Decline and Disparities in Mammography Use Trends by Socioeconomic Status and Race/Ethnicity

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Abstract

The second leading cause of death in women in the United States is breast cancer. While it remains the most common type of cancer in women, early detection through mammography screening has been used to combat and treat breast cancer. But after the 2000, the rates of mammography have been declining. The purpose of this study is to examine whether or not the decline has continued and whether all racial/ethnic and socioeconomic groups experienced the same rate of decline. Data from the National Health Interview Survey (2003 to 2005) and the Behavioral Risk Factor Surveillance System (2002 to 2004) were used to calculate the percent decline for the total population and by race/ethnicity and socioeconomic status. Mammography rates declined between 2003-2005 (NHIS) and 2002-2004 (BRFSS). Data from both the NHIS and BRFSS show a greater rate of decline for African American women, and women with lower income and education. These results differ from previous studies which examined broader time interval (2000 to 2005). Further research is recommended to explore whether the rates of decline have continued, the impact of the decline in mammography rates on breast cancer incidence, mortality, and stage of diagnosis, as well as the underlying reasons for the observed decline in mammography rates and for disparities in the rates of decline.

Nature of the Study

Breast cancer is the most common type of cancer in women throughout the United States and is also the second leading cause of death in women today (Kim & Jang, 2008). According to the National Cancer Institute's Surveillance, Epidemiology, and End Results Cancer Statistics Review (2008), the age-adjusted death rate for breast cancer was 24.5 per 100,000 women per year during 2002-2006 in the United States (Horner et al., 2008). About 40,170 women are estimated to die from breast cancer in 2009 (Horner et al., 2008). Mammography can detect breast cancer at an earlier stage when treatment is more effective (Makuc, Breen, & Freid, 1999). Mammography screening detects about 90 percent of breast cancer even before it can felt so show any symptoms (American Cancer Society [ACS], 2008). Therefore, the key to treat breast cancer certainly is early detection. Not only does mammography save women's lives by improving their treatment options and their

chances for successful treatment, but most importantly, it improves their chances of survival (ACS, 2008). Mammography screening has been one of the important keys to combating and surviving breast cancer.

In the American Cancer Society's "Breast Cancer Facts & Figures 2007-2008" Report (2008), race/ethnicity, socioeconomic status, stage at diagnosis, and age at diagnosis greatly influence breast cancer survival (ACS, 2008). Women who have less than a high school education and have no health insurance coverage are the least likely to have had a recent mammogram (ACS, 2008). This may contribute to the later discovery of breast cancer, making their chances of survival less likely. Similarly, African American patients who are more likely to be of lower socioeconomic status compared to White American patients are also less likely to have had a recent mammogram. African American women are more likely to die from breast cancer at every age, according to the American Cancer Society's report (ACS, 2008). The survival differences between White American and African American breast cancer patients suggest that these differences maybe attributed in part to racial disparities regarding in mammography screening (Chagpar, Polk, & McMasters, 2008).

The percentage of all women ages 40 and older who reported having had a mammogram within the past two years increased dramatically between 1987 and 2000, from 29% to 70% (Breen & Kessler, 1994). This increase in the use of mammography over time has had a profound effect on the incidence and mortality rate of this disease. It made early detection more common and helped to reduce mortality of breast cancer (Breen et al., 2007). Earlier this decade, the American Cancer Society observed that after the rapid increases, the rate had stabilized between 2000 and 2003. However, recent data from the National Health Interview Survey (NHIS) suggested that there was a decline in mammography use for all women ages 40 and over between 2003 and 2005, from 70% in 2003 to 66% in 2005 (ACS, 2008).

Nancy Breen's "Reported Drop in Mammography: Is this Cause for Concern?" article (2007) reported a decline in the use of mammography from 70% to 67% using 2000 and 2005 NHIS data (Breen et al., 2007). Although they found that rates were lower in 2005 than in 2000 for nearly all of the different groups of women, they found that a "significant decline was observed among white women, women with higher educational attainment" and also "the largest significant declines were among women who traditionally have used mammography at high rates, including women with higher incomes" (Breen et al., 2007). A similar study using 2000 and 2005 NHIS data, "Racial Trends in Mammography Rates: a Population-Based Study" (2008), also reported the decline in all groups of women, but further stated that the decline only reached statistical significance in the White American population (Chagpar, Polk, & McMasters, 2008). Although this report reported that rates of mammography were declining in all groups, it further stated that there is a greater rate of decline among White American populations and declared that "race is not a significant independent predictor of mammography rates in each year" (Chagpar, Polk, & McMasters, 2008). This study will further explore the results and conclusions from these previous studies using data from the NHIS and BRFSS.

Research Questions

The purpose of this study is to analyze trends of mammography use, using a more precise time interval of two-years (2003-2005 NHIS and 2002-2004 BRFSS), among women ages 40 and over by race/ethnicity and socioeconomic status in the United States in order to examine whether all racial/ethnic and socioeconomic groups experienced the same rate of decline.

According to the NHIS, there has been a decline in mammography rates for women ages 40 years and over, regardless of socioeconomic status and race/ethnicity. The questions are: 1. Has there continued to be a decline in mammography rates? 2. Has the rate of decline varied by family income, education, or race/ethnicity? 3. Do data from the Behavioral Risk Factor Surveillance System (BRFSS) show similar patterns to data from the NHIS?

Definitions

When investigating any phenomena, it is important to define explicitly the terms being used. Certain terms may have a particular meaning to people who study trends and disparities in health organizations in general. The terms and abbreviations below are typically associated with the topics of this study.

Age–adjusted rate. Age-adjusted is defined as "weighted average of the age-specific rates, where the weights are the proportions of persons in the corresponding age groups of a standard population" (United States National Institutes of Health, 2008).

Behavioral Risk Factor Surveillance System (BRFSS). This data system is a state-based system of telephone health surveys that collects information on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury. It was established in 1984 by the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2008).

Breast cancer disparities. This concept is defined as the differences in the incidence, mortality, and survival rate that existed among specific population groups (ACS, 2008).

Healthy People 2010. The national disease prevention and health promotion agenda was released by the Department of Health and Human Services in 2000 in order to provide a framework for prevention for the Nation. The national health objectives are designed to identify the most significant preventable threats to health and to establish national goals to reduce these health threats (U.S. Department of Health and Human Services [USDHHS], 2000).

Mammogram. Mammogram is defined as "a low–dose x-ray procedure that allows visualization of the internal structure of the breast." On average, mammography will detect about 90% of breast cancers in women without symptoms (ACS, 2008).

National Health Interview Survey (NHIS). This data system is a primary source of health information on the civilian, noninstitutionalized population in the United States. It is conducted by the Centers for Disease Control and Prevention (CDC) and was designed specifically to produce national estimates. An annual survey is

administered in person by Census Bureau interviewers. Information is gathered on health knowledge, attitudes, and practices for various population groups, including those defined by age, sex, race, family income, geographic region, and place of residence (Breen & Kessler, 1994).

Surveillance, Epidemiology, and End Results (SEER). This data system is sponsored by the National Cancer Institute (NCI) to provide an authoritative source of information on cancer incidence and survival in the United States (Horner et al., 2008).

Socioeconomic Status (SES). This term is defined as "a combined measure of income, education, and access to health care" (Merriam-Webster Online Dictionary, 2009).

Research Design and Methodology

Each year the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC) conducts the NHIS. It has been conducted every year since 1957 to collect data using national population-based face-to-face survey in order to represent the American civilian noninstitutionalized population (NCHS, 2006). Nationally, about 400 interviewers were trained about basic interviewing procedures and concepts and procedures unique to the NHIS. The NHIS is conducted using computer-assisted personal interviewing or CAPI. This method presents the questionnaire on computer screens to each interviewer, guides them through it and allows them to enter survey responses directly into the computer. The CAPI program system also automatically routes the interviewer to appropriate questions based on answers to previous questions of the interviewees (NCHS, 2006). Not only does the CAPI program determine if the selected response is consistent with other data collected during the interview, but it also saves the time required for transferring and processing data and it makes sure the accurate flow of the questionnaire (NCHS, 2006). The interviewers are directed under health survey supervisors in the United States Census Bureau Regional Offices to interview about 35,000 adults. Response rates for the questions fielded in the cancer module are in the range of 80% (NCHS, 2006). These adult female respondents ages 40 years old and over were asked questions regarding the use and the timing of their most recent mammogram (Appendix A). The first question was "Have you ever had a mammogram?" and if women responded "Yes," the second question was then asked: "When did you have your last mammogram?" (Appendix A). The most recent data available for mammography use for women ages 40 and over receiving it within two years is from the year of 2005. The data from 2003 to 2005 were used for this study.

Another data source that was used to examine trends and patterns in the recent use of mammography is the CDC's BRFSS data. Unlike NHIS data which represent the entire United States and is administered in person, BRFSS is administered through telephones and questions regarding mammography use were not administered to women in all states (CDC, 2008). Randomly selected from the telephone directory,

one adult age 18 or older in each household was interviewed about their health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury (CDC, 2008). Breast cancer–related questions are included in the women's health section, which is conducted differently each year and in each state (CDC, 2008). In Module 9: Women's Health section, their first question started with a brief description of a mammogram, "A mammogram is an x-ray of each breast to look for breast cancer," and then it asked "Have you ever had a mammogram?"(Appendix B). If women answer "Yes," then the second question about "How long has it been since you had your last mammogram?" was asked (Appendix B). The data for women ages 40 and over who have had a mammogram within the past two year from the year 2002, 2004, and 2006 were used for this study.

In order to examine the trends from the two data sources to answer the research questions, the percent change formula was used to calculate the percent decline of the 2003-2005 NHIS data and the 2002-2004 BRFSS data.

The formula is:

$$Percent\ Change = \frac{(V\ past - V\ present)}{V\ past} \times 100$$

$$V\ past = past\ or\ present\ value$$

$$V\ present = present\ or\ future\ value$$

The percent change from one period to another is calculated using value at beginning of period subtracted by value at end of period, and then divided it by value at beginning of period, and finally multiplies by 100. For example, to find the percent decline for all women ages 40 and over receiving mammography within the past two years from 2003 to 2005 from the NHIS data, it is calculated as follows:

$\frac{(70\% - 67\%)}{70\%} \times 100$. After the result of the percent decline comes out to be 4.2857%,

the result is rounded to one place decimal, 4.3%. This method is also repeated to calculate all of the percentages of the percent decline in the categories of race/ethnicity, family income level, and educational level in both NHIS data and BRFSS data. The percent change formula is a useful indicator to look at how much this rate is declining in this area.

Findings, Conclusions, and Recommendations for Future Research

Findings

Table 1

Comparison of Mammography Rates Among Women Ages 40 and Over by Race/Ethnicity, Family income level, and Educational level: The 2000, 2003 and 2005 National Health Interview Surveys

Category	2000	2003	2005	Percent Decline 2003–2005
Women receiving a mammogram during the past 2 years (ages 40 and over)	70%	70%	67%	**4.3%**
Race/Ethnicity				
African American	68%	70%	64%	**8.6%**
White American	71%	70%	67%	**4.3%**
Family income level				
Poor	55%	55%	48%	**12.7%**
Near poor	57%	60%	55%	**8.3%**
Middle/High income	76%	74%	72%	**2.7%**
Educational level				
Less than high school	57%	58%	54%	**6.9%**
High school graduate	69%	67%	64%	**4.5%**
At least some college	76%	75%	72%	**4.0%**

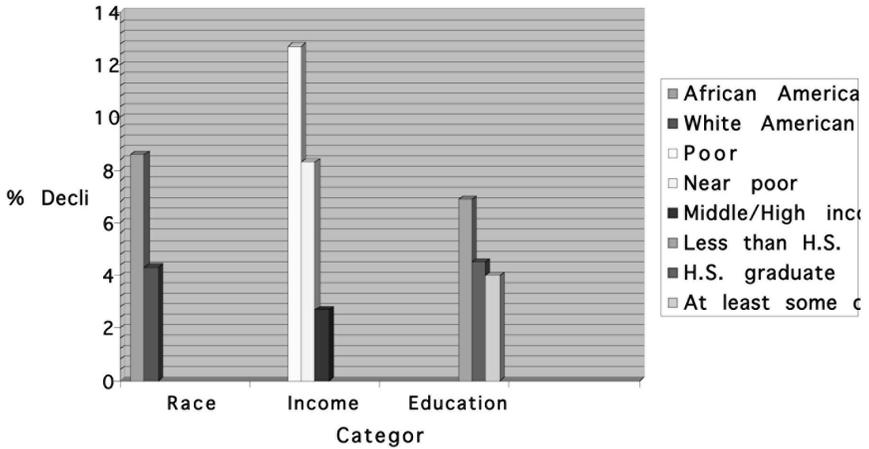*Source: National Health Interview Survey, CDC, NCHS (NCHS, 2006)*

Table 2

Comparison of Mammography Rates Among Women Ages 40 and over by Race/Ethnicity, Family income level, and Educational level: The 2000, 2002, 2004, and 2006 Behavioral Factor Risk Surveillance System
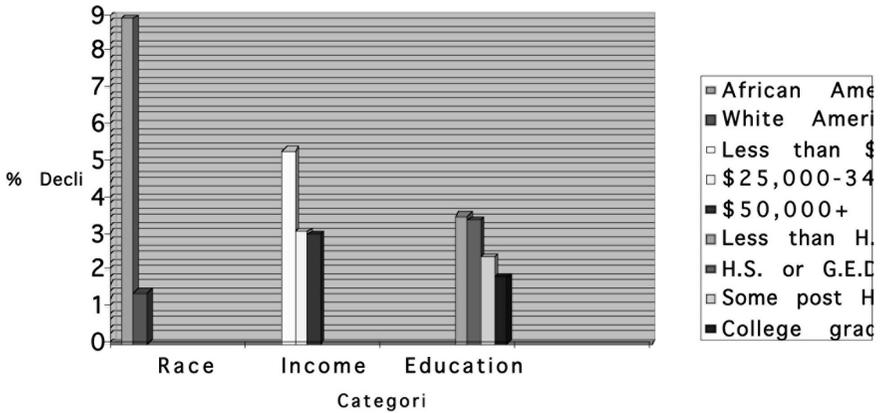
Category	2000	2002	2004	2006	Percent Decline 2002–2004
Women receiving a mammogram during the past 2 years (ages 40 years and over)	76.1%	76.1%	74.9%	76.5%	1.6%
Race/Ethnicity					
African American only	80.2%	82.8%	75.4%	80.1%	8.9%
White American only	76.4%	76.2%	75.1%	77.0%	1.4%
Income					
Less than $ 15,000	65.4%	66.3%	62.8%	64.7%	5.3%
$25,000–34,999	76.5%	76.5%	74.1%	73.6%	3.1%
$50,000+	83.4%	82.7%	80.2%	81.7%	3.0%
Education					
Less than H.S.	67.7%	65.8%	63.5%	66.0%	3.5%
H.S. or G.E.D	75.3%	75.7%	73.1%	74.6%	3.4%
Some post H.S.	78.5%	77.8%	75.9%	77.1%	2.4%
College graduate	82.4%	81.4%	79.9%	81.3%	1.8%

Source: Behavioral Risk Factor Surveillance System, CDC (CDC, 2008)

Percent Decline in Mammography Rates: The 2003 and Health Interview Surveys

Legend:
- African America
- White American
- Poor
- Near poor
- Middle/High inc
- Less than H.S.
- H.S. graduate
- At least some c

X-axis: Race, Income, Education — Categor
Y-axis: % Decli

Percent Decline in Mammography Rates: The 2002 and Factor Surveillance System

Legend:
- African Ame
- White Ameri
- Less than $
- $25,000-34
- $50,000+
- Less than H.
- H.S. or G.E.D
- Some post H
- College grad

X-axis: Race, Income, Education — Categori
Y-axis: % Decli

Overall, mammography rates declined during 2003 to 2005 according to the National Health Interview Survey and during 2002 to 2004 according to the Behavioral Risk Factor Surveillance System. According to the NHIS, the rate of having had a mammogram declined 4.3%, from 70% in 2003 to 67% in 2005. According to the BRFSS, the rate of having had a mammogram also declined 1.6%, from 76.1% in 2002 to 74.9% in 2004.

While a downward trend in mammography screening was seen in all women, there was a more significant rate of decline for certain groups based on race/ethnicity, family income level, and education level (Table I and II). Both NHIS and BRFSS data show a greater rate of decline for African American women, women with lower income, and women with lower education. In these years, both surveys suggest that African American women, women with lower income level, and women with lower education level were less likely than White women, women with higher income level, and women with higher education level to report having had a mammogram within the past two years. For example, the percent decline for African American women was 8.6% compared to 4.3% for White American women based on the NHIS 2003-2005 data. Similarly to the 2002-2004 BRFSS data, the percent decline for African American women was 8.9% while it was only 1.4% for White American women. Disparities also existed in various family income level and education level groups as well. In the NHIS data, the percent decline percentages decrease as we move from "Poor" to "Near Poor" to "Middle/High income" in the family income level category with 12.7%, 8.3%, and 2.7%, respectively. The percent decline percentages also decrease as we move from "Less than high school" to "High school graduate" to finally "At least some college" in the educational level category with 6.9%, 4.5%, and 4.0%, respectively. In the BRFSS data, the percent decline percentages decrease as we move from "Less than $15,000" to "$25,000-34,999" to "$50,000" in the income level category with 5.3%, 3.1, and 3.0%, respectively. And finally, the percent decline also decrease as we move from "Less than High School" to "High School or G.E.D." to "Some post High School" to "College graduate" with 3.5%, 3.4%, 2.4%, and 1.8%, respectively. Data from the BRFSS from 2002-2004 show similar patterns as data from the NHIS 2003-2005 regarding a decline for all women ages 40 and over and a greater rate of decline for African American women, women with lower income level, and women with lower education level.

The third finding is that BRFSS data show no further decline during 2004 to 2006 in mammography rates in all women ages 40 and over receiving mammography within the past two years. From 2004 to 2006, the percentage increased from 74.9% to 76.5%. The rates also increase for all three categories: race/ethnicity, income level, and education level. Unfortunately, public data are not yet available from more recent NHIS.

Conclusions

The percentage of women ages 40 and over having had a mammogram within the past two years increased from 29% in 1987 to 70% in 2000 (ACS, 2008). Although mammography screening across racial groups and socioeconomic statuses increased from 1987 to 2000, a decline after 2000 in the mammography rate has been noted in national studies.

Examining the differences in the period of 5 years, Breen et al. (2007) and Chagpar, Polk, & McMasters (2008) found that there was only a significant decline among White American women, women with higher education, and women with higher income. In contrast, when this study examined the trends of mammography rate for women ages 40 and over from 2003 to 2005 and from 2002 to 2004, the two-year time period indicated a greater rate of decline for African American women, women with lower education, and women with lower income. Now another question is raised: what was happening between 2003 and 2005 that did not show in the longer period between 2000 and 2005?

However, despite the contrasting findings, it is obvious that mammography rates for women ages 40 and over are not consistent with the Healthy People 2010 goal of 70% (USDHHS, 2000). Although it is not significantly different, it may indicate to us that we might be going in the opposite direction of our nation's goal. This should alarm us and should call for continued monitoring of trends in incidence, screening, mortality, and their underlying factors.

Recommendations for Future Research

For future research, I intend to closely examine the reasons why there was a decline in mammography use for all women ages 40 and over in the United States, and to examine whether the decline continues. Some literature suggests possible reasons for the decline in mammography use. The drop in rates may be caused by factors, including an increase in the number of women who do not have health insurance, higher health care costs, lower belief in the effectiveness of mammograms, reduced perceived risk because of reported decrease in mortality from breast cancer, and a lack of promotion of mammography (Campbell et al., 2009). Other reasons from the Institute of Medicine (IOM) include low reimbursements by insurers, rising malpractice law suits against radiologists who read mammograms, and fewer radiologists choosing to specialize in breast imaging (Campbell et al., 2009).

I also plan to closely examine the reasons why there are greater decline rates and breast cancer disparities among African American women, and women with lower income and education. Using Drs. Freeman and Chu's Social Determinants of Health Disparities in Cancer framework as a theoretical framework, I will guide my research study based on three major social determinants of low socioeconomic status or poverty, culture, and social injustice. These three determinants will help guide me when exploring my future research question of why disparities in mammography rates existed among racial minority and low socioeconomic population. The Institute

of Medicine (IOM) published a review explaining how Freeman and Chu's model is a model in which health care disparities arise. It is the overlap of three major factors: economic, social, and cultural factors (Ward et al, 2004).

Figure
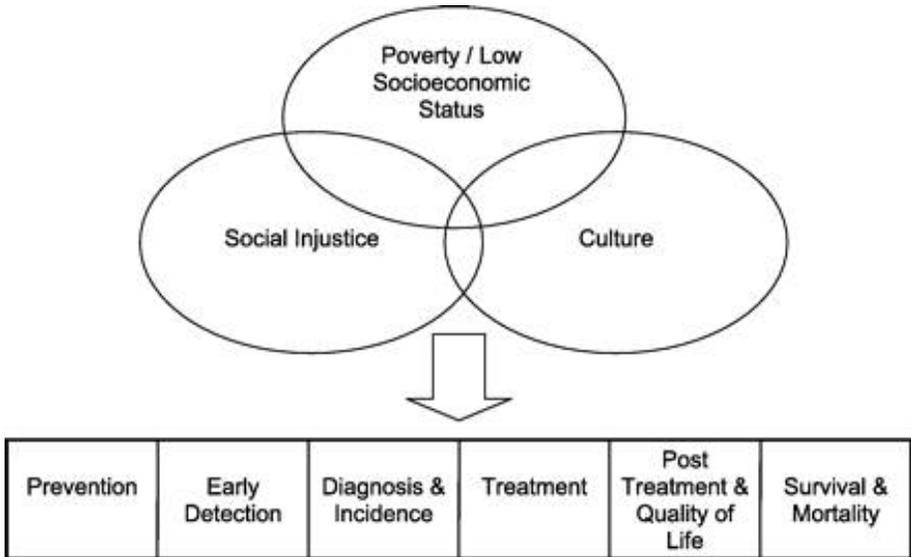
Social determinants of health disparities in cancer (Freeman and Chu) (Ward et al, 2004).

First, poverty or low socioeconomic status factors influence cancer risk factors, such as tobacco use, poor nutrition, and physical inactivity. Income, education, and health insurance coverage play important roles because they largely influence people's level of resources, information, and knowledge (Ward et al, 2004). Second, cultural factors include learned beliefs, values, traditions, and behaviors that are common to a particular social group (Ward et al, 2004). They are the accepted social norms within that particular group that largely influence people's behaviors and attitudes. For example, some groups that believe in alternative forms of healing as opposed to modern medicine may be less likely to get a regular breast cancer screening or a mammogram (Ward et al, 2004). Third, social injustice also influences the interactions between patients and physicians, according to the IOM. The unfair treatment of an individual or group based on race or socioeconomic status may determine the quality of health care that one receives (Ward et al, 2004). The three major factors, poverty or low socioeconomic status, social injustice, and culture, all influence access to health care, such as appropriate prevention, early detection, diagnosis and incidence, treatment, post treatment and quality of life, and survival or mortality (Ward et al, 2004). This framework will be useful in guiding the future research.

For the follow-up study methods, I plan to do one or more of the following: 1. Examine more recent NHIS data to see if there continues to be a decline over time (the BRRSS data suggested that it was only a short-term decline), 2. Examine breast cancer incidence and mortality trends to see whether the decline in mammography resulted in lower breast cancer incidence and/or higher breast cancer mortality and/or later average stage at diagnosis, 3. Examine changes in health insurance coverage overall and for mammography, and 4. Conduct in-depth interviews with several key informants, including breast cancer program managers, to find out why they think there was a decline in mammography rates.

References

American Cancer Society. (2008). *Breast Cancer Facts & Figures 2007-2008.* Retrieved June 10, 2009, from Atlanta, American Cancer Society, Inc Website: http://www.cancer.org/downloads/STT/BCFF-Final.pdf

Breen, N., Cronin, K., Meissner, H., Taplin, S., Tangka, F., Tiro, J., McNeel, T. (2007). Reported Drop in Mammography. *Wiley InterScience,* 109(12), 2405-2409. doi:10.1002/cncr.22723

Breen, N., Kessler, L. (1994). Changes in the Use of Screening Mammography: Evidence from the 1987 and 1990 National Health Interview Surveys. *American Journal of Public Health,* 84, 62-67. Retrieved from PubMed database.

Campbell, R., Li, X., Dolecek, T., Barrett, R., Weaver, K., Warnecke, R. (2009). Economic, Racial and Ethnic Disparities in Breast Cancer in the US: Towards a More Comprehensive Model. *Health&Place*, 15(3), 870-879. doi:10.1016/j.healthplace.2009.02.007

Centers for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System: About the BFRSS-Overview.* Atlanta: Centers for Disease Control and Prevention. [cited 2008 Mar 28]. Available from: Website: http://www.cdc.gov/brfss/about.htm.

Chagpar, A., Polk, H., McMasters, K. (2008). Racial Trends in Mammography Rates: a Population-Based Study. American Journal of Surgery, 144, 467-472. doi: 10.1016/j.surg.2008.05.006.

Horner M., Ries L., Krapcho M., Neyman N., Aminou R., Howlader N., Altekruse S., et al. (2008). *SEER Cancer Statistics Review, 1975-2006*, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2006/, based on November 2008 SEER data submission, posted to the SEER web site, 2009.

Kim, J., Jang, S., (2008). Socioeconomic Disparities in Breast Cancer Screening among US Women: Trends from 2000 to 2005. *J Prev Med Public Health,* 41(3), 186-194. Retrieved from PubMed database.

Makuc, D. Breen, N., Freid, V. (1999). Low Income, Race, and the Use of Mammography. *Health Services Research,* 34(1 Pt 2), 229-239. Retrieved from PubMed database.

National Center for Health Statistics. Data File Documentation. *National Health Interview Survey, 2005*. Hyattsville, MD: National Center for Health Statistics, Centers for Disease Control and Prevention; 2006

SES. (2009). In *Merriam-Webster Online Dictionary*. Retrieved July 12, 2009, from http://www.merriam–webster.com/dictionary/SES

United States National Institutes of Health. (2008). *SEER Stat Tutorials: Calculating Age-adjusted Rates.* Retrieved on June 10, 2009, from Surveillance Epidemiology and End Results Website: http://seer.cancer.gov/seerstat/tutorials/aarates/definition.html.

U.S. Department of Health and Human Services. *Healthy People 2010: Understanding and Improving Health*. 2nd ed. Washington, DC: U.S. Government Printing Office; 2000.

Ward, E., Jemal, A., Cokkinides, V., Singh, G., Cardinez, C., Ghafoor, A., et al. (2004). Cancer Disparities by Race/Ethnicity and Socioeconomic Status. *CA Cancer Journal for Clinicians, 54*(2), 78-93. doi:10.3322/canjclin.54.2.78

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