Geographic Variation in Breast Cancer Mortality for White and Black Women: 1986–1995

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ABSTRACT  Breast cancer mortality rates have decreased during the last 20 years in the United States overall. However, declines in breast cancer mortality rates differ among individual states. This analysis ranked states from the highest to the lowest percentage change in mortality between 1986 to 1990 and 1991 to 1995. Data on white and black females were analyzed separately. Among white women, the 10 states showing the greatest percentage change in mortality during those two periods had the greatest baseline mortality in the 1986-to-1990 period. Similarly, the 10 states with the lowest percentage change in mortality had the lowest mortality rate in 1986 to 1990. In contrast, among black women, the top 10 states ranked by percentage change in mortality included either a decline or an increase. The disparities in mortality rates by state likely depend on the stage of disease at diagnoses, socioeconomic status, access to care, and adequacy of medical care.

INTRODUCTION  Breast cancer is the most common non-skin malignant neoplasm in women, accounting for nearly 30 percent of all female cancers. In 2001, an estimated 192,200 people will develop breast cancer and 40,200 will die from the disease. During the last two decades, the benefits of early detection, early intervention, and postoperative treatment have resulted in decreased breast cancer mortality in the US general population. From 1930 to 1990, the annual age-adjusted mortality rate was 27 to 28 deaths per 100,000 women. Reversing a 60-year trend, the overall cancer mortality rate fell 6.8 percent from 1989 to 1993. Similarly, the National Cancer Institute reported a 4.7 percent drop in the mortality rate from 1992 to 1996 as well as a decrease of 3.4 percent from 1995 to 1998. However, breast cancer mortality is not equal in all geographic regions of the US. Historically, mortality has been highest in the Northeast and lowest in the Southern US. We examined breast cancer mortality from 1986 to 1995 by state to determine whether states that had the highest initial mortality rate from 1986 to 1990 were the same states that subsequently had the greatest drop in mortality.

METHODS  US breast cancer mortality statistics were obtained from the Division of Vital Statistics of the National Center for Health Statistics, Centers for Disease Control and Prevention, in Hyattsville, MD. The average age-adjusted (1970 standard) breast cancer mortality rates per 100,000 women were calculated for the periods 1986 to 1990 and 1991 to 1995. The percentage change calculation was the 1986-to-1990 mortality rates minus the 1991-to-1995 mortality rates divided by the 1986-
to-1990 mortality rates, and then multiplied by 100.

Thereafter, states were ranked from highest to lowest mortality rates based on the 1986-to-1990 mortality rates. Those states with fewer than 200 deaths in the five-year period between 1986 to 1990 and 1991 to 1995 were excluded from the analysis. Two states (Alaska and Hawaii) and the District of Columbia were excluded for white females. Only 23 states had more than 200 breast cancer deaths among black women for the five-year period.

Based on the percentage change, the 10 states in the top and bottom of the list are included in Table 1 for white women and Table 2 for black women. Additionally, the average ranking for the initial 1986-to-1990 mortality rates and average percentage change for the periods 1986 to 1990 and 1991 to 1995 were calculated for top and bottom deciles.

The $z$-test was used

$z = \frac{(p_1 - p_2)}{\sqrt{\frac{(SE_{pooled})^2}{2}}}$

TABLE 1

| State          | Mortality Rates* 1986-1990 | Mortality Rates* 1991-1995 | Rank of Mortality Rates for 1986-1990 | Percentage Change in Mortality |
|---------------|---------------------------|---------------------------|--------------------------------------|-------------------------------|
| TOP DECILE    |                           |                           |                                      |                               |
| Vermont       | 30.38                     | 25.96                     | 7                                    | -14.5%                        |
| Delaware      | 32.00                     | 28.36                     | 1                                    | -11.4%                        |
| South Dakota  | 26.78                     | 24.18                     | 23                                   | -9.7%                         |
| Connecticut   | 28.49                     | 25.73                     | 12                                   | -9.7%                         |
| Rhode Island  | 31.46                     | 28.48                     | 4                                    | -9.5%                         |
| Maryland      | 29.06                     | 26.38                     | 11                                   | -9.2%                         |
| New York      | 31.90                     | 28.98                     | 2                                    | -9.2%                         |
| Nebraska      | 27.32                     | 24.87                     | 18                                   | -8.3%                         |
| Ohio          | 29.42                     | 26.97                     | 9                                    | -8.0%                         |
| Virginia      | 27.47                     | 25.28                     | 16                                   | -8.0%                         |
| **Average**   | **(SE)**                  | **(2.27)**                | **(0.59)**                           |                               |
| BOTTOM DECILE |                           |                           |                                      |                               |
| Iowa          | 25.94                     | 25.12                     | 26                                   | -3.2%                         |
| Mississippi   | 22.60                     | 21.98                     | 48                                   | -2.7%                         |
| Utah          | 22.85                     | 22.30                     | 46                                   | -2.4%                         |
| Florida       | 25.08                     | 24.62                     | 34                                   | -1.8%                         |
| Idaho         | 23.92                     | 23.50                     | 43                                   | -1.6%                         |
| Oklahoma      | 24.99                     | 24.73                     | 36                                   | -1.0%                         |
| Louisiana     | 24.01                     | 24.08                     | 42                                   | 0.3%                          |
| Tennessee     | 24.16                     | 24.27                     | 41                                   | 0.5%                          |
| North Dakota  | 25.04                     | 25.47                     | 35                                   | 1.7%                          |
| Texas         | 22.75                     | 23.15                     | 47                                   | 1.8%                          |
| **Average**   | **(SE)**                  | **(2.20)**                | **(0.54)**                           |                               |

$z$-test -2.15

$p$-value 0.032

*Rates are per 100,000 and age adjusted to 1970 population.
to compare the average rank-in-mortality rates during 1986 to 1990 among states in the top deciles with the average ranking-in-mortality rates for states in the bottom deciles. The critical value was set at $z_{(1-0.05/2)} = \pm 1.96$.

**FINDINGS**

The 10 states with the largest declines in mortality rates among white females (Table 1) had an average initial ranking of 10 for 1986 to 1990 with an average percentage drop of 9.85 from 1986 to 1990 and 1991 to 1995. The 10 states with the lowest change in rate and a slight increase in mortality percentage had, on average, an initial ranking of 39 with an average percentage decrease of 1.02. The average rank in mortality was significant between the states in the top and bottom decile ($z > |1.96|$).

Table 2 shows the mortality rates for breast cancer among black females. The average

### Table 2

| State         | Mortality Rates* 1986-1990 | Mortality Rates* 1991-1995 | Rank of Mortality Rates for 1986-1990 | Percentage Change in Mortality |
|---------------|-----------------------------|----------------------------|---------------------------------------|-------------------------------|
| **TOP DECILE**|                             |                            |                                       |                               |
| Indiana       | 34.73                       | 29.65                      | 2                                     | -14.63                        |
| Florida       | 20.13                       | 27.99                      | 17                                    | -7.10                         |
| California    | 32.23                       | 30.95                      | 8                                     | -3.97                         |
| Ohio          | 32.16                       | 30.94                      | 10                                    | -3.79                         |
| Alabama       | 30.60                       | 29.64                      | 15                                    | -3.14                         |
| Michigan      | 32.96                       | 32.81                      | 5                                     | -0.46                         |
| North Carolina| 31.82                       | 31.93                      | 11                                    | 0.35                          |
| Illinois      | 33.71                       | 34.14                      | 3                                     | 1.28                          |
| New York      | 28.96                       | 29.50                      | 18                                    | 1.86                          |
| Missouri      | 30.92                       | 31.87                      | 14                                    | 3.07                          |
| **Average**   | 30.48                       | 30.44                      | **10**                                | **-2.71**                     |
| (SE)          | (1.81)                      | (1.64)                     |                                       |                               |
| **BOTTOM DECILE**|                             |                            |                                       |                               |
| Tennessee     | 33.18                       | 35.14                      | 4                                     | 5.91                          |
| Louisiana     | 31.09                       | 33.16                      | 13                                    | 6.66                          |
| Mississippi   | 26.31                       | 28.09                      | 22                                    | 6.70                          |
| New Jersey    | 31.56                       | 33.90                      | 12                                    | 7.41                          |
| Pennsylvania  | 32.62                       | 35.11                      | 7                                     | 7.63                          |
| South Carolina| 27.47                       | 29.78                      | 21                                    | 8.41                          |
| Maryland      | 30.42                       | 33.95                      | 16                                    | 11.60                         |
| Kentucky      | 32.70                       | 37.11                      | 6                                     | 13.49                         |
| Texas         | 28.41                       | 32.90                      | 19                                    | 14.00                         |
| Arizona       | 24.82                       | 31.52                      | 23**                                  | 26.99                         |
| **Average**   | 30.48                       | 30.44                      | 14.3                                  | 10.9                          |
| (SE)          | (2.2)                       | (6.4)                      |                                       |                               |
| **Z-test**    |                            |                            | -1.4                                  |                               |
| **p-value**   |                            |                            | 0.162                                 |                               |

*Rates are per 100,000 and age adjusted to 1970 population.

**Only 23 states had enough cases in the five-year period between 1986 to 1990 and 1991 to 1995.
ranking for 1986 to 1990 goes from 1, the highest mortality, to 23, the lowest mortality. Only six states showed a decline in breast cancer mortality.

The 10 states in the top decile ranked from the highest to lowest decline in mortality percentage change and had an initial average ranking for 1986 to 1990 of 10, with an average percentage decline of 2.71. The 10 states in the bottom decile had an average ranking of 14.3 with an average percentage increase of 10.9. There was no statistically significant difference in ranking between states in the upper and lower decile for black women \((z < |1.96|)\).

Of all states included in the analysis, Florida had a higher decrease in mortality rates for breast cancer among blacks than whites. In Texas, the average percentage change among white females was a 1.8 increase and among black females—a 14.0 increase.

**DISCUSSION**

In the last 20 years, advances in detection, diagnosis, and treatment of breast cancer have contributed to the overall reduction in breast cancer mortality in the US. Among white females, the highest percentage change in mortality from 1986 to 1990 and 1991 to 1995 occurred in those states which had the highest initial mortality rates in the former period. In contrast, states with the lowest mortality in 1986 to 1990, tended to have the lowest percentage change in mortality rates. Among black females, the states in the top and bottom decile did not differ in their ranking in mortality for the period of 1986 to 1990 \((z < |1.96|)\).

Disparities in breast cancer occurrence exist between states in our analysis, as well as in others.\(^{10,11}\) The inequalities likely reflect factors such as stage of disease at diagnoses, socioeconomic status,\(^{12,13}\) access to care, and adequacy of medical care.

Early detection and appropriate treatment are essential to lessen the burden of breast cancer and to reach the Healthy People 2010 objective of reducing breast cancer deaths to no more than 22.3 per 100,000 females.\(^{14}\) Data on population-based patterns of care and cancer outcomes beyond incidence, survival, and mortality are needed to identify deficiencies and to direct efforts with the goal of eliminating disparities.

**REFERENCES**

1. Greenlee RT, Hill Harmon MB, Murray T, Thun M. Cancer statistics, 2001. CA Cancer J Clin 2001;51:15-36.
2. Early Breast Cancer Trialist’s Collaborative Group. Systematic treatment of early breast cancer by hormonal, cytotoxic or immune therapy. 133 randomized trials involving 31,000 recurrences and 24,000 deaths among 75,000 women. Lancet 1992;339:1-15, 71-85.
3. Hortobagyi GN. Treatment of breast cancer. N Engl J Med 1998;339:974-984.
4. Early Breast Cancer Trialists’ Collaborative Group. Tameoxifén for early breast cancer: an overview of the randomized trials. Lancet 1998;351:1451-1467.
5. Wingo PA, Ries LAG, Rosenberg HM, et al. Cancer incidence and mortality, 1973-1995, a report card for the United States. Cancer 1998;82:1197-1207.
6. Chu KC, Tarone RE, Kessler LG, et al. Recent trends in US breast cancer incidence, survival, and mortality rates. J Natl Cancer Inst 1996;88:1571-1579.
7. Ries LAG, Eisner MP, Hankey BF, et al. SEER Cancer Statistics Review, 1973-1998: National Cancer Institute, 2001.
8. Sturgeon SR, Schairer C, Gail M, et al. Geographic variation in mortality from breast cancer among white women in the United States. J Natl Cancer Inst 1995;87:1846-1853.
9. Ganji GP. Statistical Test. Thousand Oaks, CA: Sage Publications; 1995.
10. Goodwin JS, Freeman JL, Freeman D, Nattinger AB. Geographic variations in breast cancer mortality: Do higher rates imply elevated incidence or poorer survival? Am J Public Health 1998;88:458-460.
11. CDC. Breast cancer incidence and mortality—United States, 1992. MMWR 1996;45:833-837.
12. Berg JW, Ross R, Latourette H. Economic status and survival of cancer patients. Cancer 1977;39:467-477.
13. Bam RP, Greenberg RS, Whitaker JO. Racial differences in survival of women with breast cancer. J Chronic Dis 1986;39:631-642.
14. US Department of Health and Human Services. Healthy People 2010. 2nd Edition. With understanding and improving health objectives for improving health. 2 vols. Washington DC, US Printing Office, November 2000.