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Impact of neighborhood and individual socioeconomic status on survival after breast cancer varies by race/ethnicity: The Neighborhood and Breast Cancer Study

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Abstract

Background—Research is limited on the independent and joint effects of individual- and neighborhood-level socioeconomic status (SES) on breast cancer survival across different racial/ethnic groups.

Methods—We studied individual-level SES, measured by self-reported education, and a composite neighborhood SES (nSES) measure in females (1,068 non-Hispanic whites, 1,670 Hispanics, 993 African-Americans, and 674 Asian-Americans), aged 18–79 years and diagnosed 1995–2008, in the San Francisco Bay Area. We evaluated all-cause and breast cancer-specific survival using stage-stratified Cox proportional hazards models with cluster adjustment for census block groups.

Results—In models adjusting for education and nSES, lower nSES was associated with worse all-cause survival among African-Americans (p-trend=0.03), Hispanics (p-trend=0.01) and Asian-Americans (p-trend=0.01). Education was not associated with all-cause survival. For breast cancer-specific survival, lower nSES was associated with poorer survival only among Asian-Americans (p-trend=0.01). When nSES and education were jointly considered, women with low education and low nSES had 1.4 to 2.7-times worse all-cause survival than women with high education and high nSES across all races/ethnicities. Among African-Americans and Asian-

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Americans, women with high education and low nSES had 1.6 to 1.9-times worse survival, respectively. For breast cancer-specific survival, joint associations were found only among Asian-Americans with worse survival for those with low nSES regardless of education.

Conclusions—Both neighborhood and individual SES are associated with survival after breast cancer diagnosis, but these relationships vary by race/ethnicity.

Impact—A better understanding of the relative contributions and interactions of SES with other factors will inform targeted interventions towards reducing long-standing disparities in breast cancer survival.

Keywords

breast cancer survival; neighborhood socioeconomic status; education; race/ethnicity

Introduction

Breast cancer is the second leading cancer cause of death in the United States (1). Despite significant improvements in breast cancer survival over the past few decades, racial/ethnic and socioeconomic disparities persist, with African-American, American Indian/Alaska Native, and low income women having worse survival after diagnosis (1–5). An individual's socioeconomic status (SES) may influence survival through material and social resources, including access to and quality of health care, and lifestyle risk factors (3, 5). Neighborhood SES (nSES) may influence survival through features of the physical (e.g., goods, services, pollutants) and social (e.g., cohesion, collective efficacy, support, stress, coping) environment (6–8). Understanding individual-level and neighborhood-level SES associations with survival can identify potential explanatory pathways for informing strategies to reduce these disparities.

Lower nSES (9–13) and lower individual-level SES (e.g., education, income, wealth) (14,15) have each been associated with worse survival after breast cancer diagnosis. Studies that have examined both individual-level and neighborhood-level SES have found either only nSES (16, 17), only individual-level SES (8), both measures (18), or the interactions between the two measures (19) to be associated with survival. These mixed findings may partly be due to the variation across studies in racial/ethnic composition of the samples, geographic regions, geographic levels used to assess nSES, and measures of SES, or residual confounding and selection bias. Further, prior studies have had limited racial/ethnic diversity, often including non-Hispanic whites and/or African-Americans only (8, 17, 18), and used larger and more heterogeneous geographic units as proxies for residential neighborhoods. The emerging literature on the differential effects of SES on health across population subgroups also may contribute to the mixed results (20–22).

We examined race/ethnicity-specific independent and joint associations of individual education and nSES with survival after breast cancer diagnosis using data from the Neighborhood and Breast Cancer (NABC) study which pooled neighborhood and cancer registry data with interview data from two multiethnic population-based studies in the San Francisco Bay Area.

Materials and Methods

Study Population

NABC includes female breast cancer patients from two epidemiologic studies, the San Francisco Bay Area Breast Cancer Study (SFBCS) and the Northern California Breast Cancer Family Registry (NC-BCFR). Both studies included patients identified through the Greater Bay Area Cancer Registry (GBACR), which participates in the NCI Surveillance, Epidemiology, and End Results (SEER) Program and the California Cancer Registry (CCR). Interview data from the two studies were harmonized and merged with CCR data and neighborhood data from the California Neighborhoods Data System (23). The protocols for the two parent studies and the NABC study were approved by the Cancer Prevention Institute of California Institutional Review Board.

The SFBCS is a population-based case-control study among women aged 35–79 years and residing in Alameda, Contra Costa, San Mateo, San Francisco, or Santa Clara counties at the time of diagnosis (24, 25). Eligible cases newly diagnosed with a first primary invasive breast cancer included all Hispanics diagnosed between 4/1/1995 and 4/30/2002, and all African-Americans and a random 10% sample of non-Hispanic whites diagnosed between 4/1/1995 and 4/30/1999.

The NC-BCFR is a family study that is part of the NCI-funded Breast Cancer Family Registry (26, 27), and included newly-diagnosed invasive breast cancer cases aged 18–64 years who lived in Alameda, Contra Costa, Marin, San Mateo, San Francisco, Santa Clara, Santa Cruz, and Monterey counties at the time of diagnosis. The study included cases of any race/ethnicity diagnosed from 1/1/1995 to 9/30/1998; Hispanic, African-American, Chinese, Filipina and Japanese diagnosed from 10/1/1998 to 4/30/2002; and Hispanic and African-American diagnosed from 5/1/2002 to 12/31/2009. Cases were eligible for the NC-BCFR if they had indicators of increased genetic susceptibility (i.e., diagnosis before age 35 years, personal history of ovarian or childhood cancer, bilateral breast cancer with a first diagnosis before age 50 years, or a first-degree family history of breast, ovarian or childhood cancer). Cases not meeting these criteria (sporadics) were randomly sampled (2.5% of non-Hispanic whites and 33% of other racial/ethnic groups because NC-BCFR focused on minority breast cancer families).

Both studies screened cases by telephone to assess study eligibility, with 84% participation among those contacted. In the SFBCS, 2,571 cases were eligible, and 2,258 (88%) completed the in-person interview, with similar response rates in Hispanics (88%), African-Americans (87%) and non-Hispanic whites (86%). In the NC-BCFR, 4,708 eligible cases were selected for the family study that involved an in-person interview, assistance with recruiting family members, and annual follow-up. Of these, 3,631 (77%) enrolled in the study and completed the interview, with similar response rates in African-Americans (82%), non-Hispanic whites (80%), Hispanics (78%), and Asian-Americans (73%).

For 339 participants that were in both studies, we used data from the SFBCS interview. Our analytic sample included participants with a first primary invasive breast cancer, who completed the questionnaire themselves, had a geocodeable address and follow-up

information from the CCR. We excluded participants of American Indian/Alaska Native or mixed race/ethnicity (n=11), or unknown education (n=36). The 4,369 breast cancer cases were interviewed on average 21.0 months (SD=11.1) after diagnosis.

Data Collection and Follow-up

In-person interviews were conducted in English, Spanish, Mandarin or Cantonese using similar structured questionnaires on breast cancer risk factors (24–26). CCR data included age and year at diagnosis, American Joint Committee on Cancer (AJCC) stage, histology, grade, tumor size, nodal status, estrogen receptor (ER) and progesterone receptor (PR) status, first course of treatment (surgery, radiation, chemotherapy), subsequent tumors, and marital status. The CCR obtains vital status and underlying cause of death through hospital follow-up and linkages to vital statistics, death records, and other databases. CCR data were used to create hospital-level indicators of percent of cancer patients in highest nSES quintile and percent of cancer patients by race/ethnicity.

Participants' addresses at time of diagnosis were geocoded to a latitude/longitude coordinate and then assigned a census block group (average of 1,500 residents with range of 600 to 3,000) for 98% of our sample, and address at interview were used for the remaining. Addresses were standardized to conform to U.S. Postal Service specifications using ZP4 software (ZP4. Monterey, CA: Semaphore Corp., 2011). Batch geocoding was performed using ArcGIS 10.0 (ArcGIS. Version10. Redlands, CA: Environmental Systems Research Institute, Inc., 2011). Extensive efforts were made to review addresses that did not batch geocode, resulting in assigning 97% of residences to a latitude and longitude.

Analytic Variables

Individual-level SES was measured using self-reported education categorized into four levels: less than high school, high school degree or equivalent, vocational/technical degree or some college, college degree or graduate school. NSES was based on a composite SES measure created by principal component analysis and comprising Census 2000 indicator variables at the block group-level: education index (among individuals age ≥ 25 years: proportion with college, high school, or less than high school weighted by 16, 12 or 9 respectively) (28), proportion with a blue collar job, proportion older than age 16 years without a job, median household income, proportion below 200% of the poverty line, median rent, median house value (29). This nSES index was categorized into statewide quintiles. Due to small numbers, the two lowest SES quintiles were combined for non-Hispanic whites and Asian-Americans. We also created a combination variable using binary indicators for education and nSES. Low education was defined as having a high school degree or less, and high education as having at least a vocational/technical degree or some college; low nSES included quintiles 1–3 and high nSES, quintiles 4–5.

Breast cancer deaths were identified from the underlying cause of death listed on the death certificate (ICD-9 (30) or ICD-10 (31) codes 174–175 and C50, respectively). Survival time was calculated in days from the date of diagnosis to date of death from breast cancer or from any cause, date of last known contact, or December 31, 2009 (the end of the study period), whichever occurred first. Of the 3,463 patients alive at the end of the study period, 97% had

a follow-up date in the last year of the study. On average, patients were followed for 7.4 years (SD=3.8) after diagnosis.

Analysis

To assess associations of education and nSES variables with survival, we employed multivariate stage-stratified Cox proportional hazards regression models, with cluster adjustment for block groups, to compute relative rates (hazard ratios, HR) of dying from any cause or from breast cancer. Follow-up time was left-censored. The sandwich estimator of the covariance structure, applied to Cox proportional hazards regression models by Lin & Wei and utilized here in the SAS PHREG procedure, accounts for the intracluster dependence and yields robust standard error estimates even under model misspecification (32). Over 70% of block groups in this study had only one participant across the racial/ethnic strata. The assumption of proportional hazards was checked by including interactions with time and assessing their significance using likelihood ratio tests and confirmed, except for AJCC stage, for which the proportionality did not hold. All Cox models were then stratified on stage allowing the baseline hazards within each model to vary by stage. We checked for and did not detect any effect modification by study type (SFBCS, high-risk NC-BCFR, sporadic NC-BCFR); all models were adjusted for study type. Analyses were conducted using SAS (version 9.3, Cary, NC). We also tested for spatial autocorrelation with Moran's I and found no evidence of it.

Base models were adjusted for age at diagnosis, year of diagnosis, study, tumor characteristics, treatment, and subsequent tumors. We considered modeling year of diagnosis using categorical intervals and found a consistent gradient of lower mortality over time which suggests that year of diagnosis has a linear effect on both all-cause and breast cancer-specific mortality in our study, therefore we have modeled year of diagnosis linearly. Linear trends for education and nSES in these models were assessed using the p-values associated with the significance of these ordinal variables (33). We are cautious in our interpretation of p-values for linear trends and only report on significant p-trends in the absence of significant main associations when we see a consistent trend with increasing or decreasing HRs across the levels of our ordinal variables. We consider these suggestive of a dose-response relationship between the SES measure and survival.

To assess their relative impact on the associations between SES and survival, additional sets of prognostic factors that may be important mediators were added to the base model if they were independently associated with survival: 1) personal and reproductive risk factors, including history of benign breast disease, years since last full-term pregnancy, use of hormonal contraception, use of menopausal hormone therapy (HT); 2) marital status; 3) behavioral factors, including alcohol consumption in the year before diagnosis, pre-diagnostic body mass index (BMI, calculated as self-reported weight (in kilograms) in the year before diagnosis divided by height (in meters) squared based on measured height for SFBCS participants or self-reported height for NC-BCFR participants), recent recreational physical activity (hours per week during the three years prior to diagnosis) (34); and 4) hospital characteristics.

Results

Non-Hispanic white women were more likely than other groups to be diagnosed with stage I disease, or ER/PR positive tumors, be nulliparous, or have a history of benign breast disease, or HT use (Table 1). They were also more likely to be seen in hospitals with proportionally more white or higher SES patients. African-American women were more likely to have had a lumpectomy, ER & PR negative tumors, be overweight or obese, and less likely to have been married. Hispanic women were more likely to be overweight or obese and report no recent recreational physical activity, and less likely to be nulliparous. Asian-American women were more likely to have had a mastectomy, be younger at diagnosis, be nulliparous, and without a history of hormonal contraceptive use or alcohol consumption.

The distributions of both SES measures varied substantially by race/ethnicity. The percent with less than a high school degree ranged from 4% among non-Hispanic whites to 37% among Hispanics. Proportions of cases living in the highest SES neighborhoods ranged from 63% among non-Hispanic whites to 15% among African-Americans.

Education was correlated with nSES and varied by race/ethnicity (correlation coefficients ranged from 0.25–0.39). Lower proportions of Hispanic and African-American women with higher education lived in higher SES neighborhoods than non-Hispanic white and Asian-American women (Table 2). Conversely, higher proportions of non-Hispanic white and Asian-American women with lower education lived in higher SES neighborhoods than Hispanic and African-American women.

All-Cause Survival

Lower education was associated with worse survival after breast cancer diagnosis among Asian-Americans and African-Americans (marginally significant) in base models, but these associations were attenuated and became non-significant after adjusting for nSES (Table 3). NSES was associated with worse survival among Hispanics and Asian-Americans and a statistically significant trend was found for African-Americans (p=0.01) and a marginally significant trend for non-Hispanic Whites (p=0.05); for all groups, HRs were increasing from high to low quintiles of nSES. The trends for nSES remained significant after adjusting for education among African-Americans, Hispanics, and Asian-Americans.

Education and nSES was jointly associated with survival and this association varied by race/ethnicity. Compared to women of high education and high nSES, survival was worse for those with low education and low nSES, both among non-Hispanic whites [HR=1.62, 95% CI: 1.02–2.56] and Hispanics [HR=1.39 (1.01–1.91)]. Among African-Americans, survival was worse for those living in low SES neighborhoods regardless of education [high education/low nSES HR=1.61(1.16–2.25); low education/low nSES HR=1.67 (1.20–2.32)]. Among Asian-Americans, survival was worse for all other groups [high education/low nSES HR=1.89 (1.02–3.50); low education/high nSES HR=1.84 (1.02–3.37); low education/low nSES HR=2.67 (1.37–5.23)].

Among African-Americans, nSES associations were attenuated after including hospital factors in the model (Table 4). Among Hispanics, further adjusting for behavioral risk

factors and hospital characteristics attenuated the association between nSES and survival. Among Asian-Americans, the nSES and survival association was not attenuated after adjusting for personal and hospital factors.

Among non-Hispanic whites, the joint association of education and nSES with all-cause survival was attenuated after adjustment for behavioral factors (low education/low nSES HR=1.44 (0.90–2.28)) and hospital characteristics (low education/low nSES HR=1.60 (0.99–2.60)). Among African-Americans, the joint association remained mostly unchanged after adjusting for additional prognostic factors, demonstrating slight attenuation with adjustment for personal and reproductive factors. Among Hispanic women, adjusting for reproductive, behavioral, and hospital factors attenuated the worse survival for low education/low nSES. Among Asian-Americans, further adjusting for prognostic factors attenuated the association for women with high education and low nSES and slightly attenuated the association for women with low education and high nSES.

Breast Cancer-Specific Survival

We observed significant associations between education and nSES for breast cancer-specific survival only in Asian-Americans (Table 5). Those with a high school degree or less had worse survival compared to those with at least a college degree. However, this association was no longer statistically significant after adjusting for nSES. Asian-American women living in lower SES neighborhoods had worse breast cancer-specific survival compared to those living in the highest SES neighborhoods. Adjusting for education and other prognostic factors did not attenuate this association (Table 6). Among African-Americans, further adjusting for reproductive factors and for marital status resulted in marginally significant (p=0.05) and significant (p=0.04) trends for nSES, respectively, for breast cancer-specific survival, though no significant HRs were observed.

For the joint association of education and nSES, worse survival was observed for Asian-American women with low nSES regardless of education compared to women with high education/high nSES. Adjusting for reproductive factors, marital status, and hospital factors slightly weakened the association for Asian-American women with low education/low nSES, whereas adjusting for behavioral factors completely attenuated the association. Adjusting for marital status and behavioral factors slightly attenuated the association while adjusting for hospital characteristics completely attenuated the association for Asian-American women with high education/low nSES.

Discussion

Combining data from two multiethnic breast cancer studies, we found an independent association between nSES and overall survival that varied by race/ethnicity, and persisted after adjustment for education, and personal and institutional characteristics. Lower nSES was associated with worse all-cause survival among Hispanics and Asian-Americans, with a 3-fold worse survival comparing the lowest to highest nSES groups among Asian-Americans. The nSES associations were not significant among African-Americans though a significant trend was observed, suggesting that the associations are likely modest and undetectable with our sample size. No significant associations were observed among non-

Hispanic whites. We also found that lower nSES was associated with a nearly 4-fold higher breast cancer-specific mortality among Asian-Americans, likely due to the high proportion of breast cancer deaths in this group (82%); HRs for the lower nSES quintiles among African-Americans and Hispanics were in the expected direction showing higher, non-significant relative hazards of death. Low education was a significant prognostic factor only in the context of low nSES. Thus, our findings underscore the importance of studying SES and survival associations by race/ethnicity and the need to consider interactions between individual-level and neighborhood-level SES.

Prior studies have shown that lower education (8, 14, 15) and lower nSES (9–13) are associated with worse survival after breast cancer diagnosis. Our findings of null associations for education after adjusting for nSES across all racial/ethnic groups is most likely because education alone may not be a sufficient indicator of individual-level SES among women (15, 19, 20). Education is a single dimension of SES; additional measures such as occupation, household income, wealth and assets, and human capital may more accurately characterize a woman's individual-level SES (35). For example, education may not accurately capture individual-level SES among married women (see Table 1 where marital status varied by race/ethnicity) or groups for whom attained education may not reflect SES, such as immigrant women. Future studies on SES should ensure that individual-level SES measures are multidimensional to better evaluate the associations between SES and health.

In prior studies, findings have been less consistent when both education and nSES were evaluated independently within the same study. In a population-based cohort of primarily non-Hispanic white breast cancer patients from Wisconsin, only nSES was associated with overall and breast cancer-specific mortality after adjustment for individual-level education and income, and established prognostic factors (17). In a subgroup of the American Cancer Society Cancer Prevention Study II cohort, associations of both individual-level and block-level SES with all-cause mortality were attenuated after adjusting for additional prognostic factors (8). Some of these discrepant results may reflect racial/ethnic and geographical differences in the study populations as well as use of different SES measures. In our study, while the nSES gradient for all-cause mortality was evident for most racial/ethnic groups (suggestive for African-Americans), except non-Hispanic whites, the magnitude of the associations varied by race/ethnicity, with Asian-Americans having the largest relative hazard of death as nSES decreased. Sample size and statistical power are likely explanations for significant nSES associations observed for all-cause, but not breast cancer-specific, mortality, except among Asian-Americans. We had adequate power to detect associations between nSES and all-cause mortality because of the larger number of events within each race/ethnicity and magnitude of the effects. For breast cancer-specific mortality, Asian-Americans had a high number of events and large effect magnitude (HRs above 2) allowing us to detect the significance. The other races/ethnicities did not have strong effects (HRs all close to 1), so even though there were more events, we had inadequate power to detect them as significant. For both all cause and breast cancer-specific mortality the HR estimates have trends in similar directions, but the CIs are wide for breast cancer-specific mortality.

To our knowledge, no prior study has examined the joint effect of individual-level and neighborhood-level SES on survival after breast cancer diagnosis. In the general population, all-cause mortality has been found to be highest among those who had low individual-level SES but resided in high SES neighborhoods (36–39). It is hypothesized that discordant individual-level and neighborhood-level SES measures may result in worse health through relative deprivation (i.e., those with low education having fewer resources to navigate their high SES neighborhoods which may include higher living costs) or relative standing (i.e., those with low education may have fewer social resources and higher stress compared to their counterparts in high SES neighborhoods and therefore different levels of stress and coping mechanisms) (36). While we observed worse survival for Asian-Americans with low education in high SES neighborhoods, Asian-American women of low education in low SES neighborhoods had the worst survival, 2.7-fold relative to Asian-Americans of high education in high SES neighborhoods. Similarly, women of other race/ethnicities with low education in low SES neighborhoods had lower survival relative to women with high education in high SES neighborhoods. Additionally, among African-Americans, living in a low SES neighborhood was associated with worse survival, regardless of education. The varying interactions between education and nSES across racial/ethnic groups may be due to variations in how well education alone captures individual-level SES as discussed above and whether this association is moderated by race/ethnicity. Further, the range of influence that a specified geographic area has could vary by individual-level SES, in that people who are higher SES may experience a diluted influence by their immediate neighborhoods, as they have access to more resources or people beyond a census block group. However, lower SES people may be more constrained and experience stronger or more concentrated influence of their more immediate surroundings. Nevertheless, our findings support the hypothesis that SES measures do not afford the same protection from death across racial/ethnic groups and the need to consider joint effects between individual-level and neighborhood-level SES (20–22).

The variation in the attenuation of our findings from further adjusting for potential mediating factors across racial/ethnic groups also suggest that nSES may be operating through multiple pathways that vary across racial/ethnic groups. Prior studies have shown that associations between education and breast cancer-specific mortality were attenuated after adjustment for behavioral factors and HT use (17) or after adjustment for marital status (8). Similarly for nSES measures, prior studies found that associations with all-cause and all-cancer mortality were attenuated after adjustment for marital status, behavioral factors and HT use (8, 16). Given our focus on examining the independent and joint associations of education and nSES on survival across racial/ethnic groups, we have been able to identify factors, including marital status, behavioral factors, HT use, and hospital characteristics, that are potentially important mediators and should be further studied using mediation analyses, as they may offer opportunities for intervention in reducing socioeconomic inequalities in breast cancer survival.

There are several limitations to our study. First, we defined neighborhoods using administrative boundaries of census block groups. However, we used the smallest level of geography for which rich SES data are available and that has been shown to be a useful approach for defining neighborhoods for health studies as census block groups are more

homogenous and better represents neighborhoods where individuals practice healthy behaviors, access services and receive health care (10). Second, we were not able to measure individual-level SES in multiple dimensions. We were also unable to include two important prognostic factors that were not measured by the study surveys, including smoking status and comorbid health conditions. Including these in our models would have most likely further attenuated the SES effects, though we already observed attenuation from the other behavioral factors in our study for the joint SES variable among Hispanic, Asian-American and non-Hispanic whites. Third, for heterogeneous racial/ethnic groups such as Asian-Americans and Hispanics, subgroup differences may confound or modify associations; unfortunately, our sample did not have sufficient statistical power to examine ethnic subgroups. Fourth, we used 2000 Census data for our nSES measure. We carried out sensitivity analyses using 1990 Census data for the 9.5% of our cases diagnosed in 1995 and saw no differences in the results. We are also missing data on length of residency and whether they moved between date of diagnosis and death or censoring date which may result in some misclassification of nSES. Fifth, CCR data on treatment are limited to first course of treatment and may lack meaningful detail, yet, the data are relatively complete and missing rates do not vary greatly by race/ethnicity (40, 41). Lastly, our racial/ethnic-specific analyses were limited by sample size. Although the patterns of associations with nSES appeared to differ by race/ethnicity, tests for interactions between race/ethnicity and the two SES variables were not statistically significant. Future studies with larger samples sizes are needed to sufficiently test such interactions and ensure that such models with adjustment for a variety of factors are not sensitive to issues of model extrapolation due to sparse data.

We have identified several important next steps to further our understanding of socioeconomic disparities in survival after breast cancer diagnosis. While we had a relatively large and diverse sample of breast cancer patients, the associations with individual-level and neighborhood-level SES should be further studied in other populations and geographic locations to extend the generalizaibilty of our findings. Future studies will need to comprehensively measure individual-level SES (e.g., education, wealth, assets) as well as multilevel measures of SES in additional groups (e.g., American Indian/Alaska Native, multiracial patients). It is also important to better understand how living in low SES neighborhoods are more directly contributing to survival and/or interacting with individual-level SES to influence survival. Most importantly, future studies need to work on identifying features of these neighborhoods and the pathways through which they produce better or worse survival. A better understanding of the relative contributions and interactions of SES with other factors will inform targeted interventions towards reducing long-standing disparities in breast cancer survival.

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Table 1

Characteristics of NABC breast cancer patients (N=4639), San Francisco Bay Area, 1995–2008

	Non-Hispanic White		African- American		Hispanic		Asian-American		Chi Square p-value	Total	
	n	%	n	%	n	%	n	%		n	%
Total patients	1067		988		1642		672			4369	
Number of deaths											
All-cause	277		280		257		92			906	
Breast cancer-specific	157	57	173	62	162	63	75	82		567	63
Study									<0.01		
NC-BCFR high risk	448	42	241	24	337	21	259	39		1285	29
NC-BCFR sporadic	99	9	293	30	365	22	413	62		1170	27
SFBCS	520	49	454	46	940	57	0	0		1914	44
Age at diagnosis (years)									<0.01		
<30	19	2	11	1	29	2	14	2		73	2
30–34	79	7	32	3	69	4	48	7		228	5
35–39	52	5	53	5	139	9	55	8		299	7
40–44	100	9	121	12	229	14	115	17		565	13
45–49	153	14	162	16	297	18	127	19		739	17
50–54	171	16	180	18	238	15	119	18		708	16
55–59	157	15	142	14	241	14	106	16		646	15
60–64	149	14	152	15	193	12	88	13		582	13
65+	187	18	135	14	207	13	0	0		529	12
AJCC Stage									<0.01		
I	535	50	398	40	685	42	291	43		1909	44
II	429	40	449	45	742	45	319	48		1939	44
III	53	5	80	8	143	9	32	5		308	7
IV	17	2	25	3	24	2	13	2		79	2
Unknown	33	3	36	4	48	3	17	3		134	3
Nodal involvement									<0.01		
No	694	65	576	58	968	59	397	59		2635	60
Yes	323	30	363	37	627	38	255	38		1568	36

	Non-Hispanic White		African- American		Hispanic		Asian-American		Chi Square p-value	Total	
	n	%	n	%	n	%	n	%		n	%
Unknown	50	5	49	5	47	3	20	3		166	4
Histology									0.19		
Ductal	839	79	786	80	1299	79	551	82		3475	80
Lobular	151	14	112	11	212	13	72	11		547	12
Other	77	7	90	9	131	8	49	7		347	8
Histological grade									<0.01		
1	192	18	125	13	243	15	85	13		645	15
2	423	40	314	32	592	36	278	41		1607	37
3 & 4	324	30	437	44	654	40	252	38		1667	38
Unknown	128	12	112	11	153	9	57	9		450	10
Estrogen and progesterone receptor status									<0.01		
ER & PR negative	160	15	261	26	378	23	127	19		926	21
ER/PR positive	796	75	627	64	1122	68	476	71		3021	69
Unknown	111	10	100	10	142	9	69	10		422	10
Surgery[a]									<0.01		
None	10	1	40	4	29	2	12	2		91	2
Lumpectomy	581	55	592	60	899	55	317	47		2389	55
Mastectomy	475	45	356	36	714	44	343	51		1888	43
Radiation									<0.01		
No	421	40	398	40	656	40	322	48		1797	41
Yes	646	61	590	60	986	60	350	52		2572	59
Chemotherapy									<0.01		
No	545	51	453	46	660	40	248	37		1906	44
Yes	505	47	519	53	968	59	417	62		2409	55
Unknown	17	2	16	2	14	1	7	1		54	1
Education									<0.01		
<High school	45	4	143	15	606	40	51	8		845	19
High school degree or equivalent	175	16	194	20	349	21	64	10		782	18
Vocational/Technical degree or some college	374	35	430	44	436	27	176	26		1416	32
College degree/graduate school	473	44	221	22	251	15	381	57		1326	30

	Non-Hispanic White		African- American		Hispanic		Asian-American		Chi Square p-value	Total	
	n	%	n	%	n	%	n	%		n	%
Neighborhood (block group) SES[b]									<0.01		
Quintile 1-Low SES	9	1	132	13	98	6	9	1		248	6
Quintile 2	30	3	282	29	240	15	31	5		583	13
Quintile 3	100	9	207	21	363	22	101	15		771	18
Quintile 4	257	24	216	22	434	26	164	24		1071	25
Quintile 5-High SES	671	63	151	15	507	31	367	55		1696	39
% Poverty (block group)									<0.01		
0–0.049, High SES	627	59	202	20	591	36	350	52		1770	41
0.05–0.09	279	26	191	19	429	26	199	30		1098	25
0.1–0.19	135	13	317	32	438	27	94	14		984	23
>= 0.2, Low SES	26	2	278	28	184	11	29	4		517	12
Marital status									<0.01		
Single/never married	164	15	282	29	258	16	98	15		802	18
Married	681	64	397	40	1018	62	522	78		2618	60
Separated/divorced	114	11	197	20	207	12	34	5		552	13
Widowed	78	7	86	9	119	7	10	2		293	7
Unknown	30	3	26	3	40	2	8	1		104	2
History of benign breast disease									<0.01		
No	817	77	794	80	1405	86	576	86		3592	82
Yes	250	23	192	19	234	14	96	14		772	18
Unknown	0	0	2	0	3	0	0	0		5	0
Years since last full-term pregnancy									<0.01		
Nulliparous	272	26	180	18	234	14	173	26		859	20
<2	25	2	14	1	21	1	17	3		77	2
2–4	40	4	26	3	82	5	47	7		195	5
5+	726	68	767	78	1303	79	435	65		3231	74
Unknown	4	0	1	0	2	0	0	0		7	0
History of oral contraceptive use									<0.01		
No	285	27	271	27	535	33	365	54		1456	33
Yes	730	68	679	69	1052	64	306	46		2767	63

	Non-Hispanic White		African- American		Hispanic		Asian-American		Chi Square p-value	Total	
	n	%	n	%	n	%	n	%		n	%
Unknown	52	5	38	4	55	3	1	0		146	3
History of menopausal hormone therapy use[C]									<0.01		
No	540	51	686	70	1126	69	514	77		2866	66
Past	197	19	201	20	232	14	90	13		720	17
Recent	330	31	101	10	284	17	68	10		783	18
Alcohol consumption (g/day) in the year before diagnosis									<0.01		
0	380	36	614	62	1045	64	617	92		2656	61
<5	240	23	125	13	263	16	21	3		649	15
5–9	135	13	97	10	107	7	12	2		351	8
10–14	109	10	48	5	99	6	9	1		265	6
≥15	196	18	101	10	124	8	10	2		431	10
Unknown	7	1	3	0	4	0	3	0		17	0
BMI (kg/m^2) in year prior to diagnosis									<0.01		
<25.0	604	57	262	27	529	32	471	70		1866	43
25.0–29.9	257	24	312	32	543	33	146	22		1258	29
≥30.0	197	19	400	41	549	33	48	7		1194	27
Unknown	9	1	14	1	21	1	7	1		51	1
Recent recreational physical activity (hours/week)									<0.01		
0, None	260	24	288	29	686	42	211	31		1445	33
Quartiles 1 & 2	330	31	460	47	476	29	241	36		1507	35
Quartile 3 & 4	476	45	240	24	479	29	218	32		1413	32
Unknown	1	0	0	0	1	0	2	0		4	0
Percent of race/ethnic-specific cancer patients in reporting hospital (%)									<0.01		
<25	1	0	646	65	1456	89	562	84		2665	61
25–49	70	7	342	35	186	11	86	13		684	16
50–74	472	44	0	0	0	0	10	2		482	11
≥75	524	49	0	0	0	0	14	2		538	12
Percent of cancer patients in highest SES quintile in reporting hospital (%)									<0.01		

	Non-Hispanic White		African- American		Hispanic		Asian-American		Chi Square p-value	Total	
	n	%	n	%	n	%	n	%		n	%
<25	169	16	317	32	420	26	124	19		1030	24
25–49	286	27	491	50	492	30	249	37		1518	35
50–74	521	49	163	17	659	40	251	37		1594	37
≥75	91	9	17	2	71	4	48	7		227	5

[a] Distributions are based on known status.

[b] Neighborhood SES was measured using a composite measure of 7 Census indicator measures known as the Yost SES Index (29).

[c] Past = stopped prior to diagnosis; recent = stopped or continued to use at diagnosis.

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Table 2

Distributions of education and neighborhood SES by race/ethnicity for NABC breast cancer patients, San Francisco Bay Area, 1995–2008

	Education									
	<High School graduation		High School graduation		Vocational School/Some College		College+		Total[a]	
Neighborhood SES[b]	N	%	N	%	N	%	N	%	N	%
Non-Hispanic White										
Neighborhood SES										
Q1-Low SES	1	11.1	3	33.3	3	33.3	2	22.2	9	0.8
Q2	3	10.0	8	26.7	14	46.7	5	16.7	30	2.8
Q3	12	12.0	24	24.0	41	41.0	23	23.0	100	9.4
Q4	21	8.1	52	20.2	86	33.3	98	38.0	258	24.2
Q5-High SES	8	1.2	88	13.1	230	34.3	345	51.4	671	62.8
Total	45	4.2	175	16.4	374	35.0	473	44.3	1068	100.0
African-American										
Neighborhood SES										
Q1-Low SES	38	28.6	34	25.6	51	38.3	9	6.8	133	13.4
Q2	55	19.4	59	20.8	133	46.8	35	12.3	284	28.6
Q3	23	11.0	46	22.0	93	44.5	45	21.5	209	21.0
Q4	19	8.8	39	18.1	103	47.7	55	25.5	216	21.8
Q5-High SES	8	5.3	16	10.6	50	33.1	77	51.0	151	15.2
Total	143	14.4	194	19.5	430	43.3	221	22.3	993	100.0
Hispanic										
Neighborhood SES										
Q1-Low SES	64	64.6	13	13.1	16	16.2	5	5.1	99	5.9
Q2	146	58.9	42	16.9	41	16.5	11	4.4	248	14.9
Q3	184	49.2	75	20.1	75	20.1	29	7.8	374	22.4
Q4	123	28.0	115	26.1	126	28.6	70	15.9	440	26.3
Q5-High SES	89	17.5	104	20.4	178	35.0	136	26.7	509	30.5
Total	606	36.3	349	20.9	436	26.1	251	15.0	1670	100.0
Asian-American										

	Education									
	<High School graduation		High School graduation		Vocational School/Some College		College+		Total[a]	
Neighborhood SES[b]	N	%	N	%	N	%	N	%	N	%
Neighborhood SES										
Q1-Low SES	3	33.3	2	22.2	1	11.1	3	33.3	9	1.3
Q2	7	22.6	8	25.8	8	25.8	8	25.8	31	4.6
Q3	14	13.9	16	15.8	22	21.8	49	48.5	101	15.0
Q4	14	8.5	19	11.6	57	34.8	74	45.1	164	24.3
Q5-High SES	13	3.5	19	5.1	88	23.8	247	66.9	369	54.7
Total	51	7.6	64	9.5	176	26.1	381	56.5	674	100.0

[a] Totals include patients with unknown education and therefore row numbers may not add up to the total. Note that those with unknown education were excluded from the analytic sample.

[b] Neighborhood SES was measured using a composite measure of 7 Census indicator measures the YOST SES Index (29).

Table 3

Association of individual and neighborhood SES with all-cause mortality by race/ethnicity: Hazard Ratios (HRs) with 95% Confidence Intervals, San Francisco Bay Area, 1995–2008 (with follow-up through 2009)

SES Variables	Non-Hispanic White		African-American		Hispanic		Asian-American	
	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)
Education								
College degree+	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	1.03 (0.78–1.36)	1.01 (0.76–1.34)	0.92 (0.65–1.31)	0.88 (0.62–1.26)	1.31 (0.83–2.06)	1.25 (0.79–1.97)	1.29 (0.74–2.23)	1.11 (0.63–1.97)
=High School Degree[c]	1.27 (0.92–1.74)	1.19 (0.86–1.65)	1.03 (0.69–1.54)	0.92 (0.60–1.40)	1.20 (0.75–1. 92)	1.08 (0.66–1.77)	**2.13 (1.28–3.52)**	1.53 (0.89–2.62)
<High School Degree			1.40 (0.96–2.06)	1.20 (0.80–1.80)	1.38 (0.90–2.11)	1.15 (0.73–1.81)		
p-trend	*0.17*	*0.34*	*0.05*	*0.31*	*0.19*	*0.76*	***0.01***	*0.13*
Neighborhood SES (nSES)[e]								
Q5-High SES	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	1.15 (0.86–1.54)	1.12 (0.84–1.50)	0.65 (0.41–1.02)	0.66 (0.42–1.03)	1.12 (0.77–1.63)	1.12 (0.76–1.64)	**2.14 (1.31–3.51)**	**1.99 (1.19–3.34)**
Q3	1.28 (0.86–1.91)	1.24 (0.83–1.85)	1.03 (0.67–1.59)	1.03 (0.66–1.61)	1.38 (0.96–1.99)	1.37 (0.92–2.02)	**2.29 (1.24–4.23)**	**2.02 (1.07–3.82)**
Q2[d]	1.64 (0.91–2.94)	1.56 (0.86–2.83)	1.17 (0.80–1.71)	1.16 (0.78–1.71)	**1.59 (1.07–2.36)**	**1.57 (1.03–2.38)**	**3.79 (1.89–7.61)**	**3.18 (1.51–6.70)**
Q1-Low SES			1.33 (0.86–2.05)	1.29 (0.82–2.03)	1.59 (0.94–2.67)	1.57 (0.92–2.71)		
p-trend	*0.05*	*0.08*	***0.01***	***0.03***	***0.01***	***0.01***	***0.01***	***0.01***
Education & nSES[f]								
≥ Some College, High SES	1.00 (reference)		1.00 (reference)		1.00 (reference)		1.00 (reference)	
≥ Some College, Low SES	1.22 (0.78–1.91)		**1.61 (1.16–2.25)**		1.41 (0.89–2.23)		**1.89 (1.02–3.50)**	
≤HS Degree, High SES	1.19 (0.86–1.63)		1.44 (0.86–2.42)		0.99 (0.70–1.41)		1.84 (1.00–3.38)	
≤HS Degree, Low SES	**1.62 (1.02–2.56)**		**1.67 (1.20–2.32)**		**1.39 (1.01–1.92)**		**2.68 (1.37–5.23)**	

[a] Adjusted for age at diagnosis (continuous), year of diagnosis (continuous), study eligibility (NC-BCFR high risk, NC-BCFR sporadic, SFBCS), nodal involvement (no, yes, unknown), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), type of surgery (none, lumpectomy, mastectomy, not otherwise specified, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), subsequent primary tumor (yes, no) and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[b] Adjusted for covariates of model 1 and clustering by block group (individual education and neighborhood SES in the same model), and stratified by AJCC stage (I, II, III, IV, unknown).

[c] Education levels <high school graduate and high school graduate collapsed as for non-Hispanic whites and Asian-Americans due to small sample sizes.

[d] Neighborhood SES quintiles 1 & 2 were collapsed for non-Hispanic Whites and Asian-Americans due to small sample sizes.

[e] Neighborhood SES was measured using a composite measure of 7 Census indicator measures the YOST SES Index (29).

[f] HS, high school. Education levels (<high school graduate and high school graduate) collapsed as <=high school graduate. Neighborhood SES levels collapsed as Q1–Q3:low SES; Q4–Q5: high SES.

Table 4

Association of individual and neighborhood SES with all-cause mortality by race/ethnicity: Hazard Ratios (HRs) with 95% Confidence Intervals, San Francisco Bay Area, 1995–2008 (with follow-up through 2009)

SES Variables	Cases	All Cause Mortality				
		Deaths	Base + SES + Reproductive Factor Model[a]	Base + SES + Marital Status Model[b]	Base + SES + Behavioral Factors Model[c]	Base + SES + Hospital Characteristics Model[d]
	n (%)	n (%)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Non-Hispanic Whites						
Education						
College+	473 (44.3%)	112 (40.4%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	374 (35.1%)	95 (34.3%)	1.01 (0.76–1.34)	1.01 (0.76–1.34)	0.96 (0.72–1.28)	1.05 (0.78–1.40)
<=High School Graduate[e]	220 (20.6%)	70 (25.3%)	1.18 (0.85–1.63)	1.23 (0.89–1.69)	1.09 (0.78–1.53)	1.25 (0.90–1.73)
p-trend			*0.37*	*0.26*	*0.66*	*0.21*
Neighborhood SES (nSES)[f]						
Q5-High SES	671 (62.9%)	161 (58.1%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	257 (24.1%)	70 (25.3%)	1.11 (0.82–1.50)	1.09 (0.81–1.47)	1.08 (0.80–1.45)	1.09 (0.81–1.46)
Q3	100 (9.4%)	32 (11.6%)	1.24 (0.83–1.85)	1.18 (0.78–1.77)	1.17 (0.78–1.79)	1.18 (0.78–1.79)
Q1, Q2-Low SES	39 (3.7%)	14 (5.1%)	1.49 (0.82–2.72)	1.51 (0.84–2.72)	1.51 (0.81–2.80)	1.48 (0.79–2.76)
p-trend			*0.12*	*0.15*	*0.17*	*0.18*
Education & nSES[g]						
>=College, High SES	759 (71.1%)	180 (65.0%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	88 (8.3%)	27 (9.8%)	1.19 (0.76–1.86)	1.18 (0.75–1.85)	1.18 (0.76–1.85)	1.17 (0.73–1.85)
<=High School Graduate, High SES	169 (15.8%)	51 (18.4%)	1.16 (0.83–1.61)	1.21 (0.88–1.66)	1.12 (0.81–1.55)	1.20 (0.88–1.65)
<=High School Graduate, Low SES	51 (4.8%)	19 (6.9%)	**1.62 (1.03–2.54)**	**1.59 (1.01–2.51)**	1.44 (0.90–2.28)	1.60 (0.99–2.60)
African-Americans						
Education	(N=980)	(N=280)				
College+	221 (22.4%)	49 (17.5%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	430 (43.5%)	112 (40.0%)	0.90 (0.62–1.31)	0.89 (0.62–1.29)	0.86 (0.60–1.25)	0.91 (0.63–1.31)
High School Graduate	194 (19.6%)	59 (21.1%)	0.91 (0.58–1.41)	0.94 (0.62–1.44)	0.87 (0.56–1.35)	0.97 (0.63–1.50)
<High School Graduate	143 (14.5%)	60 (21.4%)	1.18 (0.78–1.80)	1.24 (0.82–1.88)	1.17 (0.77–1.77)	1.26 (0.83–1.90)

SES Variables	Cases	All Cause Mortality				
		Deaths	Base + SES + Reproductive Factor Model[a]	Base + SES + Marital Status Model[b]	Base + SES + Behavioral Factors Model[c]	Base + SES + Hospital Characteristics Model[d]
	n (%)	n (%)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
p-trend			*0.38*	*0.24*	*0.40*	*0.20*
Neighborhood SES (nSES)[f]						
Q5-High SES	151 (15.3%)	42 (15.0%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	216 (21.9%)	46 (16.4%)	0.67 (0.42–1.05)	0.64 (0.41–1.01)	0.68 (0.43–1.08)	0.65 (0.41–1.03)
Q3	207 (21.0%)	54 (19.3%)	0.99 (0.62–1.59)	1.02 (0.64–1.61)	0.98 (0.63–1.55)	1.04 (0.65–1.66)
Q2	282 (28.5%)	88 (31.4%)	1.11 (0.75–1.66)	1.14 (0.77–1.69)	1.16 (0.78–1.72)	1.09 (0.72–1.66)
Q1-Low SES	132 (13.4%)	50 (17.9%)	1.26 (0.79–2.01)	1.29 (0.81–2.03)	1.29 (0.81–2.04)	1.19 (0.73–1.92)
p-trend			***0.04***	***0.02***	***0.03***	*0.06*
Education & nSES[g]						
>=College, High SES	285 (28.9%)	61 (21.8%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	366 (37.0%)	100 (35.7%)	**1.62 (1.15–2.27)**	**1.62 (1.15–2.27)**	**1.57 (1.12–2.20)**	**1.58 (1.12–2.22)**
<=High School Graduate, High SES	82 (8.3%)	27 (9.6%)	1.53 (0.91–2.57)	1.44 (0.86–2.42)	1.44 (0.85–2.42)	1.46 (0.87–2.47)
<=High School Graduate, Low SES	255 (25.8%)	92 (32.9%)	**1.58 (1.11–2.23)**	**1.70 (1.22–2.36)**	**1.58 (1.13–2.22)**	**1.68 (1.20–2.35)**
		Hispanics				
Education	(N=1,642)	(N=257)				
College+	251 (15.3%)	29 (11.3%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	436 (26.6%)	58 (22.6%)	1.20 (0.75–1.89)	1.24 (0.78–1.97)	1.24 (0.78–1.95)	1.23 (0.78–1.94)
High School Graduate	349 (21.3%)	50 (19.5%)	1.06 (0.64–1.74)	1.11 (0.67–1.83)	1.06 (0.64–1.74)	1.07 (0.65–1.75)
<High School Graduate	606 (36.9%)	120 (46.7%)	1.04 (0.65–1.64)	1.17 (0.74–1.86)	1.06 (0.66–1.71)	1.06 (0.67–1.68)
p-trend			*0.79*	*0.72*	*0.82*	*0.85*
Neighborhood SES (nSES)[f]						
Q5-High SES	507 (30.9%)	67 (26.1%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	434 (26.4%)	65 (25.3%)	1.14 (0.77–1.67)	1.13 (0.77–1.66)	1.08 (0.74–1.59)	1.07 (0.73–1.57)
Q3	363 (22.1%)	62 (24.1%)	1.33 (0.89–1.97)	1.35 (0.91–2.00)	1.29 (0.86–1.92)	1.27 (0.86–1.88)
Q2	240 (14.6%)	48 (18.7%)	**1.65 (1.08–2.50)**	**1.61 (1.07–2.43)**	1.50 (0.99–2.27)	1.41 (0.91–2.17)
Q1-Low SES	98 (6.0%)	15 (5.8%)	1.51 (0.87–2.61)	1.65 (0.97–2.82)	1.55 (0.91–2.64)	1.36 (0.78–2.39)

SES Variables	Cases	All Cause Mortality				
		Deaths	Base + SES + Reproductive Factor Model[a]	Base + SES + Marital Status Model[b]	Base + SES + Behavioral Factors Model[c]	Base + SES + Hospital Characteristics Model[d]
	n (%)	n (%)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
p-trend			***0.01***	***<0.01***	***0.02***	*0.08*
Education & nSES[g]						
>=College, High SES	510 (31.1%)	64 (24.9%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	177 (10.8%)	23 (9.0%)	1.34 (0.86–2.10)	1.40 (0.89–2.23)	1.34 (0.84–2.13)	1.26 (0.79–2.03)
<=High School Graduate, High SES	431 (26.3%)	68 (26.5%)	0.94 (0.65–1.35)	1.02 (0.71–1.45)	0.93 (0.64–1.34)	0.93 (0.65–1.33)
<=High School Graduate, Low SES	524 (31.9%)	102 (39.7%)	1.29 (0.93–1.80)	**1.43 (1.04–1.98)**	1.25 (0.87–1.78)	1.20 (0.85–1.71)
Asian-Americans						
Education	(N=672)	(N=92)				
College+	381 (56.7%)	41 (44.6%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Voct/Some College	176 (26.2%)	24 (26.1%)	1.19 (0.66–2.15)	1.18 (0.65–2.15)	1.03 (0.58–1.85)	1.08 (0.61–1.90)
<=High School Graduate[e]	115 (17.1%)	27 (29.4%)	1.45 (0.83–2.53)	1.57 (0.90–2.73)	1.31 (0.69–2.47)	1.46 (0.84–2.53)
p-trend			*0.20*	*0.12*	*0.45*	*0.21*
Neighborhood SES (nSES)[f]						
Q5-High SES	367 (54.6%)	38 (41.3%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	164 (24.4%)	27 (29.4%)	**1.85 (1.09–3.11)**	**1.91 (1.13–3.23)**	**2.01 (1.17–3.47)**	**1.93 (1.15–3.25)**
Q3	101 (15.0%)	18 (19.6%)	1.79 (0.91–3.54)	**1.93 (1.00–3.69)**	**1.89 (1.00–3.54)**	1.86 (0.95–3.62)
Q1, Q2-Low SES	40 (6.0%)	9 (9.8%)	**3.20 (1.52–6.73)**	**2.68 (1.17–6.13)**	**3.11 (1.42–6.78)**	**3.05 (1.39–6.70)**
p-trend			***<0.01***	***<0.01***	***<0.01***	***<0.01***
Education & nSES[g]						
>=College, High SES	466 (69.4%)	50 (54.4%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	91 (13.5%)	15 (16.3%)	1.85 (0.99–3.47)	1.72 (0.91–3.27)	1.78 (0.96–3.29)	1.62 (0.80–3.27)
<=High School Graduate, High SES	65 (9.7%)	15 (16.3%)	1.79 (0.94–3.42)	1.82 (0.97–3.40)	1.67 (0.82–3.43)	1.64 (0.88–3.05)
<=High School Graduate, Low SES	50 (7.4%)	12 (13.0%)	**2.32 (1.13–4.78)**	**2.54 (1.26–5.10)**	**2.21 (1.06–4.60)**	**2.43 (1.20–4.92)**

[a] Adjusted for age at diagnosis (continuous), year of diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days

between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **benign breast disease (no, yes, unknown), years since last full-term pregnancy (<2, 2–4, 5+, unknown), pre-diagnosis hormonal contraception use (never, ever, unknown), pre-diagnosis hormone therapy use (never, past, recent, unknown)** and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[b]Adjusted for age at diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **marital status (single/never married, married, separated/divorced, widowed, unknown)**, and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[c]Adjusted for age at diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **grams per day of alcohol in reference year (0,<5, 5–9, 10–14, 15+, unknown), pre-diagnosis BMI (<25, 25–29, 30+, unknown), recent recreational physical activity (0, Q1/ Q2, Q3/Q4, unknown)** and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[d]Adjusted for age at diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **percent of White cancer patients in reporting hospital (<25%, 25–49%, 50–74%, ≥ 75%, unknown), percent of cancer patients in highest SES quintile in reporting hospital (<25%, 25–49%, 50–74%, ≥ 75%, unknown)**, and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[e]Education levels (<high school graduate and high school graduate) collapsed as <=high school graduate.

[f]Neighborhood SES was measured using a composite measure of 7 Census indicator measures known as the Yost SES Index (29).

[g]SES levels collapsed as Q1–Q3: low SES; Q4–Q5: high SES.

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Table 5

Association of individual and neighborhood SES with breast cancer-specific mortality by race/ethnicity: Hazard Ratios (HRs) with 95% Confidence Intervals, San Francisco Bay Area, 1995–2002 (with follow-up through 2009)

SES Variables	Non-Hispanic White		African-American		Hispanic		Asian-American	
	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)	Base Model[a] HR (95% CI)	Base + Education + SES Model[b] HR (95% CI)
Education								
College Degree+	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	0.87 (0.59–1.29)	0.87 (0.59–1.29)	0.74 (0.49–1.14)	0.70 (0.45–1.09)	1.41 (0.83–2.37)	1.36 (0.80–2.32)	1.11 (0.59–2.09)	0.93 (0.49–1.76)
=High School Degree[c]	1.15 (0.75–1.77)	1.14 (0.73–1.77)	0.65 (0.39–1.10)	0.56 (0.32–1.00)	1.17 (0.66–2.08)	1.09 (0.60–2.00)	**1.93 (1.09–3.43)**	1.23 (0.66–2.31)
<High School Degree			0.97 (0.59–1.60)	0.83 (0.49–1.40)	1.37 (0.82–2.27)	1.22 (0.70–2.13)		
p-trend	*0.70*	*0.74*	*0.61*	*0.31*	*0.43*	*0.86*	***0.04***	*0.51*
Neighborhood SES[e]								
Q5-High SES	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	1.12 (0.76–1.65)	1.09 (0.73–1.62)	0.63 (0.37–1.09)	0.67 (0.39–1.15)	0.85 (0.54–1.35)	0.84 (0.53–1.36)	**2.63 (1.51–4.60)**	**2.55 (1.42–4.58)**
Q3	1.02 (0.61–1.70)	1.00 (0.59–1.68)	0.78 (0.45–1.37)	0.88 (0.50–1.57)	1.05 (0.67–1.66)	1.03 (0.63–1.69)	**2.97 (1.47–5.98)**	**2.78 (1.36–5.71)**
Q2[d]	1.08 (0.41–2.87)	1.05 (0.40–2.75)	0.95 (0.60–1.52)	1.08 (0.67–1.74)	1.41 (0.87–2.30)	1.38 (0.83–2.30)	**4.25 (1.99–9.08)**	**3.91 (1.72–8.91)**
Q1-Low SES			1.20 (0.71–2.02)	1.42 (0.81–2.47)	1.48 (0.78–2.84)	1.47 (0.74–2.91)		
p-trend	*0.75*	*0.80*	*0.17*	*0.10*	*0.10*	*0.14*	***0.01***	***0.01***
Education & nSES[f]								
≥ Some College, High SES	1.00 (reference)		1.00 (reference)		1.00 (reference)		1.00 (reference)	
≥ Some College, Low SES	0.78 (0.41–1.50)		1.45 (0.99–2.14)		1.08 (0.59–1.97)		**2.26 (1.14–4.49)**	
≤HS Degree, High SES	1.09 (0.69–1.73)		1.25 (0.65–2.43)		0.84 (0.52–1.34)		1.74 (0.88–3.44)	
≤HS Degree, Low SES	1.52 (0.82–2.82)		1.11 (0.72–1.70)		1.24 (0.83–1.86)		**2.82 (1.29–6.14)**	

[a] Adjusted for age at diagnosis (continuous), year of diagnosis (continuous), study eligibility (FRBC high risk, case-control, FRBC sporadic), nodal involvement (no, yes, unknown), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), subsequent primary tumor (yes, no) and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[b] Adjusted for covariates of model 1 and clustering by block group (individual education and neighborhood SES in the same model), and stratified by AJCC stage (I, II, III, IV, unknown).

[c] Education levels (<high school graduate and high school graduate) collapsed as <=high school graduate for non-Hispanic whites and Asian-Americans due to small sample sizes.

[d] Neighborhood SES quintiles 1 & 2 were collapsed for non-Hispanic Whites and Asian-Americans due to small sample sizes.

[e] Neighborhood SES was measured using a composite measure of 7 Census indicator measures the YOST SES Index (29).

[f] HS, high school. Education levels (<high school graduate and high school graduate) collapsed as <=high school graduate. Neighborhood SES levels collapsed as Q1–Q3:low SES; Q4–Q5: high SES.

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Table 6

Association of individual and neighborhood SES with breast cancer-specific mortality by race/ethnicity: Hazard Ratios (HRs) with 95% Confidence Intervals, San Francisco Bay Area, 1995–2002 (with follow-up through 2009)

SES Variables	Cases	Breast Cancer Mortality				
		Deaths	Base + SES+ Reproductive Factor Model[a]	Base + SES + Marital Status Model[b]	Base + SES + Behavioral Factors Model[c]	Base + SES + Hospital Characteristics Model[d]
	n (%)	n (%)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Non-Hispanic Whites						
Education	(N=1,067)	(N=157)				
College+	473 (44.3%)	74 (47.1%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	374 (35.1%)	49 (31.2%)	0.89 (0.60–1.31)	0.90 (0.61–1.33)	0.89 (0.59–1.33)	0.91 (0.60–1.38)
<=High School Graduate[e]	220 (20.6%)	34 (21.7%)	1.13 (0.72–1.76)	1.17 (0.76–1.82)	1.12 (0.71–1.76)	1.16 (0.74–1.82)
p-trend			*0.75*	*0.63*	*0.76*	*0.64*
Neighborhood SES (nSES)[f]						
Q5-High SES	671 (62.9%)	93 (59.2%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	257 (24.1%)	42 (26.8%)	1.07 (0.71–1.60)	1.06 (0.71–1.60)	1.07 (0.71–1.61)	0.97 (0.64–1.46)
Q3	100 (9.4%)	16 (10.2%)	0.95 (0.55–1.64)	0.91 (0.53–1.58)	0.94 (0.56–1.57)	0.81 (0.46–1.43)
Q1, Q2-Low SES	39 (3.7%)	6 (3.8%)	1.01 (0.38–2.70)	1.02 (0.40–2.61)	1.12 (0.44–2.86)	0.84 (0.30–2.34)
p-trend			*1.00*	*0.94*	*0.92*	*0.52*
Education & nSES[g]						
>=College, High SES	759 (71.1%)	111 (70.7%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	88 (8.3%)	12 (7.6%)	0.74 (0.38–1.43)	0.74 (0.39–1.42)	0.78 (0.41–1.46)	0.64 (0.33–1.27)
<=High School Graduate, High SES	169 (15.8%)	24 (15.3%)	1.06 (0.66–1.69)	1.11 (0.71–1.76)	1.07 (0.67–1.72)	1.06 (0.67–1.68)
<=High School Graduate, Low SES	51 (4.8%)	10 (6.4%)	1.48 (0.80–2.75)	1.43 (0.75–2.70)	1.44 (0.78–2.68)	1.33 (0.69–2.53)
African-Americans						
Education	(N=980)	(N=173)				
College+	221 (22.4%)	38 (22.0%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	430 (43.5%)	78 (45.1%)	0.67 (0.42–1.07)	0.70 (0.45–1.10)	0.68 (0.42–1.08)	0.72 (0.46–1.13)
High School Graduate	194 (19.6%)	31 (17.9%)	**0.52 (0.29–0.95)**	0.58 (0.33–1.03)	0.55 (0.30–1.00)	0.58 (0.33–1.04)
<High School Graduate	143 (14.5%)	26 (15.0%)	0.79 (0.46–1.36)	0.92 (0.53–1.58)	0.84 (0.49–1.45)	0.87 (0.51–1.46)

SES Variables	Cases	Breast Cancer Mortality				
		Deaths	Base + SES+ Reproductive Factor Model[a]	Base + SES + Marital Status Model[b]	Base + SES + Behavioral Factors Model[c]	Base + SES + Hospital Characteristics Model[d]
	n (%)	n (%)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Non-Hispanic Whites						
p-trend			*0.25*	*0.48*	*0.36*	*0.39*
Neighborhood SES (nSES)[f]						
Q5-High SES	151 (15.3%)	29 (16.8%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	216 (21.9%)	33 (19.1%)	0.69 (0.40–1.20)	0.68 (0.39–1.18)	0.67 (0.39–1.16)	0.66 (0.38–1.14)
Q3	207 (21.0%)	29 (16.8%)	0.85 (0.47–1.56)	0.91 (0.50–1.67)	0.81 (0.45–1.45)	0.89 (0.50–1.58)
Q2	282 (28.5%)	53 (30.6%)	1.11 (0.68–1.81)	1.12 (0.68–1.83)	1.02 (0.62–1.67)	1.04 (0.63–1.72)
Q1-Low SES	132 (13.4%)	29 (16.8%)	1.45 (0.82–2.54)	1.50 (0.85–2.62)	1.36 (0.78–2.37)	1.34 (0.75–2.40)
p-trend			*0.05*	***0.04***	*0.10*	*0.09*
Education & nSES[g]						
>=College, High SES	285 (28.9%)	46 (26.6%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	366 (37.0%)	70 (40.5%)	1.48 (0.99–2.21)	1.48 (1.00–2.20)	1.40 (0.94–2.09)	1.45 (0.97–2.15)
<=High School Graduate, High SES	82 (8.3%)	16 (9.3%)	1.30 (0.67–2.54)	1.23 (0.63–2.41)	1.36 (0.70–2.65)	1.27 (0.65–2.46)
<=High School Graduate, Low SES	255 (25.8%)	41 (23.7%)	1.05 (0.66–1.65)	1.18 (0.76–1.83)	1.07 (0.70–1.64)	1.12 (0.73–1.73)
Hispanics						
Education	(N=1,642)	(N=162)				
College+	251 (15.3%)	20 (12.4%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	436 (26.6%)	42 (25.9%)	1.29 (0.76–2.21)	1.34 (0.79–2.29)	1.35 (0.78–2.31)	1.31 (0.77–2.23)
High School Graduate	349 (21.3%)	32 (19.8%)	1.07 (0.58–1.98)	1.09 (0.59–2.01)	1.12 (0.61–2.06)	1.05 (0.57–1.92)
<High School Graduate	606 (36.9%)	68 (42.0%)	1.10 (0.62–1.97)	1.23 (0.70–2.15)	1.23 (0.68–2.24)	1.08 (0.61–1.91)
p-trend			*0.93*	*0.76*	*0.78*	*0.82*
Neighborhood SES (nSES)[f]						
Q5-High SES	507 (30.9%)	47 (29.0%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	434 (26.4%)	39 (24.1%)	0.86 (0.53–1.41)	0.84 (0.52–1.35)	0.86 (0.53–1.41)	0.82 (0.51–1.33)
Q3	363 (22.1%)	36 (22.2%)	1.07 (0.64–1.78)	1.02 (0.62–1.67)	1.02 (0.60–1.71)	0.93 (0.57–1.52)
Q2	240 (14.6%)	30 (18.5%)	1.48 (0.88–2.48)	1.43 (0.86–2.37)	1.38 (0.82–2.33)	1.20 (0.70–2.08)

SES Variables	Cases	Breast Cancer Mortality				
		Deaths	Base + SES+ Reproductive Factor Model[a]	Base + SES + Marital Status Model[b]	Base + SES + Behavioral Factors Model[c]	Base + SES + Hospital Characteristics Model[d]
	n (%)	n (%)	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Non-Hispanic Whites						
Q1-Low SES	98 (6.0%)	10 (6.2%)	1.53 (0.77–3.02)	1.50 (0.76–2.97)	1.56 (0.79–3.09)	1.14 (0.57–2.28)
p-trend			*0.09*	*0.11*	*0.13*	*0.47*
Education & nSES[g]						
>=College, High SES	510 (31.1%)	48 (29.6%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	177 (10.8%)	14 (8.6%)	1.05 (0.58–1.89)	1.09 (0.60–1.98)	1.08 (0.58–2.02)	0.93 (0.50–1.73)
<=High School Graduate, High SES	431 (26.3%)	38 (23.5%)	0.78 (0.48–1.28)	0.85 (0.53–1.37)	0.86 (0.53–1.41)	0.77 (0.48–1.25)
<=High School Graduate, Low SES	524 (31.9%)	62 (38.3%)	1.23 (0.81–1.87)	1.27 (0.85–1.89)	1.26 (0.80–1.97)	1.01 (0.65–1.55)
Asian-Americans						
Education	(N=672)	(N=75)				
College+	381 (56.7%)	35 (46.7%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Vocational/Some College	176 (26.2%)	18 (24.0%)	1.00 (0.51–1.94)	1.01 (0.52–1.98)	0.86 (0.45–1.64)	0.90 (0.48–1.68)
<=High School Graduate[e]	115 (17.1%)	22 (29.3%)	1.14 (0.59–2.20)	1.31 (0.69–2.48)	0.98 (0.47–2.03)	1.13 (0.59–2.15)
p-trend			*0.71*	*0.46*	*0.87*	*0.80*
Neighborhood SES (nSES)[f]						
Q5-High SES	367 (54.6%)	29 (38.7%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Q4	164 (24.4%)	22 (29.3%)	**2.44 (1.36–4.39)**	**2.41 (1.33–4.37)**	**2.51 (1.37–4.61)**	**2.51 (1.40–4.49)**
Q3	101 (15.0%)	16 (21.3%)	**2.58 (1.19–5.56)**	**2.64 (1.27–5.49)**	**2.59 (1.28–5.22)**	**2.51 (1.13–5.58)**
Q1, Q2-Low SES	40 (6.0%)	8 (10.7%)	**3.98 (1.78–8.92)**	**3.21 (1.20–8.63)**	**4.07 (1.76–9.41)**	**3.76 (1.52–9.30)**
p-trend			***<0.01***	***<0.01***	***<0.01***	***<0.01***
Education & nSES[g]						
>=College, High SES	466 (69.4%)	39 (52.0%)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
>=College, Low SES	91 (13.5%)	14 (18.7%)	**2.27 (1.15–4.49)**	**2.05 (1.01–4.16)**	**2.09 (1.05–4.14)**	1.92 (0.82–4.52)
<=High School Graduate, High SES	65 (9.7%)	12 (16.0%)	1.67 (0.80–3.46)	1.72 (0.85–3.46)	1.38 (0.58–3.28)	1.50 (0.75–3.01)
<=High School Graduate, Low SES	50 (7.4%)	10 (13.3%)	**2.46 (1.05–5.75)**	**2. 74 (1.21–6.23)**	2.29 (0.99–5.32)	**2.42 (1.03–5.69)**

[a] Adjusted for age at diagnosis (continuous), year of diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **benign breast disease (no, yes, unknown), years since last full-term pregnancy (<2, 2–4, 5+, unknown), pre-diagnosis hormonal contraception use (never, ever, unknown), pre-diagnosis hormone therapy use (never, past, recent, unknown)** and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[b] Adjusted for age at diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **marital status (single/never married, married, separated/divorced, widowed, unknown)**, and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[c] Adjusted for age at diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **grams per day of alcohol in reference year (0,<5, 5–9, 10–14, 15+, unknown), pre-diagnosis BMI (<25, 25–29, 30+, unknown), recent recreational physical activity (0, Q1/ Q2, Q3/Q4, unknown)** and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[d] Adjusted for age at diagnosis (continuous), study eligibility (Northern California site of the Breast Cancer Family Registry (NC-BCFR) high risk, NC-BCFR sporadic, SFBCS), histology (ductal, lobular, other), histological grade (1,2,3 & 4, unknown), joint ERPR status (ER−PR−, ER+ or PR+, unknown), nodal involvement (none, positive, unknown), type of surgery (none, lumpectomy, mastectomy, NOS, unknown), radiation (no, yes, unknown), chemotherapy (no, yes, unknown), 1st subsequent primary tumor (yes, no), 2nd subsequent primary tumor (yes, no), days between the dates of diagnosis of study qualifying tumor and the 1st subsequent tumor(continuous), days between the dates of diagnosis of the 1st and 2nd subsequent tumor (continuous), **percent of White cancer patients in reporting hospital (<25%, 25–49%, 50–74%, ≥ 75%, unknown), percent of cancer patients in highest SES quintile in reporting hospital (<25%, 25–49%, 50–74%, ≥ 75%, unknown)**, and clustering by block group, and stratified by AJCC stage (I, II, III, IV, unknown).

[e] Education levels (<high school graduate and high school graduate) collapsed as <=high school graduate.

[f] Neighborhood SES was measured using a composite measure of 7 Census indicator measures known as the Yost SES Index (29).

[g] SES levels collapsed as Q1–Q3: low SES; Q4–Q5: high SES.