Late-Stage Diagnosis of Breast Cancer in Women of Lower Socioeconomic Status: Public Health Implications

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Abstract: To assess the success of breast cancer control activities in Connecticut, we examined data from the Connecticut Tumor Registry, determining differences in breast cancer stage at time of diagnosis over time and in selected subgroups. From 1982 to 1985, the percentage of women with cancer confined to the breast increased from 54.0 percent to 61.3 percent. During 1984 and 1985, lower socioeconomic status (SES) women with breast cancer were less likely than higher SES women to be diagnosed with early-stage disease (56.9 percent vs 62.7 percent). SES was estimated by census tract of residence. In the same years, the overall incidence of breast cancer was greater in higher SES women. Projections based on these incidence data found that lower SES women, as compared to higher SES women, had a higher rate of expected breast cancer deaths (24.6 vs 19.7 per 100,000), and a greater percentage of those deaths considered preventable by early detection (22 percent vs 11 percent). The rate of preventable deaths in lower SES women was 2.5 times as great as that for higher SES women (5.3 vs 2.1 per 100,000). Tumor registries can serve as useful surveillance systems to aid cancer control programs. Breast cancer early-detection programs should give special attention to lower SES women. (*Am J Public Health* 1989; 79:1508–1512.)

Introduction

The long-term survival of women with breast cancer is dependent on the stage of disease at the time of diagnosis.[1] Attempts to control breast cancer deaths have therefore relied on promoting early cancer detection and treatment. Prospective studies have demonstrated the success of screening programs in both detecting cancers in early stages and decreasing breast cancer mortality.[2–5] However, these studies have been in groups of women enrolled in health maintenance organizations or recruited for special projects. In Connecticut, women have primarily been encouraged to have breast cancer screening by their individual physicians and through educational programs of the American Cancer Society. The extent to which these efforts have been successful in the general population of the state is unclear.

The success of the breast cancer control programs should be measurable initially as an improvement in the percentage of all breast cancers diagnosed at an early stage and ultimately as a decrease in the incidence of late-stage disease. Tumor registries regularly contain information on cancer stage, and can consequently serve as surveillance systems to guide cancer control activities. We examined recent trends in breast cancer stage at the time of diagnosis in the Connecticut Tumor Registry. We then evaluated cancer stage in selected subgroups of the population, and projected estimates of the number of deaths preventable by earlier detection in women of various socioeconomic groups.

Methods

The Connecticut Tumor Registry has collected information on all Connecticut cases of invasive breast cancer and carcinoma-in-situ in a consistent manner since 1941.[6] The cancer stage is determined for each case by trained Medical Record Technicians at the Connecticut Department of Health Services (DHS) from detailed clinical, surgical, and histological reports. The staging system for breast cancer, unchanged since the registry began, can be summarized as follows: 1) *carcinoma-in-situ*; 2) *local*—invasive cancer localized to the breast; 3) *regional*—cancer in the breast with spread to regional lymph nodes or pectoral muscles; 4) *remote*—presence of distant metastases. The tumor registry has contained basic demographic information since its inception, but data on census tract of residence, which allow an estimation of socioeconomic status, have been included only since 1984.

The outcome measured was the distribution of cancer stage at the time of diagnosis. Comparisons of stage distribution were made by year from 1975 to 1985; for 1984 and 1985 comparisons were also made by race, place of residence, and socioeconomic status (SES), as estimated from census tract information. Census tract coding was not possible for 778 (17 percent) of 4,524 women with cancer diagnosed during those years. Data from these women were analyzed separately to test for potential bias the incomplete coding may have caused. We analyzed three different markers to identify census tract socioeconomic level (as determined in the 1980 census): 1) median household income; 2) percentage of persons below the poverty line; and 3) percentage of adults who have completed a high school education. These three variables were closely correlated, and the various definitions of census tract socioeconomic level led to identical conclusions; the data presented use the percentage of census tract adults who were high school graduates as the sole SES marker. Women were grouped into quartiles. The lowest SES quartile contained census tracts with 15–61 percent of adults who were high school graduates. The middle two quartiles were combined to form the middle SES group, which contained census tracts with 62 –82 percent of adult high school graduates. The highest quartile contained census tracts with 83–97 percent of adult high school graduates. For analysis of Black women stratified by SES, the middle and higher SES groups were combined because of the small number of cancers in each stratum.

Population denominators for calculations of incidence trends from 1975 to 1985 were linear estimations based on 1970 and 1980 census figures for each age group. Incidence rates by SES were calculated using census tract population data from the 1980 census. Age-adjustment was done by the direct method, using the 1980 Connecticut population as the standard.

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The projected number of breast cancer-caused deaths in a cohort of women with breast cancer was derived according to the following general principle:

> Breast cancer-caused deaths = (Expected survivors in breast cancer cohort from actuarial estimates) − (Expected survivors in breast cancer cohort given presence of breast cancer)

The terms of this equation were calculated using: 1) 5-year survival rates by age and race from 1983 life tables; 2) 5-year relative survival rates for each stage established nationally[1] and in Connecticut; 3) estimates of the effect of SES on stage-specific 5-year relative survival rates from published studies;[7–9] and 4) mean annual numbers of breast cancer cases by age, race, and SES group during 1984–85 (see Appendix). "Nonpreventable" deaths represent similar estimates, assuming that the stage distribution in each age group achieved a goal as follows: *carcinoma-in-situ*—10 percent, *local*—60 percent, *regional*—25 percent, *remote*—5 percent of the total. This goal was felt to be reasonable based on published studies of breast cancer screening[5,10] and the current trend in Connecticut. "Preventable" deaths were defined as the difference between projected deaths and "nonpreventable" deaths. To help interpret these numbers of deaths, we calculated projected death rates by dividing them by the number of women in the population from which the cancer cases arose; population denominators were taken from the 1980 census. To study the longer-term impact of early detection, we projected 10-year death rates with similar methods.

We then assessed the reliability of these deaths rate estimates by varying the assumptions used, including: changing the program "goals", using different estimates of relative survival rates, and eliminating the differences in stage-adjusted survival by SES group. Changing these assumptions altered the magnitude of the projected death estimates, but caused only very small relative differences, and produced no difference in the conclusions regarding the SES group at highest risk. In general, increases in 5-year survival rates led to increases in the expected beneficial effect of early tumor detection, and increases in the ratio of projected preventable deaths in higher versus lower SES women. The data presented use 5-year survival rates established nationally (which include data from Connecticut)[1] and 10-year survival rates from the 1975–77 Connecticut breast cancer cohort.

The statistical significance of trends in disease stage was evaluated using extensions of the Mantel-Haenszel chi-square test for trends with multiple levels of exposure and multiple levels of disease.[11]

Results

Between 1975 and 1985, 21,131 breast cancers were diagnosed in Connecticut women. For 20,165 (95.4 percent) cancers, the available information was sufficient to accurately determine stage. In individual years, cancers of unknown stage represented between 3.9 percent and 6.0 percent of all cancers, with no increasing or decreasing trend. The trend of cancer stage among those cases in which information was complete is presented in Table 1. Between 1975 and 1981, there was little variation from year to year in stage at diagnosis, with no overall trend ($p = 0.29$). During this time, the percentage of cancers of known stage that were confined to the breast (*carcinoma-in-situ* and *local* stages) ranged from 52.2 percent to 55.9 percent. However, from 1982 to 1985 this percentage increased from 54.0 percent to 61.3 percent ($p = 0.0001$). Over these four years, the age-adjusted incidence of cancer in later stages (*regional* and *remote*) decreased slightly, from 5.06 to 5.02 cases per 10,000, while the breast cancer incidence overall increased from 11.6 to 13.6 and the incidence of disease confined to the breast increased from 5.9 to 8.0 cases per 10,000 (Figure 1).

During 1984 and 1985, the years in which information on SES was available, cancer stage was more closely and consistently related to SES than area of residence. There were no differences in the distribution of cancer stage among women residing in different counties. However, in cities of greater than 100,000 population (which have a disproportionately large share of lower SES women) only 56.7 percent of women presented with tumors confined to the breast, compared to 61.0 percent of women in smaller cities and towns ($p < 0.001$). Table 2 shows that women in the lower SES group, compared to women in the higher SES group, were less likely to have *carcinoma-in-situ* (6.2 percent vs 8.5 percent) or cancer confined to the breast (56.9 percent vs. 62.7 percent), and more likely to present with *remote* disease (8.9 percent vs 5.9 percent; $p = 0.001$ for trend). Middle SES group women had intermediate values. Black women, compared to White women, were less likely to have *carcinoma-in-situ* or cancer confined to the breast and more likely to have *remote* disease ($p = 0.007$ for trend). The differences in cancer stage by SES group were still present when cases were stratified by race ($p = 0.03$ for White women, $p = 0.04$ for Black women). There were no important differences between

TABLE 1—Percentage of Breast Cancers in Different Stages, Connecticut 1975–85

Year	Incidence*	Cancers of Known Stage				
		N	Ca-in-Situ	Local	Regional	Remote
1975	12.2	1756	3.9	50.7	37.3	8.1
1976	11.3	1641	3.3	52.4	35.6	8.6
1977	11.0	1651	3.4	52.5	35.2	8.9
1978	11.0	1641	3.0	50.7	35.2	11.1
1979	11.4	1716	4.0	51.2	38.2	6.6
1980	11.4	1761	4.0	49.9	38.5	7.6
1981	12.0	1867	3.7	48.5	38.7	9.1
1982	11.6	1814	4.9	49.1	38.5	7.5
1983	12.3	1973	4.5	50.4	37.1	7.9
1984	13.1	2125	6.3	53.1	33.1	7.4
1985	13.6	2220	7.4	53.9	31.5	7.2
Total		20,165				

*Cases per 10,000 women, including those of unknown stage, age-adjusted to 1980 Connecticut population.

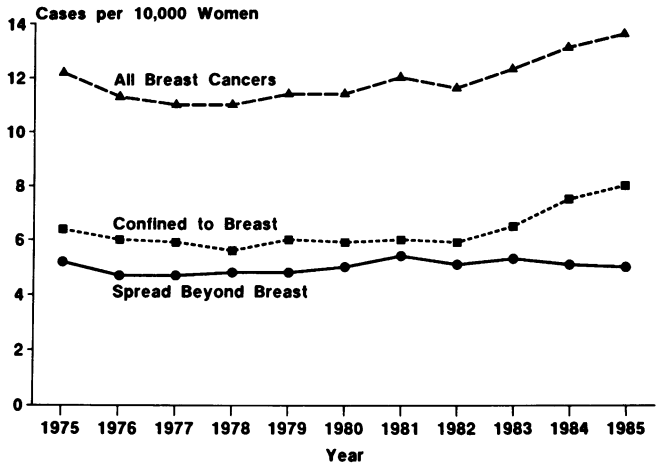

FIGURE 1—Incidence of Breast Cancer by Stage at Diagnosis, Connecticut, 1975–85

any of these subgroups in the percentage of cancers for which the stage was unknown.

The 778 women without census tract information were similar to women in known census tracts in the percentage that were Black or urban residents. Among the 684 of these women for whom the stage was known, the distribution of cancer stage was similar to that of women in known census tracts.

Population-based rates of the different cancer stages were calculated for each SES group. Lower SES women had lower crude and age-adjusted rates of breast cancer overall and of early-stage disease, but a slightly higher rate of metastatic disease (Table 3).

The numbers of cancer cases in each stage were then used to calculate projected breast cancer death rates for the different SES groups (Figure 2). These rates indicate the proportion of women annually diagnosed with fatal breast cancer ("fatal" meaning expected to die from breast cancer within five years from the time of diagnosis). To estimate the expected benefit of a moderately successful early detection program, these death rates were then separated into "preventable" and "nonpreventable" death rates as described. There were small differences among SES groups in the rates of "nonpreventable" deaths. However, lower SES women, compared to higher SES women, had a 25 percent higher projected breast cancer death rate (24.6 vs 19.7 per 100,000) and a greater percentage of those deaths classified as "preventable" (22 percent vs 11 percent). The preventable breast cancer death rate for lower SES women was 2.5 times as great as that for higher SES women (5.3 vs 2.1 per 100,000). A similar analysis projecting 10 years from the time of diagnosis produced parallel results; lower SES women had a 34 percent higher projected death rate (32.0 vs 23.8 per 100,000), and a greater percentage of those deaths "preventable" (20 percent vs 9 percent).

Discussion

The Connecticut Tumor Registry has for many years been an invaluable source of data on cancer incidence trends.[6] Recent advances in our understanding of cancer prevention allow us increasingly to use tumor registries like this as surveillance systems to aid in the design and evaluation of cancer control activities. As surveillance systems, tumor registries not only provide accessible information about the overall success or failure of control activities over time, but also identify subgroups of the population at unusually high risk of fatal disease.

Our analysis of the tumor registry data shows a shift toward early breast cancer detection in Connecticut in the 1980s, as indicated by an increase in the percentage of tumors diagnosed in early stages and a slight decrease in the incidence of later-stage disease. This shift represents an acceleration of the more gradual long-term trend toward earlier diagnosis of breast cancer present since the 1940s.[12,13] It is probable that this long-term trend is responsible (together with an improvement in stage-specific survival rates) for the stabilization of breast cancer mortality rates, in spite of a real increase in breast cancer incidence.[12–14]

No data are available regarding the frequency of screening mammograms or breast examinations in Connecticut. If breast cancer screening is responsible for the shift toward early-stage diagnosis, then we would hope to soon see a further decrease in the population-based incidence of *regional* and *remote* stage disease. Statewide surveillance of breast cancer should therefore periodically assess the incidence of disease by stage to monitor the success of early detection programs.

Both White and Black women in lower SES census tracts were more likely than race-matched women in higher SES census tracts to have later-stage disease at the time of breast cancer diagnosis. A definition of SES based on census tract information subjects the analysis to potential bias caused by an "ecologic fallacy." However, we would expect that the misclassification of women by this group attribute would tend to bias the data toward finding no differences by SES. In addition, our data show a consistent trend over three SES groups, are similar to the analysis of stage by race, and are similar to the findings of stage versus SES found by other authors.[7,8,15,16]

The relation between lower SES and late-stage diagnosis found by others has been noted in the process of correcting for the effect of stage on long-term survival rates. Rather than correcting for tumor stage, we used it as the outcome to measure the success of control activities. This allowed us to assess the effect of early detection programs independent of the effects of primary prevention and treatment programs.

Breast cancer screening programs may detect some early tumors which do not have the potential to progress to clinical cancer. Classifying these tumors as breast cancer would artificially increase both breast cancer incidence and the percentage of tumors diagnosed in early stages. This phenomenon may be partly responsible for the temporal trend and socioeconomic differences in early cancer rates. However, such benign tumors would not alter the population-based incidence of *regional* or *remote* cancer and would not have a significant impact on our projected breast cancer mortality rates.

Although lower SES women are more likely to present with later stage-disease and have poorer stage-adjusted 5-year survival rates[7,9] than higher SES women, they have a lower overall incidence of breast cancer than higher SES women. Therefore it is not immediately apparent which group should be a target of control programs. However, we estimate that these SES differences will lead to a 25 percent increase in deaths for lower SES women compared to higher SES women, with these deaths more than twice as likely to be preventable by early tumor detection.

We have had to make several assumptions in calculating these projected death rates. In particular, we have assumed

TABLE 2—Percentage of Breast Cancers in Different Stages by Socioeconomic Group and Race, Connecticut, 1984–85

Race	SES Group	Cancers of Known Stage				
		N	Ca-in-situ	Local	Regional	Remote
White	Lower	796	6.8	51.8	32.9	8.4
	Middle	1747	6.7	53.1	32.7	7.4
	Higher	897	8.2	54.0	31.9	5.9
Black	Lower	104	3*	44	40	13
	Middle	57	5*	58	26	12
	Higher	13	23*	62	8*	8*
All Women	Lower	907	6.2	50.7	34.2	8.9
	Middle	1822	6.6	53.1	32.6	7.7
	Higher	920	8.5	54.2	31.4	5.9
Total, known SES		3649	7.0	52.8	32.7	7.5

*Represents fewer than five cases.

TABLE 3—Crude (age-adjusted*) Incidence of Breast Cancer per 10,000 Women in Different Stages, 1984–85, by Socioeconomic Group

SES Group	Carcinoma-in-situ	Local	Regional	Remote	Total
Lower	0.65(0.65)	5.33(5.14)	3.60(3.51)	0.94(0.90)	10.8(10.4)
Middle	0.75(0.74)	5.98(5.88)	3.67(3.61)	0.87(0.85)	11.6(11.4)
Upper	1.06(1.04)	6.75(7.29)	3.91(4.08)	0.73(0.80)	12.7(13.5)

*1980 Connecticut population standard.

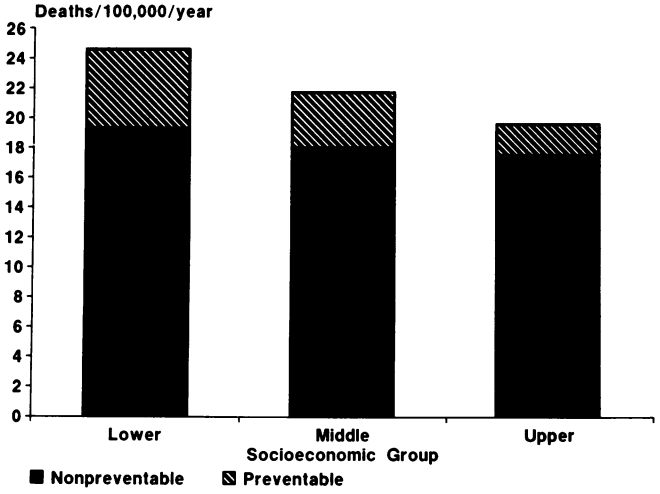

FIGURE 2—Projected Breast Cancer Death Rates for Cases Diagnosed in Connecticut during 1984–85

that within each SES group, long-term stage-specific cancer survival rates would remain unchanged after an early-detection program. This assumption is related to the effect of lead-time on cancer survival and mortality. A theoretical problem exists in assessing the benefit of screening programs if women who have cancers detected early do not have the expected improvements in long-term survival—if these women's deaths are neither prevented nor postponed, but simply occur further from diagnosis. However, over time, as cancers in Connecticut have been detected earlier, long-term survival rates for early-stage disease have actually increased (10-year rates are presently 99 percent for carcinoma-in-situ, 83 percent for cancer localized to the breast). Furthermore, two studies have demonstrated that screening has a beneficial long-term effect on mortality independent of its effect on diagnostic lead-time.[2,3,5] Therefore it is likely that the assumption of constant stage-specific survival rates is sufficiently valid to provide useful estimates regarding the benefit of early detection programs.

While the magnitude of our death rate projections depends on the numerical assumptions we have made regarding disease stage and survival, the trend toward a substantial increase in preventable deaths in lower SES women was present regardless of such assumptions. We believe these projections, combined with the established benefit of early tumor detection in decreasing cancer mortality,[2–5] provide strong justification for prevention programs to direct special attention to lower SES women.

It is probable that women of lower SES present with later-stage disease because of a combination of decreased access to medical care and a decreased awareness of or belief in the importance of early cancer detection. In the National Health Interview Survey, Black women had lower rates of utilization of breast examinations or mammography than White women, and among those >40 years old, were twice as likely as White women to have never heard of mammography.[17] Our data suggest that this difference may be due more to socioeconomic status than race. Data from neighboring Rhode Island indicate that among all women who had not had a mammogram in the past year, the most important reason for not having had the test was that they had believed it was unnecessary.[18] It is important to better define the precise reasons why women in lower SES groups appear less likely to use breast cancer screening techniques.

Connecticut has recently passed a law ensuring that all private and public medical insurance plans—including Medicare—pay for the cost of screening mammography. The Connecticut Department of Health Services is currently working with the American Cancer Society in the state to find ways

of better reaching lower SES women. We hope these efforts will improve early cancer detection and thereby contribute to the prevention of breast cancer morbidity and mortality.

APPENDIX

Estimated 5-Year Survival Rates by Cancer Stage

For each SES group, the number of projected breast cancer deaths (D) was calculated as the sum for each race of the following:

$$D = \sum_{s} \sum_{a} L_a \times C_{a,s} - \sum_{s} P_s \sum_{a} L_a \times C_{a,s}$$
$$= \sum_{s} (1 - P_s) \times (\sum_{a} L_a \times C_{a,s})$$

where s = stage, a = age-group, L_a = estimated 5-year actuarial survival for each age-group, P_s = estimated 5-year relative survival for each stage in that SES group (see below), and $C_{a,s}$ = number of actual cases of breast cancer in each age-group and stage. "Nonpreventable" deaths were calculated using the same equation except that the number of actual cases was replaced by the goal number of breast cancer cases in each stage.

	5-year Relative Survival by Cancer Stage				
SES Group	In situ	Local	Regional	Remote	All stages
High	.993	.912	.748	.190	.811
Middle	.989	.899	.685	.174	.782
Low	.986	.886	.622	.158	.754

The estimated 5-year relative survival rates were generated by adjustment of data from the Surveillance, Epidemiology, and End Results (SEER) program[1] with estimates of previously noted effects of SES on survival rates.[7–9] The rates used were as follows:

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Manual Being Developed to Assist Local Boards of Health in Policy-Making

To help improve the capabilities of local boards of health, a manual is being designed by the Association of North Carolina Boards of Health (ANCBH), under a $5,000.00 grant from the W. K. Kellogg Foundation. That financial support will enable ANCBH to review available information on public health policy-making and develop new resources specifically for boards of health in North Carolina, according to Vaughn Upshaw, Administrative Director of ANCBH in Pittsboro, NC. However, he added that the manual would be available to *all* boards of health in the US.

The manual is expected to offer a review of the state statutes in North Carolina, and also provide guidelines for board members to improve their assessment of community needs, policy-making skills, knowledge of agency operations, and advocacy for public health.

Local boards of health are empowered by the state to protect and promote public health. According to ANCBH President Ronald Tucker, "Growing concern for our environment and personal health increases the need for informed local officials." Few resources are available locally to boards of health on how to act effectively, he added. "Board members, health directors, health department staff, and the public will benefit from more knowledgeable and effective boards of health."

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