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Neighborhood archetypes and breast cancer survival in California

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Abstract

Purpose: Previous studies on neighborhoods and breast cancer survival examined neighborhood variables as unidimensional measures (e.g. walkability or deprivation) individually and thus cannot inform how the multitude of highly correlated neighborhood domains interact to impact breast cancer survival. Neighborhood archetypes were developed that consider interactions among a broad range of neighborhood social and built environment attributes and examine their associations with breast cancer survival.

Methods: Archetypes were measured using latent class analysis (LCA) fit to California census tract-level data. Thirty-nine social and built environment attributes relevant to eight neighborhood domains (socioeconomic status, urbanicity, demographics, housing, land use, commuting and traffic, residential mobility, and food environment) were included. The archetypes were linked to cancer registry data on breast cancer cases (diagnosed 1996–2005 with follow-up through Dec 31, 2017) to evaluate their associations with overall and breast cancer-specific survival using Cox proportional hazard models. Analyses were stratified by race/ethnicity.

Results: California neighborhoods were best described by nine archetypal patterns that were differentially associated with overall and breast cancer-specific survival. The lowest risk of overall death was observed in the upper middle class suburb (reference) and high status neighborhoods, while the highest was observed among inner city residents with a 39% greater risk of death (95%

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CI = 1.35 to 1.44). Results were similar for breast cancer-specific survival. Stratified analyses indicated that differences in survival by neighborhood archetype varied according to individuals' race/ethnicity.

Conclusions: By describing neighborhood archetypes that differentiate survival following breast cancer diagnosis, the study provides direction for policy and clinical practice addressing contextually-rooted social determinants of health including SES, unhealthy food environments, and greenspace.

Keywords

neighborhood archetypes; neighborhood socioeconomic status; breast cancer; cancer survival; racial/ethnic disparities; geographic disparities; latent class analysis

Introduction

Breast cancer is the most common cancer and the second-leading cause of cancer deaths among women in the U.S.[1] Neighborhoods shape individuals' exposure to health-related risks and access to resources; they have an additional and distinct effect on cancer outcomes apart from individual characteristics.[2–5] The impact of neighborhoods on cancer mortality is of increasing importance, since while cancer mortality has declined steadily over the past three decades, socioeconomic and geographic disparities in mortality have increased.[6] Thus, there is a growing interest in health disparities research for more sophisticated neighborhood measures and a more thorough understanding of how and why neighborhoods matter to individuals' health.[7–9]

Most published studies of neighborhoods and breast cancer survival have reported associations of lower neighborhood socioeconomic status (nSES) or greater neighborhood deprivation with risk of death, independent of patient tumor and sociodemographic characteristics.[5,10–22] More recent work, including work from our group, has considered additional domains of neighborhood built and social environments (e.g., food environment, walkability, and ethnic enclave).[5,18,21–33] Although few of these measures have been independently associated with overall or breast cancer-specific survival, a joint effect for ethnic enclave and nSES has been observed, which highlights the importance of considering interactions among neighborhood domains.[26,27] Accordingly, understanding the full impact of neighborhoods on breast cancer survival necessitates an approach that informs how these and other often highly correlated neighborhood attributes, measured as individual indicators (e.g., poverty) or unidimensional indices (e.g., nSES or walkability) interact.[34–38] Consequently, we suggest reconsidering how neighborhoods are assessed in epidemiologic studies to fully capture, and ultimately more effectively intervene on, their potential health impact.[39]

Combining multiple neighborhood characteristics into archetypes is conceptually a more meaningful approach to identifying neighborhoods where residents have lower survival and to inform contextually-mediated interventions. Latent variable models, including latent class analysis (LCA), provide a statistically rigorous methodological approach to measuring archetypes[40] as they allow for the assessment of potential interactions between many

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measures and summarize those measures into a more practical number of inter-relationships, apart from their impact on any given health outcome. Like principal component analysis for continuous variables and cluster analysis for categorical variables, LCA is a data reduction technique, but it has the additional benefits (shared by other latent variable methods for continuous measures like factor analysis and structural equation modeling) that it also addresses uncertainty, bias, and potential attenuation due to systematic and stochastic error in the measurement of variables.[39] Nevertheless, the majority of studies that have used latent variable models to characterize neighborhoods utilized multiple measures of a single neighborhood domain (e.g., built environment attributes to describe neighborhood physical activity) and so were not designed to observe important interactions among social and built environment domains.[41–49] A study from Weden et al. identified six neighborhood archetypes with measures across multiple neighborhood domains for 1990 and 2000 Census tracts across the U.S., but these archetypes were not used to study a health behavior or outcome.[39]

In this study, we used an analogous approach to Weden et al. with a comprehensive set of social and built environment attributes across several neighborhood domains to define neighborhood archetypes in California (CA) and to examine associations between neighborhood archetypes and breast cancer survival. Moreover, literature to date on the neighborhood environment and breast cancer survival stresses that the relative importance of neighborhoods may depend on resident characteristics, including race/ethnicity,[33] so we examine interactions between archetypes and race/ethnicity in their associations with survival.

Methods

Neighborhood data

Neighborhood data were from the California Neighborhoods Data System (CNDS)[50]. The CNDS is a geospatial dataset that compiles data on the social and built environment attributes for small areas (i.e., block groups and census tracts) using multiple sources of data. Thirty-nine indicator variables characterizing several domains of neighborhood social and built environments (i.e., socioeconomic status, urbanicity, demographics, housing, land use, commuting and traffic, residential mobility, and food environment) were selected for Census 2000 tracts in CA (Supplemental Table 1). Census tracts, with an average of 4800 residents in CA, have been shown to be a reasonable proxy for neighborhoods in population health studies.[51]

Latent class analysis

LCA modeling was implemented using R package poLCA (R Foundation for Statistical Computing, Vienna, Austria) and SAS procedure PROC LCA (SAS Institute, Cary, North Carolina). LCA models were fit to 39 indicators of neighborhood attributes to identify the model with the best fitting structure.[52] For all indicator variables, except income and education, that were included in the LCA, we defined high vs. low using the statewide medians (see Supplemental Table 1). Goodness of fit criteria were compared across models, including percentage of seeds associated with best fitted model, the log-likelihood ratio test

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statistics, the deviance of statistic, the Akaike Information Criterion, the normal and adjusted Schwarz Bayesian Information Criterion, the raw and scaled entropy of class partitioning.[40,53–56] Following standard practice for the fitting of LCA models,[54] we evaluated the improvement in model fit (from the simplest model which has only 2 classes) of iteratively increasing the number of classes. Due to the large sample size, we found that even after including 12 classes, the statistical evidence for improved fit continued to be improved by adding additional classes. Thus, again following prior practice,[39] we evaluated whether additional classes qualitatively improved the characterization of different substantively meaningful archetypes. On the basis of this qualitative evaluation of changes in the archetype structure, we determined that at minimum a 5- class structure and at maximum a 9-class structure should be considered. We report findings from the 9-class model, which offer a more nuanced look at the way neighborhoods are defined by attributes beyond socioeconomic indicators. LCA measurement statistics are in Supplemental Table 1. California census tracts were classified as belonging to one of the 9 neighborhood archetypes based on their observed attributes.

Women with breast cancer in California, 1996–2005

We identified 176,097 first primary invasive breast cancer cases [International Classification of Disease for Oncology, 3rd Edition, (ICD-O-3) site codes C50.0–50.9] from the California Cancer Registry (CCR) diagnosed among females from 1996 through 2005, a 10-year period around the 2000 Census that provides at least 10-years of follow-up time for assessing mortality. Data on age at diagnosis, race/ethnicity, marital status, primary source of payment at the time of initial diagnosis and/or treatment; tumor characteristics at diagnosis including Surveillance, Epidemiology, and End Results (SEER) Program summary stage, histological subtype, grade, estrogen receptor (ER) and progesterone receptor (PR) tumor expression status; and treatment modalities such as chemotherapy, radiation, and surgery are available in the CCR by routine abstraction from medical records. Underlying causes of death, coded in International Classification of Diseases, 9th edition (ICD-9) before December 31, 1998, and in 10th edition (ICD-10) after January 1st, 1999, were obtained from death certificates, and deaths assigned codes 174.0–174.9 (ICD-9) or C50.0-C50.9 (ICD-10) were identified as due to breast cancer. Each case was assigned to a 2000 Census tract based on their geocoded residential address at diagnosis (available from the CCR) and linked to neighborhood archetypes based on census tract identifier. Data represent 6,971 census tracts in CA (98.9%). This study was approved by the Greater Bay Area Cancer Registry Institutional Review Board protocols from the Cancer Prevention Institute of California and the University of California, San Francisco.

Survival analyses

Survival time was computed as months from the date of diagnosis to the end of follow up, defined as the first occurrence of date of death, date of last known contact, or study end date (December 31, 2017). For breast cancer-specific survival analysis, patients who died from non-breast cancer causes were right censored at the time of death. Overall, only 3% of the analytic sample had loss to follow-up (i.e., within past two years). Hazard ratios (HR) and 95% confidence intervals (CI) from Cox proportional hazards regression were calculated to assess associations between neighborhood archetypes and overall or breast cancer-specific

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survival. The proportional hazards assumption was verified by assessing the correlation between weighted Schoenfeld residuals and logarithmic transformation of survival time; no violations were observed. Minimally-adjusted models included age at diagnosis (in years), year of diagnosis (in years), race/ethnicity, and SEER summary stage. Fully-adjusted models additionally included histology, grade, ER status, PR status, chemotherapy, radiation, surgery, and marital status. The standard errors for all models were also adjusted for clustering of respondents within census tracts using a sandwich estimator of the covariance structure that accounts for intracluster dependence.[57] We tested for interactions between race/ethnicity (non-Hispanic (NH) White, NH Black, Asian/Pacific Islander, Hispanic) and archetypes using a global test of interaction for archetypes and race/ethnicity in a model that included race/ethnicity as a stratum variable, allowing for race/ethnicity-specific baseline hazards as well as interactions between all covariates and race/ethnicity to allow for optimal adjustment for each subgroup. We found marginally statistically significant interactions in the fully adjusted models for overall (p-interaction=.061) mortality but not for breast cancer specific mortality (p-interaction=.107). Thus, we also present two additional set of results, first assessing neighborhood archetype-mortality associations in models stratified by race/ethnicity and second, assessing race/ethnicity-mortality associations in models stratified by neighborhood archetype. All statistical tests were carried out using SAS software version 9.3 (SAS Institute, Cary, North Carolina). All p-values reported were two-sided, and those with a probability< 0.05 were considered statistically significant.

Results

Labels and descriptions for the 9 different classes, or types, of neighborhoods characterized are in Table 1. Descriptions are based on the prevailing characteristics that the LCA model identified for each class. For example, *suburban pioneer* and *city pioneer* neighborhoods are both located in cities, but not right in downtown, have racially/ethnically diverse populations, and lots of mixed land use, but contrast in that *suburban pioneer* neighborhoods have more families and home owners and *city pioneer* neighborhoods have more older residents, single residents, female-headed households, and renters. The largest proportion of tracts (16.4%), representing the largest proportion of the CA population (17.6%), comprise *inner city* neighborhoods.

Figure 1 provides a map of the distribution of the 9 neighborhood archetypes across census tracts in CA, and in the metropolitan areas of San Francisco, Oakland, Los Angeles and San Diego. *Rural/micropolitan* neighborhoods are preponderant in northern and eastern CA. San Francisco has many *new urban/pedestrian* neighborhoods, with diverse (although non-Hispanic) residents that are relatively young and single. Los Angeles and San Diego show concentrations of *inner city*, *metropolitan pioneer*, and *new urban/pedestrian* neighborhoods surrounded by the *high status* neighborhoods of suburban areas. *Hispanic small towns* can be found both in less populated areas of greater CA in addition to areas adjacent to *inner cities*.

Table 2 shows the distribution of demographic and tumor characteristics among women with breast cancer according to neighborhood archetypes. The largest proportion of NH White women with breast cancer resided in *high status* neighborhoods (22.0%) while nearly 30% of NH Black women resided in *inner city* neighborhoods. The majority of Hispanic women

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resided in *inner city* (26.6%), *suburban pioneer* (15.7%), or *Hispanic small town* (15.2%) neighborhoods. Approximately 28% of Asian American/Pacific Islander (AAPI) women resided in *upper-middle class suburb* neighborhoods.

Figures 2 presents HRs and 95% CIs for neighborhood archetypes and overall and breast-cancer specific survival among all women and for strata representing racial/ethnic groups. Supplemental Tables 2 and 3 additionally contain all tabulated results and results from minimally adjusted models which show similar patterns as the fully adjusted models. In fully adjusted models for overall survival among all women, compared to women residing in *upper middle-class suburbs*, those residing in all other archetypes except for *high status*, had higher risk of death with HRs ranging from 1.08 (95% CI=1.05 to 1.11) in *new urban/pedestrian* to 1.37 (95% CI=1.33 to 1.41) in *Hispanic small towns* and 1.38 (95% CI=1.34 to 1.42) in *inner city* neighborhoods. Similar patterns of associations were observed for breast-cancer specific survival among all women.

Among NH White women and compared to residents of *upper middle-class suburb* and *high status* neighborhoods, residents of all other neighborhoods had a greater risk of death with HRs ranging from 1.07 (95% CI=1.04 to 1.10) among residents of *new urban/pedestrian neighborhoods* to 1.42 (95% CI=1.36 to 1.48) among residents of *inner city* neighborhoods. Among NH Black women, residents of all other neighborhoods, except *rural/micropolitan*, had a greater risk of death compared to residents of *upper middle-class suburbs*; HRs for *new urban/pedestrian*, *high status*, *mixed SES-class suburb,* and *suburban pioneer* neighborhoods were similar, from 1.16 (95% CI=1.01 to 1.32) among residents of *new urban/pioneer* neighborhoods to 1.25 (95% CI=1.09 to 1.43) among residents of *suburban pioneer* neighborhoods. In addition, for NH Black women, HRs for *Hispanic small town*, *city pioneer*, and *inner city* neighborhoods seemed to group together and ranged from 1.31 (95% CI=1.15 to 1.49) for residents of *Hispanic small towns* to 1.43 (95% CI=1.27 to 1.60) among those of *inner city* neighborhoods. Risk of death for Hispanic women ranged from HR=0.97 (95% CI=0.87 to 1.09) among residents of *high status* neighborhoods to HR=1.36 among residents of *rural/micropolitan* (95% CI=1.21 to 1.54) and *Hispanic small town* (95% CI=1.25 to 1.48) neighborhoods. Finally, among AAPI women, HRs across neighborhoods ranged from 1.04 (95% CI=0.92 to 1.17) among residents of *high status* neighborhoods to 1.53 (95% CI=1.25 to 1.79) among residents of *rural/micropolitan* neighborhoods. Breast cancer-specific survival had similar patterns.

In order to further examine the interaction between neighborhood archetype and race/ethnicity, we additionally modeled associations between race/ethnicity and overall and breast cancer-specific survival within strata defined by neighborhood archetypes (Supplemental Table 4). With the exception of *rural/micropolitan*, *Hispanic small town*, and *inner city* neighborhoods, NH Black women had higher risk of overall death compared to NH White women, ranging from 1.16 (95% CI=1.04 to 1.30) in *upper middle-class suburb* neighborhoods to 1.36 (95% CI=1.19 to 1.55) in *high status* neighborhoods. NH Black women had higher risk of breast cancer-specific death in all neighborhoods except rural/micropolitan.

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Discussion

Neighborhood archetypes provide a novel approach to assess the impact of multiple neighborhood factors on breast cancer survival. We present 9 neighborhood archetypes for census tracts in CA for the year 2000 developed with a broad suite of variables representing several domains of neighborhood built and social environments. These archetypes can be interpreted as (1) the most likely combinations of neighborhood characteristics observed in CA and (2) the most common forms of potential synergistic interactions among neighborhood social and built environment domains in the context of breast cancer survival. Our results show that multiple neighborhood domains other than nSES are relevant to neighborhood disparities in breast cancer survival, including rural/urban designation, age and race/ethnicity of residents, commuting and traffic patterns, residential mobility, and food environment. We also show that patterns in survival by neighborhood archetypes vary across race/ethnicity.

Additional neighborhood domains associated with cancer outcomes may further extend the usefulness of these neighborhood archetypes. Health care context or geographic accessibility to healthcare resources partially explain associations between neighborhood SES and cancer outcomes,[58–61] and may provide additional insight regarding observed archetype disparities. However, data on these healthcare measures are sparse at small areas like census tracts so may need to be developed at larger geographies. In addition, Krieger et al.'s index of concentration at the extremes describes neighborhoods with high concentration of affluence and NH White residents at one end and those with low levels of affluence and high concentration of racial/ethnic minority residents at the other.[62] Overlaying this measure with neighborhood archetypes may help to identify the modifiable neighborhood attributes that associate with more fundamental causes including racial/ethnic residential segregation and/or concentrated disadvantage. Similarly, overlaying neighborhood ethnic enclave status may illustrate which types of enclave neighborhoods are protective to which populations (e.g., US-born or foreign born).

Consistent with prior studies showing differential neighborhood effects by race/ethnicity,[13,16,21,29,63–69] we observed heterogeneity in archetype-survival associations across race/ethnicity: neighborhood archetypes-survival patterns clustered more distinctly for some racial/ethnic groups compared to others. For example, among NH White women, as observed for overall survival among all women, we note three clusters of neighborhoods, relative to the reference group and the *high status* neighborhoods, with the lowest (*new urban/pedestrian and mixed SES-class*), moderate (*suburban pioneer, rural/micropolitan, and city pioneer*) and highest (*Hispanic small town, and inner city*) risk of death. Similarly, among Hispanic women, we observed three distinct clusters, while among API and NH Black women, we observed fewer distinct groups. Of note, residing in *high status* neighborhoods demonstrated relative worse survival only among NH Black women compared to the reference group. Examining common factors within these distinct clusters may help identify which factors drive disparities across racial/ethnic groups. For example, while the pattern of association of neighborhood archetypes with overall survival among AAPI women seem to be largely driven by nSES and demographics, patterns among NH Black women seem additionally driven by household composition and food environment.

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Furthermore, our observations of racial/ethnic disparities within neighborhood archetypes highlight the importance of individuals' lived experiences within their neighborhood environments. Access to health-promoting neighborhood built and social resources may depend on residents' individual social status (e.g., race/ethnicity, immigration status, or education). Discrimination (e.g., in housing or access to medical resources) may drive differential neighborhood effects on cancer outcomes by race/ethnicity and nativity.[70–74] While we have examined the interaction of broad racial/ethnic groups and neighborhood archetype, further disaggregation of racial/ethnic groups by detailed ethnicity and/or nativity may provide additional insight into how neighborhoods impact health differentially for these groups.

Methodological studies to validate neighborhood archetypes are required. Archetypes are not comparable across censal time periods given the agnostic nature of the LCA approach; slightly different sets of tract-level 9-class archetypes emerged for the 2010 and 2000 censal periods. Mixed methods approaches to validate defining features of archetypes among residents (e.g., the quality or usefulness of parks and food retailers) will improve quantitative data used in LCA.[75] likely differ across neighborhoods. Such groundtruthing of secondary data will be vital to fully appreciate the modifiable factors of neighborhoods relevant to cancer mortality and to optimize communities' health-promoting capacity.[76–82] Additionally, geospatial methods can extend these findings to determine, for example, whether spatial clustering of archetypes impacts associations with breast cancer mortality. Future studies with residential history from diagnosis onward are warranted; cancer registry data only include address at diagnosis so we could not account for impact of residential mobility. Lastly, these findings should be replicated in other geographies, with other outcomes and with other cancer sites in order to determine whether they are relatively robust measures to study place-based cancer disparities.

Here we demonstrate the applicability of 9-class census tract-level archetypes to identify disparities in breast cancer survival. The archetypes characterize neighborhoods beyond previously studied domains (i.e., nSES, ethnic/immigrant enclaves, or built environment)[5,10–33] and illustrate complex interactions among domains. Discerning the effects of many interactions with a single, summary measure is a benefit of the archetype approach, making it better suited to research questions on the synergistic effects of neighborhood factors on cancer outcomes. Used across studies, an archetype measure can indicate how and where to apply interventions by identifying which features of the neighborhood social and built environments interact and which types of neighborhoods are associated with worse outcomes. For instance, among archetypes with lower SES those with unhealthy foods have worse survival, so policies and interventions that specifically target the food environment may provide the most benefit. The archetype approach is thus a significant addition to population health studies and studies of cancer disparities. This approach may be applied to develop neighborhood archetypes for other states, or at a national level.[39]

Supplementary Material

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Abbreviations:

AAPI	Asian American/Pacific Islander
CA	California
CCR	California Cancer Registry
CI	confidence interval
CNDS	California Neighborhoods Data System
ER	estrogen receptor
HR	hazard ratio
ICD	International Classification of Disease
LCA	latent class analysis
NH	non-Hispanic
nSES	neighborhood socioeconomic status
PR	progesterone receptor
SEER	Surveillance, Epidemiology, and End Results
U.S.	United States

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Highlights

- Latent class analysis was used to classify California neighborhoods according to nine archetypes that distinguish neighborhoods according to demographics and household composition, immigration, nSES, walkability, residential mobility, commuting, rural/urban status, land use, and food environment.
- Disparities in breast cancer survival according to neighborhood archetypes that vary by race/ethnicity were found.
- By describing neighborhood archetypes that differentiate survival following breast cancer diagnosis, the study provides direction for policy and clinical practice addressing contextually-rooted social determinants of health.

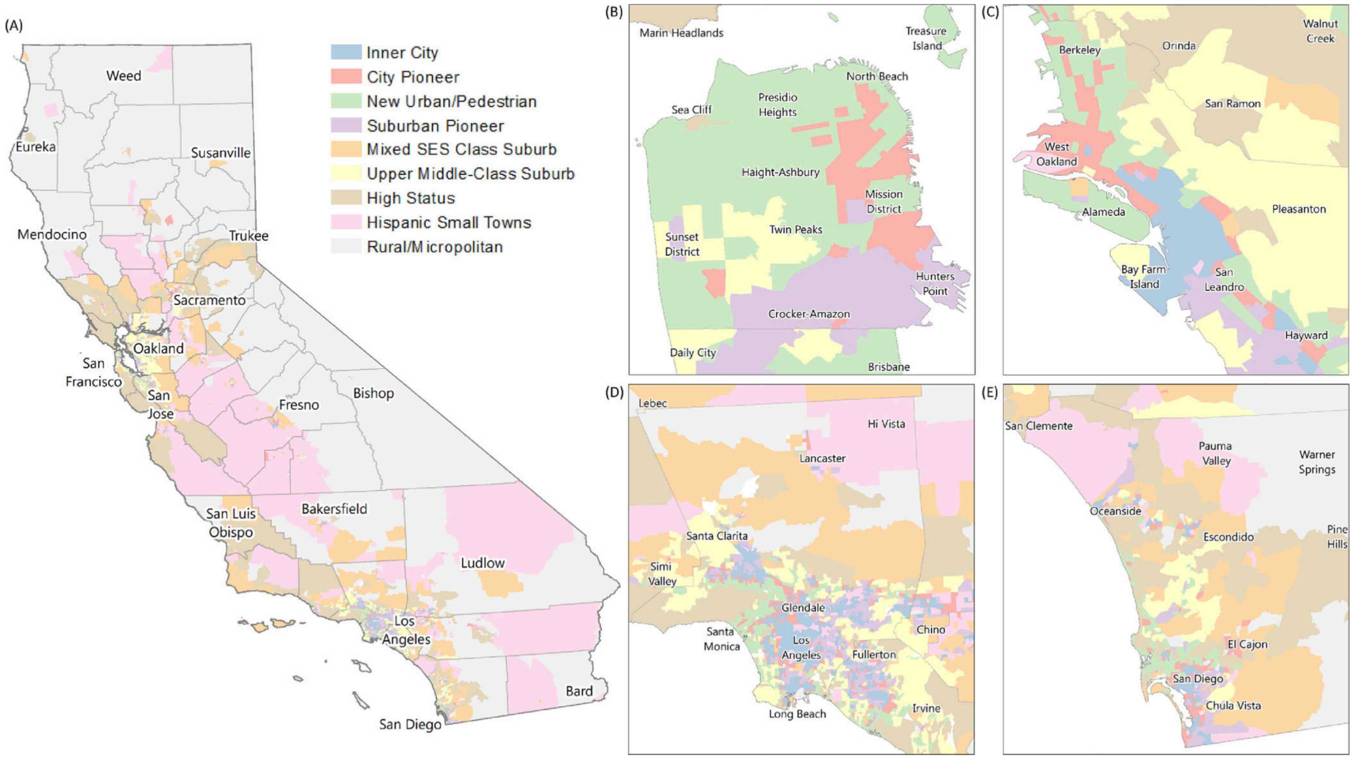

Figure 1. Neighborhood Archetypes in California.

Map of distribution of neighborhood archetypes across census tracts in (A) California and the counties surrounding (B) San Francisco, (C) Oakland, (D) Los Angeles, and (E) San Diego, California 2000. Black lines indicate county boundaries.

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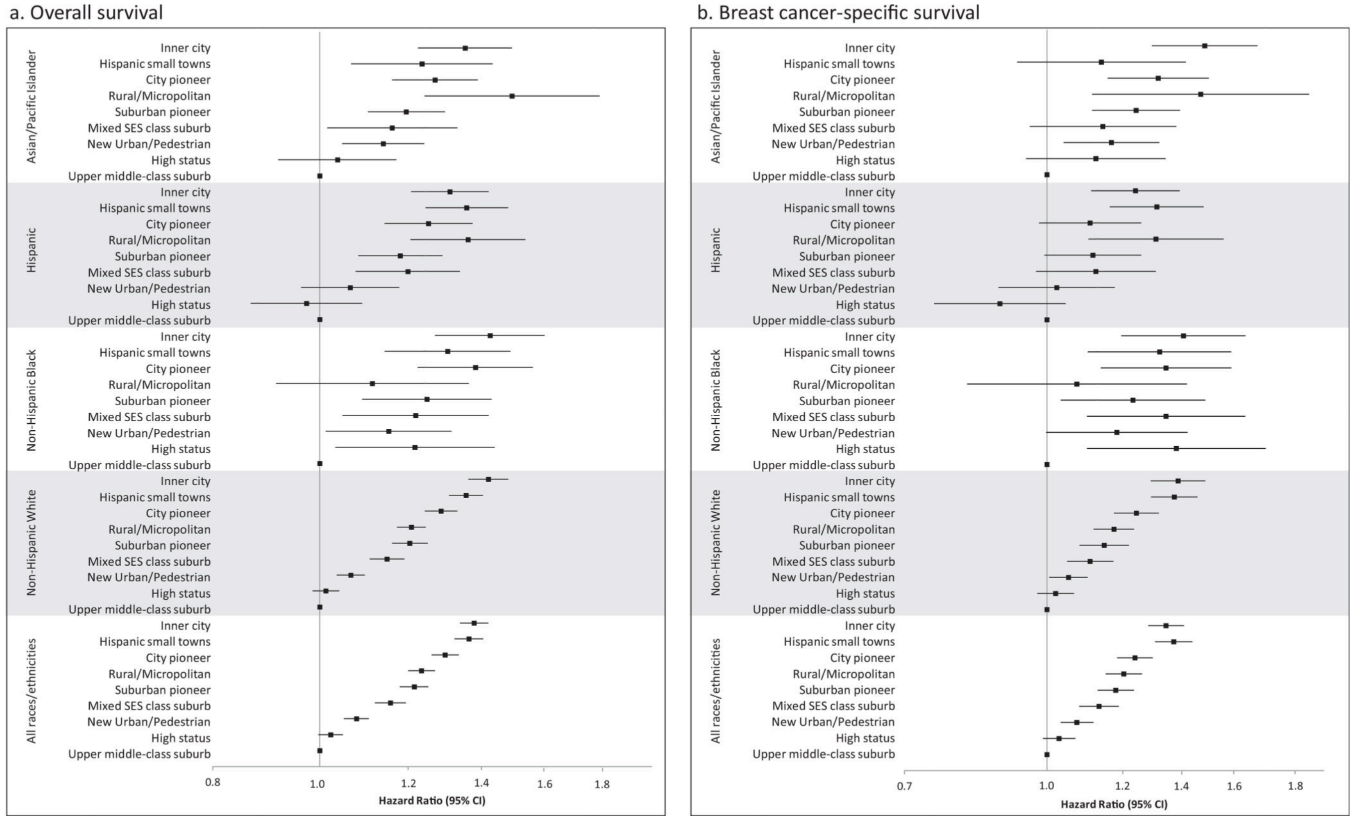

Figure 2. Disparities in Breast Cancer Survival According to Neighborhood Archetypes.

Hazard ratios (HRs, black circles) and 95% confidence intervals (CIs, black horizontal lines) for (a) overall survival and (b) breast cancer-specific survival for 9 neighborhood archetypes by among women of all races/ethnicities; non-Hispanic (NH) White, NH Black, Hispanic, and Asian American/Pacific Islander (AAPI) women diagnosed with breast cancer, California 1996–2005. The Upper middle-class suburb archetype serves as the reference category (HR, 1.00). This fully adjusted model includes age at diagnosis, year of diagnosis, SEER summary stage, histology, grade, ER status, PR status, chemotherapy, radiation, surgery, marital status and cluster effect by census tract.

Table 1.

9 neighborhood archetypes: census tract frequency, population coverage, and description across neighborhood domains, California 2000[a]

9-class archetype	Census tracts[b]	CA Population[c]	Rural/ urban status	nSES	Demographics	Households and housing	Mobility	Land use	Commuting and streets	Food
	N (%)	N(%)								
Upper middle-class suburb	846 (12.1%)	4,172,910 (12.3%)		High	White/AAPI	Midlife Fewer female-hiaded households Ownership	Low	Greenspace Recreation	Low connectivity	
High status	814 (11.6%)	3,542,270 (10.5%)		High	White	Older		Greenspace Recreation		Healthy
New urban/ Pedestrian	926 (13.2%)	4,205,539 (12.4%)	Downtown		Diverse (but not Hispanic)	Young Singles	High	Mixed land use	High traffic	
Mixed SES class suburb	553 (7.9%)	2,602,528 (7.7%)				Families		Some mixed use Recreation	More commuting Low connectivity Low traffic	Healthy
Suburban pioneer	699 (10.0%)	3,639,948 (10.8%)	City/not downtown	Middle	Diverse race/ ethnicity, immigration, and language	Families Ownership		Mixed land use		
Rural/ Micropolitan	537 (7.7%)	2,368,327 (7.0%)	Rural	Low	White	Older Single headed-households Vacants			Low traffic	
City pioneer	781 (11.1%)	3,669,614 (10.9%)	City/not downtown	Lower - middle	Diverse race/ ethnicity, immigration, and language	Older Single headed households Female headed households	High	Mixed land use	High traffic	
Hispanic small towns	7GB (10.1%)	3,BBG,385 (1G.8%)		Lower - middle	Hispanic			Some mixed use Less greenspace	Less commuting Low traffic	Unhealthy
Inner city	1146 (16.4%)	5,946,354 (17.6%)	Urban	Low	Black and Hispanic	Rentals Vacants				Unhealthy

[a] The 9-class neighborhood archetype fit model employed data from the Census 2000 year and estimated respective goodness of fit statistics.

[b] The total number of California census tracts represented in 2000 was 7008.

[c] The total California population represented in 2000 was 33,807,875.

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Table 2.

Distribution of demographic and tumor characteristics for women with breast cancer according to 9-class neighborhood archetypes, California 1996–2005

	Total	Upper-middle-class suburb	High status	New urban/ Pedestrian	Mixed-SES class suburb	Suburban pioneer	Rural/ Micropolitan	City pioneer	Hispanic small town	Inner city
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Total	176,097	27,370	30,217	26,032	13,043	15,561	17,282	16,597	13,883	16,112
Race/Ethnicity										
NH White	70.3%	71.8%	90.1%	77.7%	77.7%	48.3%	90.4%	59.9%	61.1%	31.1%
NH Black	6.0%	3.0%	1.5%	4.6%	4.8%	6.7%	1.4%	11.8%	8.1%	19.5%
Hispanic	13.5%	7.7%	4.2%	6.9%	11.0%	24.0%	5.3%	15.7%	26.1%	39.3%
AAPI	9.4%	16.9%	3.6%	10.1%	5.8%	20.3%	1.7%	11.8%	3.8%	9.5%
Other	0.7%	0.5%	0.6%	0.7%	0.7%	0.6%	1.1%	0.9%	0.9%	0.6%
Age at diagnosis (years)										
16–34	2.2%	1.9%	1.2%	2.5%	2.4%	2.7%	1.1%	2.6%	2.4%	3.8%
35–44	11.7%	13.1%	8.8%	11.3%	14.0%	13.5%	7.4%	11.8%	12.6%	15.1%
45–54	23.4%	26.4%	22.1%	23.4%	26.9%	24.2%	18.6%	22.2%	22.0%	24.5%
55–64	23.0%	24.9%	24.4%	21.6%	23.4%	22.4%	22.1%	21.3%	22.9%	21.8%
65–79	29.5%	26.7%	31.8%	28.5%	26.2%	28.5%	36.6%	29.6%	30.4%	26.4%
80+	10.4%	7.0%	11.7%	12.7%	7.0%	8.6%	14.2%	12.5%	9.6%	8.4%
Year of diagnosis										
1996	9.2%	9.0%	9.3%	9.6%	7.8%	9.3%	9.6%	9.5%	9.3%	9.4%
1997	9.4%	9.2%	9.5%	9.6%	8.4%	9.5%	9.7%	9.7%	9.3%	9.9%
1998	9.9%	9.8%	10.1%	10.4%	9.4%	9.7%	10.0%	9.8%	9.6%	9.4%
1999	10.2%	10.2%	10.5%	10.4%	9.7%	9.9%	10.5%	10.1%	10.1%	10.0%
2000	10.3%	10.4%	10.5%	10.4%	10.0%	9.9%	10.2%	9.9%	10.0%	10.4%
2001	10.4%	10.2%	10.6%	10.4%	10.6%	10.5%	10.3%	10.5%	10.4%	10.2%
2002	10.5%	10.8%	10.3%	10.1%	10.7%	11.0%	10.7%	10.6%	10.4%	10.1%
2003	9.9%	10.1%	9.7%	9.7%	10.7%	9.7%	9.6%	9.9%	10.4%	9.7%
2004	9.9%	10.1%	9.5%	9.5%	10.8%	10.1%	9.7%	9.8%	10.0%	10.5%
2005	10.2%	10.1%	10.0%	9.8%	11.9%	10.4%	9.8%	10.2%	10.5%	10.4%
Histology										
Ductal	71.6%	71.9%	70.7%	70.0%	72.8%	73.0%	71.7%	71.2%	73.9%	71.7%
Lobular	17.4%	18.9%	19.8%	19.2%	16.8%	16.0%	16.2%	16.1%	14.8%	14.5%
IBC	9.5%	8.1%	8.4%	9.5%	8.9%	9.5%	10.6%	10.9%	9.6%	11.6%
Other	1.4%	1.1%	1.0%	1.2%	1.5%	1.6%	1.4%	1.8%	1.6%	2.2%
SEER summary stage										

	Total	Upper-middle-class suburb	High status	New urban/Pedes trian	Mixed-SES class suburb	Suburban pioneer	Rural/Microp olitan	City pioneer	Hispanic small town	Inner city
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Localized	60.9%	62.7%	65.3%	61.7%	60.2%	58.8%	62.9%	58.2%	58.3%	53.7%
Regional	32.6%	32.4%	29.7%	31.9%	34.0%	34.6%	29.7%	33.5%	34.0%	37.0%
Distant	4.2%	3.4%	3.3%	4.4%	3.6%	4.3%	3.7%	5.3%	5.1%	6.0%
Unknown	2.3%	1.5%	1.8%	2.1%	2.1%	2.2%	3.6%	3.0%	2.6%	3.3%
Grade[b]										
I	19.7%	21.0%	23.0%	21.3%	19.3%	17.2%	21.7%	17.3%	17.1%	13.6%
II	36.7%	38.5%	39.2%	37.7%	35.8%	36.0%	35.5%	35.7%	34.4%	33.3%
III & IV	32.1%	30.7%	27.5%	30.3%	33.4%	35.8%	28.6%	34.9%	34.7%	40.4%
Unknown	11.5%	9.8%	10.2%	10.7%	11.6%	11.0%	14.2%	12.1%	13.8%	12.7%
ER Status										
Positive	64.7%	68.6%	69.4%	69.3%	63.8%	61.6%	62.5%	62.8%	58.5%	55.0%
Negative	17.6%	16.8%	14.9%	15.8%	19.4%	19.8%	15.9%	18.8%	20.0%	21.7%
Borderline	0.2%	0.2%	0.2%	0.2%	0.3%	0.2%	0.3%	0.2%	0.3%	0.3%
Unknown	17.5%	14.4%	15.5%	14.7%	16.4%	18.4%	21.2%	18.2%	21.2%	23.1%
PR Status										
Positive	53.2%	56.6%	57.6%	57.2%	52.9%	49.9%	52.1%	51.2%	48.5%	43.6%
Negative	25.8%	25.3%	24.2%	24.6%	26.8%	27.2%	24.3%	26.8%	27.5%	28.2%
Borderline	0.6%	0.6%	0.7%	0.6%	0.8%	0.5%	1.0%	0.6%	0.6%	0.6%
Unknown	20.4%	17.5%	17.5%	17.6%	19.5%	22.4%	22.6%	21.4%	23.3%	27.6%
Surgery										
No surgery	5.5%	4.1%	4.3%	6.1%	4.3%	5.3%	5.4%	7.5%	5.7%	8.3%
Lumpectomy	24.3%	25.3%	25.7%	24.9%	25.2%	23.5%	23.4%	23.5%	22.9%	21.6%
Mastectomy	57.9%	58.2%	57.8%	57.0%	59.8%	58.0%	58.4%	56.9%	57.8%	57.3%
Other surgeries/Unknown	12.4%	12.4%	12.1%	1.9%	10.8%	13.2%	12.7%	12.1%	13.5%	12.8%
Chemotherapy										
No	59.3%	56.2%	64.1%	61.7%	53.7%	55.7%	65.3%	59.9%	56.4%	54.8%
Yes	38.6%	42.3%	34.2%	36.8%	44.0%	42.1%	32.0%	37.8%	40.7%	42.0%
Unknown	2.1%	1.6%	1.7%	1.5%	2.3%	2.2%	2.6%	2.3%	2.9%	3.2%
Radiation										
No	51.8%	46.8%	48.5%	48.8%	49.1%	54.5%	55.2%	55.0%	55.3%	60.9%
Yes	48.2%	53.2%	51.5%	51.2%	50.8%	45.5%	44.8%	44.9%	44.7%	39.0%
Unknown	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%
Marital Status										

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	Total	Upper-middle-class suburb	High status	New urban/ Pedestrian	Mixed-SES class suburb	Suburban pioneer	Rural/ Micropolitan	City pioneer	Hispanic small town	Inner city
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Single	12.8%	8.9%	9.6%	18.7%	8.0%	13.0%	8.5%	18.3%	10.9%	20.0%
Married	56.0%	67.6%	62.2%	46.7%	65.2%	56.7%	56.3%	42.3%	55.3%	45.9%
Separated/ Divorced/ Widowed	28.8%	21.6%	26.4%	31.9%	24.5%	27.7%	33.2%	36.6%	31.3%	30.4%
Unknown	2.4%	1.9%	1.8%	2.6%	2.3%	2.6%	2.0%	2.8%	2.5%	3.7%

[a]. NH, Non-Hispanic; AAPI, Asian American/Pacific Islander; IBC, inflammatory breast cancer; ER, estrogen receptor; PR, progesterone receptor

[b]. Grade I: Grade I or well differentiated; Grade II: Grade II or moderately well differentiated; Grade III: Grade III, Grade IV or poorly differentiated/undifferentiated/ anaplastic

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