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Impact of individual and neighborhood factors on disparities in prostate cancer survival

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ABSTRACT

Background: We addressed the hypothesis that individual-level factors act jointly with social and built environment factors to influence overall survival for men with prostate cancer and contribute to racial/ethnic and socioeconomic (SES) survival disparities.

Methods: We analyzed multi-level data, combining (1) individual-level data from the California Collaborative Prostate Cancer Study, a population-based study of non-Hispanic White (NHW), Hispanic, and African American prostate cancer cases (N = 1800) diagnosed from 1997 to 2003, with (2) data on neighborhood SES (nSES) and social and built environment factors from the California Neighborhoods Data System, and (3) data on tumor characteristics, treatment and follow-up through 2009 from the California Cancer Registry. Multivariable, stage-stratified Cox proportional hazards regression models with cluster adjustments were used to assess education and nSES main and joint effects on overall survival, before and after adjustment for social and built environment factors.

Results: African American men had worse survival than NHW men, which was attenuated by nSES. Increased risk of death was associated with residence in lower SES neighborhoods (quintile 1 (lowest nSES) vs. 5: HR = 1.56, 95% CI: 1.11–2.19) and lower education (< high school vs. college: HR = 1.32, 95% CI: 1.05–1.67), and a joint association of low education and low nSES was observed. Adjustment for behavioral, hospital, and restaurant and food environment characteristics only slightly attenuated these associations between SES and survival.

Conclusion: Both individual- and contextual-level SES influence overall survival of men with prostate cancer. Additional research is needed to identify the mechanisms underlying these robust associations.

1. Introduction

In the United States (U.S.), African American (AA) men have higher incidence and mortality of prostate cancer, and worse survival compared to White men [1–5]. Many studies have reported independent associations between lower individual- or contextual-level socioeconomic status (SES) and worse survival among men diagnosed with prostate cancer [3–11], and some suggest that contextual-level SES accounts for racial/ethnic disparities in survival [4–6].

Contextual-level SES captures features of the neighborhood environment over-and-above individual-level characteristics of neighborhood residents [12,13]. Negative health consequences of residing in a low SES neighborhood may be determined by aspects of both the social environment (e.g., crowding, ethnic enclave status) and the built environment (e.g., street connectivity, food environment) through negative health behaviors, health-care access, or chronic stress, or cultural

Abbreviations: AA, African American; NHW, non-Hispanic White; SES, socioeconomic status; nSES, neighborhood socioeconomic status; NAPC, Neighborhoods and Prostate Cancer Study; CCR, California Cancer Registry; CNDS, California Neighborhoods Data System; SEER, Surveillance Epidemiology and End Results Program; REI, Restaurant Environment Index; RFEI, Retail Food Environment Index

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factors [8,14–34]. Certain aspects of the neighborhood social environment have been shown to be associated with cancer survival for some racial/ethnic groups and select cancer sites [35], including prostate cancer [32]. Ultimately, survival disparities likely result from complex relationships between these multi-level factors, such that new insights in our understanding of SES survival disparities will require a multilevel approach.

To address the persistent racial/ethnic and SES survival disparities among men with prostate cancer, we conducted the Neighborhoods and Prostate Cancer (NAPC) study that analyzed multi-level data from two multiethnic, population-based case-control studies, combining individual-level data on sociodemographics, family history of prostate cancer, clinical history, health behaviors and tumor characteristics with hospital- and neighborhood-level data on SES and social and built environment factors. Our objective was to assess 1) the contribution of individual- and neighborhood-level SES on racial/ethnic differences in survival after prostate cancer diagnosis, 2) the independent and joint effects of individual- and neighborhood-level SES on survival and, 3) the extent to which specific neighborhood factors contribute to SES survival disparities.

2. Methods

2.1. Study population

The NAPC study, approved by the Institutional Review Board of the Cancer Prevention Institute of California, comprises prostate cancer cases and controls who participated in two population-based case-control studies among AA and non-Hispanic White (NHW) men from the San Francisco Bay Area and AA, Hispanic, and NHW men from Los Angeles county [36–38]. Cases were identified through the population-based cancer registries in the Greater San Francisco Bay Area and Los Angeles County, both part of the California Cancer Registry (CCR). A common questionnaire was utilized at both sites and the survey data were pooled and merged with CCR data and neighborhood data from the California Neighborhoods Data System (CNDS) [39]. Only prostate cancer cases were included in this survival analysis.

Eligible cases from the San Francisco Bay Area site included AA and NHW men aged 40–79 years with a first primary localized prostate cancer diagnosed between October 1, 1997 and September 30, 1998; NHW men with a first primary advanced prostate cancer diagnosed between July 1, 1997 and February 29, 2000; and AA men with a first primary advanced prostate cancer diagnosed between July 1, 1997 and December 31, 2000. The site included random samples of localized cases (60% of AAs, 15% of NHWs) and all cases with advanced prostate cancer [37]. A total of 1334 cases were identified and sampled, 1062 were eligible and contacted, and 776 (191 AAs and 585 NHWs) completed the interview [36,37]. The Los Angeles County site included AA, Hispanic, and NHW men of any age diagnosed with a first primary prostate cancer between January 1, 1999 and December 31, 2003 [36]. A total of 3144 cases were identified, 2402 were contacted, 1870 met the eligibility criteria, and 1232 (376 AAs, 355 Hispanics, and 501 NHWs) completed the interview [36]. In both studies, advanced prostate cancer was defined as a tumor invading and extending beyond the prostatic capsule and/or extending into adjacent tissue or involving regional lymph nodes or distant metastatic sites [37].

2.2. Data collection and follow-up

Trained interviewers conducted in-person interviews in English or Spanish using a structured questionnaire that asked about sociodemographic background, medical history, and lifestyle factors (Table 1). Dietary intake during the calendar year before diagnosis was assessed using the Block Food Frequency questionnaire [40]. Self-reported comorbidities that were associated at $p < 0.05$ with overall survival (i.e., heart disease, diabetes, liver disease, kidney disease) in the base model (adjusted for age at diagnosis and race/ethnicity, stratified by stage at diagnosis, census-block-group adjusted) were used to create a composite measure of any comorbidities (heart disease, diabetes, liver disease, and/or kidney disease). Age at diagnosis, marital status at diagnosis, SEER Summary stage, histology, subsequent (primary) tumors (number of subsequent tumors and time from diagnosis to first subsequent tumor), and first-course treatment, all routinely abstracted from medical records, were obtained from the CCR. The CCR routinely updates vital status and cause of death through linkages with state and national databases. Characteristics of the first reporting hospital were assessed. Hospital NCI Cancer Center designation was coded based on status as of 2012. The percent of cancer cases in a racial/ethnic group or quintile of nSES among all CCR cases diagnosed from 1997 to 2003 were used to estimate hospital-level race/ethnicity (i.e., percent NHW, percent AA, and percent Hispanic) and nSES, respectively, and scaled into quartiles based on all hospitals statewide [41].

Cases with a residential address at the time of diagnosis were geocoded to latitude/longitude coordinates and then assigned a 2000 Census block group. Batch geocoding was performed using the Texas A&M Geocoder [42] or manually using ArcGIS [43]. The majority of addresses (99.6%) were geocoded successfully. Of the 1568 block groups represented, 1368 (87%) were represented by a single individual.

2.3. Socioeconomic status

Self-reported education was categorized as high school diploma (or equivalent) or less, vocational/technical degree or some college, and college degree or higher. Neighborhood-level SES (nSES) at the time of diagnosis was measured at the Census block-group level and was based on an index created with principal components analyses that incorporates 2000 Census data on education, occupation, unemployment, household income, house values, rent values, and poverty [44]. The nSES index was scaled into statewide quintiles, low nSES (Q1) to high nSES (Q5). A joint education and nSES variable was created, where low education was defined as high school diploma or less and low nSES included quintiles 1–3.

2.4. Social and built environment factors

Data on several specific social and built environment factors measured at the block group or tract level, or for a residential buffer, were obtained from the CNDS (Table 1). Measures of neighborhood housing, commuting, residential mobility, and population density were at the block group level (2000 Census Summary File 3 [SF-3]) and modeled with statewide quartiles as described previously [21,45]. Census tract-level street connectivity was modeled with quartiles based on the state distribution. Street network-based measures included the gamma measure (ratio of actual number of street segments to the maximum possible given the number of intersections) [21].

Variables measured according to a residential buffer were defined for each case in order to capture access to amenities within a walking distance of 1600 m [46] along a network of pedestrian-accessible pathways (NavStreets) [47]. Information regarding the total number of businesses (quartiles, based on the sample distribution), parks (0, 1–2, 3, or 4), and farmers markets (0, 1, or ≥2) originated from several geocoded data sources for business listings [48], farmers markets (California Department of Food and Agriculture, 2010), and NavStreets [47]. In addition, two previously developed food indices to describe the retail food environment and restaurant environment were included: the Retail Food Environment Index (RFEI) and the Restaurant Environment Index (REI) are ratios of unhealthy to healthy retail food outlets and restaurants within the residential buffer, with higher values indicating a less healthy neighborhood retail or restaurant food environment, respectively; values are presented with categories of “0” (no unhealthy outlets or restaurants) or tertiles based on the sample distribution