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Incidence of Female Breast Cancer in the United States by Race and Region

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CDC WONDER Data Set

Scholarship in Medicine Final Report

By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission

Abstract

Objective: Assess the distribution and incidence of female breast cancer in the United States in different races and regions of the United States. *Methods:* Collect and analyze CDC WONDER data from the Center for Disease and Control to see if there are varying rates of female breast cancer incidence between races and in different regions of the United States. *Results:* The results are expected to show a significant difference in female breast cancer incidence between races and a non-significant difference in female breast cancer incidence among different regions of the United States.

Key Words: breast cancer, cancer incidence, race, racial disparities, United States regions, geographic distribution

Introduction/Literature Review

Breast cancer incidence in white versus non-white women has been a topic of discussion for several decades. Non-white women have a higher mortality rate than do white women and there are some analyses that show there may be differences in types of breast tumors among women of different races.¹

While papers on breast cancer incidence rates and geographic distribution exists, few have assessed the distribution of rates between against multiple races in the years 2012 to 2016 and fewer have looked at breast cancer incidence alone. A study done by Laden et al. in 1997 found a slight increase in incidence rates of invasive breast cancer in women from California compared to other areas of the United States and no significant differences between the Northeast, the Midwest, and the South.² In a 2017 publication, DeSantis et al. reported Non-Hispanic Black women were unfairly burdened with the triple-negative breast cancer, an aggressive subtype with poor prognosis, compared to Non-Hispanic White women.³

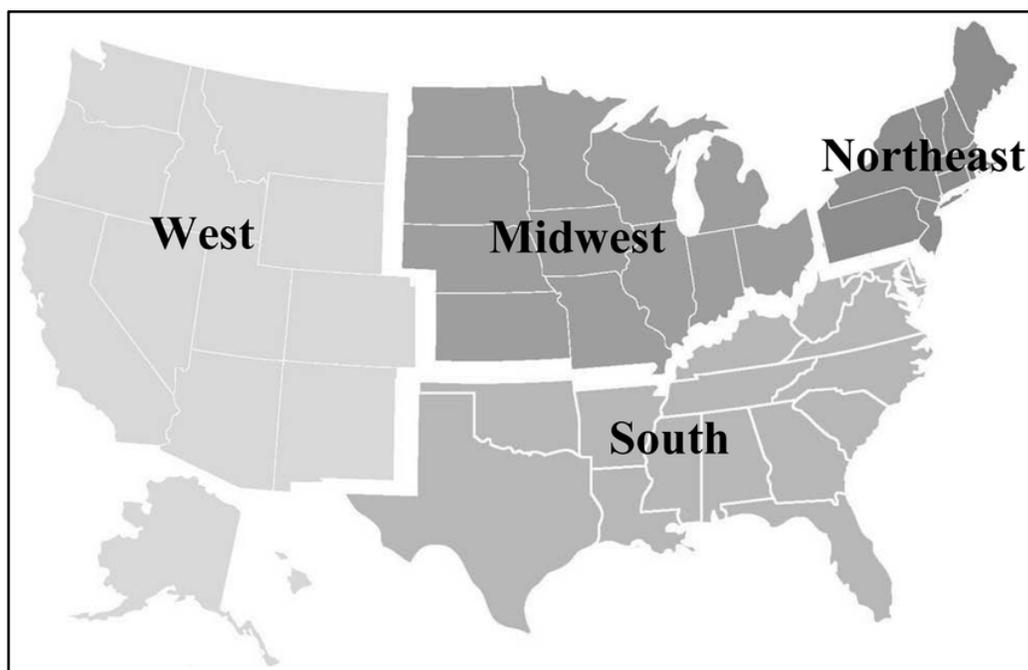
In the late 1990s and early 2000s, female breast cancer incidence was noted to be highest in White women, compared to African Americans, Asian Americans and Pacific Islanders, Hispanics/Latinas, and American Indians and Alaska Natives. Not only does breast cancer incidence vary by race, survival does as well. In the same study, relative survival from breast cancer in women was found to be consistently decreased in African American women compared to White women.⁴

Every year in the United States, nearly a quarter of a million cases of breast cancer are diagnosed in women and about 41,000 die from the disease. While the overall rate of diagnosis has remained stagnant over the course of several years, the rate of incidence has increased for

African Americans and Asian Americans and Pacific Islanders. The deaths from breast cancer have slowly declined in recent years, however, breast cancer is still the second leading cause of cancer death among women overall and is the leading cause of death in Hispanic/Latina women.⁵

To our knowledge, a study has not yet been conducted to analyze regional and racial differences in female breast cancer incidence. This study aims to analyze the geographic distribution of breast cancer incidences in American Indian, Asian/Pacific Islander, Black/African American, and White women to assess the potential of racial and regional disparity in female breast cancer incidence in the Northeast, Midwest, South, and West regions of the United States from the years 2012-2016.

Figure 1. Census Regions in the United States⁶



Hypothesis/Specific Aims/Research Questions

- *Research Question 1:* How did female breast cancer incidence vary among the states between 2012 to 2016?
- *Research Question 2:* How did female breast cancer incidence vary among different regions of the United States between 2012 and 2016?
- *Research Question 3:* How did female breast cancer incidence vary among race between 2012 and 2016?
- *Research Question 4:* How did the rate female breast cancer incidence vary between different races in each of the United States regions in the years 2012 to 2016?
- *Hypothesis:* There are no significant differences in female breast cancer incidence between the regions of the United States, however, there are significant differences in female breast cancer incidence between the various races.

Methods

Data Collection

The CDC WONDER⁷ (Wide-Ranging Online Data for Epidemiologic Research) data for this study was obtained through the United States Cancer Statistics (USCS) database, which is the official federal statistics on cancer incidence for the fifty US states and the District of Columbia. The Centers for Disease Control and Prevention (CDC) and the National Cancer Institute (NCI) produce the official United States Cancer Statistics together yearly. CDC WONDER is a publicly available database that provides demographic information including age group, sex, race, and US Census region.

Data Context

Populations in this study exclusively included women in the United States. The counts of female breast cancer rates between the years 2012 and 2016 were taken from the CDC WONDER database⁷. The rates of female breast cancer were then separated by race (Asian or Pacific Islander, Black or African American, White, American Indian or Alaska Native, and White) as well as by US Census regions (Northeast, Midwest, South, and West) by the CDC WONDER database.

Data Analysis

The CDC WONDER data set was qualitatively and quantitatively analyzed in order to determine if there is a statistically significant difference of breast cancer rates according to race and US region. Crude rates were calculated to analyze how female breast cancer rates varied among the states between the years 2012 and 2016. The rate of breast cancer was calculated based on the numbers in the population. Higher rates in some states may be due to increased population. The Bonferroni Procedure is a multiple comparison test for use in statistical analysis. One-way ANOVA with a Bonferroni post hoc tests comparing multiple regions and crude rates were calculated and used to identify how female breast cancer rates varied among each of the four US regions: Northeast, Midwest, South, and West between the years 2012 and 2016. One-way ANOVA with a Bonferroni post hoc test was also used to analyze how female breast cancer rates varied among races between 2012 and 2016.

Results

When separated by region, there were no statistically significant data showing differences in female breast cancer incidence rates ($F_{3,178} = 0.562$, $p = 0.641$). The crude rates for the US Census regions (Northeast, Midwest, South, and West) are given below in Table 1.

Data showed that the rate of breast cancer incidence varied widely and was statistically significant between each of the fifty states and the District of Columbia when separated by race ($F_{3,178} = 116.234, p < 0.001$). The sample size was 1,196,484 women and the overall crude rate for female breast cancer incidences per 100,000 in the population was 147.9.

Table 1. Crude rates per 100,000 in the population for each of the four US Census regions⁷

Region	Crude Rate Per 100,000
Northeast	164.9
Midwest	153.4
South	143.1
West	137.5

The minimum crude rate of 25.877 was found in American Indian or Alaskan Native women in the state of Tennessee, which belongs to the southern US Census region. The maximum crude rate found, 196.704, was found in White women in the state of Hawaii, which belongs to the western US Census region. The crude rates of female breast cancer incidence for each race in the US are found on Table 2.

Table 2. Crude rates per 100,000 in the population for each race in the United States⁷

Race	Crude Rate Per 100,000
American Indian or Alaska Native	61.1
Asian or Pacific Islander	95.4
Black or African American	121.2
White	156.6

The mean and standard deviations for crude rate in each of the races in each US state and the District of Columbia were 104.395 and 45.083, respectively. The state with the lowest crude rate was Wyoming (west US census region) and the state with the highest crude rate was Hawaii (west US census region). The means and respective standard deviations of breast cancer rates for women of different races and in different regions of the United States are described in Table 3.

Table 3 shows that rates of female breast cancer in a single race did not vary significantly between each region. However, the rate of female breast cancer in White women are significantly more positive than that of each of the other races in this study.

Table 3. Means and standard deviations of female breast cancer incidence in each census region of the United States separated by race.⁷

Race, Region	Mean	Std. Dev.
American Indian or Alaska Native, Northeast	66.024	67.101
American Indian or Alaska Native, Midwest	66.997	26.400
American Indian or Alaska Native, South	53.187	30.624
American Indian or Alaska Native, West	76.594	22.752
Asian or Pacific Islander, Northeast	77.106	14.450
Asian or Pacific Islander, Midwest	60.057	12.488
Asian or Pacific Islander, South	75.505	10.018
Asian or Pacific Islander, West	92.949	26.038
Black or African American, Northeast	96.799	33.024
Black or African American, Midwest	98.776	31.451
Black or African American, South	125.642	13.790
Black or African American, West	80.648	23.411
White, Northeast	181.179	6.570
White, Midwest	158.987	6.411
White, South	155.155	18.778
White, West	147.448	22.573

The study found that White women had higher rates and were more positively associated with breast cancer incidence than are American Indian or Alaska Native, Asian or Pacific Islander, and Black or African American women ($p < 0.001$). In addition, Black or African American women were more positively associated with higher rates of breast cancer than are American Indian or Alaska Native and Asian or Pacific Islander women ($p < 0.001$). There were no significant mean differences in the rate of breast cancer between American Indian or Alaska Native women and Asian or Pacific Islander women in the United States ($p = 0.141$).

Discussion

As predicted in the study hypothesis, this study found there to be no significant differences in female breast cancer rates between the four different US Census regions. While a prior study by Garland et al. proposed that vitamin D and decreased exposure to ultraviolet sunlight plays a role in reducing breast cancer risk, placing certain geographical locations and populations at higher risk, those studies primarily focused on mortality rates, rather than incidence rates alone.⁸ Other studies that initially found differences in breast cancer rates using a similar census-based method, found that several risk factors contributed to the unequal distribution of breast cancer incidence. Once a multivariate adjustment was done, the rates of breast cancer incidences were not any different among the different locations.⁹

The third research question in this study sought to identify differences in the rate of female breast cancer among races in the United States. Significant differences were found between some, but not all of the races. Mean significant differences, with a 95% confidence interval, in the rate of female breast cancer were found between White women and each of the other three races (American Indian or Alaska Native, Asian or Pacific Islander, and Black or African American) as well as between Black or African American women and each of the other three races. White women had higher rates of breast cancer than did their American Indian or Alaskan Native, Asian or Pacific Islander, or Black or African American counterparts. Black or African American women were associated with increased rates of breast cancer than American Indian or Alaska Native and Asian or Pacific Islander women.

This fourth research question in this study aimed to identify if there were any significant differences in rate of female breast cancer between each of the US regions when divided between the races. For example, did breast cancer rate in Black or African American women in the South differ significantly from the breast cancer rate in Black or African American women in the

Midwest? The study found there to be no significant differences between the races among the regions.

Previous studies have found that higher incidences of aggressive breast cancer phenotypes, higher tumor grade, and higher tumor growth index are more associated with the Black or African American population compared to the White population.¹⁰ Black or African American women were also found to be much more likely to have a diagnosis with poorer prognosis and lower five-year survival rate compared to White women.¹¹

Study Limitations

The major limitations of this study were related to the use of aggregate data from the CDC WONDER data set. Using aggregate data proved to be a limitation to the study because it prevented researchers from being able to separate the data into individual cases and patients, which in turn prevented the ability to analyze possible factors that contributed to breast cancer incidence. Confounding factors that potentially contributed to US female breast cancer incidence included genetic predisposition, exercise, diet, smoking, alcohol, and past medical history including diabetes, hypertension, cardiovascular disease, and menopausal state. The study also failed to account for the Hispanic/Latina or Non-Hispanic/Latina ethnicity of participants. This was due to the fact that the aggregate CDC WONDER data set did not provide ethnic data in addition to the data provided pertaining to race.

Future Directions

The findings of this study bring awareness to the racial disparities that persist in modern medicine. Given the rate of breast cancer and its apparent preference to certain races, it is important to promote annual breast cancer screenings and provide information and education to

those in the population who are of higher risk. In addition, further studies can be done to include confounding factors and other variables to better understand the disparities that play a role in the rates of breast cancer incidence.

Studies in the future can be modeled similar after this study and be applied to a smaller, more focused scale. Studies can analyze racial disparities pertaining to the rate of female breast cancer in specific states, specific cities, or even a specified community with different urban and rural communities. Future studies can also bring in more characteristics and factors than just race and location. Studies can consider Hispanic/Latina or Non-Hispanic/Latina ethnicity as well as consider age. In addition, if it is possible to use individual patient data, studies can identify and consider the roles of confounding factors like genetics, level of exercise, diet, and past medical history in female breast cancer incidence. Finally, future studies can consider the amount of breast cancer related deaths among races and regions, rather than focusing solely on the rate of female breast cancer, as this study does.

Conclusion

Overall, this study identifies important information regarding the rates of breast cancer in women in the United States. While there were no significant differences in the rate of female breast cancer found between women living in different regions of the United States from the years 2012 to 2016, significant differences were identified among women of different races. While the rate of breast cancer incidence is largely multifactorial, differences among races proved to be statistically significant. Future studies are needed to further evaluate confounding factors and its effects on the incidences in and deaths from female breast cancer.

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