of deprivation (Singh, Miller, & Hankey, 2002). The socioeconomic index created was found to have a high degree of reliability, with a reliability coefficient Cronbach's alpha (α) of 0.94 (Singh, Miller, Hankey et al., 2002).

Table 12
Census Variables That Make Up the Area Socioeconomic Position Index

Construct	Census Variable
Education Distribution	Percentage of population ≥25 years with less than 9 years of education
	Percent of population ≥25 years with at least a High School diploma
Income Distribution	Median family income
	Income disparity (measured as a logged ratio of the number of households with less than $10,000 income to those with at least $50,000)
	Percent of families below poverty level
Occupational composition	Unemployment rate (% civilian labor force aged ≥16 years unemployed)
	Employed persons aged ≥16 years in white collar occupations
Housing composition	Median home value
	Median gross rent
	Percent of occupied housing units without telephone
	Percent of occupied housing units without complete plumbing

Note. Adapted from "Changing area socioeconomic patterns in U.S. cancer mortality, 1950-1998: Part I-All cancers among men," Singh, G. K., Miller, B. A., Hankey, B. F., Feuer, E. J., & Pickle, L. W., 2002, *Journal of the National Cancer Institute*, *94,* 904-915. Copyright 2002 by Oxford University Press. Adapted with permission.

The researchers also performed principal components analysis on the 11 variables for different subsets of the U.S. population (across counties with populations of <50,000, <100,000, <150,000, <250,000, <500,000, and <1,000,000; which represents 17%, 27%, 35%, 43%, 58%, and 76% of the total U.S. population; Singh, Miller, Hankey et al., 2002). The aforementioned factor loadings for all variables remained fundamentally unchanged, which indicated a high degree of reliability.

Summary

In chapter 2, I reviewed the current literature and statistics that encompass the epidemiology of breast cancer in women under 40 years of age. Next, chapter 3 includes comprehensive information regarding the study design and methods that were employed in order to complete the aforementioned research.

Chapter 3: Research Method

This chapter will discuss the study's research method. It includes a general discussion of the target population and sampling timeframes, as well as data collection and analysis methods. This chapter will also discuss the eligibility criteria for inclusion in the study. The issues of confidentiality and human subjects concerns will also be included in this chapter.

Research Design and Approach

The primary purpose of this study was to identify an association between socioeconomic position (SEP), tumor size, cancer stage, and survival among women under 40 with a primary diagnosis of breast cancer. As breast cancer is a clinical and rare disease, recruitment of participants would be extremely difficult and beyond my skills, especially when the federal government has established a cancer registry for these purposes. Therefore, a quantitative, retrospective, cohort study design was utilized in order to analyze the incidence and prognostic variations of breast cancer among women under 40 years of age. This study was performed by utilizing the SEER Program database. The SEER database encompasses 17 population based cancer registries across the United States, and it is a program of the NCI. SEER currently collects and analyzes cancer incidence and survival data which consists of approximately 26% of the total U.S. population to include 23% of African-Americans, 23% of European-Americans, 40% of Hispanics, 42% of American Indians and Alaska Natives, 53% of Asians, and 70% of Hawaiian/Pacific Islanders (SEER, 2009).

A retrospective cohort design involves the use of secondary data in order to investigate a specific health outcome or issue that has already occurred in the past within a defined population. The baseline measurements and follow-up have already been performed, and a dataset for the population has been created. The main advantages of a retrospective cohort design include the low-cost, ease of use, and expeditious manner of accessing a secondary data set (Young, Mazyck, & Schulz, 2006). Another major advantage, as with SEER, is that the dataset is linked to the census data in order to allow researchers to investigate disease patterns or trends across different demographic and socioeconomic variables. This current design allowed for an analysis of variables such as age, socioeconomic position, and survival, based upon specific tumor characteristics such as summary stage and size. A disadvantage of a retrospective cohort design is the reliance on secondary data that was collected prior to the study. If there were not data standardization procedures for the database, there may be incomplete or erroneous entries.

Setting and Sample

The target population for this study was women aged 20 to 39 with no prior history of any type of cancer who were diagnosed with breast cancer between the years of 2001-2006. The start date of January 1, 2001, was chosen to reflect guidelines put in place by the National Comprehensive Care Network, which standardized cancer registry reporting SEER (SEER, 2000). By utilizing the data following the standardization changes in 2000, it decreased the probability of inclusion due to miscoding within the individual population-based cancer registries.

Eligibility Criteria

The eligibility criterions for inclusion are; being female, between the ages of 20 and 39 with a primary diagnosis of breast cancer between the years of 2001 and 2006. The SEER database assigns a four-digit CPT code to each type of cancer; this study utilized the following codes: C50.0-C50.9. The selection also included a variable for *first primary malignancy*. This variable is based on each patient within the SEER registry. Each malignancy is coded in a sequence based on when it was reported. A special marker has been built into the SEER Stat program to choose individuals based on the case being a *first primary malignancy*.

SEER also has data quality management procedures in place to prevent duplicate cases for each individual. If there is a conflict within the database—meaning a potential duplicate case—a flow chart is followed in order to ascertain if the case truly is a duplicate or a secondary diagnosis. The protocol is required by NAACCR in order for cancer registries to be certified (NAACCR, 2010). To deconflict potential duplicates, registries match cases on individual identifying information in the following order: last and first name, social security number, date of birth, SEER cancer site, middle name, age at diagnosis, sex, race, date of diagnosis, tumor sequence number, primary site code, morphology code, laterality, stage of disease, and class of case (NAACCR, 2010).

Sampling Method and Procedure

For the purpose of this study, the independent variable was socioeconomic position (SEP). Dependent variables included SEER summary stage, tumor size, and survival time. The purpose of this study was to evaluate differences in tumor size, cancer

stage, and survival by socioeconomic position (SEP) in women under 40 diagnosed with breast cancer. Additionally, race was dichotomized and controlled for as a covariate in the final analysis.

Power Analysis

Statistical power was conducted a priori using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). By definition, the power of a statistical test is the probability to detect an effect, or the likelihood that there is no effect, and the null hypothesis will be rejected (Faul et al., 2007a). For this study, the likelihood of (a) the rejection of the null hypothesis that there is no association between socioeconomic position and tumor size at diagnosis, (b) the rejection of the null hypothesis that there is no association between socioeconomic position and stage at diagnosis, or (c) the rejection of the null hypothesis that there is no association between socioeconomic position and survival; was determined by using hierarchical regression. Sample size calculation for logistic regression is a complex problem, but Peduzzi, John, Elizabeth, Theodore, & Alvan (1996) suggested the following guideline for a minimum number of cases to include in a study. Let *p* equal the smallest of the proportions of negative or positive cases in the population and *k* equal the number of covariates (stage, tumor size, survival, and SEP). The proportion of women diagnosed with breast cancer under 40 years of age to the total number of women diagnosed with breast cancer was based on Table 1. Therefore the minimum number of cases to include is:

$$N = 10\ k / p > N = 10(4)/.064 > N = 625$$

Instrumentation and Materials

For the purpose of the study, the SEER 17 registry was utilized. The study was based on one main assumption that participating cancer registries followed the National Comprehensive Care Network cancer registry guidelines, which standardized registry reporting as of 2000 (SEER, 2000). The SEER dataset has several limitations. Currently the SEER registry dataset is limited to 26% of the United States population. This coverage includes 23% of African-Americans, 23% of European-Americans, 40% of Hispanics, 42 % of American Indians and Alaska Natives, 53% of Asians, and 70 % of Hawaiian/Pacific Islanders (SEER, 2000). The SEER program has a special focus on minority racial and ethnic groups as well as urban populations, which, in turn, equates to an overrepresentation of minorities within the data set. The overrepresentation of racial and ethnic groups within SEER is done in order to ensure sufficient population sizes for the purpose of statistical analysis.

All of the necessary raw data were extracted from the SEER registry DVD obtained through the limited data use agreement (Appendix A), and transferred into and analyzed utilizing IBM® SPSS® Statistics 18 (IBM, 2009).

Table 13
Variables in SEER

Item Name	SEER variable name	Variable Range	Type
Race/Ethnicity	Race recode	1 = European-American/Non Hispanic 0 = African-American 0 = Hispanic White 0 = Asian 0 = Pacific Islander 0 = American Indian/Alaska Native	Dichotomous with European-American being reference category
Primary diagnosis in patients lifetime	First malignant primary indicator	0 = No 1 = Yes	Ordinal
Tumor size	EOD-size (1998-2003) CS Tumor Size (2003+)	000, 001-988, 989-995, 999, and 888	Ordinal
Summary Stage	SEER Summary stage	1 = Localized 2 = Regional 3 = Distant	Ordinal
Survival	Survival Time recode	MMMM = Survival time in months	Continuous
SEP	County Codes were pulled from SEER and used to calculate SEP based on the 11 variables outlined and explained in Table 12.		

Socioeconomic Position Measure

For the purpose of this study, I will refer to these variables and functions of SES as the broader category of SEP. Based on the created index and findings of Singh, Miller, & Hankey (2002), I utilized the socioeconomic index in Table 14 to measure SEP. Each individual patient within the SEER registry has their county of residence (at the time of diagnosis) included with their record, this county code became the foundation on which SEP was based. The SEER 17 registry is comprised of 17 geographic regions (Figure 2), these regions were divided into their respective counties, which were stratified into quartiles, analyzed based on the aforementioned socioeconomic position index, and then placed into 1 of 5 socioeconomic position categories.

When interpreting this scale, a high index score indicates high levels of SEP and low levels of deprivation. Respectively, a low index score indicates low levels of SEP and high levels of deprivation. Therefore, counties placed in category SEP I are considered to have low SEP and a category of SEP V are considered to have a high SEP. All of the data that were utilized for the SEP index was derived from the 2000 decennial census.

Table 14
Census Variables and Data Source for the Area Socioeconomic Position Index

Construct	Census Variable	Data Source
Education Distribution	Percentage of population ≥25 years with less than 9 years of education	Census 2000 dataset
	Percent of population ≥25 years with at least a High School diploma	Census 2000 dataset
Income Distribution	Median family income	Census 2000 dataset
	Income disparity (measured as a logged ratio of the number of households with less than $10,000 income to those with at least $50,000)	Census 2000 dataset
	Percent of families below poverty level	Census 2000 dataset
Occupational composition	Unemployment rate (% civilian labor force aged ≥16 years unemployed)	Census 2000 dataset
	Employed persons aged ≥16 years in white collar occupations	Census 2000 dataset
Housing composition	Median home value	Census 2000 dataset
	Median gross rent	Census 2000 dataset
	Percent of occupied housing units without telephone	Census 2000 dataset
	Percent of occupied housing units without complete plumbing	Census 2000 dataset

Note. Adapted from "Changing area socioeconomic patterns in U.S. cancer mortality, 1950-1998: Part I-All cancers among men," Singh, G. K., Miller, B. A., Hankey, B. F., Feuer, E. J., & Pickle, L. W., 2002, *Journal of the National Cancer Institute*, *94,* 904-915. Copyright 2002 by Oxford University Press. Adapted with permission.

Data Collection and Analysis

The SEER database is the leading source of cancer incidence and survival data within the United States. This comprehensive dataset allowed for a large sample size and increased power. By utilizing SEER as a secondary data source, I was able to conduct a retrospective cohort study in order to examine the possible relationship between SEP, tumor size, cancer stage, and survival within this population. The independent variable was SEP; the dependent variables were SEER Summary Stage, tumor size, and survival. Additionally, race was dichotomized and controlled for as a covariate in the final analysis. The statistical model (Table 15) utilized measured the effect of covariates individually as well as in the presence of other covariates.

Table 15
Statistical Model

	Predictor Variable			
	SEP	Tumor Size	Stage	Race
DV = Tumor Size				
Partial Model			X	X
Full Model	X		X	X
DV = Stage				
Partial Model		X		X
Full Model	X	X		X
DV = Survival				
Partial Model		X	X	X
Full Model	X	X	X	X

Research Questions and Hypotheses

This was a quantitative, retrospective, cohort study of newly diagnosed female breast cancer patients under the age of 40. Participants were drawn from the SEER Program database (SEER, 2009). More details abou the SEER data are found in chapter 3. To analyze differences in tumor size, cancer stage, and survival by SEP in women under 40 years of age diagnosed with breast cancer, the following research questions and hypotheses were utilized for this study.

1. What is the independent effect of socioeconomic position on tumor size at the time of breast cancer diagnosis in women under 40?

H_0:. There is no association between socioeconomic position and tumor size at diagnosis.

H_1: There is an association between socioeconomic position and tumor size at diagnosis.

2. What is the independent effect of socioeconomic position on the stage of cancer at the time of breast cancer diagnosis in women under 40?

H_0: There is no association between socioeconomic position and the stage of cancer at the time of breast cancer diagnosis in women under 40.

H_1: There is an association between socioeconomic position and the stage of cancer at the time of breast cancer diagnosis in women under 40.

3. What is the independent effect of socioeconomic position on survival in women under 40 diagnosed with breast cancer?

H_0:There is no association between socioeconomic position and survival.

H_1: There is an association between socioeconomic position and survival.

Protection of Human Participants

All data utilized within the context of this study were obtained from the SEER cancer registry public web site. This registry is anonymous other than indicators of race and age. These variables do not allow registry data to be linked to specific individuals. The NCI maintains the SEER database, which is publically available (SEER, 2009). The NCI also publishes periodic cancer surveillance reports as well as an Annual Report to the Nation on the Status of Cancer (NCI, 2009c). Therefore, this study was based on the examination of public records which are completely anonymous. Thus the risk of potential harm to human subjects is extremely minimal if at all probable.

The SEER registry program granted a Limited Use Agreement in writing for use in this study (Appendix A). In accordance with Walden University Institutional Review Board (IRB) procedures, an application for approval was submitted; data collection and analysis commenced upon the final approval from the IRB committee (approval #06-24-11-0019763).

Dissemination of Findings

In order to uphold Walden University's ongoing commitment to social change, the study results will be disseminated via publications from the dissertation to the appropriate peer-reviewed journals in the field. Submissions for poster presentations and round table discussions will also be submitted to the appropriate organizations.

Chapter 4: Results

The purpose of this quantitative, retrospective, cohort study was to evaluate differences in tumor size, tumor stage, and survival by socioeconomic position in women under 40 years of age diagnosed with breast cancer. This chapter begins with the descriptive statistics for the study population, sociodemographic variables, and clinical characteristics for each variable of interest. The chapter will then discuss the results of the analyses for the three research questions:

1. What is the independent effect of socioeconomic position on tumor size at the time of breast cancer diagnosis in women under 40?
2. What is the independent effect of socioeconomic position on the stage of cancer at the time of breast cancer diagnosis in women under 40?
3. What is the independent effect of socioeconomic position on survival in women under 40 diagnosed with breast cancer?

The data were obtained from the SEER Program database, SEER 17 Registry for all primary breast cancers reported between the years 2001-2006. The SEER database encompasses 17 population based cancer registries across the United States, and it is a program of the NCI. SEER currently collects and analyzes cancer incidence and survival data which consists of approximately 26% of the total U.S. population to include 23% of African-Americans, 23% of European-Americans, 40% of Hispanics, 42% of American Indians and Alaska Natives, 53% of Asians, and 70% of Hawaiian/Pacific Islanders (SEER, 2009).

In order to obtain the data from SEER 17 for analysis, a case listing was created using the selection tab to define the parameters for the study population. This case listing included females ages 20 to 39 who had a primary diagnosis of breast cancer (CPT codes C50.0-C50.9) in the years 2001-2006, had a first primary malignancy indicator, and whose records included coding for both stage and tumor size upon diagnosis. There were 819 women who were excluded due to invalid or missing entries for tumor size, and 61 women were excluded due to missing or invalid summary stage. Women whose survival was coded as *0* were also excluded due to the fact that diagnosis occurred at the time of autopsy or listing on the death certificate; this exclusion criteria accounted for 41 total cases. Additionally, 28 cases were excluded from the state of Alaska. These cases were part of the Alaska Natives Registry and did not include county level geocoding; therefore, county level SEP could not be calculated. These delineations resulted in 14,696 eligible cases for this study. The case listing was exported into IBM® SPSS® Statistics 18 (IBM, 2009) for the complete analysis.

As previously noted, SEER does not collect data on health habits such as smoking, sedentary lifestyle, breast feeding behaviors, or obesity; therefore these confounding factors were not controlled for during the data analysis, a limitation of this study. SEER does, however, collect socioeconomic measures at a county level. In constructing the 11 variable measure of SEP, I obtained all socioeconomic position data from the 2000 decennial census to ensure the integrity and cohesiveness of the final SEP measure. For the purpose of this study, SEP was comprised of 11 census variables: education distribution (two variables: percentage of population with less than 9 years of

education and percentage of population with at least 12 years of education), median family income, income disparity (measured as a logged ratio of the number of households with less than $10,000 income to those with at least $50,000), occupational composition (percentage with a white collar occupation), unemployment rate, family poverty rate, median home value, median gross rent, percentage of households without access to phone, and percentage of households without complete plumbing. All of the aforementioned variables were extracted from the 2000 decennial census utilizing DataFerrett. DataFerrett stands for Federated Electronic Research, Review, Extraction, and Tabulation Tool (United States Census Bureau, 2010). DataFerrett is a web based data extraction and analysis tool provided by the U.S. Census Bureau. This tool is open access and readily available at no cost for public use.

All counties included in the 2000 decennial census were analyzed based on the aforementioned socioeconomic index and then stratified into one of five socioeconomic position categories. When interpreting this scale, a high index score indicates high levels of SEP and low levels of deprivation. Respectively, a low index score indicates low levels of SEP and high levels of deprivation. Therefore, counties were placed in the following categories: (a) SEP I, low socioeconomic position and high deprivation; (b) SEP II, moderately low socioeconomic position and moderately high deprivation; (c) SEP III, medium socioeconomic position and medium deprivation; (d) SEP IV, moderately high socioeconomic position and moderately low deprivation; and (e) SEP V, high socioeconomic position and low deprivation.

Table 16
Sociodemographic and Clinical Characteristics of Study Population

	SEP I	SEP II	SEP III	SEP IV	SEP V	Total *n* (%)
ETHNICITY [b]						
European-American	389 (55.6%)	367 (57.8%)	622 (52.2%)	1555 (47.2%)	5683 (64.0%)	8616 (58.6%)
African-American	152 (21.7%)	115 (18.1%)	305 (25.6%)	472 (14.3%)	972 (11.0%)	2016 (13.7%)
American Indian/Alaska Native	16 (2.3%)	4 (.63%)	4 (.34%)	14 (.43%)	39 (.44%)	77 (.52%)
Asian or Pacific Islander	13 (1.9%)	26 (4.1%)	47 (3.9%)	349 (10.6%)	1064 (12.0%)	1499 (10.2%)
Spanish-Hispanic-Latino	130 (18.6%)	123 (19.4%)	214 (18.0%)	903 (27.4%)	118 (12.6%)	2488 (16.9%)
TUMOR SIZE [b]						
< 2 cm	237 (33.9%)	212 (33.4%)	393 (33.0%)	1238 (37.6%)	3721 (41.9%)	5801 (39.5%)
2-5 cm	365 (52.14%)	342 (53.9%)	597 (50.1%)	1591 (48.3%)	4102 (46.2%)	6997 (47.6%)
> 5 cm	98 (14.0%)	81 (12.8%)	202 (16.9%)	464 (14.1%)	1053 (11.9%)	1898 (12.9%)
SUMMARY STAGE						
Localized	341 (48.7%)	312 (49.1%)	553 (46.4%)	1657 (50.3%)	4322 (48.7%)	7185 (48.9%)
Regional	327 (46.7%)	287 (45.2%)	573 (48.1%)	1500 (45.6%)	4154 (46.8%)	6841 (46.6%)
Distant	32 (4.6%)	36 (5.7%)	66 (5.5%)	136 (4.1%)	400 (4.5%)	670 (4.6%)
SURVIVAL [a]						
1-12 Months	33 (4.7%)	33 (5.2%)	85 (7.1%)	171 (5.2%)	393 (4.4%)	715 (4.9%)
13-24 Months	150 (21.4%)	106 (16.7%)	237 (19.9%)	691 (21.0%)	1721 (19.4%)	2905 (19.8%)

(table continues)

	SEP I	SEP II	SEP III	SEP IV	SEP V	Total *n* (%)
37-48 Months	118 (16.9%)	102 (16.1%)	202 (16.9%)	571 (17.3%)	1521 (17.1%)	2514 (17.1%)
49-60 Months	101 (14.4%)	105 (16.5%)	162 (13.6%)	477 (14.5%)	1340 (15.1%)	2185 (14.9%)
61-72 Months	98 (13.1%)	83 (13.1%)	141 (11.8%)	450 (13.7%)	1213 (13.7%)	1979 (13.5%)
73-83 Months	80 (11.4%)	82 (12.9%)	138 (11.6%)	375 (11.4%)	116 (12.6%)	1791 (12.2%)

Note. $N = 14{,}696$; [a] = $p<.05$; [b] = $p<.000$

Table 16 presents the descriptive sociodemographic and clinical characteristics of newly diagnosed breast cancer cases from 2001 to 2006. The study population was comprised of 14,696 women ages 20-39 with the largest percentage of women were ages 35-39 (64.1%). The majority of the women were European-American (58.6%) followed by Hispanic (16.9%), African-American (13.7%), and Asian (10.2%). The majority of women (60.4%) were classified as high socioeconomic position and low deprivation, while 22.4% were classified as moderately high position and moderately low deprivation. Survival time ranged from 1 to 83 months, with the three most prevalent survival times being 13-24 months (19.8%), 25-36 months (17.7%), and 37-48 months (17.1%). The majority of women had tumor summary staged as either localized (48.9%) or regional (46.9%) and tumor sizes of less than 2 cm (39.5%), 2-5 cm (47.6%), or greater than 5 cm (12.9%). Bivariate analyses examining the association between SEP, ethnicity, and tumor characteristics indicated that SEP was significantly associated with ethnicity ($p<.000$), tumor size ($p<.000$), overall survival ($p<.035$) and summary stage ($p<.0248$).

Data Collection and Analysis

The SEER database is the leading source of cancer incidence and survival data within the United States. This comprehensive dataset allowed for a large sample size and increased power. By utilizing SEER as a secondary data source, I was able to conduct a retrospective cohort study in order to examine the possible relationship between SEP, tumor size, cancer stage, and survival within this population. The independent variable was SEP; the dependent variables were SEER Summary Stage, tumor size, and survival.

Additionally, race was dichotomized and controlled for as a covariate in the final analysis.

Research Question 1

The first research question this study was as follows: What is the independent effect of socioeconomic position on tumor size at the time of breast cancer diagnosis in women under 40? H_0: There is no association between socioeconomic position and tumor size at diagnosis. H_1: There is an association between socioeconomic position and tumor size at diagnosis.

Hierarchical regression analysis was conducted to assess the ability of SEP to predict tumor size after controlling for ethnicity and cancer summary stage. Ethnicity and cancer summary stage were entered in the partial model in Step 1, explaining 13% of the variance in tumor size. After entry of SEP in the full model in Step 2, the total variance explained by the model was 13.2%, $F(3, 14{,}692) = 745.71$, $p < .01$. SEP explained .2%, F change $(1, 14{,}692) = 42.28$, $p < .01$ (see Table 17). In the final model, all three variables made a significant contribution to the model, with cancer summary stage reporting the highest beta value ($\beta = .389$, $p < .01$), indicating that as cancer summary stage scores increased tumor size also increased. Ethnicity had the next highest beta value ($\beta = .106$, $p < .01$) indicating that non Caucasians have higher tumor sizes than Caucasians. Finally, the beta values of SEP ($\beta = -.050$, $p < .01$) indicated that as SEP increased, tumor size decreased. Based on these results, the null hypothesis that SEP is not a significant predictor of tumor size was rejected.

Table 17
Hierarchical Regression: SEP and Tumor Size, Controlling for Ethnicity and Summary Stage

	B	*SE B*	*β*	R^2	ΔR^2
Step 1:				.130**	
Ethnicity	.151	.011	.110**		
Summary Stage	.389	.009	.336**		
Step 2:				.132**	.002**
Ethnicity	.146	.011	.106**		
Summary Stage	.389	.009	.336**		
SEP	-.031	.005	-.050**		

*Note. ** = p < .01; N = 14,696*

The parameter estimates shown in Table 18 indicate that for women with a tumor size less than 2 cm, cancer summary stage, SEP, and ethnicity make a significant contribution to the model (p<.05). As cancer summary stage increases by 1 unit, the women were .14 times less likely to have a tumor size of less than 2 cm versus a tumor size of greater than 5 cm. As the SEP increases by 1 unit, the likelihood of having a tumor size of less than 2 cm versus greater than 5 cm increases by a factor of 1.14.

For the 2 cm to 5 cm model, cancer summary stage and race made a significant contribution to the model but SEP did not. A 1-unit increase in cancer summary stage decreased the likelihood of a 2 cm tumor versus a tumor greater than 5 cm by .34 times. The results of the coefficients table (Table 19) indicate that race, cancer summary stage, and SEP all make a significant contribution to the model (p<.05). Specifically, the beta coefficients indicate that SEP is associated with decreases in tumor size. Conversely, increases in cancer summary stage are associated with decreases in tumor size.

Additionally, non European-Americans have significantly larger tumor sizes than European-Americans. Based on the aforementioned results, the null hypothesis that socioeconomic position is not a significant predictor of tumor size was rejected.

Table 18
Tumor Size Parameter Estimates

Tumor Size[a]		*B*	*Std. Error*	*Wald*	*df*	*Sig.*	Exp(*B*)	95% *CI* for Exp(*B*) Lower Bound	95% *CI* for Exp(*B*) Upper Bound
< 2 cm	Intercept	4.054	.148	755.327	1	.000			
	Cancer Stage	-1.951	.052	1417.318	1	.000	.142	.128	.157
	Race Dichotomized	-.695	.057	147.493	1	.000	.499	.446	.558
	SEP Index	.135	.025	27.963	1	.000	1.144	1.088	1.203
2-5 cm	Intercept	3.241	.138	551.038	1	.000			
	Cancer Stage	-1.067	.047	515.489	1	.000	.344	.314	.377
	Race Dichotomized	-.283	.053	28.184	1	.000	.753	.678	.836
	SEP Index	.026	.023	1.288	1	.256	1.027	.981	1.075

[a] The reference category is: > 5 cm.

Table 19
Tumor Size Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations		
		B	*Std. Error*	*Beta*	*t*	*Sig.*	Zero-order	Partial	Part
1	(Constant)	1.066	.015		69.970	.000			
	Cancer stage	.389	.009	.336	43.616	.000	.343	.339	.336
	Race Dichotomized	.151	.011	.110	14.330	.000	.130	.117	.110
2	(Constant)	1.200	.026		46.739	.000			
	Cancer stage	.389	.009	.336	43.677	.000	.343	.339	.336
	Race Dichotomized	.146	.011	.106	13.788	.000	.130	.113	.106
	SEP Index	-.031	.005	-.050	-6.502	.000	-.060	-.054	-.050

[a]. Dependent Variable: Tumor Size

Research Question 2

The second research question for this study aimed was as follows: What is the independent effect of socioeconomic position on the stage of cancer at the time of breast cancer diagnosis in women under 40? H_0: There is no association between socioeconomic position and the stage of cancer at the time of breast cancer diagnosis in women under 40. H_1: There is an association between socioeconomic position and the stage of cancer at the time of breast cancer diagnosis in women under 40.

Hierarchical regression analysis sought to determine if SEP predicted cancer summary stage after controlling for tumor size and ethnicity. Tumor size and ethnicity were entered in the partial model at Step 1 and explained 11.8% of the variability in summary stage. After entering SEP in the full model in Step 2, the total variance

explained for the full model remained at 11.8%, $F(3, 14{,}695) = 655.08$, $p < .01$ (Table 20). All three variables made a significant contribution to the final model. Specifically, as tumor size increased ($\beta = .342$, $p < .01$) so too did summary stage. Increases in SEP index scores which indicate high levels of SEP and low levels of deprivation; ($\beta = .017$, $p = .03$) were also associated with increases in summary stage. The beta values for ethnicity ($\beta = .016$, $p = .046$), revealed that non European-Americans had higher summary stages than European-Americans. Given the significant contribution of SEP to the final model, the null hypothesis that SEP is not a significant predictor of cancer stage was rejected.

The results of the coefficients table (see Table 21) indicate that race, tumor size, and SEP make a significant contribution to the model ($p<.05$). Specifically, the beta coefficients indicate that as tumor size, and SEP increase, there are also increases in cancer summary stage classifications. Additionally, non European-Americans have a significant higher summary stage classification than European-Americans.

Table 20
Hierarchical Regression: SEP and Summary Stage, Controlling for Ethnicity and Tumor Size

	B	*SE B*	*β*	R^2	ΔR^2
Step 1:				.118**	
Ethnicity	.017	.009	.014		
Tumor Size	.294	.007	.341**		
Step 2:				.118**	
Ethnicity	.018	.009	.016*		
Tumor Size	.295	.007	.342**		
SEP	.009	.004	.017*		

Note. * = $p < .05$; ** = $p < .01$; $N = 14{,}696$

Table 21
Cancer Summary Stage Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations		
		B	*Std. Error*	*Beta*	*t*	*Sig.*	Zero-order	Partial	Part
1	(Constant)	1.039	.013		82.098	.000			
	Tumor Size	.294	.007	.341	43.616	.000	.343	.339	.338
	Race Dichotomized	.017	.009	.014	1.841	.066	.059	.015	.014
2	(Constant)	.998	.022		44.371	.000			
	Tumor Size	.295	.007	.342	43.677	.000	.343	.339	.338
	Race Dichotomized	.018	.009	.016	1.996	.046	.059	.016	.015
	SEP Index	.009	.004	.017	2.204	.028	-.005	.018	.017

[a] Dependent Variable: Cancer summary stage

Research Question 3

The final research question this study aimed to address was as follows: What is the independent effect of socioeconomic position on survival in women under 40 diagnosed with breast cancer? H_0: There is no association between socioeconomic position and survival. H_1: There is an association between socioeconomic position and survival.

Hierarchical regression analysis was conducted to assess the ability of SEP to predict survival time after controlling for ethnicity, summary stage, and tumor size. Ethnicity, summary stage, and tumor size were entered into the partial model at Step 1. They accounted for 3.3% of the explained variance in survival time. When SEP was

added to the full model in Step 2, there was no change in the explained variance for the full model, $F(4, 14{,}691) = 126.23$, $p < .01$ (Table 22). Results also indicated that summary stage ($\beta = -.107$, $p < .01$), tumor size ($\beta = -.082$, $p < .01$), and ethnicity ($\beta = -.078$, $p < .01$) all made significant contributions to the model, while SEP ($\beta = .010$, $p = .24$) did not. Based on the results of this analysis, the null hypothesis that SEP is not a significant predictor of survival time after controlling for summary stage, tumor size, and ethnicity; was accepted.

The results of the coefficients table (Table 23) indicate the ethnicity, tumor size, and cancer summary stage make a significant contribution to the model ($p<.05$). However, SEP does not make a significant contribution to the model. Specifically, the beta coefficients indicate that increases in tumor size, and cancer summary stage are associated with lower survival times, and that non European-Americans have a significantly lower survival time the European-Americans.

Table 22
Hierarchical Regression: SEP and Survival Time, Controlling for Ethnicity and Tumor Size and Summary Stage

	B	*SE B*	*β*	R^2	ΔR^2
Step 1:				.033**	
Ethnicity	-3.418	.356	-.079***		
Tumor Size	-2.612	.276	-.082**		
Summary Stage	-3.945	.318	-.107**		
Step 2:				.033	
Ethnicity	-3.388	.357	-.078**		
Tumor Size	-2.595	.277	-.082**		
Summary Stage	-3.952	.318	-.107**		
SEP	.189	.159	.010		

Note. ** = $p < .01$; $N = 14{,}696$

Table 23
Survival Time Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Correlations		
		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
1	(Constant)	55.374	.589		93.986	.000			
	Tumor Size	-2.612	.276	-.082	-9.451	.000	-.129	-.078	-.077
	Summary stage	-3.945	.318	-.107	-12.408	.000	-.140	-.102	-.101
	Race Dichotomized	-3.418	.356	-.079	-9.613	.000	-.096	-.079	-.078
2	(Constant)	54.531	.923		59.058	.000			
	Tumor Size	-2.595	.277	-.082	-9.374	.000	-.129	-.077	-.076
	Summary stage	-3.952	.318	-.107	-12.427	.000	-.140	-.102	-.101
	Race Dichotomized	-3.388	.357	-.078	-9.501	.000	-.096	-.078	-.077
	SEP Index	.189	.159	.010	1.186	.236	.021	.010	.010

[a] Dependent Variable: Survival Time

Summary

The purpose of this quantitative, retrospective, cohort study was to evaluate differences in tumor size, tumor stage, and survival by socioeconomic position in women under 40 years of age, diagnosed with breast cancer. This chapter presented descriptive statistics of the sample and hypotheses testing findings for the three research questions posed. The study aimed to answer whether there was an independent effect of socioeconomic position on tumor size and stage of cancer at the time of breast cancer diagnosis in women under 40, and survival time after diagnosis with breast cancer also in women under 40.

The findings of the first question indicate that there were significant differences across SEP categories and tumor size. Therefore, the null hypothesis stating that there is no association between socioeconomic position and tumor size at diagnosis was rejected. The findings of the second question indicate race, tumor size, and SEP all had a significant impact on cancer stage at diagnosis. Therefore, the null hypothesis stating that there is no association between SEP and the stage of cancer at the time of breast cancer diagnosis in women under 40 was rejected. The findings of the third question indicated that while ethnicity, tumor size, and cancer summary stage had a significant effect on survival time, SEP did not. Therefore the null hypothesis stating that there is no association between SEP and survival time in women under 40 was not rejected.

Chapter 4 presented the study demographics and results in order to answer the overarching research question: Are there differences in tumor size, cancer stage, and survival based on socioeconomic status in women less than 40 year of age? Chapter 5 discusses the results in depth, implications for positive social change, and offers recommendations for future research and advocacy for women in this population.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this chapter is to discuss the findings of this study. It includes an interpretation of the study findings and a discussion of the three research questions posed in this study. Additionally, it will discuss limitations which arose during the data analysis period as well as implications for social change and recommendations for further action and research.

The aim of this quantitative, retrospective, cohort study was to evaluate differences in tumor size, tumor stage, and survival by socioeconomic position in women between 20 and 39 diagnosed with breast cancer. Although the incidence of breast cancer is lower among women under 40 years of age, young women present with cancer that is more advanced and with poorer prognostic characteristics. On both a national and global scale, there are apparent socioeconomic, racial, and ethnic health disparities in breast cancer incidence and survival (Baquet et al., 2008; Harper et al., 2009). Due to being diagnosed at a later stage, the 5-year relative survival rate is slightly lower among women diagnosed with breast cancer before age 40 (83%) compared to women diagnosed at ages 40 or older (90%; ACS, 2010a).

Summary of Findings

Hierarchical regression analysis was performed in order to evaluate statistical differences in cancer summary stage and tumor size in women aged 20 to 39. An ordinary least square regression was utilized to assess differences in survival based on SEP, after controlling for race, tumor size, and cancer summary stage. It was found that there were significant differences in tumor size and cancer summary stage across SEP categories.

However, statistically significant differences in survival based solely on SEP were not observed.

Interpretation of Findings

This study sought to investigate differences in clinical prognostic characteristics of young women, based on SEP. An initial observation was that the SEP Index was somewhat evenly distributed, which may be attributed to the overrepresentation of ethnic/racial groups within the SEER registry as a whole. That being said, the majority of women with a lower SEP Index score appeared to be from the Southern part of the U.S. Although the compilation of geographic clusters of breast cancer is beyond the scope of this study, it is an area that should be addressed in future research among this population.

Tumor Size and Socioeconomic Position

Hierarchical regression analysis was conducted to assess the ability of SEP to predict tumor size after controlling for ethnicity and cancer summary stage. Ethnicity and cancer summary stage were entered in the partial model in Step 1, explaining 13% of the variance in tumor size. After entry of SEP in the full model in Step 2, the total variance explained by the model was 13.2%, $F(3, 14{,}692) = 745.71$, $p < .01$. SEP explained .2%, F change $(1, 14{,}692) = 42.28$, $p < .01$ (see Table 17). In the final model, all three variables made a significant contribution to the model, with cancer summary stage reporting the highest beta value ($\beta = .389$, $p < .01$), indicating that as cancer summary stage scores increased, tumor size also increased. Ethnicity had the next highest beta value ($\beta = .106$, $p < .01$) indicating that non Caucasians have higher tumor sizes than Caucasians. Finally, the beta values of SEP ($\beta = -.050$, $p < .01$) indicated that as SEP increased, tumor size

decreased. Based on these results, the null hypothesis that SEP is not a significant predictor of tumor size was rejected.

These results corroborate prior observations (Galobardes et al., 2007; Macleod et al., 2000) which states that women with a lower SEP tend to present with a larger tumor size. However, not all studies have come to the same conclusion (Robsahm & Tretli, 2005; Vona-Davis & Rose, 2009). These discrepancies may be attributed to inconsistent methods of measuring SEP (Woods, Rachet, & Coleman, 2005), as well as the fact that current body of literature pertaining to breast cancer tends to focus on older women, whereas the focus of this study was women under 40 years of age.

Cancer Summary Stage and Socioeconomic Position

Hierarchical regression analysis sought to determine if SEP predicted survival time after controlling for tumor size and ethnicity. Tumor size and ethnicity were entered in the partial model at Step 1 and explained 11.8% of the variability in summary stage. After entering SEP in the full model in Step 2, the total variance explained for the full model remained at 11.8%, $F(3, 14{,}695) = 655.08$, $p < .01$ (Table 20). All three variables made a significant contribution to the final model. Specifically, as tumor size increased ($\beta = .342$, $p < .01$), so did summary stage. Increases in SEP ($\beta = .017$, $p = .03$) were also associated with increases in summary stage. The beta values for ethnicity ($\beta = .016$, $p = .046$) revealed that non European-Americans had higher summary stages than European-Americans. Given the significant contribution of SEP to the final model, the null hypothesis that SEP is not a significant predictor of cancer stage was rejected.

The results of this study indicate that race, tumor size, and SEP make a significant contribution to cancer summary stage; specifically, as tumor size and SEP increase, there are also increases in cancer summary stage classifications. Additionally, non European-Americans have a significant higher summary stage classification than European-Americans. These findings are reflective of prior observations (Bradley, Given, & Roberts, 2002) in women across all age groups.

Survival Analysis

Hierarchical regression analysis was conducted to assess the ability of SEP to predict survival time after controlling for ethnicity, summary stage, and tumor size. Ethnicity, summary stage and tumor size were entered into the partial model at Step 1. They accounted for 3.3% of the explained variance in survival time. When SEP was added to the full model in Step 2, there was no change in the explained variance for the full model, $F(4, 14{,}691) = 126.23$, $p < .01$ (Table 22). Results also indicated that summary stage ($\beta = -.107$, $p < .01$), tumor size ($\beta = -.082$, $p < .01$), and ethnicity ($\beta = -.078$, $p < .01$) all made significant contributions to the model, while SEP ($\beta = .010$, $p = .24$) did not. Based on the beta values, increases in summary stage and tumor size were associated with decreases in survival time. Additionally, European-Americans have a higher survival time than non European-Americans.

Based on the results of this analysis, the null hypothesis that SEP is not a significant predictor of survival time after controlling for summary stage, tumor size, and ethnicity was accepted. These findings will contribute to the current body of literature on SEP and breast cancer and survival. The relationship between SEP and survival is not

well documented, and the findings that have been published differ in their results (Klassen & Smith, 2011).

Theoretical Base

The theoretical base for this study was driven by the association of the independent and dependent variables being investigated. The conceptual model utilized highlights the relationship between socioeconomic position, cancer stage, tumor size, and survival. To investigate if socioeconomic position has an effect on the biologic makeup of breast cancer in young women, variables such as tumor summary stage and size were analyzed. Within the context of this study, SEP was utilized to discuss the broader groupings of SES.

As previously discussed, the SEP index utilized for this study is unable to take into account health behavior issues which are known to have an impact on breast cancer incidence as a whole (Krieger et al., 2009; O'Malley et al., 2003; Wallington et al., 2009). Nor does SEER collect data on health habits such as smoking, sedentary lifestyle, breast feeding behaviors, or obesity. These confounding factors could not be controlled for and are a continued limitation of this study. However, when individual level data are not available to determine one's SEP, it is not uncommon to use an ecological approach in creating a census-based index (Woods et al., 2005).

Implications for Social Change

The results of this study have the potential to promote positive social change by advancing the understanding of breast cancer in young women and of the impact of socioeconomic factors on breast cancer within this population. Existing literature shows

that young women tend to present with cancer that is more advanced and with poorer prognostic characteristics. It also has been noted that there are numerous socioeconomic, racial, and ethnic health disparities in breast cancer incidence and survival (Baquet et al., 2008; Harper et al., 2009). This study found that prognostic characteristics such as cancer stage and tumor size have an inverse relationship with SEP. As the SEP category decreases, tumor size and cancer summary stage increase.

Recommendations for Action

In order to raise awareness about breast cancer in young women, it is imperative for nurses and doctors to have a discussion with women about their breast cancer family history and their own personal breast cancer risk. Public service announcements, events, and pamphlets can be created to target specific populations to encourage these women to talk with their primary healthcare providers. However, women who have a lower SEP may not have the resources or access to consistent quality healthcare. These women are of utmost concern in that they tend to present with more advanced clinical symptoms. To reach this population, community outreach through women's health advocacy groups, social media outlets, religious, and social service organizations would be beneficial.

Furthermore, continued discussion of this issue at professional meetings, through social media, and with health advocacy organizations will keep the overarching topic of breast cancer and SEP relevant and in the forefront of policy makers' minds.

Recommendations for Further Studies

Taking into consideration that women under 40 account for only 6% of newly diagnosed breast cancer cases and the SEER 17 registry currently encompasses

approximately 26% of the United States population, future studies would benefit from including geographic areas that are not currently covered by the SEER 17 registry area. This proposed design would allow for a larger sampling of women that fit into this population. Also, SEER does not include individual level health behaviors or potential environmental and occupational exposures. When investigating breast cancer, race, ethnicity, and SES are difficult concepts to define in theory and practice. Each concept encompasses specific health behaviors, treatment choices, comorbid conditions, as well as overall health status (Krieger et al., 2009; O'Malley et al., 2003; Wallington et al., 2009). Utilizing a data set that includes individual level health behaviors would allow for researchers to have a more complete picture of the health behaviors and exposures that women have had within their lifetimes that may have contributed to their breast cancer statuses.

Within the current body of literature, there have been discussions regarding the impact of race on socioeconomic status (SES) in breast cancer diagnosis. Some studies have concluded that when controlling for socioeconomic status, racial disparities do not appear to be significant (Maloney et al., 2006); whereas other studies have found that the effect of SES on prognostic characteristics is not as strong as that of race (Albano et al., 2007).

As previously mentioned, an initial observation of the dataset was that the SEP Index was somewhat evenly distributed, which may be attributed to the overrepresentation of ethnic/racial groups within the SEER registry as a whole. That being said, the majority of women with a lower SEP Index score appeared to be from the

southern part of the U.S. Although the compilation of geographic clusters of breast cancer is beyond the scope of this study, it is an area that should be addressed in future research among this population. By geocoding the data, there would be the potential to readily identify specific barriers to care at a county level. This would allow policymakers to focus outreach efforts and funding to reach those women who need it most.

Conclusion

Breast cancer is the second leading cause of cancer death among women in the United States and the first cause of cancer related deaths globally. As the understanding of what causes breast cancer progresses through science and technology, so should the guidelines for screening and treatment. The key to survival among women of all ages is early detection and treatment. Raising awareness about the emerging demographics of breast cancer in young women could save the lives of many women. No woman should have to suffer the consequences of delayed detection and treatment due to the fact that they were unable to obtain proper medical care or were dubbed too young to be diagnosed.

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Appendix A:

Surveillance, Epidemiology, and End Results Program

Data-Use Agreement for the 1973-2006 SEER Research Data File

Last Name: TOMÁŠKA
SEER ID: 12976-Nov2009
Request Type: DVD
Delivery

SURVEILLANCE, EPIDEMIOLOGY, AND END RESULTS PROGRAM
Data-Use Agreement for the 1973-2006 SEER Research Data File

It is of utmost importance to protect the identities of cancer patients. Every effort has been made to exclude identifying information on individual patients from the computer files. Certain demographic information—such as sex, race, etc.—has been included for research purposes. All research results must be presented or published in a manner that ensures that no individual can be identified. In addition, there must be no attempt either to identify individuals from any computer file or to link with a computer file containing patient identifiers.

In order for the Surveillance, Epidemiology, and End Results Program to provide access to its Research Data File to you, it is necessary that you agree to the following provisions.

1. I will not use—or permit others to use—the data in any way other than for statistical reporting and analysis for research purposes. I must notify the SEER Program if I discover that there has been any other use of the data.
2. I will not present or publish data in which an individual patient can be identified. I will not publish any information on an individual patient, including any information generated on an individual case by the case listing session of SEER*Stat. In addition, I will avoid publication of statistics for very small groups.
3. I will not attempt either to link—or permit others to link—the data with individually identified records in another database.
4. I will not attempt to learn the identity of any patient whose cancer data is contained in the supplied file(s).
5. If I inadvertently discover the identity of any patient, then (a) I will make no use of this knowledge, (b) I will notify the SEER Program of the incident, and (c) I will inform no one else of the discovered identity.

(cont.)

6. I will not either release—or permit others to release—the data—in full or in part—to any person except with the written approval of the SEER Program. In particular, all members of a research team who have access to the data must sign this data-use agreement.
7. I will use appropriate safeguards to prevent use or disclosure of the information other than as provided for by this data-use agreement. If accessing the data from a centralized location on a time sharing computer system or LAN with SEER*Stat or another statistical package, I will not share my logon name or password with any other individuals. I will also not allow any other individuals to use my computer account after I have logged on with my logon name and password.
8. For all software provided by the SEER Program, I will not copy it, distribute it, reverse engineer it, profit from its sale or use, or incorporate it in any other software system.

Curriculum Vitae

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MN Air National Guard, Duluth, MN
148th Fighter Wing Family Adaptability and Child Behavior Study

Designed and implemented a study assessing child behavior and family adaptability across the deployment cycle. Maintained contact with family members during the deployment cycle, while working in collaboration with unit Family Programs Director, local and state level commanders, to address family concerns before, during and after the deployment.

Health Science Specialist *2007-Present*
Department of Veterans Affairs, VA Medical Center, Minneapolis, MN
CSP #546 - Randomized Clinical Trial of Vitamin E and Memantine in Alzheimer's Disease

Coordinate and monitor selected aspects of multi-site clinical trial, to include: protocol and policy adherence, IRB integrity, project management, and training. Assist in study methodology design, compilation of technical reports, design of patient recruitment and retention materials, and conference planning.

Independent Researcher *2006-2011*
MN Air National Guard, Minneapolis, MN
The State of Minnesota's Air National Guard Reintegration Assessment

Designed and implemented an internal Reintegration Assessment for the Minnesota Air National Guard. The main objective of the assessment is to identify, track and address emerging issues at each unit among members reintegrating from a combat zone environment. Actively promoted and recruited participants, while working directly with state and local level commanders to address identified gaps in reintegration programs and services for returning combat veterans.

Professional Presentations and Papers

American Public Health Association—Annual Meeting *2010*
Denver, CO
Evaluation of the Minnesota Air National Guard reintegration program: Assessing the effectiveness and implementation over multiple deployment cycles — Roundtable Discussion

International Conference on Alzheimer's Disease *2009*
Vienna, Austria
IRBs' concerns about DNA banking: The CSP #546 experience. —Poster Presentation

Annual Air National Guard Senior Leaders Conference *2009*
Camp Ripley, MN
MNANG Reintegration Assessment Update and Preliminary Data Discussion—Presentation

International Conference on Alzheimer's Disease *2008*
Chicago, IL
A Randomized Clinical Trial of Vitamin E and Memantine in Alzheimer's Disease—Poster Presentation

Annual Air National Guard Senior Leaders Conference *2008*
St. Paul, MN
MNANG Reintegration Assessment Overview and Implementation Plans —Presentation

Honors and Awards

Non-Commissioned Officer of the Year *2010*
148th Fighter Wing, Duluth, MN

Civil Servant of the Year *2010*
Minneapolis VA Medical Center, Minneapolis, MN

Professional Affiliations

Member, American Public Health Association
Member, Minnesota Public Health Association
Member, International Society to Advance Alzheimer Research and Treatment
Member, National Guard Enlisted Association
Member, Veterans of Foreign War—Post 9024
Member, Federally Employed Women