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Erica Figueroa

Date

Racial/Ethnic Disparity in Survival of Primary Invasive Breast Cancer for Patients Undergoing Breast Conserving Surgery followed by Radiation

By

Erica Figueroa
MPH

Department of Epidemiology

_____ [Chair's signature]
Kevin Ward
Faculty Thesis Advisor

Racial/Ethnic Disparity in Survival of Primary Invasive Breast Cancer for Patients Undergoing Breast Conserving Surgery followed by Radiation

By

Erica Figueroa

Bachelor of Science

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Faculty Thesis Advisor: Kevin Ward, PhD, MPH

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Abstract

Racial/Ethnic Disparity in Survival of Primary Invasive Breast Cancer for Patients Undergoing Breast Conserving Surgery followed by Radiation

By Erica Figueroa

Background: The aim of this study is to compare breast cancer survival between Hispanic whites and non-Hispanic whites in order to better understand the risk factors for each group. The study will focus on women who received both radiation and breast conserving surgery, controlling for factors that are known to have an effect on survival. Previous studies have identified racial disparities in breast cancer survival among whites, blacks, and Hispanic women but have not focused on comparing the different Hispanic racial groups.

Methods: Data for this study was obtained from the Surveillance, Epidemiology, and End Results (SEER) Program for cases of primary malignant breast cancer diagnosed from 2000 to 2010, with a localized or regional disease stage. The study participants all received breast conserving surgery followed by beam radiation. Unadjusted Kaplan-Meier survival curves and crude 5 and 10-year relative survival estimates were used to compare survival between the racial subgroups. A multivariable Cox proportional hazards model was used to calculate hazard ratios, controlling for age and marital status at diagnosis, tumor grade, disease stage, and hormone receptor status.

Results: The final study population included 142,374 cases: with 12,665 Hispanic whites and 129,709, non-Hispanic whites. Unadjusted Kaplan-Meier survival curves and adjusted Cox-regression model estimates for 5 and 10-year analyses showed better survival for non-Hispanic whites versus Hispanic whites. The cox multivariable analyses showed that Hispanic whites had an increased risk of death from breast cancer in both the 5 and 10-year analyses. For the 5-year stratified Cox-regression model, Hispanic whites had an increased risk of 12% (HR=1.12; 95% CI: 1.01-1.25). The 10-year analysis showed a lower risk of death for Hispanic whites, but it was still higher compared to non-Hispanic whites, 10% (HR=1.10; 95% CI: 1.00-1.20).

Conclusions: There are still breast cancer survival disparities that exist between Hispanic white and non-Hispanic white women even after controlling for several risk factors. Hispanic white women continue to have an increased risk of death that is likely due to more behavioral and socioeconomic risk factors. Further research is needed to collect data on these factors that can be modified in order to increase breast cancer survival rates.

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Background

The aim of this study is to assess disparities in survival between female Hispanic whites and non-Hispanic whites diagnosed with a first primary invasive breast cancer, and undergoing breast conserving surgery (BCS) with radiation as first course of therapy. The study seeks to explore whether disparities still persist after controlling and adjusting for standard of care therapy and other factors that have previously been identified as leading to survival disparities across the ethnic groups of one race.

Questions that will be addressed include:

1. *What other factors might help to explain survival disparities between Hispanic and non-Hispanic whites undergoing one form of standard therapy for early stage breast cancer, breast conserving surgery with radiation?*

2. *Is there an equal dissemination of this treatment across the racial/ethnic subgroups (Hispanic white vs. non-Hispanic white)?*

3. *What other differences could account for the disparity in survival outcomes for these different subgroups beyond what can be measured?*

Introduction

Breast cancer continues to be the leading incident cancer and one of the top causes of cancer death for women, after lung cancer, with about 1 in 8 women developing it during their lifetime [1]. According to the National Cancer Institute's Surveillance, Epidemiology, and End Results Program, the average percent of women who survive breast cancer for five years or more is 89.2% [2]. The age adjusted mortality rate from breast cancer is 22.2 per every 100,000 women a year. Although earlier detection of breast cancer through screening results in earlier stage of the disease, with rates fairly stable over the past decade, it is important to address the racial/ethnic disparities that still persist in addressing this disease. Breast cancer is the leading incidence cancer among

women and literature has shown there are differences in outcomes for women of different races. Previous research has primarily focused on the black and white racial disparities found in women with breast cancer [3-8]. Additional research is needed with a focus on Hispanic women, especially among subgroups of this population where the data are available. There are many disparities that exist among racial and ethnic subgroups and therefore it is important to not ignore these populations and to avoid generalizing them into broader categories where possible [9-11]. For this study, breast cancer survival rates among Hispanic white women will be compared to those of non-Hispanic white women. There is not sufficient data available in the research use SEER dataset to conduct a meaningful analysis that includes Hispanic women of other race classifications or subclassifications of the Hispanic population. Minorities continue to be underrepresented in public health research and this study aims to address that in one small way.

BCS with Radiation as a Standard Treatment

One of the standard treatments for breast cancer is breast conservation surgery followed by radiation, which has been shown to be very effective at treating invasive breast cancer in patients with early stage disease [12-14]. Standard of care guidelines, like those from the National Comprehensive Cancer Network, indicate that most women undergoing BCS should have post-surgical radiation [17]. Patients who undergo adjuvant radiation therapy following breast conserving surgery have a higher survival rate and lower risk of local recurrence than do women who undergo breast conserving surgery without radiation [15, 16]. While there are some concerns about the potential for cardiac toxicity of breast radiation, these concerns have largely decreased due to a number of studies that have shown the importance of other risk factors besides radiation [16]. In an

ideal situation where no disparities exist between racial or ethnic subgroups for primary invasive or in-situ breast cancer patients receiving this standard of treatment, survival rates should be similar across all racial/ethnic subgroups. This includes Hispanic white patients compared to non-Hispanic white patients. Previous studies have shown that disparities exist in the type of treatment being administered for different racial groups, either with variances in the treatments themselves or lack of adjuvant therapies for certain groups [4, 5, 7, 8, 10, 11, 18-27]. A Florida study found that Hispanics with local breast cancer were 23% less likely to receive the standard treatment compared to non-Hispanic white patients [11]. The disparities between racial and ethnic subgroups in the receipt of standard treatments can be caused by a number of other factors including: a lack of oncologic consultation, language barrier, insurance status, access to care facilities, tumor characteristics, lack of appropriate radiation therapy, and socioeconomic status. If all of the risk factors are identified, there exists a possibility that the differences in breast cancer survival for these racial groups can be reduced through proper interventions targeting these mitigating factors. The majority of studies to date have not focused on Hispanic subgroups, but more so on the white and black racial disparities. This once again highlights the need for research targeting Hispanic populations. However, the research that has been conducted for blacks can shed light on the breast cancer survival disparities related to standard of care treatment adherence that could also be present among Hispanic populations.

Post-Surgical Radiation Therapy

For most women who choose breast conserving surgery, post-surgical radiation therapy should be administered as part of the treatment since, as previously noted, it has

been found to result in better survival outcomes and lower risk of local recurrence. However, disparities have been found among minority women with regard to the proper receipt of radiation therapy after BCS.

Numerous studies have shown that African-American women are less likely to receive follow-up radiation therapy than their white counterparts, and their survival with either early or late stage breast carcinoma was significantly worse as a result [5, 8, 11, 18, 25, 27]. In these studies, it was evident that if treatments had been equally administered across all patients, the racial disparities in survival would be significantly less. Since these differences in treatment exist, it is important that they are also examined among other minority groups as well to see if that pattern carries over. A cross-sectional study conducted from 1999-2000 at six New York City hospitals, revealed that 23% of Hispanics experienced underuse of adjuvant therapy, compared to 16% in whites, with blacks having the highest percentage of underuse at 34% [4]. The study further found that this underuse of adjuvant therapy leads to a lower survival rate for the minority women. This finding was also identified for foreign-born Hispanic women. Foreign-born Hispanic women actually have lower rates of follow-up radiation therapy than US-born Hispanic women, 34.9% compared to 41.5% [19]. Another study showed that foreign-born Hispanics were associated with later stages of breast cancer and lower survival rates, but U.S. born Hispanics had higher prevalence of breast cancer overall [28]. Country of origin has been found to be a predictor for overall survival among Hispanic women with breast cancer [29]. Yet another finding that supports the idea of foreign-born Hispanic women receiving lower rates of follow-up radiation therapy is the finding that English speaking Hispanic women are more likely to get radiation therapy [30]. Current research

shows that these disparities extend within the Hispanic groups [31]. Thus, there seems to be underlying factors for different Hispanic subgroups, which are usually generalized and grouped together. Previous studies rarely separate Hispanics by racial subgroups. It is important to address racial groups specifically when analyzing risk factors since these more than likely differ across each group. The trend in the lack of radiation therapy that is concordant with the standard of care for patients undergoing breast conserving surgery is clear and demonstrates the importance of increasing awareness about the underuse of this standard procedure [23, 24]. Improving the rates of radiation after breast conserving surgery for these populations is one way that could potentially reduce the survival disparity that exists. Once the treatments are being administered equally among all racial groups, with the proper adjuvant and follow-up therapies, any remaining survival disparity across racial groups will predominately be as a result of other factors. One study did show that lack of radiation therapy was not the only reason for the survival disparity in black patients relative to whites, since they demonstrated poorer survival regardless of surgery or radiation therapy [7]. This same study found that disparities in radiation use did not influence survival in Hispanic patients as much as it did in black patients. Hispanics did not demonstrate an overall survival (OS) or disease-specific survival (DSS) that was significantly different from their white counterparts. Radiation therapy was, however, associated with a lower risk of breast cancer mortality and so it remains an important part of the standard of therapy for breast cancer patients.

The distance to a radiation center has been shown in several studies to affect whether a patient will mostly likely follow-up with the adjuvant therapy that follows the standard treatment [11, 32, 33]. The distance to a radiation therapy center has also been

shown to be a factor for women trying to decide whether mastectomy or BCS without radiation is more convenient for them over BCS with radiation [34]. Patients with lower resources, usually minorities, tend to live closer to lower quality medical centers. Studies have shown that high quality therapy centers are not as close to areas of low income as they are to higher income areas [33]. Some of these patients may forgo the recommended treatment for reasons that to some degree are out of their control. But factors like these can in fact be addressed if appropriate measures and interventions are implemented, for example by providing transportation or establishing higher-quality therapy centers at locations that are equally accessible to all. Socioeconomic status, which tends to be lower on average for Hispanic and black patients, is also found to be lower in those women who do not receive radiation after BCS [31]. This is another variable that needs to be controlled for when analyzing the breast cancer survival of the racial subgroups for this study, in order to assess whether other variables that have not already been thoroughly researched are impacting specific racial subgroups.

Breast Conserving Surgery

Another disparity related to the administration of standard of care treatment for breast cancer is the underuse of BCS and greater use of mastectomies in the Hispanic populations [20, 23]. Although, both BCS followed by radiation and mastectomy have similar rates of breast cancer survival and local recurrence, recent research has indicated that mastectomy patients tend to experience lower outcomes in physical functioning than do BCS patients after the treatment is complete [35]. Patients who are treated with BCS followed by radiation have been shown in some studies to experience overall better quality of life measures over those who chose mastectomy [36]. They also had better

emotional and social functioning, which affects their health in the future. Recent studies have shown that Hispanic white women with stage I or II breast carcinomas less than 2.0 cm in size were more likely to receive a more aggressive type of primary treatment [10, 23]. Other research has shown that patients with early-stage invasive breast cancer, who underwent breast conserving surgery with radiation had a higher breast cancer-specific survival rate compared to those treated with mastectomy alone or with radiation [12, 13]. Recently published observational studies and meta-analyses indicate that there may be a locoregional, and perhaps a systemic benefit of BCT (breast-conserving therapy including radiation) over mastectomy. Retrospective studies analyzed whether there could be a potential survival benefit in women who underwent BCT versus mastectomy and the investigators discovered that after adjustment for measured confounders, the BCT group had better disease and overall survival rates [11,12]. However, these studies did not control for behavioral or socioeconomic risk factors that could have an effect on the choice and outcome of each treatment, since other studies have shown there are no differences in survival across different treatments. Further research is needed to verify whether BCT does in fact provide better overall survival rates versus mastectomies.

Tumor Stage

Although Hispanic women have lower cancer incidence rates than white women, they are more likely to be diagnosed with breast cancer at a later stage, which decreases their chances of survival [1, 10, 19, 23, 26, 38, 39]. Studies have shown that Hispanic groups tend to present with larger tumors and have a higher likelihood of metastatic disease [4, 23, 38, 40, 41]. In addition, positive lymph node status can lead to breast cancers that have a worse prognosis and studies have found that black and Hispanic

women are more likely to have positive lymph node breast cancers [3, 5, 23]. Yet another factor that can be attributed to the differences in survival for Hispanic women is that they are less likely to be diagnosed with in situ breast cancer, or ductal carcinoma in situ [23]. This is the earliest stage at which breast cancer can be detected and the prognosis for patients with this kind of cancer is excellent. However, even after adjusting for stage, there were still disparities in survival shown in the studies above. This suggests that the other factors after diagnosis, including treatment, could be affecting patients' survival. This could be attributed to differences in screening practices and the manifestation of breast cancer at a later stage compared to non-Hispanic white women.

Tumor Characteristics

Tumor characteristics like hormone receptor (ER/PR) status can have an effect on breast cancer survival as well. Hispanic women were also more likely to have ER negative or PR negative tumors when compared to non-Hispanic white women [22, 23]. These kinds of tumors are harder to treat since hormone receptor therapy will not work and they also tend to be larger and more aggressive than positive hormone receptor tumors [42]. There have been other studies which found that black women continued to have significantly poorer survival compared to non-Hispanic white women after controlling for hormone receptor status and inflammatory status, a finding that may translate to the Hispanic groups [43]. Tumor grade is another characteristic that affects breast cancer survival, with grades ranging from well differentiated to undifferentiated. [44]. Tumors that are poorly differentiated or undifferentiated tend to grow and spread faster than those with lower grades. This tumor characteristic should thus also be

controlled for in this study analyzing the breast cancer survival between the two racial/ethnic subgroups.

Physician Communication

There is a general medical mistrust that can be found among minority women which leads to poorer medical choices, and indirectly leads to poorer quality of life [20]. The manner in which the physician communicates to patients effectively, especially to those not speaking the same language, makes a huge impact on the type of treatment the patient will ultimately select [45]. Hispanic patients are found to receive less informational support from their healthcare providers, and therefore there is a need for improving the patient-physician interaction to a level that significantly reduces treatment disparities. Oncologic referrals and consultations were administered less frequently to Hispanic women [4]. Even if the patients do end up receiving the same treatment, the kind of care and behaviors they follow during the treatments and thereafter will impact their survival and recovery. Physician recommendation was found to be the strongest predictor of receiving concordant radiation therapy among women receiving BCS in a study that analyzed patients with DCIS [30]. If physicians are failing to have the same level of communication with patients of different ethnicities this will ultimately lead to unequal administration of the standard treatment among these groups. This lack of information and general knowledge about cancer care begins early, with the disparities in cancer screenings for Hispanic groups, who have lower rates of cancer screenings like mammograms [19, 41, 46]. Physicians and the health care system overall can find ways to reach out to these groups to promote screenings and preventative services that they are largely failing to currently follow.

Socioeconomic Status

Socioeconomic and behavioral contexts that are more difficult to control could be accounting for some of the disparities in breast cancer survival. A greater proportion of Hispanic white women live in areas with the highest quartile of the population living below the federal poverty level, more so than Hispanic blacks and non-Hispanic whites [9, 38]. Both Hispanic white and Hispanic black women tended to live in areas with higher proportions of people, who were foreign-born, less educated, and did not speak English. Education is going to be an important factor in determining whether a person is aware of the many preventative measures they can take and risk factors they can avoid. These could all play a role in determining why these women have poorer outcomes. Hispanics tend to have higher levels of no insurance or government insurance plans like Medicaid, which have been shown to have an effect on the type of care and their breast cancer survival rates [4, 11, 19, 22, 23, 25]. Income and insurance status were also found to be more important and stronger predictors of breast cancer care quality than race in some studies [25]. These socioeconomic factors will be controlled for in this study.

Other studies that have found no significant survival disparities among Hispanics or better survival rates for Hispanics after adjusting for certain variables and factors. These studies found that there were no differences in the administration of the standard treatment, BCS with radiation, across the different racial groups [3, 30, 47]. For this study, only patients who received BCS with radiation will be included, and so the course of treatment received will be adjusted for through restriction. Other factors influencing the disparities could then surface that need further attention.

The main risk factors described above have shown to have an effect on breast cancer survival for women and to also play a role in the racial disparities for survival. This analysis will focus on the breast cancer survival for Hispanic and non-Hispanic whites, who have primary malignant breast cancer diagnosed between 2000 and 2010. In order to control for treatment disparities that have been previously found between Hispanic and non-Hispanic white women, only women who have received BCS followed with radiation will be included as the target study group, with a disease stage of local or regional. After restricting to women receiving one form of standard of care treatment, other risk factors will be controlled for in order to assess whether a difference in breast cancer survival for the two ethnic subgroups still exists that warrants more research. The risk factors that will be considered for the analyses include education level, language isolation, poverty level, marital status, age at diagnosis, tumor grade, disease stage, and hormone receptor status. If there is still a difference in survival rates between the two groups, then it will reveal that these risk factors are not the only ones having an effect on the disparities.

Methods

Study Population

The target study population consists of 142,374 observations obtained from a total of 18 data registries from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program for patients diagnosed between 2000 and 2010. The SEER program publishes data on cancer survival and incidence for more than a quarter of the country's population. The study population only included Hispanic and non-Hispanic white women diagnosed with first primary malignant breast cancer with a disease stage

that was localized or regional. Only participants who received breast conserving surgery followed by beam radiation therapy were included. A preliminary analysis to show the proportion of women, who underwent BCS followed by radiation, will also include women who chose a mastectomy with or without radiation. This study group includes women who have a regional or localized cancer stage, with primary malignant breast cancer for a total of 292,537 cases, which includes the target study population of 142,374 observations.

In the primary analysis, there were 129,709 non-Hispanic white females and 12,665 Hispanic white females, who were diagnosed between 2000 and 2010. Patients who received other radiation therapies besides beam radiation were excluded in order to restrict to patients all receiving the same therapy and eliminate any possible confounding related to other types of radiation therapies received. Cases that were death-certificate only were excluded since they cannot be used for survival analyses. All ages were included in order to analyze breast cancer survival while controlling at different age categories.

Covariates

The primary exposure of interest for this study was the race/ethnic subgroup variable (Hispanic whites versus non-Hispanic whites). The two ethnic groups were created using the North American Association of Central Cancer Registries (NAACCR) Hispanic Identification Algorithm, or NHIA. The NHIA identifies cancer cases that are Hispanic/Latino by using variables on race, maiden name, surname, sex and place of birth [48]. The main outcome of interest is breast cancer survival. Other covariates do exist and have been previously identified as having an effect on this outcome. Risk factors that

affect breast cancer survival in both groups are breast cancer grade, hormone receptor status, patient's age at diagnosis, marital status, percent language isolation, tumor grade, disease stage, education and socioeconomic status, including the percentage of those under the federal poverty level and the percentage of those with less than a high school education. Age at diagnosis was categorized into 3 groups: patients less than 50 years of age, 50-69, and those 70 years of age and older. The marital status variable was coded as a four-category variable including: single, married or in a domestic partnership, separated or divorced, and widowed. Disease stage includes two categories: localized and regional while tumor grade includes four categories: moderately differentiated, well differentiated, poorly differentiated, and undifferentiated. County variables were used to create area-based measures of socioeconomic status between the two groups. These three county variables included the percentage of those living with language isolation, less than a high-school education, and the percentage living below the federal poverty level. Language isolation is defined as households where no member who is 14 and over speaks English only or speaks a language other than English, and also speaks English with difficulty. The county variables were all recoded into equal quartiles.

Survival and Censoring Time

Breast cancer survival time was defined as the number of months from the date of diagnosis until death from breast cancer or censoring. Survival time was limited to those patients diagnosed between 2000 and 2010 and was censored at a maximum of 5 or 10 years for all subjects depending on the analysis. Patients dying of other causes other than breast cancer, those lost to follow-up and patients reaching the study end-point were

censored. Mean survival time was defined as the average number of months that the study population survived their breast cancer diagnosis within the study period.

Statistical Analyses

All analyses were conducted using SEER*STAT Version 8.0.2 and the SAS statistical software. Demographic and clinical variables for the two racial groups, Hispanic whites and non-Hispanic whites, were compared in order to assess whether there were any statistically significant differences between the two groups. Survival months and all of the categorical variables were presented as counts and percentages based on the two racial/ethnic groups. Categorical variables were analyzed using Pearson's chi-square test, at an alpha of 0.05. Continuous variables were analyzed using a t-test at a p-value of 0.05 as well.

Survival analysis included both 5 and 10-year unadjusted Kaplan-Meier survival curves for Hispanic white versus the reference group, non-Hispanic white women. Patients were censored at 60 months for the 5-year survival analysis. Univariate comparisons between the two ethnic groups were made using Kaplan-Meier plots and the log-rank test. Prior to running adjusted multivariable models, single variable Cox regression models for both the 5 and 10-year cohorts will be assessed with only race as the variable of interest in order to compare the hazard ratios to the multivariate models that controlled for confounders. Proportional hazard assumptions were conducted on the covariates using log-log rank survival functions, interaction with survival time, and Goodness of Fit tests. Variables that failed the proportional hazards assumptions were stratified upon. Those that grossly failed the PH assumptions included tumor grade, and the ER/PR hormone receptor status variables. Re-categorizing these variables did not

solve the problem with the proportional hazards assumption. The stratified, multivariate cox regression model adjusts for race, age, tumor grade, hormone receptor status, disease stage, marital status, and all the county SES variables. The appropriate 95% confidence intervals for the hazard ratios were calculated. Interaction terms between the main exposure (racial/ethnic variable) and each of the covariates were assessed in order to avoid effect modification. Variables were dropped at an alpha level of 0.05. All of the models were analyzed at a 5% significance level.

Results

Treatment and Demographic Characteristics

Table 1 shows that a higher percentage of Hispanic whites chose mastectomy with or without radiation over BCS followed by beam radiation compared to Non-Hispanic whites (43.5% versus 49.2%). The total amount of patients in both ethnic groups who chose BCS followed by beam radiation was 142,374.

From the total 142,374 eligible study participants, 129,709 (91.1%) were Non-Hispanic white and 12,665 were Hispanic white (8.9%), showing a large difference in the study groups. More Hispanic whites were younger than 50 at diagnosis compared to non-Hispanic whites, 32.7% versus 19.0% (Table 2). There were a higher percentage of non-Hispanic whites in the older age categories, with the highest percentage being diagnosed between 60-69 as opposed to less than 50 for the Hispanic whites. Slightly more non-Hispanic whites were married or in a domestic partnership, 63.6% versus 60.3%. The county variables used to analyze socioeconomic status for the two ethnic groups presented statistically significant differences between the two groups. There was a higher percentage of Hispanic whites in the highest quartile of the poverty variable, 21.9%

versus 17.8%. This suggests that more of the Hispanic cases lived in counties with a larger portion of the county population living in the highest quartile of poverty, where percentages living below the federal poverty level were the highest. A higher number of Hispanics were in the upper quartile for percentages with less than a high school education, 46.2% versus 22.0%. Thus, a higher number of Hispanics lived in counties where a higher portion of the population did not have a high school education, compared to the non-Hispanic whites. More Hispanics resided in counties where language isolation was more prevalent, with 49.4% belonging in the upper quartile, versus 21.6% non-Hispanic whites. Non-Hispanic whites presented larger values for the lower quartiles of all three of the county SES variables. The percent of non-Hispanic whites that died from breast cancer for those diagnosed from 2000 to 2010 was slightly lower compared to Hispanic whites, 3.8% versus 4.8%.

Clinical Characteristics

The estrogen and progesterone hormone receptor status for Non-Hispanic whites was positive at a higher percentage compared to Hispanic whites, 84.2% versus 78.4% and 73.2% versus 68.2% (Table 3). Non-Hispanic whites had more tumors that were well and moderately differentiated, while Hispanic whites had higher percentages of poorly or undifferentiated tumors. Hispanic whites had a higher percentage of regionalized breast cancer than did non-Hispanic whites (27.3% versus 22.3%). A preliminary analysis of the difference in survival of breast cancer for both groups showed a statistically significant difference between the average survival months for each racial group. The non-Hispanic whites in the study group had an average of 70.5 survival months, while Hispanic whites had an average of 65.5 survival months.

Survival

For the 5-year analysis, there were 533 observations for Hispanic whites and 7,827 for non-Hispanic whites (total of 8,360) that were dropped from the survival analyses due to unknown or missing values for the cause of death variable. There were 942 observations for Hispanic whites and 14,295 for non-Hispanic whites that were also dropped from the survival analyses for the 10-year analyses (Tables 4 and 5). These observations in both the 5 and 10-year analyses were deleted due to an unknown or missing value in the cause of death variable used to create the censoring variable. The Kaplan-Meier (KM) survival curves differed significantly by race for both the 5 and 10-year survival analysis (Log-Rank 44.2; $p<0.001$ and Log-Rank 43.4; $p<0.001$) (Figures 1 and 2). The unadjusted Kaplan-Meier analysis revealed only a slight difference in the average survival months for the 5-year analysis (58.3 versus 57.9) between non-Hispanic whites and Hispanic whites (Table 4). However, the 10-year unadjusted KM survival analysis presented a slightly larger difference between the two groups. Non-Hispanic whites survived an average of 115.0 months while Hispanic whites survived an average of 113.8 months during the 10-year analysis (Table 5). Non-Hispanic whites presented higher averages of breast cancer survival months across all the risk factors, including the county SES variables, that have been previously found to cause lower breast cancer survival rates when compared to Hispanic whites (Tables 4 and 5).

The results of a 5-year single variable Cox model, with just race in the model, shows that Hispanic whites have an increased risk of 41% compared to non-Hispanic whites (HR=1.41; 95% CI 1.28-1.57) (Table 6). For the 10-year single variable Cox model, Hispanic whites had an increased risk of 33% over non-Hispanic whites

(HR=1.33; 95% CI 1.22-1.45) (Table 8). These will be compared to the multivariate models that adjust for confounders.

The race, marital status, age category, county SES, and disease stage variables satisfied the proportional hazards assumption, while the tumor grade, and hormone receptor status variables did not. The 5-year adjusted hazard ratio estimates showed that Hispanic whites had an increased risk for breast cancer specific death of 12% (HR=1.12; 95% CI: 1.01-1.25) (Table 7). The education and language isolation county variables presented statistically significant results that were different between the two ethnic groups. The hazard ratio for the education variable from the 5-year stratified Cox model suggests that cases from counties in the upper quartile of those having less than a high school education had a 50% increased risk of death from breast cancer versus the lower quartile (HR=1.50; 95% CI: 1.28-1.77) (Table 7). The language isolation variable suggests those from counties in the upper quartile have a protective effect against breast cancer death for both the 5 and 10-year Cox models (Tables 7 and 9). All these county variables present area-based estimates and not individual estimates. There was an increased risk of death as patient's age at diagnosis increased for both the 5 and 10-year adjusted analyses, with those ages 70 and up having the highest increased risk (Tables 7 and 9). Localized disease stage presented a decreased risk of death when compared to regional disease stage since there was a protective effect for both the 5 and 10-year estimates. The hazard ratio estimate for the categories in the marital status variable that were significant for both 5 and 10-year models were the married/domestic partners versus the single/never married estimates. There was a protective effect when patients were married for both the 5 and 10-year risk estimates. Patients from counties belonging in the

upper quartile of the variable for those having less than a high school education versus the lower quartile, had a 52% increased risk of death (HR=1.52; 95% CI: 1.33-1.74) (Table 9). For the 10-year adjusted model, Hispanic whites had an increased risk of breast cancer death of 10% (HR=1.10; 95% CI: 1.00-1.20) (Table 9).

Discussion

The results of the 5 and 10-year cause specific breast cancer survival analyses suggest that Hispanic whites have a lower chance of surviving breast cancer when compared to non-Hispanic whites even when both groups were treated with the same type of standard therapy and when other confounders were adjusted for in the models. The single variable Cox models hazard ratio estimates for both the 5 and 10-year analyses compared to the adjusted multivariate models shows that there are still survival disparities between Hispanic whites and non-Hispanic whites, although not as pronounced. Previous research supported this finding as well. Hispanics were diagnosed at younger ages and present a more difficult to treat breast cancer as seen through the higher percentage of Hispanic whites that have ER and PR-negative hormone receptor tumors. Non-Hispanic whites had a higher percentage of ER and PR-positive hormone receptor tumors, which can be treated with hormone therapies. Studies have shown that the 5-year survival for women who have ER-positive tumors is ten percent better than those with ER-negative tumors [49]. These tumors recur at an earlier rate and the survival difference reduces after five years. However, the 10-year survival for this study still reveals a difference in outcomes between the two ethnic groups after hormone receptor status is controlled for and suggests that other risk factors might be accounting for the survival difference. However, this study did not consider patients who received hormone

therapy or chemotherapy because these data are unfortunately not available in the research use SEER data. Hispanic whites also had tumors that were undifferentiated or poorly differentiated at higher rates than did non-Hispanic whites. These types of tumors grow and spread faster [50].

Since the adjusted-stratified Cox model still revealed a disparity in breast cancer survival between the two ethnic groups even after controlling for previously proven clinical and demographic risk factors, it is evident that other outside risk factors unable to be measured are still at play. Both the 5 and 10-year unadjusted KM survival analyses that were done separately for each ethnic group revealed that non-Hispanic whites had better survival outcomes across all the risk factors associated with lower breast cancer survival. Once again, this indicates that there are underlying risk factors that are causing Hispanic whites to have worse survival outcomes.

Both the 5 and 10-year stratified cox models that adjusted for several risk factors, still presented an increased risk of death for Hispanic whites over non-Hispanic whites. The results of these models also showed that the different age categories presented an increased risk of death from breast cancer as age increased, this suggests that preventative and intervention services for breast cancer should focus on targeting both young and older women so that no age group is left out when designing target group interventions. Married women, or those in domestic partnerships, also appeared to fare better than those women who were not married and should perhaps indicate that interventions or treatments should also try to improve the relationships and support groups for women who are not married. It may be a lack of support that is causing the difference in the survival rate. Women who had a localized disease stage also fared better than those who

had a regional disease stage. Better treatments are needed to effectively target all stages of breast cancer.

Limitations and Strengths

Limitations for previous studies included the method in which race and ethnicity were classified for the Hispanic subgroups. These groups were created using the NAACR Hispanic Identification Algorithm (NHIA) and can be misclassified [38, 51]. Since the data for this study being conducted also uses the NHIA, this limitation could carry over. Some of the Hispanic whites can be misclassified as non-Hispanic whites, or vice versa. Another limitation is that there is simply not a lot of data on the Hispanic population as much as there is for non-Hispanic groups. Given that the difference in percentage for each racial group for this SEER study was large (8.9% versus 91.1%), it is evident that more data and research is needed for the Hispanic population. This limits the statistical power of this and many other studies that do include Hispanic black and white subgroups as well since the sample size is not representative of the actual population. It might also be hard to assess whether each person did actually receive the exact same treatment even if SEER reports that they received the respective radiation therapy after lumpectomy, which is the standard treatment. A shortcoming for the analyses of this study includes the large number of observations that were dropped due to invalid time, censoring, or strata values. Those dropped observations could have had a significant effect on the results of this study. The variables that did not satisfy the proportional hazards assumptions included the tumor grade and hormone receptor status variables. Perhaps different methods of re-categorizing these variables could be introduced in future studies if they still do not satisfy the assumptions since it was not possible for this study without

erroneously categorizing the variables. Patients who received hormone therapy or chemotherapy were not taken into account. This could present a confounding effect for the study. Another limitation that can present itself in this study is the inability to track whether patients are receiving the same information from their physicians across all visits, both in a language they understand and at the same level of communication. The county SES variables used for this study (language isolation, poverty, and education) present a constraint for the study since this information is not based on an individual patient's response but on the county statistics as a whole. These are area-based variables. As a result, this may not be representative of each individual. Language isolation is persistent among the Hispanic populations and is not truly accounted for in this study, which is important in order to measure possible lack of physician-patient communication. The results of this study revealed that language isolation might have a protective effect against breast cancer, which goes against previous research and also suggests that other methods of collecting such data are needed. There is also lack of data for some variables, which would otherwise be controlled for since they have been shown to have an effect on breast cancer survival, including the insurance status and household income variables. The insurance status variable information started being collected in 2007. This limits what can be said about the variation found among the racial subgroups in regards to their insurance status. All these variables are important since they have been shown to influence breast cancer survival between the two racial groups. An important finding is that women in both ethnic categories, especially Hispanics whites are choosing mastectomies with or without radiation at higher percentages than BCS followed by radiation for their choice of treatment. There could be many reasons for it but it should be

further researched in order to see if the most appropriate treatment is being administered that could result in better survival outcomes. The strengths for this study are the comparisons between white racial groups alone for the analysis of Hispanic whites versus non-Hispanic whites, since many studies generalize Hispanics into one category while ignoring the subgroups that exist within the Hispanic population. This study does not group black and white Hispanics into one Hispanic category like the majority of studies do, so the survival disparities can shed light on different subgroups rather than one general ethnic group. This could also help to determine whether a survival disparity is more present in the white racial group for Hispanic and non-Hispanic groups versus the black racial group for Hispanic and non-Hispanic groups.

Future Directions

It was originally intended to also include a Hispanic black subgroup, but the numbers were too small compared to the Hispanic white subgroup, which already presents a limitation. This group is one that is often not included in studies and the lack of cases may be a reason for doing so but it is still an important group that should not be ignored. Future studies should focus on including an analysis that looks at Hispanic blacks as well but only after sufficient data is collected and is representative of the actual population. Those that do include Hispanic blacks, note that the majority is from Los Angeles. Country of origin, years in the US, and insurance status could all be potential confounders and effect modifiers. It would be important to further stratify the Hispanic racial groups into their more specific country of origin groups to see if disparities are statistically significant across these groups within the Hispanic racial groups. By further stratifying, it would help to deduce what could be causing, if any, the disparities that exist

in the breast cancer survival rates for each specific group. In the future, this analysis could be conducted on in-situ patients as well since this study focused on primary invasive breast cancer patients, it would also be interesting to see if the racial survival disparities are present for localized breast cancer. More variables that are able to accurately predict a group's socioeconomic status are needed. Since major behavioral and socio-economical risk factors were not completely controlled for in this study, given the difficulty in finding the variables to do so, future research should focus on finding the best method to take these types of variables into account. If the data for these kinds of conditions to be considered is not available than the first action to take is to look for research that involves collecting this type of data for future research on the subject matter.

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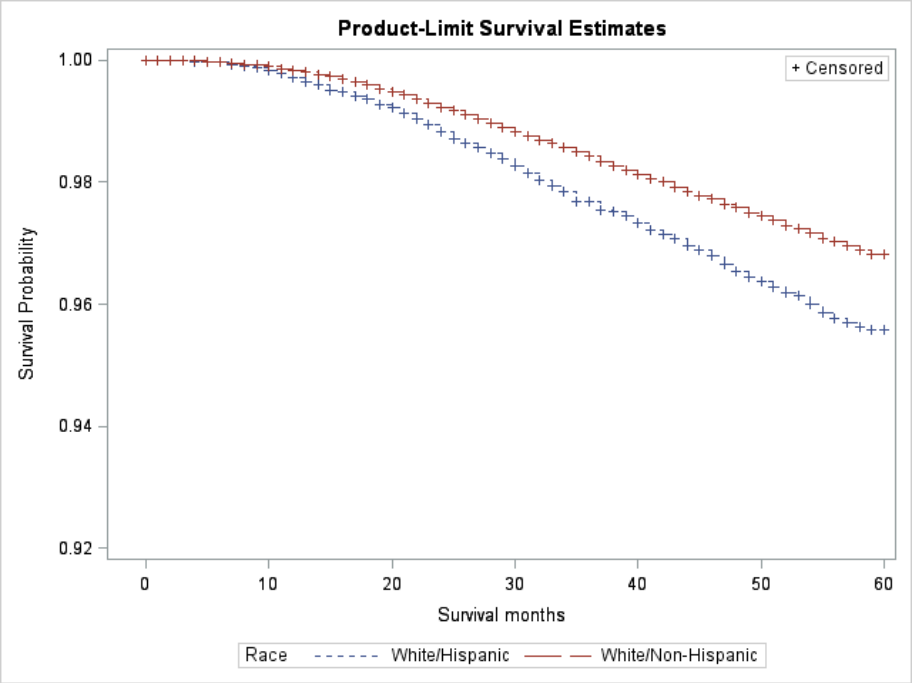
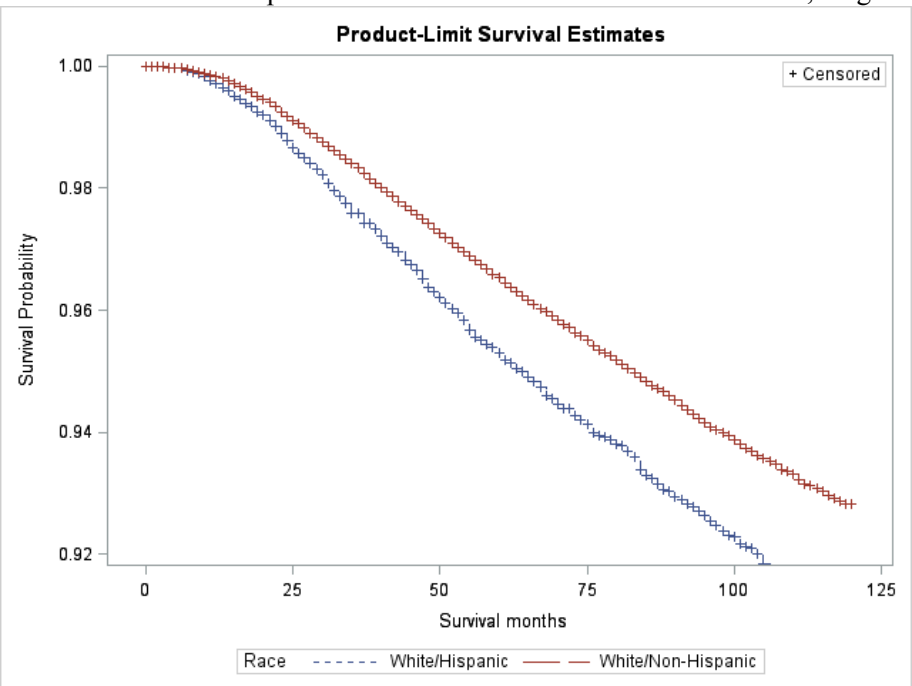
Figure 1. Unadjusted 5-Year Kaplan-Meier Survival Curve by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.



Log-rank p-value: <0.001 (44.2)

Figure 2. Unadjusted 10-year Kaplan-Meier Survival Curve by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.



Log-rank p-value: <0.001 (43.4)

Table 1. Distribution of initial therapy by racial/ethnic group for primary invasive breast cancer patients diagnosed from 2000-2010.

Treatment	N (%)	White/Non-Hispanic N (%)	White/Hispanic N (%)
BCS followed by Beam Radiation	142,374 (48.7)	129,709(49.2)	12,665(43.5)
Mastectomy[1]	150,163 (51.3)	133,727(50.8)	16,436(56.5)
1. All type of mastectomy surgeries with or without radiation.			

Table 2. Demographics by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

Demographic Characteristics	White/ Non-Hispanic N (%)	White/ Hispanic N (%)	X^2 p-value
Total	129,709 (91.1%)	12,665 (8.9%)	
Mean Age at Diagnosis	61.2	56.3	<0.001
Age at Diagnosis			<0.001
<50	24,662 (19.0)	4,138 (32.7)	
50-59	34,411 (24.2)	3,523 (27.8)	
60-69	35,047 (27.0)	2,904 (22.9)	
70-79	25,831 (19.9)	1,688 (13.3)	
80+	9,758 (7.5)	412 (3.3)	
Marital Status			<0.001
Single	13,022 (10.0)	1,959 (15.5)	
Married/Domestic Partner	82,455 (63.6)	7,642 (60.3)	
Separated/Divorced	15,167 (11.7)	1,687 (13.3)	
Widowed	19,065 (14.7)	1,377 (10.9)	
% Below Federal Poverty Level[1]			<0.001
Upper Quartile	23,059 (17.8)	2,768 (21.9)	
Third Quartile	39,033 (30.1)	5,729 (45.2)	
Second Quartile	33,405 (25.8)	2,063 (16.3)	
Lower Quartile	34,212 (26.4)	2,105 (16.7)	
% Less than HS Education[2]			<0.001
Upper Quartile	28,550 (22.0)	5,854 (46.2)	
Third Quartile	32,120 (24.8)	3,674 (29.0)	
Second Quartile	33,621 (25.9)	2,147 (17.0)	
Lower Quartile	35,418 (27.3)	990 (7.8)	

% Percent Language Isolation[3]			<0.001
Upper Quartile	27,858 (21.6)	6,251 (49.4)	
Third Quartile	28,604 (22.2)	3,953 (31.2)	
Second Quartile	37,342 (28.9)	1,845 (14.6)	
Lower Quartile	35,219 (27.3)	614 (4.9)	
Vital Status[4]			<0.001
Alive or died of other	108, 922 (84.0)	11,020 (87.0)	
Died from Breast Cancer	4,941 (3.8)	605 (4.8)	

1. The county variable quartiles represent the number of people belonging at each level based on the value of their county percent for that variable. The lower quartile includes the people that made up the lower percentage values for those below the federal poverty level. The upper quartile represents the people that had the higher percentage values for a county that was below the federal poverty level.
2. The lower quartiles indicate lower percentage values for those with less than a high school education. Those in the higher quartiles were in counties with higher percentages having less than a high school education.
3. The upper quartiles of the percent language isolated, indicate those living in counties with higher reported percentages of language isolation.
4. Those with unknown or missing values for cause of death were deleted in the survival analyses.

Table 3. Clinical characteristics by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

Clinical Characteristics	**White/Non-Hispanic N (%)**	**White/Hispanic N (%)**	**X^2 p-value N (%)**
Total	129,709 (91.1%)	12,665 (8.9%)	
Hormone Receptor Status			<0.001
Estrogen +	109,199 (84.2)	9,930 (78.4)	
Estrogen -	20,510 (15.8)	2,735 (21.6)	
Progesterone +	94,918 (73.2)	8,635 (68.2)	
Progesterone -	34,791 (26.8)	4,030 (31.8)	
Grade			<0.001
Well differentiated	36,522 (28.2)	2,832 (22.4)	
Moderately differentiated	57,213 (44.1)	5,323 (42.0)	
Poorly differentiated	34,804 (26.8)	4,331 (34.2)	
Undifferentiated	1,170 (0.9)	179 (1.4)	
Stage			<0.001
Localized	100,850 (77.8)	9,211 (72.7)	
Regional	28,859 (22.3)	3,454 (27.3)	
Breast Cancer survival months	70.5	65.5	<0.001

Table 4. Unadjusted 5-Year Survival Analysis by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

	Non-Hispanic Whites Mean Survival (Months)	Total[1] (Died)	Log-rank p-value	Hispanic Whites Mean Survival (Months)	Total[2] (Died)	Log-rank p-value
	58.3	121,882(3,128)		57.9	12,132(416)	
Marital Status			<0.001			0.002
Single	58.3	12,300 (309)		53.8	1,887 (76)	
Married/Domestic	58.3	78,116 (1,834)		58.1	7,341 (226)	
Separated/Divorced	58.2	14,223 (416)		55.0	1,602 (62)	
Widowed	58.0	17,243 (569)		57.7	1,302 (52)	
Age at Diagnosis			<0.001			0.001
<50	58.1	24,133 (749)		56.7	4,052 (177)	
50-59	58.4	33,129 (756)		58.2	3,401 (98)	
60-69	58.5	32,717 (629)		55.2	2,747 (74)	
70-79	58.2	23,462 (635)		58.1	1,572 (51)	
80+	57.6	8,441 (359)		56.6	360 (16)	
% < Federal Poverty Level			<0.001			0.001
Upper Quartile	58.1	21,763 (632)		56.7	2,647 (115)	
Third Quartile	58.2	36,750 (1,005)		57.9	5,509 (199)	
Second Quartile	58.3	31,330 (744)		58.3	1,980 (47)	
Lower Quartile	58.3	32,039 (747)		54.3	1,996 (55)	
% < HS Education			<0.001			0.017
Upper Quartile	58.1	26,913 (823)		57.8	5,628 (225)	
Third Quartile	58.3	30,225 (812)		58.1	3,536 (104)	
Second Quartile	58.3	31,565 (768)		58.0	2,037 (62)	
Lower Quartile	58.4	33,179 (725)		54.4	931 (25)	
% Language Isolation			0.099			0.942
Upper Quartile	58.2	26,176 (698)		58.0	6,014 (205)	
Third Quartile	58.3	26,889 (697)		57.8	3,785 (131)	
Second Quartile	58.3	34,978 (836)		58.0	1,747 (62)	
Lower Quartile	58.2	33,190 (873)		47.4	584 (18)	
Hormone Receptor Status			<0.001			<0.001
Estrogen +	58.6	102,469(1,628)		58.5	9,516 (177)	
Estrogen -	56.7	19,413 (1,500)		56.0	2,616 (239)	
Progesterone +	58.6	89,194 (1,272)		58.5	8,277 (143)	
Progesterone -	57.3	32,688 (1,856)		56.7	3,855 (273)	
Stage			<0.001			<0.001
Localized	58.5	94,520 (1,612)		58.4	8,781 (179)	
Regional	57.4	27,362 (1,516)		56.9	3,351 (237)	

Grade			<0.001			<0.001
Well differentiated	57.8	34,234 (231)		54.8	2,698 (17)	
Moderately differentiated	58.6	53,531 (869)		57.6	5,093 (78)	
Poorly differentiated	57.3	32,985 (1,952)		56.7	4,168 (303)	
Undifferentiated	57.3	1,132 (76)		52.2	173 (18)	

1. Observations with missing values for cause of death were deleted from the analyses.
2. Observations with missing values for cause of death were deleted from the analyses.

Table 5. Unadjusted 10-Year Survival Analysis by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

	Non-Hispanic Whites Mean Survival (Months)	**Total[1] (Died)**	**Log-rank p-value**	**Hispanic Whites Mean Survival (Months)**	**Total[2] (Died)**	**Log-rank p-value**
	115.0	115,414(4,819)		113.8	11,723(593)	
Marital Status			<0.001			0.183
Single	115.0	11,751 (482)		109.3	1,835 (101)	
Married/Domestic	115.4	74,325 (2,858)		114.1	7,104 (343)	
Separated/Divorced	114.5	13,472 (612)		111.7	1,546 (83)	
Widowed	113.6	15,866 (867)		103.2	1,238 (66)	
Age at diagnosis			<0.001			0.000
<50	114.4	23,502 (1,194)		112.6	3,981 (256)	
50-59	115.7	31,820 (1,144)		113.5	3,293 (145)	
60-69	115.9	30,923 (974)		112.9	2,630 (103)	
70-79	114.5	21,580 (1,002)		111.3	1,490 (71)	
80+	110.7	7,589 (505)		80.5	329 (18)	
% < Federal Poverty Level			<0.001			0.000
Upper Quartile	114.4	20,810 (979)		110.8	2,567 (158)	
Third Quartile	114.8	34,798 (1,516)		112.5	5,327 (287)	
Second Quartile	115.3	29,618 (1,166)		115.3	1,894 (68)	
Lower Quartile	115.3	30,188 (1,158)		112.0	1,935 (80)	
% < HS Education			<0.001			0.002
Upper Quartile	114.3	25,547 (1,237)		111.1	5,457 (321)	
Third Quartile	114.9	28,674 (1,236)		114.3	3,415 (156)	
Second Quartile	115.0	29,904 (1,236)		111.0	1,964 (79)	
Lower Quartile	115.6	31,289 (1,110)		101.8	887 (37)	

% Language Isolation			0.049			0.811
Upper Quartile	114.0	24,689 (1,071)		112.1	5,806 (293)	
Third Quartile	115.0	25,329 (1,086)		112.6	3,681 (190)	
Second Quartile	115.3	33,115 (1,308)		113.6	1,669 (86)	
Lower Quartile	114.8	31,654 (1,318)		102.4	565 (24)	
Hormone Receptor Status			<0.001			<0.001
Estrogen +	116.2	96,913 (2,947)		115.6	2,536 (287)	
Estrogen -	109.2	18,501 (1,872)		103.3	9,187 (306)	
Progesterone +	116.4	84,542 (2,371)		115.8	3,729 (339)	
Progesterone -	111.4	30,872 (2,448)		105.3	7,994 (254)	
Stage			<0.001			<0.001
Localized	116.3	89,236 (2,522)		115.7	8,453 (266)	
Regional	110.8	26,178 (2,297)		107.1	3,270 (327)	
Grade			<0.001			<0.001
Well differentiated	117.7	32,264 (445)		115.0	2,599 (29)	
Moderately differentiated	116.1	50,641 (1,594)		116.0	4,900 (143)	
Poorly differentiated	110.8	31,450 (2,677)		106.3	4,058 (399)	
Undifferentiated	111.0	1,059 (103)		77.4	166 (22)	

1. Observations with missing values for cause of death were deleted from the analyses.
2. Observations with missing values for cause of death were deleted from the analyses.

Table 6. 5-Year Single Variable Cox Model[1] for Risk of Breast Cancer Mortality for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

Variable	Hazard Ratio	95 % CI	p-value
Race			
Non-Hispanic Whites	Reference		
Hispanic Whites	1.41	1.28 1.57	<0.001

1. Cox model only includes race and does not adjust for confounders.

Table 7. 5-Year Multivariable Cox Proportional Hazard Model[1] for Risk of Breast Cancer Mortality by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

Variable	Hazard Ratio	95% CI		p-value
Race				
Non-Hispanic Whites	Reference			
Hispanic Whites	1.12	1.01	1.25	0.039
Age				
<50	Reference			
50-69	0.92	0.84	1.00	0.041
70+	1.62	1.46	1.79	<0.001
Marital Status				
Single/Never Married	Reference			
Married/Domestic Partner	0.84	0.75	0.94	0.002
Widowed	1.16	1.01	1.34	0.031
Separated/Divorced	1.07	0.94	1.23	0.311
***% < Federal Poverty Level**				
Upper Quartile	0.97	0.84	1.12	0.677
Third Quartile	0.97	0.86	1.08	0.555
Second Quartile	0.93	0.83	1.03	0.158
***% < HS Education**				
Upper Quartile	1.50	1.28	1.77	<0.001
Third Quartile	1.33	1.16	1.53	<0.001
Second Quartile	1.18	1.06	1.32	0.003
***% Language Isolation**				
Upper Quartile	0.84	0.75	0.95	0.006
Third Quartile	0.90	0.80	1.00	0.049
Second Quartile	0.99	0.90	1.09	0.833
Stage				
Regional	Reference			
Localized	0.34	0.32	0.37	<0.001

1. Adjusted Cox Model, stratified on tumor grade, and both ER and PR hormone receptor statuses. All patients received beam radiation after BCS.

* County variables included the lowest quartile as the reference category.

Table 8. 10-Year Single Variable Cox Model[1] for Risk of Breast Cancer Mortality for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

Variable	Hazard Ratio	95 % CI		p-value
Race				
Non-Hispanic Whites	Reference			
Hispanic Whites	1.33	1.22	1.45	<0.001

1. Cox model only includes race and does not adjust for confounders.

Table 9. 10-Year Multivariable Cox Proportional Hazard Model[1] for Risk of Breast Cancer Mortality by racial/ethnic group for primary invasive breast cancer patients who received both radiation and BCS, diagnosed from 2000-2010.

Variable	Hazard Ratio	95% CI		p-value
Race				
Non-Hispanic Whites	Reference			
Hispanic Whites	1.10	1.00	1.20	0.048
Age				
<50	Reference			
50-69	0.88	0.82	0.94	0.000
70+	1.60	1.47	1.73	<0.001
Marital Status				
Single/Never Married	Reference			
Married/Domestic Partner	0.86	0.79	0.94	0.001
Widowed	1.18	1.05	1.31	0.005
Separated/Divorced	1.05	0.94	1.17	0.423
***% < Federal Poverty Level**				
Upper Quartile	0.97	0.86	1.08	0.567
Third Quartile	0.94	0.86	1.03	0.205
Second Quartile	0.92	0.85	1.01	0.065
***% < HS Education**				
Upper Quartile	1.52	1.33	1.74	<0.001
Third Quartile	1.34	1.20	1.50	<0.001
Second Quartile	1.23	1.12	1.34	<0.001
***% Language Isolation**				
Upper Quartile	0.83	0.76	0.92	0.000
Third Quartile	0.91	0.83	0.99	0.031
Second Quartile	0.99	0.91	1.07	0.737
Stage				
Regional	Reference			
Localized	0.35	0.33	0.37	<0.001

1. Adjusted Cox Model, stratified on tumor grade, and both ER and PR hormone receptor statuses. All patients received beam radiation after BCS.

*County variables included the lowest quartile as the reference category.