# A Neighborhood-Level Hispanic Paradox: The Interaction among Hispanic Density, Neighborhood Disadvantage, and Survival in Patients with Breast Cancer

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## ABSTRACT

**Background:** To evaluate the impact of Hispanic ethnic enclaves (EE) on the relationship between neighborhood disadvantage and overall survival in patients with breast cancer.

**Methods:** Data from patients with stage I to IV breast cancer diagnosed between 2005 and 2017 were used to analyze the effects of area deprivation index (ADI) scores, a measure of neighborhood disadvantage, and census tract–level Hispanic density, a measure of EE, on overall survival using mixed-effects Cox regression models. The final model included the individual-level factors [age, income, race, Hispanic/Latino origin, nativity, insurance status, and comorbidities (hypertension, diabetes, and body mass index)] and clinical factors (National Comprehensive Cancer Network guideline–concordant treatment, stage, and receptor subtype).

**Results:** A total of 5,387 patients were analyzed. Fifty-two percent resided in Hispanic EE. Enclave residents were predominantly White (93%), with Cubans the predominant subgroup (37%). Overall, there were 1,040 deaths within the cohort. Patients residing in highly disadvantaged neighborhoods (ADI tertile 3) within Hispanic EE experienced reduced HR compared with those outside of EE, evidenced by the interaction effect {EE × ADI tertile 3 − HR [95% confidence interval (CI)], 0.66 (0.44–0.98)}.

**Conclusions:** Hispanic EE may protect against mortality in patients with breast cancer, suggesting that positive social factors help combat negative effects of neighborhood disadvantage for patients. Understanding the protective attributes of EE can help create effective cancer interventions and promote more equitable outcomes in minority populations.

**Impact:** This study found that EE may protect against mortality in patients with breast cancer, suggesting that positive social factors may help mitigate the negative effects caused by the neighborhood.

## Introduction

Neighborhood disadvantage stands as a pivotal determinant of cancer disparities in the United States, having a profound impact on the incidence, outcomes, and survival rates among patients with cancer (1–6). Neighborhoods are shaped by the downstream effects of history, policy, and structural racism, culminating in racial, ethnic, and economic segregation (7). This segregation, particularly affecting minority racial and ethnic groups, concentrates individuals in objectively disadvantaged regions. Amidst the burgeoning diversity in major US cities, these concentrations of persons with shared racial and ethnic identity can manifest as ethnic enclaves (EE). Generally, EEs describe neighborhood-level areas with a high concentration of one race or ethnicity, and because Hispanic patients are a large minority across the United States, many studies on EE focus specifically on Hispanic and Latinx enclaves (8).

The benefits of EE may be one of the drivers behind the "Hispanic paradox," a concept first described by Markides and colleagues (9) when noting that Hispanics living in the American Southwest had similar or better health outcomes than non-Hispanic Whites despite sociodemographically being aligned more closely with the Black population. This paradox was later supported by Chen and colleagues (10) in a study that found that Latin women had the lowest premature mortality rate of all populations studied. Hispanic patients are more likely to live in disadvantaged neighborhoods, have lower income, and experience language barriers and other hardships faced by immigrating to a foreign country compared with White women, all of which contribute to disparities in health outcomes (11, 12). Thus, the "paradox" that Hispanic women experience better health outcomes is a critical area of study. Additional meta-analysis by Ruiz and colleagues (13) confirmed the Hispanic mortality paradox and called attention to the importance of studying the underlying causes of this effect that stem from the complex mix of social and cultural factors in the context of socioeconomic and structural determinants of health.

Although some studies suggest better outcomes for patients with cancer in EE, the literature remains mixed. Studies have shown that those in Hispanic EE have lower breast cancer incidence (14, 15); however, other studies found that these patients are more likely to present with later stage disease (14, 16–18). Moreover, several studies found shorter survival in higher Hispanic ethnic density areas, though other studies found no significant association with Hispanic enclaves and survival (19, 20). Many of these studies are

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limited, however, as they did not account for the potential role of neighborhood disadvantage, a key element that overlaps with EE and may confound the association. A study by Shariff-Marco and colleagues (8), which controlled for socioeconomic status, revealed that foreign-born Latinx women faced higher breast cancer and all-cause mortality, but living in enclaves and higher socioeconomic neighborhoods correlated with improved survival. However, this study is more than 20 years old, and contemporary studies accounting for EE and neighborhood disadvantage are lacking. Moreover, Hispanic/Latinx registry studies mainly focus on California and Texas, predominantly representing the Mexican American population. These equivocal findings may in part be attributed to the lack of studies, accounting for both EE and neighborhood disadvantage. This is important as Hispanic populations, as addressed previously, are more likely to live in disadvantaged neighborhoods, which subsequently may also be enclaves for Hispanic or other minority populations. Thus, the interplay between neighborhood disadvantage and EE is important, as the EE may play a role in potentially mitigating the detrimental effects of neighborhood disadvantage.

To bridge these gaps in the literature, our study capitalizes on a predominantly Hispanic, "majority-to-minority" patient tumor registry in South Florida. The objective of our study was to evaluate the impact of Hispanic EE on the relationship between neighborhood disadvantage and overall survival (OS). We hypothesized that the interaction between Hispanic EE and neighborhood disadvantage would be significant. Specifically, among those living in the most disadvantaged neighborhoods, we hypothesized that a patient living in an EE would have a lower HR of mortality than a patient not living in an EE.

## Materials and Methods

### Study site and population

Institutional tumor registries were used to identify patients diagnosed and treated for stage I to IV breast cancer between 2005 and 2017 at an NCI-Designated Cancer Center and a sister safety-net hospital. The catchment area includes Broward, Miami-Dade, Monroe, and Palm Beach counties. This region spans 10,000 square miles and is home to 6.2 million people, approximately 30% of Florida's total population. Patients with ductal carcinoma *in situ* were excluded as ductal carcinoma *in situ* rarely affects survival (21–23). Those with addresses outside of the catchment area counties were not included in the study. **Figure 1** details the study flow diagram. We followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for presenting observational studies (24).

### Variables

Descriptive variables collected on our population included sociodemographic factors; age at diagnosis, self-identified race and ethnicity, birthplace (non–US-born, US-born, or unknown), relationship status (married, unmarried, or unknown), insurance status (insured, uninsured, or unknown), comorbidities [body mass index (BMI), diabetes mellitus, hypertension, or coronary artery disease], and breast cancer risk factors [tobacco use (never, active, or former) and alcohol use (never, active, or former)]. Self-identified race and ethnicity was used as a sociopolitical construct and a proxy for structural racism (7, 25). Insurance type was included as a measure of individual-level socioeconomic status and access to care (26, 27). These data points are routinely collected on patient intake forms and were individually recorded from patient charts. Tumor characteristics; pathologic stage (I, II, III, or IV), subtype [estrogen receptor (ER)–positive and HER2−, ER+/HER2+, ER−/HER2−, ER−/HER2+, or unknown)], and tumor grade (well/moderately differentiated, poorly differentiated, or anaplastic/undifferentiated), were collected from patient pathology reports. To account for treatment, adherence to National Comprehensive Cancer Network (NCCN) stage and receptor–appropriate guidelines was determined by individual chart review by two surgical oncologists and treated as a dichotomous variable representing whether the patient completed or did not complete concordant treatment (28).

### Outcome and measures

The primary outcome was OS, determined as the time from primary diagnosis to point of death. Censoring was calculated using the date of death (with the cause of death) or last known follow-up. These data were collected through medical chart review.

Hispanic density (HD) was measured as the percentage of Hispanic individuals of the total population based on census tract–level data from the 2012 American Community Survey tables. Based on previous literature, HD was dichotomized, with areas exceeding 50% HD considered an EE (29–31).

The area deprivation index (ADI) was used to measure neighborhood disadvantage. It is a validated, neighborhood-level composite index reflecting 17 dimensions of social determinants of health within the domains of housing, income, employment, and education, captured in the American Community Survey and US Census Survey data via principal component analysis methodology. We used the 2015 ADI, which is a 5-year average of the American Community Survey data from 2011 to 2015, as earlier versions of the ADI are not available. The ADI state rankings range from 1 to 10, with disadvantage reflected by higher scores (32). The state ADI composite score was calculated at the census block group level using the ADI mapping atlas and participant addresses (32).

In preparation for the following analysis, state deciles were categorized into tertiles (T) based on the literature (33–37). T1 reflects the lowest ADI (most advantaged neighborhood), and T3 reflects the highest ADI (most disadvantaged neighborhood).

### Statistical analysis

Descriptive statistics with $\chi^2$ and ANOVA for categorical variables and *t* tests for continuous variables were conducted by HD. Unknown or missing values were removed from data before hypothesis (e.g., $\chi^2$) tests were run. A mixed-effects model was conducted to account for the hierarchical nature of patients nested within census tracts. Previous studies have shown that cancer rates are similar at census tract and block group levels with minimal bias due to unstable rates (38). To evaluate the association between OS and HD, multivariable mixed-effects Cox proportional hazard models were conducted. Model 1 of the multivariable analysis was unadjusted. Model 2 controlled for individual-level sociodemographic and cultural factors: age, race, income, Hispanic origin, and nativity. Model 3 controlled for model 2 variables with the addition of important clinical factors including NCCN guideline–concordant treatment receipt, clinical stage, and receptor subtype. Finally, model 4 controlled for model 3 variables with the addition of individual-level comorbidities (BMI, diabetes mellitus, and hypertension) and insurance status. These models were defined *a priori* based on the literature and subject matter knowledge and to optimize model fit (39–45). We also defined the interaction groups between EE [no (≤50% HD) and yes (>50% HD)] and ADI tertiles

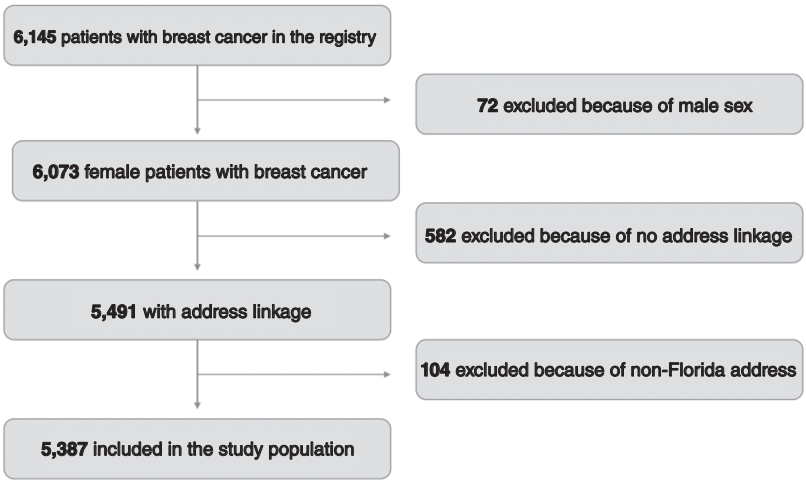


**Figure 1.**
Study flow diagram. The process of patient inclusion is shown.

*a priori* based on previous literature using these groupings (29, 30, 36). The reference group for interaction was no (≤50% HD) × ADI T1. We geospatially mapped ADI and HD tertiles, simultaneously by census tract, over our catchment area to visualize these distributions and degree of interaction, with ggplot and biscale packages in RStudio. All analyses were conducted using R 4.3.0 with coxme version 2.2-18.1. All statistical tests were two-sided, and statistical significance was assessed at $\alpha < 0.05$.

### Data availability

The data generated in this study are available upon request from the corresponding author.

## Results

### Population characteristics

A total of 5,387 patients were included in the study, with 2,782 (51.7%) living in a Hispanic EE (**Table 1**). Looking specifically at the demographic makeup of EE and non-enclave areas, the percentage of White individuals living in an EE ($n = 2{,}584$, 93%) was higher than the percentage of White individuals living in non-EE areas ($n = 1{,}762$, 68%). In Hispanic EE specifically, individuals of Cuban origin were the most predominant ($n = 1{,}019$, 37%), followed by those of South or Central American origin ($n = 585$, 21%). Nineteen percent ($n = 521$) of patients living in Hispanic EE were non-Hispanic. In contrast, in non-EE areas, individuals of Hispanic/Latino origin were less represented, with the majority ($n = 1{,}853$, 71%) of patients being non-Hispanic. Birthplace distribution also varied significantly between the two groups, with a higher proportion of individuals born outside of the United States observed in Hispanic EE ($n = 1{,}613$, 58%) compared with non-EE areas ($n = 757$, 29%). Health insurance status differed significantly between the groups ($P < 0.001$), with a higher percentage of uninsured individuals in Hispanic EE ($n = 564$, 20%) compared with non-EE areas ($n = 300$, 12%). Smoking status ($P < 0.001$) and alcohol use ($P < 0.001$) also showed significant differences between the two groups, with higher proportions of smokers and alcohol users in Hispanic EE compared with non-EE areas. No significant differences were observed between the groups in terms of comorbidities; however, the mean BMI was significantly higher in patients from Hispanic EE (28.8, SD = 5.8) compared with those from non-EE areas (28.4, SD = 6.4; $P < 0.001$).

The geospatial map of ADI and HD by census tract is visualized in **Fig. 2**. This map identifies specific EE with the highest neighborhood disadvantage across our South Florida catchment area.

### Tumor and treatment characteristics

With regard to tumor characteristics, significant differences were observed between patients from Hispanic EE and non-EE areas. The tumor stage distribution differed between the two groups ($P = 0.024$), with a higher proportion of patients diagnosed with stage II disease residing in Hispanic EE ($n = 1{,}032$, 37%) compared with non-EE areas ($n = 889$, 34%). Receptor subtype distribution also varied significantly ($P = 0.001$) between the two groups, with a higher proportion of patients categorized as $ER^+/HER2^-$ in Hispanic EE ($n = 1{,}770$, 64%) compared with non-EE areas ($n = 1{,}549$, 59%). NCCN treatment categories showed significant differences between the groups ($P = 0.033$), with a higher proportion of patients not having received guideline-concordant treatment in Hispanic EE ($n = 553$, 20%) compared with non-EE areas ($n = 467$, 18%). Tumor grade distribution showed a significant difference ($P = 0.035$) between the groups, with a higher proportion of well to moderately differentiated tumors observed in Hispanic EE ($n = 1{,}679$, 60%) compared with non-EE areas ($n = 1{,}489$, 57%).

### Survival analysis

Overall, there were 1,040 deaths in the cohort. HD alone did not have a significant effect on mortality risk in almost all models (**Table 2**). However, in model 2, which controlled for age, income, race, Hispanic/Latino origin, and nativity, we saw a significant increased risk of mortality for those living in an EE compared with those not living in an EE [HR = 1.32; 95% confidence interval (CI) = 1.01–1.71; $P = 0.036$]. Patients living in the most disadvantaged neighborhoods (ADI T3) had significantly increased mortality risk in each model (HR = 2.42; 95% CI = 1.93–3.04; $P < 0.001$ in model 1; HR = 1.66; 95% CI = 1.28–2.15; $P < 0.001$ in model 2; HR = 1.79; 95% CI = 1.41–2.27; $P < 0.001$ in model 3; HR = 1.74; 95% CI = 1.31–2.29; $P < 0.001$ in model 4). These main effects are subjected to the other variable in the interaction term set to its respective reference level.

**Table 1.** Patient, tumor, and treatment characteristics.

| Characteristic | Overall *N* = 5,387 Mean (SD) or *n* (%) | Hispanic EE | |
|---|---|---|---|
| | | No *n* = 2,605 Mean (SD) or *n* (%) | Yes *n* = 2,782 Mean (SD) or *n* (%) |
| Age, years | 56 (12) | 57 (12) | 56 (12) |
| Race | | | |
| Black | 1,041 (19%) | 843 (32%) | 198 (7.1%) |
| White | 4,346 (81%) | 1,762 (68%) | 2,584 (93%) |
| Non-Hispanic/Latino | 2,374 (44%) | 1,853 (71%) | 521 (19%) |
| Hispanic/Latino origin | | | |
| Cuban | 1,168 (22%) | 149 (5.7%) | 1,019 (37%) |
| Dominican Republic | 95 (1.8%) | 41 (1.6%) | 54 (1.9%) |
| Mexican | 21 (0.4%) | 11 (0.4%) | 10 (0.4%) |
| Other Hispanic/Latino origin | 42 (0.8%) | 17 (0.7%) | 25 (0.9%) |
| Puerto Rican | 57 (1.1%) | 36 (1.4%) | 21 (0.8%) |
| South or Central American | 786 (15%) | 201 (7.7%) | 585 (21%) |
| Unknown | 844 (16%) | 297 (11%) | 547 (20%) |
| Birth place | | | |
| Foreign | 2,370 (44%) | 757 (29%) | 1,613 (58%) |
| United States | 1,932 (36%) | 1,226 (47%) | 706 (25%) |
| Unknown | 1,085 (20%) | 622 (24%) | 463 (17%) |
| Marital status | | | |
| Married | 2,515 (47%) | 1,223 (47%) | 1,292 (46%) |
| Unmarried | 2,739 (51%) | 1,311 (50%) | 1,428 (51%) |
| Unknown | 133 (2.5%) | 71 (2.7%) | 62 (2.2%) |
| Health insurance | | | |
| Insured | 4,426 (82%) | 2,268 (87%) | 2,158 (78%) |
| Uninsured | 864 (16%) | 300 (12%) | 564 (20%) |
| Unknown | 97 (1.8%) | 37 (1.4%) | 60 (2.2%) |
| Smoking status | | | |
| Never | 3,481 (65%) | 1,637 (63%) | 1,844 (66%) |
| Current | 411 (7.6%) | 179 (6.9%) | 232 (8.3%) |
| Former | 1,117 (21%) | 569 (22%) | 548 (20%) |
| Unknown | 378 (7.0%) | 220 (8.4%) | 158 (5.7%) |
| Alcohol use | | | |
| Never | 3,556 (66%) | 1,564 (60%) | 1,992 (72%) |
| Current | 1,403 (26%) | 797 (31%) | 606 (22%) |
| Former | 38 (0.7%) | 19 (0.7%) | 19 (0.7%) |
| Unknown | 390 (7.2%) | 225 (8.6%) | 165 (5.9%) |
| Hypertension | 1,420 (26%) | 716 (27%) | 704 (25%) |
| Diabetes mellitus | 411 (7.6%) | 203 (7.8%) | 208 (7.5%) |
| Coronary artery disease | 27 (0.5%) | 15 (0.6%) | 12 (0.4%) |
| Hyperlipidemia | 339 (6.3%) | 176 (6.8%) | 163 (5.9%) |
| BMI | 28.6 (6.1) | 28.4 (6.4) | 28.8 (5.8) |
| Pathologic stage | | | |
| I | 2,062 (38%) | 1,031 (40%) | 1,031 (37%) |
| II | 1,921 (36%) | 889 (34%) | 1,032 (37%) |
| III | 941 (17%) | 442 (17%) | 499 (18%) |
| IV | 463 (8.6%) | 243 (9.3%) | 220 (7.9%) |
| Receptor subtype | | | |
| $ER^+/HER2^+$ | 575 (11%) | 290 (11%) | 285 (10%) |
| $ER^+/HER2^-$ | 3,319 (62%) | 1,549 (59%) | 1,770 (64%) |
| $ER^-/HER2^-$ | 1,103 (20%) | 586 (22%) | 517 (19%) |
| $ER^-/HER2^+$ | 390 (7.2%) | 180 (6.9%) | 210 (7.5%) |
| Tumor grade | | | |
| Well to moderately differentiated | 3,168 (59%) | 1,489 (57%) | 1,679 (60%) |
| Poorly differentiated | 2,174 (40%) | 1,090 (42%) | 1,084 (39%) |
| Anaplastic/undifferentiated | 45 (0.8%) | 26 (1.0%) | 19 (0.7%) |
| NCCN guideline–concordant treatment | | | |
| No | 1,020 (19%) | 467 (18%) | 553 (20%) |
| Yes | 4,182 (78%) | 2,035 (78%) | 2,147 (77%) |
| Unknown | 185 (3.4%) | 103 (4.0%) | 82 (2.9%) |

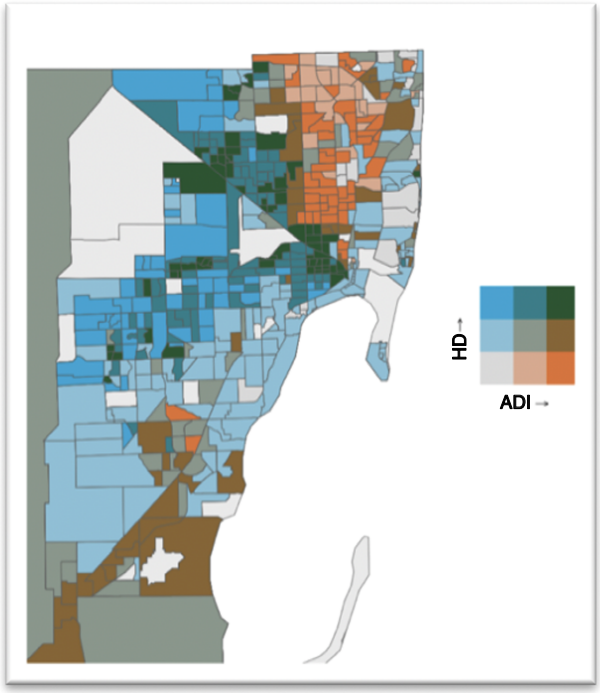


**Figure 2.**
Hispanic density and neighborhood disadvantage by census tract across South Florida. Census tracts with higher HD are indicated in increasing blue scale and those with higher ADI in orange scale. The overlap between the highest ADI (highest disadvantage) and highest HD is indicated in dark green.

### Interaction analysis

Patients residing in highly disadvantaged neighborhoods with more than 50% HD experienced a significantly reduced HR compared with those outside of an EE [reference group: no EE (≤50% HD) × ADI T1], evidenced by the interaction effect in each model [EE × ADI T3: model 1 hazard ratio's ratio (HRR) = 0.52; 95% CI = 0.38–0.73; $P < 0.001$; model 2 HRR = 0.65; 95% CI = 0.47–0.92; $P = 0.012$; model 3 HRR = 0.66; 95% CI = 0.47–0.93; $P = 0.016$; model 4 HRR = 0.66; 95% CI = 0.44–0.98; $P = 0.033$].

## Discussion

Our study revealed that the presence of Hispanic EE in disadvantaged neighborhoods has a protective effect on OS among patients with breast cancer in South Florida, independent of individual factors such as country of origin and nativity, tumor characteristics such as stage and subtype, and receipt of NCCN guideline–concordant treatment. This finding suggests a potential protective effect associated with living in an enclave residence among women diagnosed with breast cancer. This has important implications for the social and cultural factors that contribute to resiliency in patients with cancer, which ultimately affect survival.

Although the present study is believed to be the first to report specifically on the interaction between EE and the ADI, the results are supported by prior literature. In a two-state parallel analysis assessing the association between enclave residence and neighborhood disadvantage, as measured through neighborhood socioeconomic status incorporating census tract–level geocodes from the year 2000, Shariff-Marco and colleagues (8) found that living both in an enclave and in a high neighborhood socioeconomic status independently predicted improved all-cause and breast cancer–specific survival. More importantly, the authors found that after combining independent factors into a four-level variable, Latina patients with breast cancer living in low neighborhood socioeconomic status and non-enclave neighborhoods had worse all-cause and breast cancer specific–survival compared with women living in low neighborhood socioeconomic status enclave neighborhoods. Additionally, women living in high neighborhood socioeconomic status, regardless of enclave status, had improved all-cause survival compared with those living in low neighborhood socioeconomic status (8).

Although the literature with regard to the protective effect on survival of living within an enclave for Hispanic patients with breast cancer remains limited, the beneficial impact of the Hispanic enclave has been reported for other cancers as well. For example, Gomes and colleagues analyzed the association between the duration of enclave residence and colon cancer stage at diagnosis for more than 1,000 adult Hispanic patients from the New Jersey State Cancer Registry. In their analysis, they found that patients living within an enclave at the time of diagnosis had a 35% lower likelihood of distant-stage (regional + distant) disease compared with those not living within an enclave, even after controlling for age, sex, insurance status, and poverty status (31). Additionally, the authors found a protective association between the duration of enclave residence and likelihood of distant-stage disease, with patients living in an enclave for 10+ years immediately prior to diagnosis having a 43% lower likelihood of distant-stage disease. Overall, the authors found that each additional 12-month residency in an enclave prior to diagnosis was associated with a 2.8% lower odds for distant-stage disease at the time of diagnosis (31). Although these findings are not specific to breast cancer, they are nevertheless supportive of the protective role of the EE, particularly for Hispanic patients.

Several mechanisms may explain this observed association. The interplay between the social and built environments that compose neighborhoods is an important factor in the health of residents. Social factors such as social cohesion, culture, and community engagement may be enhanced in an EE, providing a strong social support network for Latinas facing a cancer diagnosis. Social support alone can improve patient well-being, adherence to treatment, and overall health outcomes, including cancer survival (46–48). Additionally, social support may offer practical forms of assistance, such as childcare or transportation, which can alleviate burdens on patients and help them focus on treatment (48, 49). Living in an EE may foster social support, a sense of belonging, shared cultural practices, and access to emotional and practical support from family, friends, and neighbors, which can act as a buffer against the stress of the disease (50–54).

Our findings that the protective effect of EE on neighborhood disadvantage remained beyond individual-level cultural, clinical, and access to care barriers suggest that some of the protective effects of EE may affect biology. Neighborhood disadvantage has been shown in recent studies to act as a chronic stressor and is associated with stress responses in the body, namely, the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system (37, 55–58). This social adversity–induced neuroendocrine activation can subsequently influence health at a systemic level and on the tumor itself, potentially affecting cancer progression and

**Table 2.** Hazard ratios for overall survival.

| | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **HR** | **CI** | ***P*** | **aHR[a]** | **CI** | ***P*** | **aHR[b]** | **CI** | ***P*** | **aHR[c]** | **CI** | ***P*** |
| EE (Hispanic) | | | | | | | | | | | | |
| No (≤50% HD) | | Ref | | | Ref | | | Ref | | | Ref | |
| Yes (>50% HD) | 1.19 | (0.93–1.53) | 0.160 | 1.32 | (1.01–1.71) | **0.036** | 1.08 | (0.84–1.40) | 0.540 | 1.14 | (0.84–1.54) | 0.380 |
| ADI | | | | | | | | | | | | |
| T1 | | Ref | | | Ref | | | Ref | | | Ref | |
| T2 | 1.67 | (1.29–2.15) | <**0.001** | 1.29 | (0.98–1.69) | 0.062 | 1.33 | (1.02–1.73) | **0.034** | 1.39 | (1.02–1.91) | **0.038** |
| T3 (highest disadvantage) | 2.42 | (1.93–3.04) | <**0.001** | 1.66 | (1.28–2.15) | <**0.001** | 1.79 | (1.41–2.27) | <**0.001** | 1.74 | (1.31–2.29) | <**0.001** |
| EE × ADI (interaction); reference group: no EE (<50% HD) × ADI T1 | | | | | | | | | | | | |
| Yes (>50% HD) × ADI T2 | 0.68 | (0.48–0.97) | **0.028** | 0.78 | (0.55–1.10) | 0.150 | 0.86 | (0.59–1.23) | 0.390 | 0.84 | (0.56–1.28) | 0.410 |
| Yes (>50% HD) × ADI T3 | 0.52 | (0.38–0.73) | <**0.001** | 0.65 | (0.47–0.92) | **0.012** | 0.66 | (0.47–0.93) | **0.016** | 0.66 | (0.44–0.98) | **0.033** |

Bold values indiciate a statistially significant *p*-value that is < 0.05.
Abbreviation: aHR, adjusted HR.
[a]Adjusted HR (model 2) adjusts for demographic factors including age, income, race, Hispanic/Latino origin, and nativity.
[b]Adjusted HR (model 3) adjusts for age and clinical factors including NCCN, stage, and receptor subtype.
[c]Adjusted HR (model 4) model 3 adjustments plus insurance status and comorbidities including hypertension, diabetes mellitus, and BMI.

survival (3, 6, 59–62). Factors like social support have shown effects on tumor biology as well. A lack of social support or social isolation in patients with breast cancer specifically has been associated with higher levels of cortisol, sympathetic nervous system activation, increased activation of proinflammatory pathways, immunosuppression, and multiple metastasis–related processes in the tumor microenvironment (32–35). Therefore, some of the protective effects of EE may be through the ways that social support buffers the effect of neighborhood-level stressors at a biological level.

This study has limitations. The observational design precludes establishing causality. We relied on census data to define EE, which cannot fully capture the nuances of social connectedness within these communities. Future research using more detailed measures of social support networks within EE could provide deeper insights. Additionally, as the Hispanic and Latinx populations in the United States increase, it is important to differentiate immigration status and country of origin as there are not only differences between US-born and foreign-born Hispanics and Latinos but also differences within these populations based on the country of origin. Approximately one third of Latinx persons living in the United States are immigrants, and the rates of US-born Latinos are increasing (63). Subsequently, there are major health differences between US-born Latinos and those who immigrated, with the former having higher rates of chronic disease and cancer, some of which is based on acculturation. Our study attempted to account for this using the information we collected on the country of origin and place of birth as covariates in our analysis. Future studies on Hispanic populations must recognize the nuanced differences within this group that make generalizing all Hispanic patients into one broad category an oversimplification of these patients and their ethnicity (41). Understanding that Hispanics are a diverse group with cultural differences from country to country that cannot be easily lumped under one category requires diverse cohorts such as ours for future studies. Additionally, the amount of time since immigration to the United States is an important consideration, as health differences between first generation and second generation Hispanic immigrants have begun to show increasing rates of obesity and diabetes, which some attribute to adaptation to a Western diet and health behaviors (64, 65). Although our study does not have information on timing of immigration status, we were able to control for birthplace in or outside of the United States. Moreover, our study represents a diverse Hispanic cohort, with a majority being of Cuban origin, compared with the mostly Mexican population seen in many other national studies (65). Moreover, the percentage of Hispanic patients in our cohort is similar to that across South Florida but much higher than state or national averages (66). The higher proportion of Hispanic patients in our cohort is important in the context of our focus on the possible protective role of the Hispanic EE, suggesting that our findings may be especially relevant to other populations living in similar enclave residences, where shared cultural factors may mitigate detrimental impacts of neighborhood disadvantage.

Our study identified that women living in Hispanic EEs among disadvantaged neighborhoods had improved survival, suggesting a protective effect of EEs independent of individual and clinical factors. This finding underscores the multifaceted impact of social and cultural determinants on health resilience and patient survival. The implications extend beyond the clinical realm, encompassing the broader social fabric that shapes the lived experiences of patients with cancer. The stability and social cohesion found within EEs may provide a buffer against the multifarious challenges associated with breast cancer, from diagnosis to treatment and beyond.

## Authors' Disclosures

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## Authors' Contributions

**A.E. Hernandez:** Resources, data curation, formal analysis, writing–original draft, writing–review and editing. **P.A. Borowsky:** Resources, writing–original draft, writing–review and editing. **L. Nahodyl:** Data curation, formal analysis, writing–original draft, writing–review and editing. **P.S. Pinheiro:** Conceptualization, supervision, investigation, methodology, writing–review and editing. **E.N. Kobetz:**

Supervision, visualization, writing–review and editing. **M.H. Antoni:** Conceptualization, supervision, methodology, project administration, writing–review and editing. **N. Goel:** Conceptualization, supervision, methodology, project administration, writing–review and editing.

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