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Nativity, ethnic enclave residence and breast cancer survival among Latinas: variations between California and Texas

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Abstract

Background—Residence in an ethnic enclave may be associated with survival among Latinas with breast cancer, but findings from prior studies are inconsistent.

Methods—We conducted parallel analyses of California and Texas cancer registry data for adult (≥18 years of age) Latinas diagnosed with invasive breast cancer from 1996 to 2005, with follow-up through 2014. We used existing indices applied to tract-level 2000 US Census data to measure Latinx enclaves and neighborhood socioeconomic status (nSES). We fitted multivariable Cox Proportional Hazard models for all-cause and breast cancer specific mortality adjusted for diagnosis year, patient age, nativity (with multiple imputation), tumor stage, histology, grade, size, and clustering by census tract.

Results—Among 38,858 Latinas, the majority (61.3% in CA, 70.5% in TX) lived in enclaves. In fully adjusted models for both states, foreign-born women, compared to US-born women, were more likely to die from breast cancer and all causes. Living in enclaves and in neighborhoods with higher SES were independently associated with improved survival from both causes. When combined into a four-level variable, compared to those living in low nSES enclaves, those in low nSES non-enclaves had worse survival for both causes; and, in the all-cause but not breast-cancer specific models, those in high nSES neighborhoods, regardless of enclave status, had improved survival from all-causes.

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Author contributions: SSM and SLP conceived of the study idea, led the manuscript writing and supervised the analysis. SLG helped to shape the original study idea and HZ provided guidance on imputation methods. AJC and HF conducted the analyses. AEH created the Texas neighborhood measures. All contributed to critically interpreting findings, writing and editing the manuscript and have read and approved the final submitted manuscript.

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Conclusion—Applying the same methods across two states eliminated previously published inconsistent associations between enclave residence and breast cancer survival. Future studies should identify specific protective effects of enclave residence to inform interventions.

Precis:

Among Latinas with breast cancer living in California and Texas, foreign birthplace (vs. US birthplace) was associated with worse survival. Latinas living in more ethnically distinct neighborhoods and in higher SES neighborhoods had improved survival.

Keywords

Latino; ethnic enclave; nativity; neighborhood socioeconomic status; breast cancer survival

INTRODUCTION

Among US Latinas, breast cancer is the most commonly diagnosed cancer and is the leading cause of cancer death.[1,2] Once diagnosed with breast cancer, most studies, but not all, demonstrate that Latinas do not survive as long as non-Latina white women.[3–6] While there is growing recognition that neighborhoods play some role on outcomes across the cancer continuum, the extent to which features of a residential neighborhood may influence survival among Latinas with breast cancer is unclear.

Many Latinxs live in *ethnic enclaves* – culturally distinct neighborhoods with high concentrations of individuals of the same ethnic origin, high linguistic isolation, a large share of recent immigrants, and ethnic specific businesses and resources. Ethnic enclaves are hypothesized to contribute to outcomes across the cancer continuum through multiple pathways, some positively and some negatively.[7,8] Co-ethnic residents within an enclave often maintain cultural norms and behaviors (e.g., diet and physical activity, social support) that may be health-promoting. Enclaves may facilitate communication and information sharing due to greater access to linguistic resources; they may also reduce exposure to discrimination and thus limit use of unhealthy coping behaviors (e.g., smoking, drinking) and reduce stress.[9–13]

In contrast, some features of enclaves could contribute to worse health. For example, neighborhoods with large Latinx and/or foreign-born populations face disproportionately higher poverty.[14–16] Residence in neighborhoods with low socioeconomic status (nSES) is associated with worse survival among cancer patients.[17,18] Low nSES may influence unhealthy behaviors and worse health through pathways associated with adverse social, built, and physical environments. For example, low nSES neighborhoods may have high crime and poor safety, greater social isolation, and low walkability resulting from high traffic density and poor street conditions, poor food environments with high concentrations of fast food restaurants, tobacco outlets or liquor stores, and greater proximity to environmental pollutants. Thus, to elucidate the association of ethnic enclave residence and cancer survival, nSES must be considered.[19,20]

Prior studies on the association of enclave residence and cancer survival demonstrated mixed results, underscored in a recent literature review on ethnic density and cancer outcomes.[21] Five of the reviewed studies examined associations of Latinx ethnic density with survival of Latinas with breast cancer. Associations varied, with 2 null studies and others documenting both increased (n=1 study) and decreased (n=2 studies) survival among Latinas residing within ethnic enclaves compared to Latinas in non-enclave areas.[19,22–25] These studies applied varying measures of neighborhood ethnic density or ethnic enclave residence and different analytic strategies, including adjustments for patient nativity and nSES. Because all 5 studies were limited to single states or metropolitan areas, it is unclear whether observed inconsistencies are a result of different analytic methods or true regional differences in enclave effects.

As nativity is often missing in cancer registry data, it can be imputed using varying approaches.[23,25] Perhaps as a result, findings are varied and demonstrate that foreign-born Latinas, compared to US-born Latinas with breast cancer, have worse survival, no difference in survival, or improved survival.[19,22,26]

Given published inconsistencies, an improved understanding of the role of enclaves can help to inform neighborhood-level interventions designed to improve survival among Latinas. In this study, we aimed to investigate the independent associations of ethnic enclaves on survival after breast cancer among Latinas, accounting for patient nativity and nSES. We applied consistent measures and analytic methods to parallel analyses of California and Texas cancer registry data to compare and contrast ethnic enclave effects.

METHODS

Data

The data for these analyses are from two population-based cancer registries—the California Cancer Registry (CCR) and the Texas Cancer Registry. These two states have two of the largest U.S. Latinx populations. Both registries collect demographic and clinical data on incident cancers diagnosed in the state in accordance with North American Association of Central Cancer Registries standards.

In all, n=50,696 Latina adults (age 18+) with a first primary breast cancer diagnosed between January 1, 1996 and December 31, 2005 were identified by the California (n=29,217) and Texas (n=21,479) Cancer Registries. The total number of Latinas eligible for analyses from California and Texas were 23,281 and 15,577, respectively (see Figure 1 for inclusion/exclusion criteria). We chose these years to anchor cancer diagnoses on 2000 Census data for our neighborhood variables and to have sufficient follow-up time to accrue enough events/deaths, given 5 year survival for breast cancer is approximately 90%.

Registry geocodes were used to append Census 2000 tract-level data to ascertain nSES and Latinx enclave.[8] The nSES index we used is a validated and well-established composite measure of 7 SES indicators, including education, occupation, employment, household income, poverty, rent and house values.[5,6,27–32] We defined Latinx enclaves using an established multidimensional index of seven measures (percent of residents who are Latinx,

foreign-born, recent immigrants, and linguistically isolated [general and of those who speak Spanish], with limited English proficiency [general and of those who speak Spanish]).[33] We classified each index into state-specific quintiles. For nSES, Quintile 5 (Q5) represents the highest SES neighborhoods, while Q1 represent the lowest SES neighborhoods. For ethnic enclaves, Q5 represents most ethnically distinct neighborhoods while Q1 represents the least distinct.

We calculated follow-up time as number of days between diagnosis and either death or December 31, 2014. For breast cancer-specific survival, we censored follow-up at death date for those dying from another cause, and we excluded those with unknown cause of death.

Imputation

We imputed missing birthplace data (22% California; 44% Texas) to US-born or foreign-born using multiple imputation separately by state. We used maximum likelihood logistic regression to impute nativity using variables available from both states including age at diagnosis, year of diagnosis, tumor stage, tumor grade, tumor histology, tumor size (continuous with an indicator for missing data), reporting source, diagnosis and/or treatment at reporting facility (versus elsewhere), microscopic tumor confirmation, Hispanic origin, quintile categories of nSES and Latinx enclave and all component continuous census-level measures, time from diagnosis to death or December 31, 2014, and status at study end (alive, died of breast cancer, died of another cause, unknown cause of death).[34] We fit imputation models 20 times, creating 20 datasets of imputed nativity. We excluded those missing data for any covariate (except for tumor size or grade) from imputation models (CA n=1,257; TX n=4,272). For descriptive analyses, we defined patients missing birthplace as foreign-born if nativity was imputed to foreign-born in more than 10 imputation runs, and US-born otherwise.

Statistical analysis

Separately by state, we fit multivariable Cox regression models on each of the 20 imputation datasets and combined regression results across all 20 imputed datasets to estimate hazard ratios (HR) and 95% confidence intervals for associations with mortality risk, using the rules by Rubin.[35] The proportional hazards assumption did not hold for stage and tumor grade. Therefore, stage was included as a stratifying variable in all Cox regressions, allowing baseline hazards to vary by stage. Additionally stratifying by grade did not meaningfully change HRs for nativity, nSES, or enclave, so grade was included as a covariate. Minimally adjusted models included age (continuous) and diagnosis year (continuous). Fully adjusted models also included histology (ductal, lobular, other, unknown), grade (I, II, III/IV, unknown), tumor size (continuous in cm; with an indicator variable for other/missing), and census tract clustering (i.e., by using a sandwich estimator of the covariance structure that accounts for intracluster dependence). In CA and TX there was a median of 3 cases per census tract with interquartile ranges of 2–5 and 1–6, respectively. We performed Wald tests for trend across quintile categories.

We initially allowed the variables of interest, nSES and Latinx enclave, categorized by quintiles, to enter into models separately. Given high correlation as continuous measures (r=

−0.76 in CA and r=−0.72 in TX) and an observed statistically significant interaction (CA overall survival, p-interaction=0.004; TX breast cancer-specific survival, p-interaction=0.013), we created a 4-level combined variable of nSES (low/high) and enclave residence (no/yes). Based on sample distributions, we defined high nSES as the top three state-specific quintiles and Latinx enclave as the top two state-specific quintiles. We did not observe statistically significant interactions between nativity and nSES nor enclave in both states.

Finally, to facilitate comparison of survival across the multiple independent and joint associations of interest, we calculated five-year survival probabilities and associated 95% confidence intervals from the fully adjusted Cox models with covariates set to their reference level or mean value and stage entered into the model as a covariate. Survival probability estimates were first normalized using the complementary log-log transformation before combining results across the 20 multiple imputation runs, and then the combined results were back-transformed.[36]

RESULTS

Table 1 shows the percent of Latina breast cancer cases who were foreign-born increased slightly after imputation. Table 2 shows patient characteristics. Texas had higher percent of cases living in ethnic enclaves than California. In both states, more foreign-born compared to US-born Latinas lived in ethnic enclaves and in low SES neighborhoods.

In minimally- and fully-adjusted models, nativity, Latinx enclave residence, and nSES were independently associated with both outcomes in both states. Given the similarity in findings across models, we present associations for fully adjusted models in Table 3 (see Supplemental Table 1 for minimally adjusted results). For all-causes, foreign-born Latinas had worse survival compared to US-born Latinas. Compared to those residing in the most ethnically distinct neighborhoods, those in the least distinct neighborhoods had worse survival. Compared to those residing in the highest SES neighborhoods, those in the lowest SES neighborhoods had worse survival. Results were similar for breast-cancer specific mortality.

In fully-adjusted models with enclave and nSES defined as a 4-category combination variable (Table 4; see Supplemental Table 1 for minimally adjusted results), foreign-born Latinas had worse all-cause and breast-cancer specific survival compared to US-born Latinas. In comparison to Latinas residing in low-nSES enclaves, those in high-SES neighborhoods had improved all-cause survival in both states regardless of enclave status. Latinas residing in low–nSES non-enclave neighborhoods had higher all-cause mortality (compared to low-nSES enclaves). For breast cancer-specific survival, results were similar, but statistical significance was only observed in CA for those residing in high-SES non-enclave neighborhoods.

Adjusted survival probabilities demonstrate the differences between enclave and nSES quintiles, the four-level variable, and between nativity groups. Differences in survival probabilities allow for a more qualitative comparison among various categories showing

little difference in probability of survival for those residing in high SES neighborhoods, regardless of enclave status, but for those residing in low SES neighborhoods, we observed lower survival probability for those in non-enclave neighborhoods compared to those residing in enclaves. Notably, differences appear larger for overall survival compared with breast cancer-specific survival.

DISCUSSION

To address inconsistent associations between ethnic enclave and breast cancer survival in the literature, we used the same multilevel measures and analytic methods and found similar associations across two states. We observed consistent associations between survival, nSES, ethnic enclave residence, and nativity among Latinas with breast cancer across both states. We also demonstrated that foreign-born Latinas are more likely to live in low-SES neighborhoods and in more ethnically distinct neighborhoods, compared to US-born Latinas, Taken together, these results provide a compelling rationale for continued attention to multilevel and place-based factors contributing to the survival of Latinas with breast cancer.

Enclave

When examined using quintiles, we observed associations of enclave residence after accounting for nativity and nSES and other covariates, with residence in more distinct ethnic neighborhoods associated with improved survival in both states. We observed statistically significant trends for quintiles of all-cause survival in both states; however for breast-cancer specific survival, while the direction of the point estimates was nearly always consistent, the trend across quintiles was significant in California but not Texas.

Neighborhood SES

Latinas living in neighborhoods with lower SES faced worse survival from both causes in both states. This finding is consistent with a large body of literature demonstrating worse survival among cancer patients living in neighborhoods with low-SES, regardless of how nSES is measured.[17–19,22–24]

Enclave and Neighborhood SES

When compared to those in low-nSES enclaves, Latinas in either type of high-SES neighborhood (enclave or non-enclave) had improved survival and Latinas in low-nSES non-enclaves had the worst survival, although this was not consistently statistically significant by cause of death or state. This demonstrates that enclaves may entail some benefits for residents that result in improved survival. Co-ethnic residents within enclaves often maintain lifestyles, cultural norms, and behaviors (e.g., diet and physical activity, social networks, social cohesion) that are health-promoting. Enclaves may facilitate communication and information sharing due to greater access to linguistic resources; they may also reduce exposure to discrimination and thus limit use of unhealthy coping behaviors (e.g., smoking, drinking) and reduce levels of individual stress.[12,37–40] Enclave-survival associations for Texas, while trending in the same direction as results for California, are somewhat more attenuated, which may reflect differences in sample distribution, historical patterns related to

immigration and settlement, or numerous other social, political, and physical environment differences between the states.

Comparison with Prior Research

Prior breast cancer studies from California using the same nSES and enclave measures as in our study also demonstrated worse survival for those in low-SES neighborhoods, regardless of enclave status.[19,22] Prior studies demonstrated differing results, both positive and negative, regarding enclave residence. In two prior Texas studies, two different measures of neighborhood Latinx composition were associated with increased mortality.[23,26] These prior studies may not be directly comparable to this study given different methods (e.g., differing lengths of follow-up, adjustment for different covariates, inclusion of other racial/ethnic groups, and in the Texas studies, use of a single indicator of enclave, i.e., neighborhood ethnic composition/segregation).

We demonstrated the importance of using the same methods across states to ensure findings are comparable and not artifacts of methodological differences. A multicomponent ethnic enclave index better captures the multiple dimensions of place that may be relevant for survival, going beyond single measures such as ethnic density. Our measure allows for identification of enclaves that are both culturally and ethnically concentrated and distinct from the remainder of the state in regard to race/ethnicity, language, nativity, and recency of immigration.[33]

Nativity

Foreign-born, compared to US-born Latinas in both states had worse survival from both causes. Prior studies demonstrated inconsistent findings. Foreign-born Latinas with breast cancer had worse survival in a Texas study,[24] slightly improved all-cause (but not cause-specific) survival in one California study,[19] and equivalent survival to US-born Latinas in another California study.[22] Differences in methodology, including nativity imputation methods, may explain these discrepancies. Consistent with prior research, we also demonstrated that foreign-born Latinas are more likely to live in ethnic enclaves and low-SES neighborhoods.[19,24]

Implications

Future intervention and research should prioritize historically underserved populations and neighborhoods. More research on the pathways through which enclaves and neighborhood SES impact survival is needed to inform and tailor community interventions. Future research is needed in other states with Latinx populations who differ by race, country of origin, nativity, length of time in the US, and residential settlement patterns.

Limitations

Our study has several limitations. Birthplace is often missing in registry data.[41–44] Imputation is necessary because dropping patients missing birthplace reduces generalizability and introduces bias due to the unique reasons why data are missing.[34,45,46] Registry data are often missing at random (MAR), i.e., missing conditional to other observed variables. For example, missing nativity and ethnicity are conditional on vital status, among

other variables, because these data are obtained from death certificates.[34,41–44] Multiple imputation (MI) can be used to handle data that are MAR or missing completely at random and has been applied and validated to impute missing cancer registry data (e.g., stage).[47–50] While we used a multiple imputation model validated in a study of cervical cancer,[34] there may be some misclassification. We calculated sensitivity and specificity of our imputation using a sample of Latinas with known birthplace and found we could determine US-birthplace (93.5% in CA and 86.2%) and foreign-birthplace (90.7% in CA and 77.0%) with good accuracy. Notably, when we did not impute nativity and kept unknown as a category, direction of enclave and nSES variables remained unchanged. Our imputation approach is the best available method to examine nativity disparities in survival at this time because any interpretation of nativity is flawed without imputation (given reasons for missingness outlined above), and because we lacked gold-standard (i.e., self-report) birthplace data. Future studies should collect self-report birthplace to allow these validations. In addition, cancer registries should work with their reporting facilities to ensure that this information is collected in a systematic way given its importance in understanding patterns of cancer burden in rapidly growing populations in the US.

Data were unavailable for several prognostic factors and length of neighborhood residence. When we repeated analyses with CA treatment data (missing in TX data), findings were similar. Results may not be generalizable outside of Texas and California, where Latinx are predominantly white, many are US-born, many are multi-generational, and most foreign-born are from Mexico.[51]

Finally, we acknowledge that any potential beneficial or detrimental impacts of ethnic enclaves are likely highly contextualized and dependent on specific place-based historic and cultural patterns of immigration and assimilation. Despite these limitations, our study fills key gaps in the literature by using the same multilevel measures and imputation methods across two states with the largest U.S. Latinx populations.

Conclusions

We demonstrated consistently harmful effects of low-nSES residence, but some evidence that enclaves may have small protective effects. We also found synergistic effects between enclaves and nSES, and worse survival for foreign-born Latinas with breast cancer, compared to US-born Latinas. Future place-based, mixed-methods research and intervention within ethnic enclaves is warranted given enclaves' high concentration of underserved populations and overall lower nSES compared to non-enclave areas. By engaging community members in future research, cancer prevention and control efforts can better leverage local assets, such as ethnic-specific businesses and social networks, to improve cancer outcomes within enclaves.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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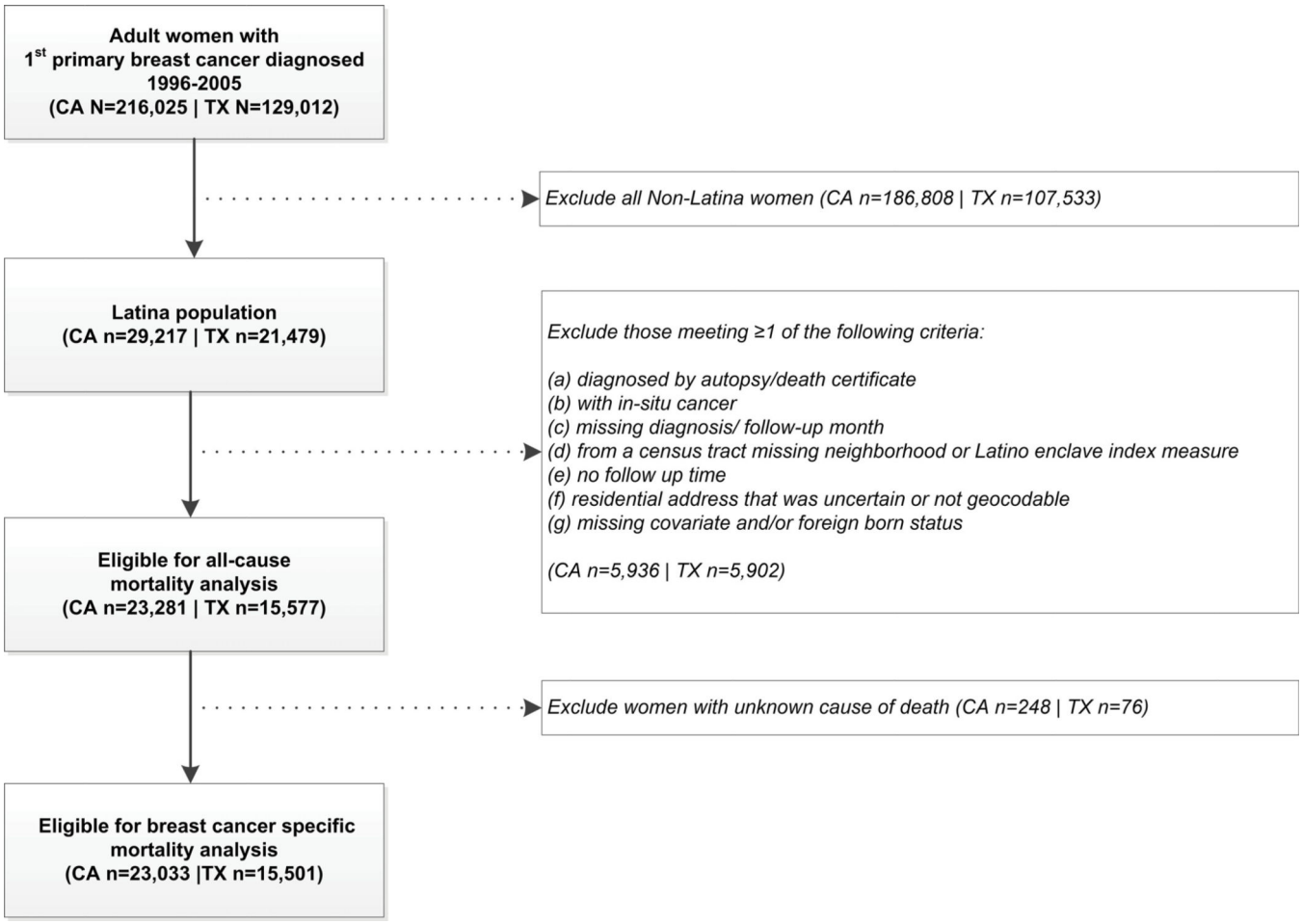

Figure 1.

Inclusion and exclusion criteria and the final sample from the California and Texas Cancer Registries.

Table 1.

Distribution of patient nativity with and without multiple imputation among Latinas with breast cancer diagnosed in California or Texas, 1996–2005, by state.

	US-Born		Foreign-Born		Missing		Total	
	N	Row Percent	N	Row Percent	N	Row Percent	N	Row Percent
CA-no imputation	7,876	33.83	10,217	43.89	5,188	22.28	23,281	100
CA-with imputation	12,621	54.21	10,660	45.79	-	-	23,281	100
TX-no imputation	5,965	38.29	2,735	17.56	6,877	44.15	15577	100
TX-with imputation	11,897	76.38	3,680	23.62	-	-	15577	100

Table 2.

Characteristics of Latinas with breast cancer diagnosed in California or Texas, 1996–2005, by state.

	Texas						California					
	US-Born (n=11,897) n (column %)		Foreign-Born (n=3,680) n (column %)		All (n=15,577) n (column %)		US-Born (n=12,621) n (column %)		Foreign-Born (n=10,660) n (column %)		All (n=23,281) n (column %)	
Age at diagnosis												
<40	1302	(10.9)	456	(12.4)	1758	(11.3)	1386	(11.0)	1381	(13.0)	2767	(11.9)
40–49	2983	(25.1)	908	(24.7)	3891	(25.0)	3217	(25.5)	2971	(27.9)	6188	(26.6)
50–59	3058	(25.7)	861	(23.4)	3919	(25.2)	3094	(24.5)	2644	(24.8)	5738	(24.6)
60–69	2201	(18.5)	702	(19.1)	2903	(18.6)	2463	(19.5)	1892	(17.7)	4355	(18.7)
70+	2353	(19.8)	753	(20.5)	3106	(19.9)	2461	(19.5)	1772	(16.6)	4233	(18.2)
Diagnosis year												
1996–2000	4863	(40.9)	1627	(44.2)	6490	(41.7)	5593	(44.3)	4713	(44.2)	10306	(44.3)
2001–2005	7034	(59.1)	2053	(55.8)	9087	(58.3)	7028	(55.7)	5947	(55.8)	12975	(55.7)
Summary stage												
Local	6150	(51.7)	1565	(42.5)	7715	(49.5)	7419	(58.8)	5331	(50.0)	12750	(54.8)
Regional	4522	(38.0)	1493	(40.6)	6015	(38.6)	4578	(36.3)	4523	(42.4)	9101	(39.1)
Distant	716	(6.0)	299	(8.1)	1015	(6.5)	509	(4.0)	562	(5.3)	1071	(4.6)
Unknown	509	(4.3)	323	(8.8)	832	(5.3)	115	(0.9)	244	(2.3)	359	(1.5)
Histology												
Ductal	9440	(79.3)	2918	(79.3)	12358	(79.3)	10271	(81.4)	8456	(79.3)	18727	(80.4)
Lobular	768	(6.5)	196	(5.3)	964	(6.2)	885	(7.0)	630	(5.9)	1515	(6.5)
Other	1531	(12.9)	482	(13.1)	2013	(12.9)	1439	(11.4)	1539	(14.4)	2978	(12.8)
Unknown	158	(1.3)	84	(2.3)	242	(1.6)	26	(0.2)	35	(0.3)	61	(0.3)
Grade												
I	1253	(10.5)	296	(8.0)	1549	(9.9)	1991	(15.8)	1231	(11.5)	3222	(13.8)
II	3506	(29.5)	1109	(30.1)	4615	(29.6)	4333	(34.3)	3549	(33.3)	7882	(33.9)
III/IV	5221	(43.9)	1566	(42.6)	6787	(43.6)	4976	(39.4)	4679	(43.9)	9655	(41.5)
Unknown	1917	(16.1)	709	(19.3)	2626	(16.9)	1321	(10.5)	1201	(11.3)	2522	(10.8)

	Texas						California					
	US-Born (n=11,897) n (column %)		Foreign-Born (n=3,680) n (column %)		All (n=15,577) n (column %)		US-Born (n=12,621) n (column %)		Foreign-Born (n=10,660) n (column %)		All (n=23,281) n (column %)	
Tumor Size (cm)												
Mean	2.3		2.3		2.3		2.2		2.5		2.3	
Standard deviation	3.2		4.1		3.5		2.1		2.5		2.3	
Missing: N (%)	2422	20.4	1005	27.3	3427	22.0	1243	(9.9)	1265	(11.9)	2508	(10.8)
Neighborhood socioeconomic status (nSES) quintile												
Quintile 1: Low SES	3793	(31.9)	1544	(42.0)	5337	(34.3)	2973	(23.6)	3950	(37.1)	6923	(29.7)
Q2	2730	(22.9)	799	(21.7)	3529	(22.7)	3117	(24.7)	2706	(25.4)	5823	(25.0)
Q3	1772	(14.9)	440	(12.0)	2212	(14.2)	2765	(21.9)	1850	(17.4)	4615	(19.8)
Q4	1895	(15.9)	473	(12.9)	2368	(15.2)	2201	(17.4)	1229	(11.5)	3430	(14.7)
Q5- High SES	1707	(14.3)	424	(11.5)	2131	(13.7)	1565	(12.4)	925	(8.7)	2490	(10.7)
Ethnic enclave quintile												
Quintile 1: Least ethnically distinct	662	(5.6)	102	(2.8)	764	(4.9)	1405	(11.1)	525	(4.9)	1930	(8.3)
Q2	1365	(11.5)	255	(6.9)	1620	(10.4)	2015	(16.0)	943	(8.8)	2958	(12.7)
Q3	1935	(16.3)	338	(9.2)	2273	(14.6)	2602	(20.6)	1518	(14.2)	4120	(17.7)
Q4	2998	(25.2)	786	(21.4)	3784	(24.3)	3352	(26.6)	2778	(26.1)	6130	(26.3)
Q5: Most ethnically distinct	4937	(41.5)	2199	(59.8)	7136	(45.8)	3247	(25.7)	4896	(45.9)	8143	(35.0)
Joint nSES/enclave measure												
No Enclave, Low SES	529	(4.4)	85	(2.3)	614	(3.9)	1108	(8.8)	465	(4.4)	1573	(6.8)
Enclave, Low SES	6900	(58.0)	2511	(68.2)	9411	(60.4)	4982	(39.5)	6191	(58.1)	11173	(48.0)
No Enclave, High SES	2306	(19.4)	428	(11.6)	2734	(17.6)	4914	(38.9)	2521	(23.6)	7435	(31.9)
Enclave, High SES	2162	(18.2)	656	(17.8)	2818	(18.1)	1617	(12.8)	1483	(13.9)	3100	(13.3)
Vital Status												
Alive	7033	(59.1)	1764	(47.9)	8797	(56.5)	8399	(66.5)	6256	(58.7)	14655	(62.9)
Dead	4864	(40.9)	1916	(52.1)	6780	(43.5)	4222	(33.5)	4404	(41.3)	8626	(37.1)

Table 3.

Independent associations (Hazard Ratios, 95% Confidence Intervals; 5-year survival probabilities) of nativity, ethnic enclave and neighborhood socioeconomic status (nSES) and survival after breast cancer, CA and TX, 1996–2005

	All-cause mortality				*Breast cancer-specific mortality*			
	Fully Adjusted HR (95% CI)		**5-year survival Probability (95% CI)**		**Fully Adjusted HR (95% CI)**		**5-year survival Probability (95% CI)**	
CALIFORNIA								
Nativity								
US Born (ref)	1.00		0.953	(0.946–0.959)	1.00		0.986	(0.983–0.989)
Foreign Born	1.13	(1.08–1.19)	0.947	(0.940–0.953)	1.19	(1.11–1.26)	0.984	(0.980–0.987)
Ethnic enclave quintile								
Quintile 1: Least ethnically distinct	1.18	(1.06–1.31)	0.944	(0.937–0.950)	1.16	(1.01–1.34)	0.984	(0.981–0.987)
Q2	1.21	(1.10–1.34)	0.942	(0.935–0.948)	1.21	(1.07–1.38)	0.983	(0.980–0.986)
Q3	1.11	(1.02–1.21)	0.947	(0.941–0.954)	1.03	(0.92–1.16)	0.986	(0.983–0.988)
Q4	1.06	(1.00–1.14)	0.950	(0.943–0.956)	1.05	(0.96–1.15)	0.986	(0.982–0.988)
Q5: Most ethnically distinct (ref)	1.00		0.953	(0.946–0.959)	1.00		0.986	(0.983–0.989)
p-trend		<0.001				0.008		
nSES quintile								
Q1: Low SES	1.58	(1.41–1.76)	0.926	(0.919–0.932)	1.47	(1.27–1.70)	0.980	(0.976–0.983)
Q2	1.48	(1.34–1.64)	0.929	(0.921–0.935)	1.42	(1.24–1.62)	0.980	(0.977–0.983)
Q3	1.32	(1.20–1.46)	0.937	(0.930–0.944)	1.29	(1.14–1.47)	0.982	(0.979–0.985)
Q4	1.16	(1.06–1.28)	0.944	(0.937–0.950)	1.24	(1.10–1.41)	0.983	(0.979–0.986)
Q5: High SES (ref)	1.00		0.953	(0.946–0.959)	1.00		0.986	(0.983–0.989)
p-trend		<0.001				<0.001		
TEXAS								
Nativity								
US Born (ref)	1.00		0.937	(0.927–0.945)	1.00		0.982	(0.977–0.985)
Foreign Born	1.18	(1.10–1.26)	0.917	(0.905–0.928)	1.27	(1.16–1.38)	0.975	(0.969–0.980)
Ethnic enclave quintile								
Quintile 1: Least ethnically distinct	1.28	(1.12–1.47)	0.918	(0.905–0.929)	1.19	(1.00–1.42)	0.978	(0.972–0.982)
Q2	1.11	(1.00–1.24)	0.929	(0.920–0.938)	0.97	(0.84–1.12)	0.982	(0.977–0.986)

	All-cause mortality				*Breast cancer-specific mortality*			
	Fully Adjusted HR (95% CI)		**5-year survival Probability (95% CI)**		**Fully Adjusted HR (95% CI)**		**5-year survival Probability (95% CI)**	
Q3	1.15	(1.06–1.25)	0.926	(0.916–0.935)	1.16	(1.04–1.29)	0.978	(0.973–0.983)
Q4	1.12	(1.05–1.19)	0.929	(0.919–0.938)	1.07	(0.98–1.17)	0.980	(0.975–0.984)
Q5: Most ethnically distinct (ref)	1.00		0.937	(0.927–0.945)	1.00		0.982	(0.977–0.985)
p-trend		<0.001				0.115		
nSES quintile								
Q1: Low SES	1.44	(1.29–1.60)	0.908	(0.899–0.917)	1.24	(1.08–1.43)	0.977	(0.972–0.981)
Q2	1.31	(1.18–1.46)	0.917	(0.908–0.925)	1.15	(1.00–1.31)	0.979	(0.974–0.983)
Q3	1.30	(1.17–1.45)	0.918	(0.908–0.927)	1.17	(1.02–1.35)	0.978	(0.973–0.983)
Q4	1.14	(1.03–1.27)	0.927	(0.918–0.935)	1.06	(0.93–1.21)	0.980	(0.976–0.984)
Q5: High SES (ref)	1.00		0.937	(0.927–0.945)	1.00		0.982	(0.977–0.985)
p-trend		<0.001				0.001		

Fully adjusted models include age at diagnosis, tumor grade, tumor size, year of diagnosis, histology, underlying stratification by stage and clustering by census tract.

Table 4.

Independent association of nativity and joint associations (Hazard Ratios, 95% Confidence Intervals; 5-year survival probabilities) of neighborhood socioeconomic status (nSES)/ethnic enclave and survival after breast cancer, CA and TX, 1996–2005

	All-cause mortality		*Breast cancer-specific mortality*	
	Fully Adjusted HR (95% CI)	**5-year survival Probability (95% CI)**	**Fully Adjusted HR (95% CI)**	**5-year survival Probability (95% CI)**
CALIFORNIA				
Nativity				
US Born (ref)	1.00	0.926 (0.919–0.932)	1.00	0.980 (0.976–0.983)
Foreign Born	1.12 (1.07–1.17)	0.918 (0.911–0.924)	1.17 (1.10–1.25)	0.976 (0.973–0.980)
Joint nSES/ enclave measure				
High SES, Enclave	0.89 (0.84–0.95)	0.934 (0.927–0.940)	0.95 (0.87–1.03)	0.981 (0.977–0.984)
High SES, Non-Enclave	0.85 (0.81–0.89)	0.936 (0.931–0.941)	0.89 (0.83–0.95)	0.982 (0.979–0.984)
Low SES, Enclave (ref)	1.00	0.926 (0.919–0.932)	1.00	0.980 (0.976–0.983)
Low SES, Non-Enclave	1.15 (1.06–1.26)	0.914 (0.904–0.922)	1.13 (1.00–1.28)	0.977 (0.972–0.981)
TEXAS				
Nativity				
US Born (ref)	1.00	0.909 (0.900–0.917)	1.00	0.977 (0.972–0.981)
Foreign Born	1.17 (1.09–1.25)	0.895 (0.884–0.905)	1.26 (1.16–1.37)	0.971 (0.965–0.977)
Joint nSES/ enclave measure				
High SES, Enclave	0.91 (0.85–0.97)	0.917 (0.909–0.925)	0.94 (0.86–1.02)	0.979 (0.974–0.982)
High SES, Non-Enclave	0.90 (0.85–0.96)	0.917 (0.909–0.925)	0.94 (0.87–1.02)	0.978 (0.974–0.982)
Low SES, Enclave (ref)	1.00	0.909 (0.900–0.917)	1.00	0.977 (0.972–0.981)
Low SES, Non-Enclave	1.09 (0.97–1.23)	0.900 (0.885–0.913)	1.06 (0.92–1.22)	0.975 (0.969–0.980)

Fully adjusted models include age at diagnosis, tumor grade, tumor size, year of diagnosis, histology, underlying stratification by stage and clustering by census tract.