Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

Impact of Social and Built Environment Factors on Body Size among Breast Cancer Survivors: The Pathways Study

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Abstract

Background: As social and built environment factors have been shown to be associated with physical activity, dietary patterns, and obesity in the general population, they likely also influence these health behaviors among cancer survivors and thereby impact survivorship outcomes.

Methods: Enhancing the rich, individual-level survey and medical record data from 4,505 breast cancer survivors in the Pathways Study, a prospective cohort drawn from Kaiser Permanente Northern California, we geocoded baseline residential addresses and appended social and built environment data. With multinomial logistic models, we examined associations between neighborhood characteristics and body mass index and whether neighborhood factors explained racial/ethnic/nativity disparities in overweight/obesity.

Results: Low neighborhood socioeconomic status, high minority composition, high traffic density, high prevalence of commuting by car, and a higher number of fast food restaurants were independently associated with higher odds of overweight or obesity. The higher odds of overweight among African Americans, U.S.-born Asian Americans/Pacific Islanders, and foreign-born Hispanics and the higher odds of obesity among African Americans and U.S.-born Hispanics, compared with non-Hispanic whites, remained significant, although somewhat attenuated, when accounting for social and built environment features.

Conclusions: Addressing aspects of neighborhood environments may help breast cancer survivors maintain a healthy body weight.

Impact: Further research in this area, such as incorporating data on individuals' perceptions and use of their neighborhood environments, is needed to ultimately inform multilevel interventions that would ameliorate such disparities and improve outcomes for breast cancer survivors, regardless of their social status (e.g., race/ethnicity, socioeconomic status, nativity). *Cancer Epidemiol Biomarkers Prev; 26(4); 505–15. ©2017 AACR.*

See all the articles in this *CEBP Focus* section, "Geospatial Approaches to Cancer Control and Population Sciences."

Introduction

As social and built environment factors have been shown to be associated with physical activity, dietary patterns, and obesity in the general population (1–4), these neighborhood factors likely also influence these health behaviors among cancer survivors, impacting survivorship outcomes including patient-reported outcomes, disease recurrence, and mortality. Neighborhoods can influence health outcomes through environmental exposures, material deprivation (e.g., inadequate housing), psychosocial mechanisms (e.g., stress and social support), health behaviors (e.g., physical activity, smoking, diet), and access to resources (5–9). The built environment, that is, the man-made attributes of a neighborhood, provides the context for individuals to engage in healthful behaviors. For example, street connectivity, traffic density, parks, businesses, or the food environment may influence opportunities or create barriers for physical activity or healthful food choices. In addition, neighborhood socioeconomic status (nSES) as well as demographic and social environment characteristics of the neighborhood have been associated with opportunities for education, employment, social support, collective efficacy, stress and coping, health behaviors, prognostic factors, and ultimately health outcomes (5, 6, 8).

The recognition of the importance of neighborhood context is illustrated in several conceptual frameworks that emphasize the relevance of factors at multiple levels impacting outcomes across the cancer continuum (10, 11). Yet few studies of outcomes across the cancer continuum have considered the influence of social and built neighborhood environments, and to date, only 7 published studies have examined and found significant associations between neighborhood characteristics and cancer survivorship outcomes including self-rated health and behavioral factors (reviewed in ref. 12).

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Note: Supplementary data for this article are available at Cancer Epidemiology, Biomarkers & Prevention Online (http://cebp.aacrjournals.org/).

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doi: 10.1158/1055-9965.EPI-16-0932

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

We recently found an association of nSES with breast cancer survival after accounting for individual education and other prognostic factors (13, 14), suggesting an independent effect of nSES, or other neighborhood factors related to nSES, on survival. The nSES associations with overall mortality were stronger in some racial/ethnic groups [i.e., African Americans, Hispanics, and Asian Americans/Pacific Islanders (AAPI)] than in others [i.e., non-Hispanic (NH) whites], and associations between nSES and breast cancer–specific mortality were seen only for AAPI women (14, 15). In addition to nSES, prior studies have also shown neighborhood ethnic composition, ethnic enclave, or racial/ethnic residential segregation to be independently associated with breast cancer mortality (16–22). Together, these findings point to the relevance of neighborhood factors in breast cancer survival and the importance of distinguishing effects among racial/ethnic groups and in combination with patient-level factors.

With this motivation, we incorporated small area-level neighborhood social and built environment data from the California Neighborhoods Data System (23) into the Pathways Study, a prospective cohort study of 4,505 women with incident breast cancer in the Kaiser Permanente Northern California (KPNC) integrated health care system. Here, we describe associations between baseline neighborhood social and built environment factors and body size (overweight/obesity), as being overweight or obese may lead to worse breast cancer survival (24–27). We capitalize on the diversity in Pathways to focus on racial/ethnic differences in these associations.

Materials and Methods

Study sample and data collection

The Pathways Study is designed to examine the effects of lifestyle, use of complementary and alternative therapies, and molecular and biologic factors on cancer outcomes, while considering factors known to influence prognosis. From 2006 through 2013, women with invasive breast cancer were identified from computerized pathology reports and recruited into the study on average within 2 months of diagnosis. In addition to baseline and follow-up questionnaire data, the study also collected biologic specimens at baseline and updated vital status and clinical data from KPNC electronic data sources, including the KPNC Cancer Registry. Ninety-seven percent of the participants were residents of the San Francisco Bay Area (75%) and Sacramento (22%) metropolitan regions. Detailed information on the study design and the cohort has been previously published (28).

The baseline data collection included interviewer- and self-administered questionnaires, with information on demographics, reproductive and family histories, lifestyle, and other factors. All women who participated in this study provided informed consent upon enrollment. The study protocol was approved by the Institutional Review Boards of all of the participating institutions.

Geocoding

Residential address at baseline was geocoded to latitude and longitude coordinates and then assigned a 2010 Census block group. Addresses were standardized to conform to U.S. Postal Service specifications using ZP4 software (ZP4; Semaphore Corp., 2011). ZP4 is software certified by the U.S. Postal Service that uses official USPS databases to correct, standardize, confirm, and validate addresses, which can greatly improve geocoding success. Batch geocoding was performed using ArcGIS with both current address point and street geocoding reference files (ArcGIS; Environmental Systems Research Institute, Inc., 2011). Manual review was performed to geocode addresses that did not batch geocode, resulting in 97% of all Pathways addresses being assigned latitude and longitude coordinates. The 151 addresses that could not be geocoded were post office box addresses. The total geocoded sample size was 4,354. Sixty-seven percent of block groups had one Pathways participant, 23% had 2, and 10% had 3 or more.

Neighborhood measures of the social and built environment

As Pathways patients were recruited from 2006 to 2013, we used neighborhood data anchored around the 2010 Census (see Table 1). At the block group level, we included measures of nSES, population density, racial/ethnic composition, street connectivity, and urban/rural status. nSES was measured with a composite measure using American Community Survey (ACS) data on the basis of 7 indicator variables at the census block group level (29, 30). Population density (the number of people per square meter), percentage of racial/ethnic population, and urban/rural status were derived from 2010 Census data. Street

Table 1. Description of neighborhood social and built environment measures

Contextual data	Data source	Description of measure
Socioeconomic status	2007–2011 ACS (29)	Block group-level composite measure for income, education, poverty, employment, occupation, housing, and rent values (53)
Racial/ethnic composition	U.S. Census 2010 short-form data (54)	Block group-level measures of % of each racial/ethnic group
Immigration/acculturation characteristics	2007–2011 ACS	Block group-level measures of residential composition on % foreign-born; tract-level measure of ethnic enclave (Hispanic, Asian)
Population density	U.S. Census 2010 short-form data	Block group-level measures of population size per square mile
Urbanization (rural/urban)	U.S. Census 2010 short-form data	Block group-level composite measure based on census defined urbanized area, population size, and population density
Businesses	Dunn & Bradstreet annual business listings (1990–2008), via Walls & Associates (35)	Residential buffer (1,600 m) measures of total businesses, total number of recreational facilities, retail food environment index (38), and restaurant environment index
Commuting by car	2007–2011 ACS	Tract-level measures of proportion of population who drive to work (car, motorcycle, taxicab, and other)
Street connectivity	NAVTEQ (32)	Block group-level measure of walkability, using the gamma index (31)
Parks	NAVTEQ (32)	Residential buffer (1,600 m) measure of total number of parks
Farmer's markets	California Department of Food and Agriculture (36)	Tract-level counts of farmers' markets
Traffic density	California Department of Transportation (33)	Residential buffer (500 m) measure of volume of traffic (34)

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connectivity was measured using Gamma, the ratio of actual number of street segments to maximum possible number of intersections, with a higher ratio indicating more street connectivity (i.e., more walkable neighborhoods) and was derived using NavTeq's NavStreets dataset (31, 32). The level of urbanization was developed from census-defined variables for urbanized areas, urban clusters, population and population density and has 5 categories to capture the range of neighborhoods in the urban/rural spectrum: metropolitan urban (highest quartile of population density within a census-defined urbanized area with a population of one million or more), metropolitan suburban (the rest of the population within an urbanized area with a population of one million or more), city (census-designated places with >50,000 people outside of a metropolitan area with a population of one million or more), town (places with <50,000 people, outside of an urbanized area, and not the lowest quartile of population density), and rural (places with <50,000 people, outside of an urbanized area, and in the lowest quartile of population density).

The percentage of the population that was foreign-born was not available at the census block group level from ACS data; therefore, we used the census tract measure. Similarly, for stable measures of commuting, including percent of residents commuting to work by car (including taxicab, motorcycle and other), we used tract-level ACS data.

We created a series of racial/ethnic composition variables on the basis of the block group population being above or below statewide median for each of the 3 nonwhite racial/ethnic groups (African American, Hispanic, and AAPI). We combined these variables into mutually exclusive categories as follows: above median for all 3 groups (predominantly minority neighborhoods), above AAPI median only, above AAPI and African American medians, and all other combinations.

Several neighborhood features were developed on the basis of residential buffers. Data on traffic counts from the California Department of Transportation (33) were used to obtain traffic density within a 500-meter buffer of each participant's residence (34). Neighborhood amenities were based on business listings from Walls & Associates' National Establishment Time-Series Database (35), farmers' markets listings from the California Department of Food and Agriculture (36), and parks from NavTeq's NavStreets database. Using the ArcGIS software, neighborhood amenities within a 1,600-meter pedestrian network distance (37) from a participant's residence at baseline interview were averaged over a 4-year window of 2005–2008 (the latest available business data for this study). The average number of recreational facilities included places where recreational activities could take place (e.g., fitness centers, sports clubs). The Restaurant Environment Index (REI) is the ratio of the average number of fast food restaurants to other restaurants, and the Retail Food Environment Index (RFEI; ref. 38) is the ratio of the average number of convenience stores, liquor stores, and fast food restaurants to supermarkets and farmers' markets.

Quintiles/quartiles for neighborhood measures were based on either distributions in California (nSES, population density, racial/ethnic composition, percentage of foreign-born) or among study participants (street connectivity, commuting by car, traffic density, businesses, recreational facilities). RFEI was categorized into neighborhoods with no unhealthy food outlets (ratio = 0), fewer unhealthy versus healthy outlets (ratio < 1), equal or more unhealthy versus healthy outlets (ratio $\geq$ 1), and neighborhoods without any retail food outlets. REI was categorized so that 0 indicates a neighborhood with no fast food restaurants; for neighborhoods with fast food restaurants, we used the median value of the ratio of fast food to other restaurants to split the sample into those living in neighborhoods with relatively fewer fast food to other restaurants, and those living in neighborhoods with relatively more fast foods to other restaurants, where the latter includes those who have a numerator value >0 and a denominator = 0.

Individual-level characteristics

In the baseline questionnaire, women were asked to report their race/ethnicity, nativity, education level, and annual household income. For these analyses, we combined the race/ethnicity and nativity variable into a single variable resulting in eight racial/ethnic/nativity groups: NH white, African American, AAPI/foreign-born, AAPI/U.S.-born, Hispanic/foreign-born, Hispanic/U.S.-born, and Other. The numbers of foreign-born NH white and African Americans were too small to examine separately (8.6% and 5.2%, respectively). We also combined education (1, $\leq$high school; 2, some college; 3, college graduate; 4, postgraduate) and income (1, <\$25,000; 2, \$25,000–\$49,000; 3, \$50,000–89,000; 4, $\geq$\$90,000) into an individual-level summary SES variable with possible values ranging from 2 to 8. Lowest scores (2 and 3) combined the lowest education and income group. The highest score (8) was obtained in women in both the highest income and highest education categories. We also included a measure of self-reported physical activity at baseline, categorized as quartiles of metabolic hours per week of moderate/vigorous leisure time activities.

BMI is the primary outcome of interest, calculated from self-reported height and weight at baseline as weight (kilograms) divided by squared height (meters): underweight/normal (BMI < 25 kg/m^2), overweight (25–29.9 kg/m^2), and obese ($\geq$30 kg/m^2). For AAPIs, we used the WHO Asian–specific cutoff points where underweight/normal, overweight, and obese are defined as <23, 23.0–27.4, and $\geq$27.5, respectively (39, 40).

Analysis

Our analytic sample included 4,312 women, after excluding participants with addresses that could not be geocoded and 42 participants with unknown BMI. For all other variables with missing responses, we created a missing category to preserve our sample size. For ordinal variables with missing responses, such as the neighborhood attributes, we did not include the missing category when testing for trends. We used multinomial logistic regression to calculate adjusted ORs and 95% confidence intervals (CI) of the social and built environment features for overweight and obese compared to normal weight and underweight women. Covariates and neighborhood characteristics that were significant at $P < 0.05$ in minimally adjusted (age at diagnosis, race/ethnicity/nativity, and individual SES) models were included in the multivariable models. Tests for linear trend were used to evaluate associations between body size and increasing ordinal categories of neighborhood characteristics (41). $P < 0.05$ was considered statistically significant, and all tests of significance were 2-sided.

To examine whether observed racial/ethnic/nativity disparities in overweight or obesity was explained when accounting for social and built environment features of the residential neighborhood, we used a series of multinomial logistic regression models: (i) minimally adjusted models including race/ethnicity/nativity, age,

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

marital status, and physical activity; (ii) model 1 + individual-level SES; (iii) model 2 + nSES; and (iv) model 3 + social and built environment characteristics that were associated with BMI in minimally adjusted models. Analyses were conducted in SAS Version 9.4 using PROC GLIMMIX (SAS Institute Inc.). We used this method for modeling to account for clustering within block groups. We also checked for multicollinearity with a weighted regression model (as explained at http://support.sas.com/kb/32/471.html) but did not find evidence of it.

Results

The majority of Pathways Study participants were older than 50 years at diagnosis (78%), NH white race/ethnicity (64%), had at least some college education (84%), had a household income of at least $50,000 (59%), and were married or living as married (61%; Table 2). One third of participants worked full-time (34%) and almost another third were retired (31%).

Study participants resided in 2,933 unique block groups. The majority of study participants resided in neighborhoods that were in the highest 2 statewide quintiles of SES (63%; Table 3). Thirty-three percent of the women resided in neighborhoods where the percentage of AAPI and African American residents was higher than the state median and another 22% resided in neighborhoods where the percentage of AAPI was higher than the state median. Most participants resided in neighborhoods with lower proportions of foreign-born residents (72%). Just more than half of participants resided in block groups in the lowest 2 categories of population density (57%). Forty-two percent lived in neighborhoods where the number of unhealthy food outlets outnumbered healthy ones and the majority resided within a 1,600-m walking network distance of one or more parks (74%).

The neighborhood characteristics for the study participants stratified by race/ethnicity/nativity are shown in Supplementary Table S1. The distribution of neighborhood characteristics varied considerably by race/ethnicity and nativity among Hispanics and AAPIs. For example, nearly half of U.S.-born AAPIs lived in the highest nSES quintile, compared with fewer than 20% among African Americans and among foreign-born Hispanics on the other extreme. Generally, individuals were more likely to live in neighborhoods with similar racial/ethnic composition as their own race/ethnicity. More than one third of African Americans and foreign-born Hispanics lived in the highest quartile of population density, compared with 12% among whites and 8% among those of other races/ethnicities.

Neighborhood factors associated with overweight

Several social and built environment attributes were associated with overweight compared to normal/underweight, when modeled on their own with adjustment for race/ethnicity/nativity, individual-level SES, and age at diagnosis. Lower neighborhood SES was associated with overweight (Q1/lowest nSES compared to Q5: OR, 1.31; 95% CI, 0.85–2.01; $P_{\text{trend}} = 0.017$; Table 4, Model 1). Certain neighborhood racial/ethnic compositions were associated with higher odds of overweight: those with higher than statewide median percentages of AAPIs, African Americans, and Hispanics (OR, 1.54; 95% CI, 1.14–2.08) and those with higher than statewide median percentages of AAPIs and African Americans (OR, 1.31; 95% CI, 1.04–1.65) compared with neighborhoods with percentages of AAPIs, African Americans, and Hispanics that were lower than the statewide median. In addition, the following neighborhood characteristics were associated with overweight: higher traffic density (Q1/highest % traffic density vs. Q5: OR, 1.26; 95% CI, 0.99–1.60; $P_{\text{trend}} = 0.04$); higher proportion of workers commuting by car (Q1/highest %

Table 2. Individual characteristics for breast cancer survivors with geocoded addresses ($N = 4,354$)

Individual characteristics	*n* (%)
BMI[a]	
Underweight	45 (1.0)
Normal weight	1,404 (32.2)
Overweight	1,352 (31.1)
Obese	1,511 (34.7)
Unknown	42 (1.0)
Age at breast cancer diagnosis, y	
<50	960 (22.0)
50–59	1,271 (29.2)
60–69	1,252 (28.8)
>70	871 (20.0)
Race/ethnicity and nativity	
White, NH	2,786 (64.0)
African American	348 (8.0)
AAPI, foreign-born	423 (9.7)
AAPI, U.S.-born	141 (3.2)
Hispanic, foreign-born	228 (5.2)
Hispanic, U.S.-born	314 (7.2)
Other	114 (2.6)
Educational level	
High school or less	688 (15.8)
Some college	1,510 (34.7)
College graduate	1,204 (27.7)
Post-graduate	942 (21.6)
Unknown	10 (0.2)
Household income	
<$25,000	404 (9.3)
$25,000–49,000	802 (18.4)
$50,000–89,000	1,227 (28.2)
≥$90,000	1,351 (31.0)
Unknown	570 (13.1)
Combined education + income (individual-level SES)[b]	
1: lowest SES	462 (10.6)
2	582 (13.4)
3	789 (18.1)
4	750 (17.2)
5	730 (16.8)
6: highest SES	469 (10.8)
Unknown	572 (13.1)
Employment status	
Full-time	1,452 (33.3)
Part-time	517 (11.9)
Unemployed	188 (4.3)
Retired	1,347 (30.9)
On disability	408 (9.4)
Other	238 (5.5)
Unknown	204 (4.7)
Marital status	
Married or living as married	2,653 (60.9)
Widowed	489 (11.2)
Separated/divorced	841 (19.3)
Single	353 (8.1)
Unknown	18 (0.4)

NOTE: Pathways study, KPNC, 2006–2013.

[a]BMI for Asians were defined using Asian-specific cutoff points from WHO.

[b]Combined education and income variable created by adding education value 1–4 and income value 1–4. Baseline education: 1, ≤high school; 2, some college; 3, college graduate; 4, post-graduate. Baseline income: 1, <$25,000; 2, $25,000–49,000; 3, $50,000–89,000; 4, ≥$90,000. Possible values 2 through 8. Lowest scores (2 and 3) combined for the lowest education and income group. Reference group score 8, women in both the highest income and highest education categories.

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

Table 3. Neighborhood characteristics for breast cancer survivors with geocoded addresses ($N = 4,354$)

Neighborhood characteristics	n (%)
nSES, statewide quintiles, (Yang index,[a] block group)	
Quintile 1: lowest nSES	209 (4.8)
Quintile 2	522 (12.0)
Quintile 3	898 (20.6)
Quintile 4	1,278 (29.4)
Quintile 5: highest nSES	1,447 (33.2)
Neighborhood racial/ethnic composition[b] (block group)	
Above state medians for all 3 groups (predominantly minority)	530 (12.2)
Other combinations	682 (15.7)
Above AAPI and African American state medians	1,465 (33.6)
Above AAPI state median	970 (22.3)
Below state medians for all 3 groups	707 (16.2)
Percent of population foreign-born, statewide quintiles (census tract)	
Quintile 1: highest % foreign-born	532 (12.2)
Quintile 2	693 (15.9)
Quintile 3	1,040 (23.9)
Quintile 4	1,066 (24.5)
Quintile 5: lowest % foreign-born	1,023 (23.5)
Population density, statewide quartiles (persons/km^2, block group)	
Quartile 1: lowest population density	1,139 (26.2)
Quartile 2	1,356 (31.1)
Quartile 3	1,112 (25.5)
Quartile 4: highest population density	747 (17.2)
Traffic density,[c] study-specific quintiles (500-m buffer)	
Quintile 1: highest traffic density	871 (20,0)
Quintile 2	871 (20.0)
Quintile 3	871 (20.0)
Quintile 4	871 (20.0)
Quintile 5: lowest traffic density	870 (20.0)
Percent of population commuting by car, study-specific quintiles (census tract)	
Quintile 1: highest % commuting by car	873 (20.1)
Quintile 2	868 (19.9)
Quintile 3	873 (20.1)
Quintile 4	868 (19.9)
Quintile 5: lowest % commuting by car	872 (20.0)
Number of total businesses within 1,600-m walking network distance, study-specific quintiles	
Quintile 1: lowest number of total businesses	871 (20.0)
Quintile 2	867 (19.9)
Quintile 3	874 (20.1)
Quintile 4	871 (20.0)
Quintile 5: highest number of total businesses	871 (20.0)
RFEI[d] within 1,600-m walking network distance	
0	330 (7.6)
<1	1,698 (39.0)
1+	1,836 (42.2)
No businesses of interest	490 (11.3)
REI[e] within 1,600-m walking network distance	
None	1,197 (27.5)
>0 but less than median among those with a value (0.15)	1,383 (31.8)
>0 and above median	1,338 (30.7)
No businesses of interest	436 (10.0)
Number of recreational facilities[f] within 1,600-m walking network distance, sample-specific quintiles	
Quintile 1: lowest (none)	576 (13.2)
Quintile 2: (0.25–0.5)	974 (22.4)
Quintile 3: (0.75–1.25)	1,066 (24.5)
Quintile 4: (1.5–2.5)	889 (20.4)
Quintile 5: highest (2.75+)	849 (19.5)
Number of parks within 1,600-m walking network distance	
None	1,150 (26.4)
1 park	1,149 (26.4)
2 parks	906 (20.8)
3 or more	1,149 (26.4)
Street connectivity—gamma,[g] study-specific quintiles (block group)	
Quintile 1: lowest street connectivity	871 (20.0)
Quintile 2	873 (20.1)
Quintile 3	864 (19.8)
Quintile 4	872 (20.0)
Quintile 5: highest street connectivity	874 (20.1)
Urbanicity[h] (block group)	
Small town/rural	258 (5.9)
City	1,192 (27.4)
Suburban	2,449 (56.2)
Metropolitan urban	455 (10.5)
AAPI enclave index,[i] statewide quintiles (census tract)	
Quintile 1: highest enclave	1,290 (29.6)
Quintile 2	1,043 (24.0)
Quintile 3	899 (20.6)
Quintile 4	722 (16.6)
Quintile 5: lowest enclave	400 (9.2)
Hispanic enclave index,[j] statewide quintiles (census tract)	
Quintile 1: highest enclave	215 (4.9)
Quintile 2	582 (13.4)
Quintile 3	1,091 (25.1)
Quintile 4	1,231 (28.3)
Quintile 5: lowest enclave	1,235 (28.4)

(Continued on the following column)

Table 3. Neighborhood characteristics for breast cancer survivors with geocoded addresses ($N = 4,354$) (Cont'd)

NOTE: Pathways study, KPNC, 2006–2013.

[a]Yang SES index is a composite measure of 7 indicator variables for Census block groups (Liu education index, proportion blue collar job, proportion > 16 years in the workforce without a job, median household income, percent <200% of federal poverty line, median rent, median house value).

[b]Neighborhood racial/ethnic composition is based on the block group population being above or below state median for each nonwhite racial/ethnic group.

[c]Traffic density is based on traffic counts within a 500-m buffer in units of vehicle miles traveled per square mile.

[d]RFEI is a ratio of unhealthy food outlets (fast food restaurants, liquor stores, and convenient stores) to healthy food outlets (grocery stores and farmers' markets). 0 indicates that the neighborhood has no unhealthy food outlets, a ratio of <1 indicates that there are fewer unhealthy food outlets compared with healthy food outlets, whereas a ratio greater than 1 indicates that there are more unhealthy food outlets compared with healthy ones.

[e]REI is a ratio of the average number of fast food restaurants to other restaurants. 0 indicates that the neighborhood has no fast food restaurants; for neighborhoods with fast food restaurants, we used the median value of the ratio of fast food to other restaurants to split the sample into those living in neighborhoods with relatively fewer fast food to other restaurants, and those living in neighborhoods with relatively more fast foods to other restaurants, where the latter includes those who have a numerator value >0 and a denominator = 0.

[f]Recreational facilities included places where recreational activities could take place (e.g., fitness centers, sports clubs, yoga centers, dance schools).

[g]Gamma is the ratio of actual number of street segments to maximum possible number of intersections, with a higher ratio indicating more street connectivity/walkability.

[h]Urbanicity is based on a combination of census-defined metropolitan areas and population density, with 5 categories: metropolitan urban (highest quartile of population density within a census-defined urbanized area with a population of one million or more), metropolitan suburban (the rest of the population within an urbanized area with a population of one million or more), city (census-designated places with >50,000 people outside of a metropolitan area with a population of one million or more), town (places with <50,000 people, outside of an urbanized area, and not the lowest quartile of population density), and rural (places with <50,000 people, outside of an urbanized area, and in the lowest quartile of population density).

[i]AAPI enclave index is a composite measure of 4 indicator variables for census tracts (% recent immigrants, % API language–speaking households that were linguistically isolated, % API language speakers with limited English proficiency, and % API).

[j]Hispanic enclave index is a composite measure of 7 indicator variables for census tracts (% foreign-born, % recent immigrants, % households that were linguistically isolated, % of Spanish language–speaking households that were linguistically isolated, % all language speakers with limited English proficiency, % of Spanish language speakers with limited English proficiency, and % Hispanic).

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

Table 4. ORs for associations between neighborhood characteristics and odds of overweight or obesity among breast cancer survivors ($N = 4,312$)

	Overweight						Obesity					
	Model 1[a]			Model 2[b]			Model 1[a]			Model 2[b]		
Neighborhood characteristics	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**
nSES, statewide quintiles, (Yang index,[c] block group)												
Quintile 1: lowest nSES	1.31	0.85	2.01	0.92	0.57	1.47	**2.32**	**1.55**	**3.47**	1.35	0.86	2.12
Quintile 2	**1.73**	**1.31**	**2.29**	1.38	1.00	1.90	**2.38**	**1.79**	**3.14**	**1.64**	**1.18**	**2.27**
Quintile 3	0.90	0.72	1.12	**0.73**	**0.57**	**0.94**	**1.43**	**1.15**	**1.77**	1.07	0.83	1.39
Quintile 4	1.17	0.97	1.41	1.06	0.86	1.30	**1.52**	**1.25**	**1.85**	**1.28**	**1.03**	**1.59**
Quintile 5: highest nSES (ref)	1.00			1.00			1.00			1.00		
p-trend	**0.017**			0.898			**<0.0001**			**0.046**		
Neighborhood racial/ethnic composition[d] (block groups)												
Above state medians for all 3 groups ((predominantly minority)	**1.54**	**1.14**	**2.08**	**1.50**	**1.03**	**2.19**	**2.03**	**1.50**	**2.75**	1.37	0.93	2.00
Other combinations	**1.45**	**1.10**	**1.91**	**1.42**	**1.04**	**1.94**	**2.13**	**1.62**	**2.79**	**1.66**	**1.21**	**2.28**
Above AAPI and African American state medians	**1.31**	**1.04**	**1.65**	**1.41**	**1.07**	**1.86**	**1.64**	**1.30**	**2.08**	**1.51**	**1.13**	**2.01**
Above AAPI state median	1.11	0.88	1.41	1.15	0.86	1.53	1.17	0.91	1.50	1.21	0.89	1.64
Below state medians for all 3 groups (ref)	1.00			1.00			1.00			1.00		
Percent of population foreign-born, statewide quintiles (census tract)												
Quintile 1: highest % foreign-born	1.08	0.81	1.44	0.84	0.60	1.19	**1.53**	**1.15**	**2.04**	1.18	0.83	1.68
Quintile 2	1.09	0.85	1.41	0.83	0.61	1.12	**1.47**	**1.14**	**1.89**	1.07	0.79	1.45
Quintile 3	0.93	0.75	1.16	**0.74**	**0.58**	**0.96**	1.23	0.98	1.53	0.95	0.73	1.24
Quintile 4	0.96	0.78	1.19	0.82	0.65	1.05	0.99	0.80	1.24	0.85	0.66	1.09
Quintile 5: lowest % of foreign-born (ref)	1.00			1.00			1.00			1.00		
P_{trend}	0.471			0.276			**<0.0001**			0.184		
Population density, statewide quartiles (persons/km^2, block group)												
Quartile 1: lowest population density	0.92	0.72	1.17	0.84	0.59	1.19	0.82	0.64	1.05	0.88	0.62	1.26
Quartile 2	1.02	0.81	1.29	0.90	0.66	1.23	0.95	0.75	1.20	0.85	0.62	1.16
Quartile 3	1.16	0.91	1.48	1.03	0.77	1.37	1.14	0.90	1.45	0.94	0.70	1.26
Quartile 4: highest population density (ref)	1.00			1.00			1.00			1.00		
P_{trend}	0.181			0.181			**0.016**			0.408		
Traffic density,[e] study-specific quintiles (500-m buffer)												
Quintile 1: highest traffic density	1.26	0.99	1.60	**1.36**	**1.00**	**1.85**	1.25	0.98	1.59	1.19	0.87	1.62
Quintile 2	**1.38**	**1.09**	**1.76**	**1.45**	**1.07**	**1.97**	**1.52**	**1.20**	**1.94**	**1.40**	**1.03**	**1.91**
Quintile 3	1.11	0.88	1.41	1.12	0.84	1.49	1.11	0.88	1.41	0.96	0.72	1.29
Quintile 4	1.25	0.99	1.58	1.28	0.99	1.67	**1.34**	**1.05**	**1.70**	1.20	0.92	1.56
Quintile 5: lowest traffic density (ref)	1.00			1.00			1.00			1.00		
P_{trend}	**0.037**			0.053			**0.037**			0.189		
Percent commuting by car, study-specific quintiles (census tract)												
Quintile 1: highest % commuting by car	**1.35**	**1.06**	**1.71**	1.14	0.85	1.54	**1.93**	**1.51**	**2.47**	**1.46**	**1.07**	**1.99**
Quintile 2	1.18	0.94	1.50	1.06	0.80	1.40	**1.42**	**1.11**	**1.82**	1.18	0.88	1.58
Quintile 3	1.16	0.92	1.47	1.05	0.80	1.38	**1.48**	**1.16**	**1.89**	1.30	0.97	1.74
Quintile 4	0.98	0.77	1.23	0.90	0.69	1.17	**1.29**	**1.01**	**1.65**	1.20	0.90	1.58
Quintile 5: lowest % commuting by car (ref)	1.00			1.00			1.00			1.00		
P_{trend}	**0.005**			0.149			**<0.0001**			0.050		
Number of total businesses within 1,600-m walking network distance, study-specific quintiles												
Quintile 1: lowest number of businesses	1.03	0.81	1.29	1.21	0.73	2.00	1.01	0.79	1.29	1.22	0.73	2.03
Quintile 2	1.01	0.79	1.28	0.96	0.64	1.45	**1.44**	**1.13**	**1.83**	1.24	0.82	1.89
Quintile 3	1.10	0.87	1.40	0.87	0.61	1.24	**1.44**	**1.13**	**1.83**	1.06	0.74	1.52
Quintile 4	1.19	0.94	1.50	0.97	0.72	1.31	**1.33**	**1.04**	**1.70**	1.06	0.78	1.45
Quintile 5: highest number of businesses (ref)	1.00			1.00			1.00			1.00		
P_{trend}	0.688			0.690			0.689			0.353		
RFEI within 1,600-m walking network distance[f]												
1+	**1.35**	**1.01**	**1.82**	1.09	0.76	1.56	**1.36**	**1.01**	**1.83**	1.33	0.92	1.90
<1	1.16	0.86	1.55	1.17	0.83	1.64	1.20	0.89	1.62	1.28	0.91	1.81
0 (ref.)	1.00			1.00			1.00			1.00		

(*Continued on the following page*)

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

Table 4. ORs for associations between neighborhood characteristics and odds of overweight or obesity among breast cancer survivors ($N = 4{,}312$) (Cont'd)

	Overweight						Obesity					
	Model 1[a]			Model 2[b]			Model 1[a]			Model 2[b]		
Neighborhood characteristics	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**
No businesses of interest	1.14	0.81	1.60	1.11	0.77	1.61	0.87	0.61	1.24	1.03	0.70	1.51
P_{trend}	**0.016**			0.573			**0.029**			0.306		
REI within 1,600-m walking network distance[g]												
None	1.00			1.00			1.00			1.00		
>0 but less than median among those with a value (0.15)	0.99	0.82	1.21	0.89	0.67	1.18	0.85	0.70	1.04	0.79	0.60	1.04
>0 and above median	**1.42**	**1.16**	**1.74**	1.26	0.98	1.61	**1.29**	**1.06**	**1.58**	1.06	0.83	1.36
No businesses of interest	1.09	0.83	1.42	1.15	0.83	1.61	**0.75**	**0.57**	**0.99**	0.97	0.68	1.38
P_{trend}	**0.001**			**0.028**			**0.011**			0.282		
Number of recreational facilities within 1,600-m walking network distance, study-specific quintiles[h]												
Quintile 1: lowest (none)	1.14	0.88	1.48	1.09	0.71	1.68	1.22	0.93	1.60	1.21	0.78	1.88
Quintile 2 (0.25–0.5)	1.03	0.82	1.30	1.02	0.70	1.47	**1.31**	**1.04**	**1.66**	1.12	0.77	1.64
Quintile 3	1.20	0.95	1.50	1.20	0.86	1.66	**1.46**	**1.16**	**1.84**	1.22	0.87	1.72
Quintile 4	**1.42**	**1.12**	**1.79**	**1.44**	**1.08**	**1.93**	**1.53**	**1.20**	**1.96**	1.33	0.99	1.80
Quintile 5: highest (≥2.75) (ref)	1.00			1.00			1.00			1.00		
P_{trend}	0.820			0.588			0.284			0.801		
Number of parks within 1,600-m walking network distance												
None	0.99	0.81	1.21				0.97	0.79	1.20			
1	1.09	0.88	1.34				1.14	0.92	1.40			
2	1.05	0.84	1.32				1.22	0.98	1.52			
≥3 (ref)	1.00						1.00					
P_{trend}	0.992						0.704					
Street connectivity—gamma,[i] study-specific quintiles (block group)												
Quintile 1: lowest street connectivity	0.97	0.77	1.23				0.87	0.68	1.11			
Quintile 2	1.10	0.86	1.39				1.17	0.92	1.48			
Quintile 3	1.13	0.89	1.44				1.26	0.99	1.60			
Quintile 4	1.15	0.90	1.46				1.23	0.97	1.56			
Quintile 5: highest street connectivity (ref)	1.00						1.00					
P_{trend}	0.644						0.224					
Urbanicity (block group)[j]												
Small town/Rural	0.99	0.66	1.47				1.03	0.70	1.52			
City	1.19	0.90	1.57				1.15	0.87	1.52			
Suburban	1.09	0.84	1.41				1.05	0.81	1.37			
Metropolitan urban (ref)	1.00						1.00					

NOTE: Pathways study, KONC, 2006–2013. $n = 42$ women with missing BMI excluded. Bolded estimates are statistically significant at $P < 0.05$.

[a]Models 1 and 2 adjusted for age at diagnosis, race/ethnicity/nativity, individual SES.

[b]Model 2 additionally adjusted for nSES, neighborhood racial/ethnic composition, percent foreign-born, population density, traffic density, percent commuting to work by car, number of total businesses within 1,600-m walking network distance, RFEI within 1,600-m walking network distance, REI within 1,600-m walking network distance, number of recreational facilities within 1,600-m walking network distance. Neighborhood variables from Model 1 that were not associated with BMI ($P < 0.05$) were not included in Model 2.

[c]Yang SES index is a composite measure of 7 indicator variables for census block groups (Liu education index, proportion blue collar job, proportion > 16 years in the workforce without a job, median household income, percent below 200% of federal poverty line, median rent, median house value).

[d]Neighborhood racial/ethnic composition is based on the block group population being above or below state median for each nonwhite racial/ethnic group.

[e]Traffic density is based on traffic counts within a 500-m buffer in units of vehicle miles traveled per square mile.

[f]Gamma is the ratio of actual number of street segments to maximum possible number of intersections, with a higher ratio indicating more street connectivity/walkability.

[g]RFEI is a ratio of unhealthy food outlets (fast food restaurants, liquor stores, and convenient stores) to healthy food outlets (grocery stores and farmers' markets). 0 indicates that the neighborhood has no unhealthy food outlets, a ratio of <1 indicates that there are fewer unhealthy food outlets compared with healthy food outlets, whereas a ratio greater than 1 indicates that there are more unhealthy food outlets compared with healthy ones.

[h]REI is a ratio of the average number of fast food restaurants to other restaurants. 0 indicates that the neighborhood has no fast food restaurants; for neighborhoods with fast food restaurants, we used the median value of the ratio of fast food to other restaurants to split the sample into those living in neighborhoods with relatively fewer fast food to other restaurants, and those living in neighborhoods with relatively more fast foods to other restaurants, where the latter includes those who have a numerator value >0 and a denominator = 0.

[i]Recreational facilities included places where recreational activities could take place (e.g., fitness centers, sports clubs, yoga centers, dance schools).

[j]Urbanicity is based on a combination of census-defined metropolitan areas and population density, with 5 categories: metropolitan urban (highest quartile of population density within a census-defined urbanized area with a population of one million or more), metropolitan suburban (the rest of the population within an urbanized area with a population of one million or more), city (census-designated places with >50,000 people outside of a metropolitan area with a population of one million or more), town (places with <50,000 people, outside of an urbanized area, and not the lowest quartile of population density), and rural (places with <50,000 people, outside of an urbanized area, and in the lowest quartile of population density).

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

commuting vs. Q5: OR, 1.35; 95% CI, 1.06–1.71; $P_{trend} = 0.01$); higher ratio of unhealthy to healthy food outlets compared with having only healthy food outlets (RFEI $\geq$ 1: OR, 1.35; 95% CI, 1.01–1.82; $P_{trend} = 0.02$); and more fast food restaurants compared with only non–fast food restaurants (REI > median OR, 1.42; 95% CI, 1.16–1.74; P_{trend} = <0.01).

In multivariable models adjusting for all neighborhood factors associated with overweight (Table 4, Model 2), neighborhood racial/ethnic composition, specifically neighborhoods with high minority representation (predominantly minority OR, 1.50; 95% CI, 1.03–2.19; >median for AAPI and African American OR, 1.41; 95% CI, 1.07–1.86), higher traffic density (Q1/highest % traffic density vs. Q5: OR, 1.36; 95% CI, 1.00–1.85; $P_{trend} = 0.04$), and higher number of fast food restaurants (REI > median OR, 1.26; 95% CI, 0.98–1.61; $P_{trend} = 0.03$) remained associated with higher odds of overweight.

Neighborhood factors associated with obesity

When considering social and built environment attributes individually, with adjustment for race/ethnicity/nativity, individual-level SES, and age at diagnosis, several neighborhood attributes were associated with obesity compared with normal/underweight (Table 4, Model 1): lower nSES (Q1/lowest nSES compared with Q5: OR, 2.32; 95% CI, 1.55–3.47; $P_{trend} < 0.01$); higher proportion of foreign-born residents (Q1/highest % foreign-born vs. Q5: OR, 1.53; 95% CI, 1.15–2.04; $P_{trend} < 0.01$); higher traffic density (Q1/highest % traffic density vs. Q5: OR, 1.25, 95% CI, 0.98–1.59; $P_{trend} = 0.04$); higher commuting to work by car (Q1/highest % of commuting by car: OR, 1.93; 95% CI, 1.51–2.47; $P_{trend} < 0.01$); higher ratio of unhealthy to healthy food outlets (RFEI >1 vs. none: OR, 1.36; 95% CI, 1.01–1.38; $P_{trend} = 0.03$); and more fast food restaurants compared with only non–fast food restaurants (REI > median: OR, 1.29; 95% CI, 1.06–1.58; $P_{trend} = 0.01$). Residing in neighborhoods with more businesses and with more recreational facilities was associated with obesity, although no significant trends were observed. Residing in a lower versus higher population density neighborhood was associated with lower odds of being obese (Q1/lowest population density compared with Q5: OR, 0.82; 95% CI, 0.64–1.05; $P_{trend} = 0.02$). In addition, neighborhood racial/ethnic composition was also associated with obesity—those with higher percentage of AAPI, African American, and Hispanic than the statewide median (OR, 2.03; 95% CI, 1.50–2.75) and those with a higher percentage of AAPI and African American (OR, 1.64; 95% CI, 1.30–2.08) compared with those with lower percentages of AAPI, African American, and Hispanic than the statewide median.

In a model including all of the neighborhood variables, residing in a neighborhood with lower SES (Q1/lowest nSES: OR, 1.35; 95% CI, 0.86–2.12; $P_{trend} = 0.05$), higher percentage of AAPIs and African Americans (OR, 1.51; 95% CI, 1.13–2.01), and higher proportion of workers commuting by car (Q1/highest % commuting compared with Q5: OR, 1.46; 95% CI, 1.07–1.99; $P_{trend} = 0.05$) remained associated with higher odds of obesity (Table 4, Model 2).

Racial/ethnic/nativity disparities in body mass index

Using sequential models (Table 5), we show the persistence of racial/ethnic/nativity disparities in overweight and obesity after accounting for individual-level SES (Model 2), nSES (Model 3), and other social and built environment attributes (Model 4). In minimally adjusted models, we observed racial/ethnic disparities in overweight with African Americans (OR, 1.79; 95% CI, 1.26–2.55), AAPIs (foreign-born: OR, 1.31; 95% CI, 1.02–1.68; U.S.-born: OR, 1.67; 95% CI, 1.11–2.52), and foreign-born Hispanics (OR, 1.84; 95% CI, 1.29–2.64) having increased odds of overweight compared with NH whites. Adjusting for individual SES and nSES slightly attenuated these associations; further adjusting for neighborhood features fully attenuated the higher odds observed among foreign-born (OR, 1.25; 95% CI, 0.96–1.63), but not U.S.-born AAPIs, African Americans, and foreign-born Hispanics relative to NH whites.

For obesity, we also observed racial/ethnic disparities in minimally adjusted models with African Americans (OR, 3.50; 95% CI, 2.55–4.80) and Hispanics (foreign-born: OR, 1.50; 95% CI, 1.04–2.16; U.S.-born: OR, 1.80; 95% CI, 1.34–2.43) having higher odds of obesity compared with NH whites; foreign-born AAPIs had lower odds of obesity (OR, 0.71; 95% CI, 0.54–0.94). Additionally adjusting for individual-level SES fully attenuated

Table 5. Associations between race/ethnicity/nativity with odds of being overweight or obese (vs. normal/underweight) among breast cancer survivors ($N = 4{,}312$)

	Model 1: adjusted for age at dx, marital status, and physical activity			Model 2: Model 1 + individual SES			Model 3: Model 2 + neighborhood SES			Model 4: Model 3 + other neighborhood attributes		
Race/ethnicity and nativity	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**	**OR**	**LCI**	**UCI**
Overweight												
White, NH	1.00			1.00			1.00			1.00		
African American	**1.79**	**1.26**	**2.55**	**1.72**	**1.21**	**2.45**	**1.66**	**1.16**	**2.37**	**1.61**	**1.11**	**2.31**
AAPI, foreign-born	**1.31**	**1.02**	**1.68**	**1.30**	**1.02**	**1.68**	**1.31**	**1.02**	**1.69**	1.25	0.96	1.63
AAPI, U.S.-born	**1.67**	**1.11**	**2.52**	**1.73**	**1.15**	**2.63**	**1.76**	**1.16**	**2.66**	**1.78**	**1.16**	**2.72**
Hispanic, foreign-born	**1.84**	**1.29**	**2.64**	**1.70**	**1.18**	**2.44**	**1.64**	**1.14**	**2.36**	**1.55**	**1.06**	**2.25**
Hispanic, U.S.-born	1.35	0.98	1.85	1.27	0.92	1.74	1.26	0.92	1.74	1.23	0.89	1.70
Other	1.05	0.64	1.75	0.98	0.59	1.63	0.92	0.56	1.54	0.88	0.53	1.47
Obesity												
White, NH	1.00			1.00			1.00			1.00		
African American	**3.50**	**2.55**	**4.80**	**3.20**	**2.33**	**4.40**	**2.88**	**2.08**	**3.97**	**2.70**	**1.93**	**3.77**
AAPI, foreign-born	**0.71**	**0.54**	**0.94**	**0.71**	**0.54**	**0.94**	**0.72**	**0.54**	**0.95**	**0.61**	**0.46**	**0.83**
AAPI, U.S.-born	1.03	0.65	1.62	1.11	0.70	1.76	1.16	0.73	1.85	1.11	0.69	1.79
Hispanic, foreign-born	**1.50**	**1.04**	**2.16**	1.26	0.87	1.83	1.17	0.80	1.70	1.04	0.70	1.53
Hispanic, U.S.-born	**1.80**	**1.34**	**2.43**	**1.63**	**1.21**	**2.20**	**1.57**	**1.16**	**2.13**	**1.51**	**1.11**	**2.05**
Other	**1.82**	**1.15**	**2.90**	1.59	1.00	2.54	1.46	0.91	2.33	1.45	0.90	2.34

NOTE: Pathways study, KPNC. $n = 42$ women with missing BMI excluded. Bolded estimates are statistically significant at $P < 0.05$.

Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

the increased odds of obesity among foreign-born Hispanics relative to NH whites. Addition of nSES slightly attenuated the associations for African Americans and U.S.-born Hispanics. Further adjustment for neighborhood factors slightly attenuated associations in African Americans and U.S.-born Hispanics but strengthened associations in foreign-born AAPIs (OR, 0.61; 95% CI, 0.46–0.83).

Discussion

Among a diverse cohort of breast cancer survivors within an integrated healthcare system in Northern California, we found that select neighborhood social and built environment factors, including low nSES, high minority composition, high traffic density, high prevalence of commuting by car, and a higher number of fast food restaurants were independently associated with higher odds of being overweight or obese. These neighborhood features also somewhat attenuated the higher odds of overweight among African Americans, U.S.-born AAPIs, and foreign-born Hispanics and the higher odds of obesity among African Americans and U.S.-born Hispanics, relative to NH whites. However, racial/ethnic/nativity disparities in overweight and obesity persisted, suggesting that additional research is warranted to understand other potential mediating factors. In addition, this is the first study, to our knowledge, that has examined whether social and built environment variables may explain these disparities, and one of the few studies to focus on the role of these environmental factors among breast cancer survivors. As maintaining a healthy body weight is a key modifiable factor for optimizing breast cancer survivorship outcomes, our study suggests that addressing aspects of survivors' neighborhood environments may help lower their risks of recurrence, low quality of life, and poor survival.

Higher BMI is associated with increased disease morbidity and mortality in general (42) and with higher mortality among breast cancer survivors (25, 43–49). As a result, breast cancer survivors are encouraged to achieve and/or maintain a healthy weight after diagnosis (50). Consistent with the broader literature on neighborhoods and obesity, we found that lower nSES, higher minority racial/ethnic composition, higher traffic density, higher commuting by car, and more fast food restaurants were associated with being overweight or obese (3, 51). In the breast cancer literature, only 2 studies, both from our group, have looked at neighborhood factors and body size among breast cancer survivors, finding similar results of lower nSES (measured similarly as in the current study) associated with higher odds of having larger body size (24, 55).

Racial/ethnic disparities in obesity have also been previously reported, although only descriptively, in studies of breast cancer survivors, with findings showing African Americans and Hispanics are more likely, and Asian Americans less likely, to be overweight or obese compared with NH whites (44, 45). However, this is the first study to provide a more nuanced look at these disparities by considering nativity in Hispanics and AAPIs concurrently with race/ethnicity. For example, after adjusting for individual-level covariates including SES, we found that all groups, excluding other races/ethnicities, are at higher odds of being overweight compared with NH whites. For obesity, these disparities differ, with African Americans and U.S.-born Hispanics at higher odds of obesity and foreign-born AAPIs at lower odds compared with NH whites. The opposite direction of associations observed among foreign-born AAPIs was unexpected. While it may be partly a function of the more conservative cutoff points used to define the overweight and obese categories among AAPIs, these associations should be further explored in future studies. These findings also suggest that neighborhoods may be differently experienced by racial/ethnic and nativity groups. Further research in this area, such as incorporating data on individuals' perceptions and their use of their neighborhood environments, is needed to ultimately inform multilevel interventions that would ameliorate such disparities and improve outcomes for breast cancer survivors, regardless of their social status (e.g., race/ethnicity, SES, nativity).

We demonstrated that the racial/ethnic/nativity disparities in overweight were slightly attenuated with the addition of nSES into the model, but still persisted, and only the foreign-born AAPI association was fully attenuated after accounting for the other social and built environment attributes. Similarly, the addition of nSES only slightly attenuated the observed disparities in obesity, and the addition of the other social and built environment attributes into the model resulted in a stronger association for foreign-born AAPIs.

Despite the strengths of this diverse breast cancer survivorship cohort including rich, multilevel data, our study had several limitations. The data for these analyses are cross-sectional and based on self-reported measures of height and weight to calculate BMI and physical activity; yet these data provided a unique opportunity to explore these associations among breast cancer survivors. Our findings regarding associations of neighborhood factors with body size and their influence on racial/ethnic/nativity differences may not be generalizable to other patient populations as patients with breast cancer from the KPNC integrated healthcare system live in more middle SES, suburban, and higher minority neighborhoods relative to other patients with breast cancer in the same catchment area (52). Our study uses secondary geospatial data to describe neighborhood environments and thus does not capture how residents perceive and use their environments. However, secondary geospatial data for capturing social and built environment characteristics are commonly used, capture objective assessments of neighborhoods, and show robust associations with health behaviors and health outcomes (3, 6). Finally, even with the large overall sample size, the relatively small number of minorities precluded our ability to assess neighborhood associations in specific racial/ethnic groups.

Selected self-reported neighborhood characteristics are being collected in the Pathways cohort 72-month interview and will be assessed in future work as the cohort matures. With these data, we will be able to study the impact of neighborhood social and built environment characteristics on health-related quality of life and other breast cancer outcomes, as well as potential interaction with molecular factors. With these integrated sources of neighborhood data, we will be able to assess how cancer survivors' neighborhoods enable healthy behaviors and shape breast cancer outcomes and which neighborhood features influence breast cancer survivorship.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

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Acknowledgments

We thank all Pathways Study participants and staff members for their numerous contributions to this study.

Grant Support

The Pathways Study is funded by the National Cancer Institute, NIH (R01CA105274 and U01CA195565). C.H. Kroenke was also supported by National Cancer Institute Grant #K07CA187403.

Received November 15, 2016; revised January 13, 2017; accepted January 28, 2017; published OnlineFirst February 2, 2017.

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Published OnlineFirst February 2, 2017; DOI: 10.1158/1055-9965.EPI-16-0932

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Cancer Epidemiol Biomarkers Prev 2017;26:505-515. Published OnlineFirst February 2, 2017.