Socioeconomic Status and Breast Cancer Mortality, 1989 through 1993: An Analysis of Education Data from Death Certificates

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ABSTRACT

Objectives. This study examined whether more highly educated women were at greater risk of dying of breast cancer during 1989 through 1993.

Methods. Breast cancer mortality rates were calculated through death certificates and Current Population Survey data.

Results. Breast cancer mortality rates were highest among women with 12 and with 16 or more years of education. Non-Hispanic Black women had the highest mortality rates and Asian women the lowest. Positive relationships between mortality and education were found for Hispanic women as well as non-Hispanic Black and Asian women.

Conclusions. The previously seen positive relationship between breast cancer mortality and education was found among US women of color but not non-Hispanic White women. (*Am J Public Health.* 1997; 87:1218–1222)

Introduction

All-cause mortality has long been known to be elevated among individuals of lower, relative to higher, socioeconomic status (SES).[1,2] Numerous analyses of occupational groups in Europe have shown higher death rates, particularly in midlife, among lower-SES individuals.[3,4] Some research suggests that the differentials by education level have widened in recent years, with health improving significantly only among higher-SES populations.[5–7]

Unlike death from most other diseases, breast cancer mortality has been demonstrated to have a positive association with SES. In several analyses in the United States and Europe, breast cancer has been demonstrated to cause disproportionately more deaths among higher-SES women.[1,8–10] A positive socioeconomic gradient for breast cancer incidence has also been demonstrated in ecologic analyses for Whites and Blacks in the Third National Cancer Survey and the Surveillance, Epidemiology, and End Results (SEER) program.[11,12] Analytic studies also have shown positive gradients in risk using a variety of SES indicators.[13,14]

In the United States, health data routinely have been collected by race and, more recently, ethnicity. In contrast, data collected on indicators of SES, such as household income and education, have been sparse. In the past few years, however, states have begun to code death-certificate information on years of education achieved by the decedent, and these data are now available in the national multiple-cause-of-death data sets. This change allows for individual-level analysis of socioeconomic differences in breast cancer mortality in the United States, with education used as the measure of SES.

Methods

US death certificates[15] for the years 1989 through 1993 were examined for women aged 25 and older, whose underlying cause of death was listed as breast cancer (*International Classification of Diseases,* 9th Revision, 1991 [ICD-9], code 174). Collection of data on education level and ethnicity improved during this time period, but for some states, information was missing. For the purposes of the following analyses, states were omitted if more than 20% of records were missing in a given year for either education or ethnicity (see "Results"). A summary racial/ethnic category was created through the use of the separate racial and ethnicity fields on the death certificate: all women who had any Hispanic field checked were categorized as Hispanic, and other women were classified as non-Hispanic White, non-Hispanic Black, and non-Hispanic Asian. Native Americans and other groups were excluded from analyses because of small numbers. Women were categorized on the basis of years of completed education listed on the death certificate: 0 through 8 years, 9 through 11 years, 12 years, 13 through 15 years, and 16 or more years of education.

The denominators (populations of women aged 25 and older by educational attainment, age, race/ethnicity, and state) were obtained from the Current Population Survey (CPS) of the US Bureau of the Census for the years 1989 through 1993.[16] Data for March of each year were weighted to reflect the US female population aged 25 and older. States excluded because of data missing on the death certificates were also excluded from the CPS estimates. Thus, the populations matched the deaths on a state-by-year basis. The deaths and the population were

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This paper was accepted October 24, 1996.

pooled over the time period into 5-year age, education, and racial/ethnic groups. In 1992, the CPS changed its education collection from years of completed education to degrees completed. The categories "some college but no degree," "associate's degree in college—occupation/vocation program," and "associate's degree in college—academic program" were combined to form the 13-through-15-year group, and all categories including bachelor's degree and higher were combined to form the 16-and-greater group. This change affected reporting; the level of 13 through 15 years of education increased slightly, appearing to pull some women from the 12- and the 16-year categories. The death certificate question did not change during the time period.

To examine the potential discrepancy between educational reporting on the death certificate and the CPS, the education level was examined for women in the National Longitudinal Mortality Survey (NLMS).[17] The NLMS selected over one million individuals from the CPSs of 1973 through 1985 and used the National Death Index to determine whether the individual had died. Data from the death certificates were obtained and matched with CPS data.

SAS was used for the analyses.[18] Age-adjusted rates were calculated for each education category across all racial/ethnic groups. Total and education-specific age-adjusted rates were calculated for each racial/ethnic group for the cumulative period; all rates were directly standardized to the 1970 US female population aged 25 and older. In addition, an index of inequality in mortality across the educational spectrum was calculated for each racial/ethnic group. This relative index of inequality[19] is equivalent to a mortality ratio. It provides a summary measure of the variation in rates across educational groups by weighting the value of the education-ordered rates by the proportion of the population (in this case, women aged 25 and older) represented in each educational group, fitting a regression line to the weighted rates, and then dividing by the age-adjusted mean mortality rate. The relative index of inequality simplifies the comparison of sociodemographic groups with varying educational distributions. The index approaches zero when education has no relationship to the mortality rate and is positive when a direct educational association exists.

TABLE 1—Age-Adjusted Breast Cancer Mortality Rates among Women, by Educational Group, Selected States, 1989 through 1993

Educational Group	Deaths	Rate[a]	95% CI
Fewer than 9 years	23 640	39.27	39.15, 39.39
9–11 years	17 412	38.63	38.54, 38.72
12 years	71 198	56.50	56.45, 56.55
13–15 years	25 507	48.46	48.40, 48.52
16 or more years	22 701	55.56	55.50, 55.62

Note. CI = confidence interval.
[a]All rates are per 100 000 and are directly age-adjusted to the US 1970 female population aged 25 and older. Rates exclude states with more than 20% of education or ethnicity information missing. Numerators are deaths from vital statistics files; denominators are derived from the Current Population Survey of the US Bureau of the Census.

Results

Coding of education and ethnicity information in the death certificate data improved during 1989 through 1993, thereby decreasing the number of states excluded from analyses because of incomplete reporting in the later years. In 1989, 19 states, with 37.1% of all US breast cancer decedents, were eliminated from the analyses, but by 1993, only 7 states, with 14.7% of deaths, were excluded. The largest state eliminated in every year was New York, where from 44% through 100% of education values were missing each year. Overall for the entire study, 78.2% of all US deaths due to female breast cancer were included in the analyses.

Breast cancer mortality varied by educational attainment: women with fewer than 12 years of education had lower rates than those with at least 12 years (Table 1). However, the rates did not increase monotonically. The highest rates of breast cancer mortality were found among women with 12 and those with 16 or more years of education. Women with fewer than 9 years and with 9 through 11 years of education had nearly identical, lower rates, while those with 12 or more years of education shared similar, higher rates. The mortality ratio of the highest to the lowest education groups was 1.41 (95% confidence interval [CI] = 1.36, 1.46).

We examined the relationships between education and breast cancer mortality separately for four racial/ethnic groups (Table 2, Figure 1). Non-Hispanic Black women had the highest age-adjusted overall breast cancer mortality, followed closely by non-Hispanic White women. Asian women had the lowest overall rate. Race/ethnicity-specific mortality rates for the selected states with educational attainment reported were similar to the national rates.

Among each of the non-White populations, breast cancer mortality increased with greater education through 12 years. Among non-Hispanic Black women, the mortality among women with 16 or more years of education was similar to that of women with 12 years, but was lower for those with 13 through 15 years. Rates among Hispanic and Asian women rose further with 13 through 15 years but were somewhat lower for those with 16 or more years of education. The mortality ratios of highest to lowest groups were 2.03 (CI = 1.81, 2.24), 1.75 (CI = 1.58, 1.92), and 1.86 (CI = 1.68, 2.04) for Black, Asian, and Hispanic women, respectively.

Non-Hispanic White women did not demonstrate the expected strong positive gradient of mortality by educational level. Instead, rates were similar among women in each category of education except 9 through 11 years, which was markedly lower. The mortality ratio for the most compared with the least educated non-Hispanic White women was 1.11 (CI = 1.05, 1.17).

The mortality ratios between the highest and lowest education groups do not account for variation in mortality of the intermediate education groups. Therefore, the relative index of inequality was used to summarize the increase in mortality across education groups, within racial/ethnic populations. Among non-Hispanic White women, the relative index of inequality was 11.2%, indicating a little over an 11% increase in mortality from the lowest to the highest stratum of education. Among both non-Hispanic Black and Asian women, the relative index of inequality was 59.5%, and among Hispanics, 102.2%. Among Hispanics, therefore, mortality risk is expected to double from the lowest to highest education category.

TABLE 2—Age-Adjusted Breast Cancer Mortality Rates among Women, by Education Level and Racial/Ethnic Group, Selected States and US Total, 1989 through 1993

Racial/Ethnic Group	Education	Deaths	Age-Adjusted Rate[a]	95% CI
Non-Hispanic White	0–8 years	18 220	50.20	50.00, 50.40
	9–11 years	13 963	39.88	39.76, 40.00
	12 years	62 666	56.48	56.42, 56.54
	13–15 years	22 240	48.20	48.13, 48.27
	16+ years	19 884	55.67	55.60, 55.74
	Total, selected states	136 973	52.82	52.78, 52.86
	Total, US	177 813	51.57	51.54, 51.60
Non-Hispanic Black	0–8 years	3 119	39.76	39.41, 40.11
	9–11 years	2 721	43.69	43.47, 43.91
	12 years	6 038	80.73	80.57, 80.89
	13–15 years	2 316	61.37	61.19, 61.55
	16+ years	1 807	80.52	80.24, 80.80
	Total, selected states	16 001	60.04	59.94, 60.14
	Total, US	22 517	56.47	56.38, 56.56
Hispanic	0–8 years	1 873	24.37	24.25, 24.49
	9–11 years	534	29.28	29.14, 29.42
	12 years	1 550	45.54	45.42, 45.66
	13–15 years	490	55.97	55.84, 56.10
	16+ years	413	42.64	42.44, 42.84
	Total, selected states	4 860	31.66	31.60, 31.72
	Total, US	6 239	30.82	30.76, 30.88
Non-Hispanic Asian	0–8 years	259	15.58	15.29, 15.87
	9–11 years	104	21.74	21.23, 22.25
	12 years	519	24.98	24.76, 25.20
	13–15 years	294	34.15	33.87, 34.43
	16+ years	439	28.98	28.81, 29.15
	Total, selected states	1 615	23.23	23.12, 23.34
	Total, US	1 907	22.78	22.68, 22.88

Note. CI = confidence interval.
[a]All rates are per 100 000 and are directly age-adjusted to the US 1970 female population aged 25 and older. Education-specific rates exclude states with more than 20% of education or ethnicity information missing. Numerators are deaths from vital statistics files; denominators are derived from the Current Population Survey of the US Bureau of the Census.

Discussion

This study provided a unique opportunity to evaluate breast cancer mortality by SES with the use of newly available individual-level education data from death certificates. It showed that all racial/ethnic groups displayed a positive education–breast cancer mortality gradient; however, the mortality gradient among non-Hispanic White women deviated only slightly from zero.

The lack of a strong gradient among non-Hispanic White women suggests either that the historically higher mortality rates among higher-SES White women may have come down or that the lower rates in lower-SES women have increased. A study of 1960 deaths[1] demonstrated a clear breast cancer mortality gradient among White women. Relative to all White women aged 25 years and older at death, mortality ratios were 0.83 for women with fewer than 8 years of school and 1.18 for those with at least 1 year of college. However, more recently, a Norwegian study found no difference in breast cancer mortality across education groups.[20]

Time trend analyses have suggested that the traditionally excessive rates among higher-SES women may be declining. A British study showed a steep positive occupational gradient in breast cancer mortality in Britain in the 1930s and a much flatter slope in the 1970s.[8] An ecologic analysis of US counties found a reduction in the mortality differential between higher- and lower-SES areas for breast cancer from 1969 to 1989, among both Whites and Blacks.[9] The individual-level analyses presented here indicate that non-Hispanic White women had very little variation in recent breast cancer mortality rates across the educational distribution, while women of color varied considerably more. This was true despite the fact that mammography rates were similar among Blacks and Whites by 1992,[21] and screening rates have tended to be higher among better educated women in each racial/ethnic group.[22]

There are several possible explanations, among which this study cannot distinguish, for why the positive SES–breast cancer mortality gradient has largely disappeared among White women but continues among non-White women. First, access to health care is greater among White women in the United States: a higher proportion of Whites have health insurance,[23] and Whites have more physician office visits than Blacks, particularly among older adults.[24] Previous research has demonstrated that Black women tend to be diagnosed with breast cancer at a later stage than Whites, suggesting that they may have delayed seeking care[25–28] or have a more difficult time obtaining care. SEER data indicate that in each age group, survival is worse for Black women than for Whites.[29] Women with better health care may have a greater likelihood of survival from breast cancer, perhaps dampening an effect of higher incidence among higher-SES Whites. Survival differences between Black and White women may be related to the socioeconomic differences between the groups.[30] An analysis of western Washington state data found that survival after a diagnosis of breast cancer was worse for both Blacks and Whites who lived in low-SES areas.[31] It is possible that socioeconomic factors among non-White women in the analysis were lower than those of White women within a given education level.

Alternatively, White women's mortality may have flattened across educational groups if there has been a reduction of variation in breast cancer–risk factors across socioeconomic groups; this might cause a flattening in the incidence gradient. A recent Finnish study of cancer incidence rates showed that the positive breast cancer–incidence gradient across occupational groups has declined over time.[32]

Finally, the flattening of the SES–breast cancer mortality slope among

White women may reflect a more general trend: the relative improvement of the health status of higher-, compared with lower-, SES groups.[7] This relative improvement can take one of two forms: a widening of the high-to-low-SES gap for diseases with an inverse SES gradient or a narrowing of the SES difference for diseases with a direct SES gradient. The SES–breast cancer mortality relation in industrialized countries, at least among White women, may be indicative of this second form. It will be of considerable interest to see whether a comparable flattening of the SES–breast cancer mortality curve occurs over time among non-White women.

Among non-Hispanic White and Black women, breast cancer mortality peaked in the 12-year education group. A possible explanation might be an educational reporting bias occurring on the death certificate. Research suggests that death certificates may overestimate the number of women with 12 years of education.[33] Since death certificate data are responses to questions asked of the decedents' relatives or other caretakers, the education level might be misclassified because of imprecise questioning or lack of knowledge of family members.

The NLMS was used to examine the potential reporting bias in educational attainment from self-report compared with proxy reports for death certificates. All breast cancer deaths occurring among women in the sample in 1989 were included. In 54.7% of the deaths, education on death certificates matched the baseline education variable (P.D. Sorlie, personal communication, February 1996). The category most likely to be misclassified was the 9- through 11-year group, as self-reported at baseline, and there was an overreporting on the death certificate of 12 and 13 through 15 years of education.

If the NLMS error rate for breast cancer deaths is similar to the error in this analysis, the mortality calculated here would tend to be higher in the 12-year group and lower in the 9- through 11-year group than the true rates, assuming self-reported education reflects the true educational attainment. This potential bias may account for the nonlinear trends in the rates observed in this study, especially among Blacks and Whites.

Another limitation of this study is the missing information for several states, in particular New York, which during this period accounted for 9% of the US non-White population. However, from 74% to 84% of the person-years for each racial/ethnic group were included in the analyses. It is unlikely that the relation between education and breast cancer mortality differed for persons residing in states excluded because of inadequate education data.

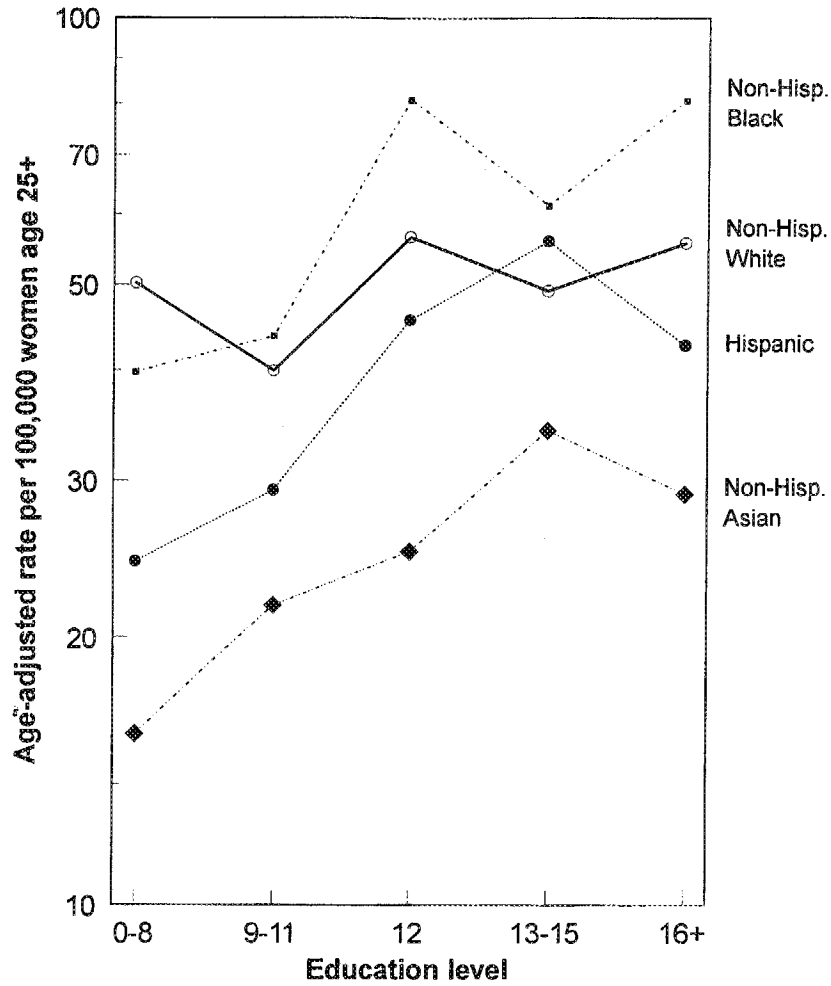

FIGURE 1—Breast cancer mortality among women, by race/ethnicity and education level, selected states, 1989 through 1993.

These analyses presented mortality rates for breast cancer by the education of the decedent as listed on the death certificate. Although some misclassification of education level may have occurred, the results suggest that the historically higher mortality rates for breast cancer found in higher socioeconomic groups may have changed among White women, so that there was little difference in 1989 to 1993 in mortality between educational groups. Among other racial/ethnic groups, a positive socioeconomic gradient was apparent. The results of this study strengthen previous ecologic findings suggesting a decline in the socioeconomic gradient in breast cancer, at least among White women. The variation between Whites and other groups may be due to White women's having higher SES and therefore superior access to care, or lower variability among White women in breast cancer–risk factors such as parity or diet; a more detailed data set might enable researchers to determine the source of the racial/ethnic differences in the relation between education and breast cancer mortality. It is unclear whether the decline in the SES gradient among White women is due to the trend toward greater inequality, access to care, or other causes. Understanding the causes of this decline, perhaps through analysis of data sets with additional individual-level information, may give us further insight into the causes of breast cancer as well as ways of reducing mortality in women diagnosed with the disease. □

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