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14. ABSTRACT Residing in disadvantaged neighborhoods has been linked to poor disease outcomes. The purpose of this project is to determine if neighborhood characteristics are associated with prostate cancer stage, grade and age at diagnosis in African-American and Caucasian men in the Philadelphia, PA region. In our most recent analysis, we examined prostate cancer patients included in the PA Cancer Registry. We calculated a neighborhood deprivation index and neighborhood deprivation quartiles for each census tract. The associations were strongest and most consistent for African Americans. We observed associations of low neighborhood SES with high Gleason score among African-Americans residing in neighborhoods with low educational attainment (OR=1.30, 95% CI=1.08-1.56), high poverty (OR=1.33, 95% CI=1.08-1.64), low car ownership (OR=1.41, 95% CI=1.14-1.75), and higher percentage of residents on public assistance (OR=1.25, 95%=1.02-1.53). For both Caucasians and African-Americans, the highest quartile of neighborhood deprivation was associated with high Gleason score at diagnosis (OR=1.27, 95% CI=1.11-1.44; OR=1.61, 95% CI=1.15-2.25, respectively.) These results demonstrated significant effects of neighborhood socioeconomic factors on prostate cancer severity. Understanding which neighborhood-level variables best predict poor health outcomes in different environmental settings may aid researchers in unraveling the complexities of prostate cancer disparities in America. Future analyses will explore neighborhood stress and include multilevel models.					
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Introduction

Neighborhood characteristics such as low socioeconomic status (SES) and aspects of social disorder or neighborhood stress are risk factors for a number of disease outcomes. It has been suggested that prostate cancer outcomes are also influenced by neighborhood characteristics and that these factors may contribute to prostate cancer disparities. The proposed multi-level study will combine neighborhood variables with patient-level risk factors, behaviors, medical history and family history to determine neighborhood influence on prostate cancer severity. This research will employ the infrastructure at the University of Pennsylvania Health System (UPHS) in Philadelphia and the Pennsylvania Cancer Registry to address the following specific aims:

Specific Aim 1. To determine if neighborhood characteristics are associated with prostate cancer stage, grade and age at diagnosis in the Philadelphia 5-county region

Specific Aim 2. To evaluate multi-level interactions of neighborhood characteristics with patient-level risk factors in relationship to prostate cancer stage, grade and age at diagnosis

Body

Statement of Work Years 1-2

Task 1: To determine if neighborhood characteristics are associated with prostate cancer stage, grade and age at diagnosis in the Philadelphia 5-county region
Examine associations between prostate cancer and outcomes using PA Cancer Registry data

- Purchase ArcGIS Desktop Program
 - **Item has been purchased.**
- Completion of geocoding for the other 4 counties in the state dataset for the PA Cancer Registry
 - **Geocoding of the Cancer Registry data is completed. The University of Pennsylvania Cartographic Modeling Laboratory provided guidance in geocoding during several meetings. Incomplete addresses were problematic and could not be geocoded. The state data also contained many repeat entries that took longer to sort through and remove than anticipated. The final dataset for the PA Cancer Registry includes 21,808 prostate cancer cases. Approximately $\frac{3}{4}$ of these patients used in the analyses were recorded as European American (n=16,672), and $\sim\frac{1}{4}$ were recorded as African-American (n=5,136).**
- UPENN Cartographic Modeling Laboratory gathering and formatting of Philadelphia county data
 - **The Cartographic Modeling Laboratory (CML) maintains these data (crime, social stress, and structural decline) for Philadelphia County only. We have received crime data for Philadelphia County and are in the process of analyzing those data.**
- Downloading census variables of interest
 - **Downloading of SES variables is completed. We have also downloaded additional variables to capture neighborhood physical characteristics, and race, gender and age composition. A subset of these variables were used to calculate a neighborhood deprivation index using methods similar to Messer, et al. (2006.)(1) Using this validated index allowed us to examine the benefit of composite measures of neighborhood socioeconomic status compared to univariate measures.**
- Formatting variables and merging datasets
 - **The primary datasets including geocodes and PA registry patient data are merged. We have merged and analyzed SES and demographic variables from the Census Bureau Website. Additional analyses will be performed with these variables and the SCORE dataset as analyses with the PA Cancer Registry are completed.**
- Generate frequency tables and check for correlation of variables
 - **Correlations and frequency tables for neighborhood SES variables have been computed. Seventy-six percent of cases had a low-grade tumor and 86% had a low stage at diagnosis. The mean age at diagnosis was 67.9 years (median=68 years.) Significant correlations were observed among all neighborhood variables ($p<0.05$) except for inconsistencies for two. Percent of second language speakers was not correlated with family income, per capita income, male income, or percent unemployed. Percent of young high school drop-outs**

was not correlated with percent of working parents with children under age 6 years.

- Build Regression models to analyze neighborhood associations
 - *Consultations with Dr. Andrew Rundle and Ms. Ann Tierney (biostatistician) have been ongoing this year. Our work together resulted in a number of regression analyses highlighted in invited talks and a new publication for an upcoming special Prostate Cancer Disparities edition of Prostate Cancer. Current analyses of SES variables focused on moving beyond univariate analyses and into the use of quartiles of neighborhood deprivation to examine this composite variable in relation to prostate cancer severity (Tables 1-3 in Supporting Data Section) The findings in these tables are discussed below (under “summarize findings.”)*

- Summarize findings / prepare manuscripts
 - **Sample Characteristics -- Table 1 presents demographic characteristics of prostate cancer patients by race. There were significant ethnic differences for all patient-level variables. ($p < 0.001$) Compared to Caucasians, African-Americans were younger (66 vs. 68 years), less likely to be married (57% vs. 77%), and more likely to have unfavorable prostate cancer characteristics (high stage, 15% vs. 12%, and high Gleason Score, 28% vs. 22%).**
 - **Neighborhood SES Characteristics -- Table 1 also presents SES characteristics of the patients’ residential census tracts. There were significant ethnic differences for all neighborhood-level variables ($p < 0.001$) Compared to Caucasians patients (38-39%), African-Americans (86-90%) were more likely to live in low SES neighborhoods, characterized by below sample median income and education. The neighborhoods of African-American cases were also more likely to have higher than median percentages of poverty, single female head of households, no car ownership, and households on public assistance.**
 - **Table 2 presents neighborhood SES indicators in association with prostate cancer severity outcomes. There were no associations of neighborhood SES with aggressive (high stage and high grade) tumor in this subset of cases. However, the prevalence of high stage prostate cancer was lower in Caucasian men living in neighborhoods with high percentage of residents on public assistance (OR=0.89, 95% CI=0.80-0.99). No other associations with stage at diagnosis were observed.**
 - **The strongest associations between Gleason score and neighborhood SES were observed for African-Americans. African-Americans residing in neighborhoods with high poverty (OR=1.39, 95% CI=1.15-1.67), low income (OR=1.26, 95% CI=1.05-1.51), low educational attainment (OR=1.34, 95% CI=1.13-1.60), more households with no car (OR=1.46, 95% CI=1.20-1.78), and higher percentage of residents on public assistance (OR=1.32, 95%=1.08-1.62) had a higher Gleason score at diagnosis. Except for \geq median percent of households with no car (OR=1.09, 95% CI=1.01-1.19), there were no associations of these individual neighborhood SES indicators and Gleason score among Caucasians.**

- **Neighborhood Deprivation--** Tumor aggressiveness was associated with the highest level of neighborhood deprivation in Caucasian patients only (OR=1.27, 95% CI=1.01-1.59). The overall p-value for neighborhood deprivation for this outcome was not significant (p=0.055). For both Caucasians and African-Americans, the highest quartile of neighborhood deprivation was associated with high Gleason score at diagnosis (OR=1.27, 95% CI=1.11-1.44; OR=1.61, 95% CI=1.15-2.25, respectively.) (Table 2) The overall p-value for neighborhood deprivation for both groups was <0.001. Trend tests were significant only for Gleason score for both Caucasian (p=<0.001) and African-American patients (p=0.002).
- **Race Effects--** By conducting an unstratified analysis, we observed that African-American race was significantly associated with tumor aggressiveness (OR=1.32, p<0.001), high stage (OR=1.27, p<0.001) and high Gleason grade (OR=1.38, p<0.001) at diagnosis. (Table 3) The association between race and prostate cancer severity was only slightly attenuated or remained unchanged when neighborhood SES variables were included in the model. The addition of census tract variables, including the deprivation index, to the models did not change the significance level race (p=0.001) except in the model including neighborhood deprivation in association with tumor aggressiveness. In this model, the odds of patients with aggressive disease being African-American was 1.21 but still significant (p=0.020). The interaction between race and the neighborhood deprivation index was not statistically significant for any of the outcomes (p=0.170 for aggressiveness, p=0.622 for stage, and p=0.416 for Gleason.) Trend tests showed that increasing deprivation was associated with increased odds of high Gleason score in the combined sample (p<0.001). No significant trends were observed for the other two outcomes.
- **Neighborhood SES and Obesity in Relationship to Prostate Cancer Severity--** *Obesity has been shown to increase the risk for advanced prostate cancer. Although linked to both obesity and advanced cancer, neighborhood socioeconomic status (SES) has not been studied as a modifier of obesity effects in prostate cancer patients. Ethnic differences in obesity among men are less pronounced in lower SES environments. It is possible that the relationship between obesity and prostate cancer outcomes varies by neighborhood characteristics. The goal of this project was to study neighborhood SES as an effect modifier of obesity on prostate cancer characteristics. Neighborhood SES differences may help to explain ethnic differences observed in prostate cancer outcomes. Our general hypotheses are that (1) neighborhood SES differs for African-American and European American prostate cancer patients recruited from the same medical center and (2) neighborhood SES modifies the effects of obesity on prostate cancer outcomes. A case-case design was proposed to examine the relationship between neighborhood SES and prostate cancer severity. The residential addresses of prostate cancer patients from the University of Pennsylvania were geocoded. Census tract data was downloaded from the Census Bureau website and merged with patient data.*

Obesity was defined as a Body Mass Index (BMI) ≥ 30 kg/m² and non-obese as BMI < 30 kg/m². Median cut-points for census tract variables were determined for all patients combined. A principal components analysis was conducted to determine the census variables most likely to contribute to neighborhood deprivation for this PA Cancer Registry participants from the same Philadelphia region. Census tract variables included in the index were % of households with income $< \$30,000$ /yr, % poverty, % households on public assistance, % female head of household with dependent children, and % households with no car. Outcomes for this study included tumor stage and tumor grade. Age-adjusted multivariate models were used to examine obesity effects on stage and grade stratified by median neighborhood deprivation. Analyses were stratified by ethnicity. SCORE patients reflecting 943 European American and 119 African-American prostate cancer patients were included in these analyses. Neighborhood SES characterized by below median census tract income and education was more prevalent among African-Americans ($p < 0.001$, as in Table 1.) Our most recent analysis showed a significant difference in stage at diagnosis by obesity status only for European Americans (1.48, 95% CI=1.06-2.08, Table 4 in Supporting Data Section.) Odds ratios increased to greater significance among European American men who lived in high deprivation neighborhoods (OR=2.90, 95% CI=1.20-7.01 for European Americans). Obesity was associated with tumor grade at baseline in European Americans (OR=1.64, 95% CI=1.19-2.27). Stratification by neighborhood deprivation demonstrated no association of obesity on tumor grade for European Americans. Among African-Americans, obesity was associated with high grade only among men living in high deprivation neighborhoods (OR=3.81, 95% CI=1.14-12.75). The relationship between obesity and prostate cancer severity may be influenced by lower neighborhood SES. Lower neighborhood SES is more common among African-American prostate cancer patients than European American cases. Modification of obesity effects by neighborhood SES may suggest strategies for prostate cancer intervention in high-risk communities.

Statement of Work Years 2-3

Task 2: To evaluate multi-level interactions of neighborhood characteristics with patient-level risk factors in relationship to prostate cancer stage, grade and age at diagnosis

Analyze multi-level interactions with screening history, risk behaviors, obesity, and medical history in the SCORE Study

- Continue accrual of all patients cases for the SCORE Study
 - **Patient accrual is continuing at Presbyterian Hospital, an affiliate of the Hospital of the University of Pennsylvania. We currently have 219 African-American cases and 1018 European American cases from the Pennsylvania 5-county region geocoded. Our smaller sample size reflects the fact that under new research regulations at the Philadelphia VA Hospital, we do not currently have permission**

to use identifiable patient information for the VA patients that were accrued at an earlier date.

- Continue medical record abstraction and data entry
 - **Medical record abstraction is ongoing.**
- Geocoding of remaining 5-county SCORE sample
 - **Geocoding is ongoing and happens shortly after patient accrual.**
- Merge final datasets and format patient-level variables (1 month)
 - **Merger is ongoing with the obesity work in SCORE.**
- Confirmation of Aim 1 findings using the SCORE Study (1 month)
 - **Increasing accrual is the focus for now before we conduct the final confirmatory analysis.**
- Determine race interactions in each univariate model. (1 month)
 - **Race interactions will be conducted within the next year.**
- Stratify by race and build regression models to analyze multi-level affects of neighborhood and patient-level variables in relation to prostate cancer outcomes (1 month)
 - **Preliminary multilevel analysis with obesity in the SCORE dataset has begun (as described above.) Additional multilevel analyses will begin in the next year, pending additional accrual.**
- Summarize findings / prepare manuscripts (3 months)
 - **Additional manuscripts highlighting these results will be prepared in the new year.**

Key Research Accomplishments

- Increased SCORE study participant accrual
- Completed geocoding of the 5-county area data from the PA Cancer Registry
- Completed coding of SES neighborhood variables
- Created a neighborhood deprivation index suitable for this sample of prostate cancer patients
- Analyzed SES deprivation with prostate cancer characteristics
- Obtained biostatistical support to complete data downloading, mergers, and analysis for Aim 1.
- Worked with methods consultant and Cartographic Modeling Laboratory to complete Aim1 and our first manuscript from this project

Report Outcomes

- Submitted 3 abstracts related to the study topic (abstracts located in Appendix 1)
 - AACR Cancer Disparities Conference, September 2010, Miami, FL
 - DOD IMPACT Meeting, March 2011, FL
 - RCMAR Conference, May 2011
- Obtained funding to do an obesity and neighborhoods study research pilot
 - Resource Centers for Minority Aging Research (RCMAR) PennMarch Pilot Grant (2009-2010)
“Effects of Obesity and Neighborhood Socioeconomic Status on Prostate Cancer Outcomes”
- One manuscript accepted for publication
 - Prostate cancer severity associations with neighborhood deprivation. C. Zeigler-Johnson, A. Tierney, T. Rebbeck, A Rundle. Prostate Cancer, in press.

Conclusion

Prostate cancer is the most prevalent non-cutaneous malignant cancer in the U.S. The disease occurs at a high incidence, differentially affecting African-American men who are at highest risk and suffer the greatest mortality associated with prostate cancer (2). In spite of its common occurrence and the strong racial disparities that exist in prostate cancer, modifiable risk factors have not been confirmed. These disparities are believed to be a result of interactions among genes, health behaviors, and environmental factors.

Neighborhood (SES), such as indicated by neighborhood income or poverty level, has been used in several studies assessing residence and clinical outcome. (3-7). Higher socioeconomic (SES) communities appear to have fewer hazards, more support, and more options for coping when problems do arise. Limited income, education, and/or low social class may increase the likelihood that people live in poorer, stressful settings(8). Neighborhood characteristics such as degree of deterioration, urbanization, poverty, educational attainment and percentage of low-income residents have been correlated with increasing disease rates and poorer health outcomes, including mortality

(5, 9-12). To date, few studies have examined prostate cancer severity by neighborhood SES (13-15) or deprivation (16, 17), and none have used a multi-level approach including other neighborhood factors plus patient-level behaviors, medical and family history, obesity and demographics.

The results of this project to date demonstrate that there are significant associations of neighborhood SES on prostate cancer severity that are independent of patient age and race. Southeastern Pennsylvania patients residing in high income and highly educated neighborhoods were more likely to be diagnosed with prostate cancer at a younger age. African Americans and Caucasians living in high deprivation neighborhoods are significantly more likely to be diagnosed with high grade prostate cancer. The association was strongest among African-American cases. Most of these neighborhood variables measure similar SES parameters, so observed associations are expected for multiple variables and in the same direction. Although African-Americans are at high risk for advanced prostate cancer, it is interesting that this particular outcome and not stage is so consistently associated with low neighborhood SES only in African-Americans. This is the first report that the authors are aware of showing this difference by race and suggests that tumor grade in African-Americans may be particularly prone to neighborhood influences. The Gleason score may be less affected by screening practices than stage at diagnosis, and therefore may be more closely tied to biological mechanisms of prostate cancer progression. Although speculative, these mechanisms may be genetic or tied to other risk factors that are disproportionately prevalent among African-Americans. Obesity is one factor that is more common in African-Americans and is associated with a biologically more aggressive form of prostate cancer. (18) Obesity varies by SES factors and, therefore, may be even more relevant in the discussion of prostate cancer disparities. As African-Americans are much more likely than Caucasians to live in disadvantaged areas (19), the possibility of an interaction among patient-level and neighborhood-level SES is possible. These results also suggest that neighborhood dynamics may influence prostate-cancer screening and treatment seeking-behavior differentially by neighborhood SES and race. Aim 2 of this study will add patient-level data to determine if neighborhood characteristics have independent effects or may modify effects of patient level risk factors for prostate cancer severity.

Significance (“So what?”)

Prostate cancer has the highest incidence of any cancer site in American men. African Americans suffer from the highest rates of prostate cancer in the world, presenting with more advanced disease at initial diagnosis and have a worse prognosis than European American men. Studies to date have not determined the reasons for the high rates and apparent ethnic disparities, but it is likely that these disparities are multifactorial and complex.

One issue related to prostate cancer that is not well studied is that of the environmental contribution to disease progression. Individual patient characteristics do not fully explain the occurrence of advanced disease among prostate cancer cases, and only a subset of patients is at risk for advanced disease. Studying environmental factors may help to elucidate prostate cancer causes of progression and provide additional information about the groups of men that are at highest risk for advanced disease.

Residential neighborhoods are promising venues for identifying environmental pathways to disease and for studying contextual variables and environmental interactions with other risk factors. Neighborhoods in the US vary widely by a number of key factors that may influence one’s well-being, stress level, lifestyle, and ultimately, disease susceptibility. These factors also differ substantially by race.

Although it long remained unclear which neighborhood factors were most important in determining certain disease outcomes, our work is helping to identify many neighborhood effects on prostate cancer, which include SES and lifestyle factors. The mechanisms of the pathways that lead to cancer pathogenesis overlap and interact, reflecting the complexity of cancer progression and making it difficult to determine the causal pathways. If multiple and seemingly different health outcomes occur together across communities and are predicted by similar neighborhood characteristics, there may be underlying causes/mediating mechanisms that cause these health effects at the neighborhood level. (20) Although neighborhood factors overlap quite a bit, the primary categories for ecologic influences on health include neighborhood SES, racial composition, psychosocial factors, and physical components. Multilevel analysis of neighborhood characteristics with prostate cancer outcomes may provide insight into new factors and pathways to pursue in the quest to unravel the mysteries of prostate cancer progression and disparities. Modification of other putative risk factors may also be found by stratifying analyses by neighborhood characteristics, thereby examining associations in context. The results of this project hopefully will suggest how high risk communities for poor outcomes (or individuals from those communities) might be targeted with more intense cancer education, early detection and prevention tactics.

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Appendices

Appendix 1 – Abstracts

EFFECTS OF OBESITY AND NEIGHBORHOOD SOCIOECONOMIC STATUS ON PROSTATE CANCER STAGE AND GRADE

(Presented at the AACR Disparities Conference 2010)

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Background: Prostate cancer is a common, complex disease with few confirmed risk factors, including advancing age. African-Americans are at highest risk for developing prostate cancer and often present with advanced disease. Obesity has been shown to increase the risk of advanced disease and poor outcomes. Although linked to obesity and advanced cancer, neighborhood socioeconomic status (SES) has not been studied as a modifier of obesity effects in prostate cancer patients.

Objective/Hypothesis: The goal of this project is to identify neighborhood factors that are associated with prostate cancer outcomes. Residing in disadvantaged neighborhoods has been linked to a number of disease outcomes and mortality. There are significant differences in the neighborhood conditions of many African-Americans compared to European-Americans. These differences may help to explain the racial differences observed in prostate cancer outcomes. Our general hypotheses are that neighborhood SES differs for African-American and European American prostate cancer patients, and that neighborhood SES modifies the effects of obesity on prostate cancer outcomes.

Specific Aims:

Specific Aim 1: To determine the prevalence of neighborhood disadvantage in European American and African American prostate cancer patients.

Specific Aim 2: To identify patient-level confounders that are associated with neighborhood disadvantage and obesity using prostate cancer cases from the Study for Clinical Outcomes, Risk and Ethnicity (SCORE)

Specific Aim 3: To examine the modification of BMI effects on prostate cancer outcomes by neighborhood SES.

Methods: A case-case study design is proposed to examine the relationship between neighborhood characteristics and prostate cancer severity. The residential addresses of prostate cancer patients from the SCORE Study at the University of Pennsylvania will be geocoded. Census tract data will be downloaded from the Census Bureau website and merged with patient data. Outcomes for this study will include tumor stage, tumor grade, age at diagnosis and biochemical (treatment) failure. Multivariate models will be used to examine the effects of obesity on prostate cancer outcomes stratified by neighborhood SES. Analyses will be stratified by race to determine if the observed effects differ by ethnicity.

Results: Preliminary results from this work demonstrated associations of obesity with tumor characteristics and risk of treatment failure. Among 924 patients who underwent radical prostatectomy, obesity was associated with higher tumor stage. Obesity was also a risk factor for biochemical failure in African American men (HR 4.59, CI 95% =1.87-11.2), suggesting that obesity may in part explain poorer prostate cancer prognosis seen in African Americans. Analyses are in progress to evaluate modifying effects of neighborhood SES.

Conclusions: Obesity increases the risk for poor prognosis from prostate cancer. Future research will determine if neighborhood SES modifies these effects.

Multilevel Analysis of Neighborhood Characteristics and Prostate Cancer Severity (Presented at the DOD Impact meeting 2011)

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Background/Objectives: African-Americans are at highest risk for developing prostate cancer and often present with advanced disease. Differences in the neighborhood conditions of African Americans and European Americans may help to explain the racial differences observed in prostate cancer outcomes, as residing in disadvantaged neighborhoods has been linked to a number of disease outcomes. The goal of this project is to identify the neighborhood-level factors that are most strongly associated with prostate cancer severity. The specific aim of this project is to determine if neighborhood characteristics are associated with prostate cancer stage, grade and age at diagnosis in African-American and European-American men in the Philadelphia, PA region.

Methods: Residential addresses of 5,684 African-American and 14,601 European-American prostate cancer patients from the PA registry (1995-2007) were geocoded and linked to census tract data. Multivariate models were conducted to determine which variables were associated with less than age 60 at diagnosis, higher stage (T3 and 4) and higher grade. Variable quartiles were evaluated in separate models to avoid collinearity. Age at diagnosis was included in models examining tumor stage and grade as outcomes.

Preliminary Results: Preliminary results of our analyses identified associations of prostate cancer severity with a number of neighborhood socioeconomic variables. Younger age at diagnosis was more common among residents in higher income neighborhoods ($p < 0.001$) and those with a higher percent of residents in the workforce ($p < 0.001$). Higher proportion of bilingual residents in the neighborhood was associated with increased odds of young diagnosis among African-Americans ($p < 0.01$). Higher proportions of residents with less than high school education decreased the odds of early diagnosis for both ethnic groups ($p < 0.05$). For European Americans, higher tumor grade was significantly less likely among high income neighborhoods ($p < 0.01$) and neighborhoods with high percent of young adults with college degrees ($p < 0.05$). Also for European-Americans, higher stage at diagnosis was inversely associated with higher percent of bilingual residents ($p < 0.05$) and higher percent of young adults attending college ($p < 0.001$).

Conclusions: The early results of this study demonstrated significant effects of neighborhood socioeconomic factors on prostate cancer severity. Significant factors varied by prostate cancer characteristic and ethnic group, suggesting that different contextual variables may determine prostate cancer severity among diverse populations. Future analyses will explore neighborhood stress, racial composition, and physical characteristics. Additional analyses with a subset of cases will add patient-level variables to multi-level models.

Impact: This study focuses on neighborhood factors that impact risk for advanced prostate cancer and may differentially impacts minority groups who are often more likely to live in disadvantaged areas. Significant neighborhood effects may identify groups of patients at highest risk for poor outcomes and provide strategies for effective intervention in high-risk communities.

COMMUNITY CONTEXT: LINKING NEIGHBORHOOD DATA AND PROSTATE CANCER SEVERITY

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Background: Prostate cancer is a common, complex disease with few confirmed risk factors, including advancing age. African-Americans are at highest risk for developing prostate cancer and often present with advanced disease. Obesity has been shown to increase the risk of advanced disease and poor outcomes. Although linked to both obesity and cancer severity, neighborhood factors, such as socioeconomic status (SES), have not been studied as a modifier of obesity effects in prostate cancer patients.

Objective/Hypothesis: The goal of this project is to identify neighborhood factors that are associated with prostate cancer severity. Differences in the neighborhood conditions of African Americans and European Americans may help to explain the racial differences observed in prostate cancer outcomes, as residing in disadvantaged neighborhoods has been linked to a number of disease outcomes and mortality. Our hypothesis is that neighborhood characteristics are related to prostate cancer severity and may modify the relationship between obesity and prostate cancer outcomes among men.

Specific Aims:

Specific Aim 1: To determine the prevalence of neighborhood disadvantage in European American and African American prostate cancer patients.

Specific Aim 2: To identify patient-level confounders that are associated with neighborhood disadvantage and obesity using prostate cancer cases from the Study for Clinical Outcomes, Risk and Ethnicity (SCORE)

Specific Aim 3: To examine the modification of BMI effects on prostate cancer outcomes by neighborhood characteristics.

Methods: A case-case study design is used to examine the relationship between neighborhood characteristics and prostate cancer severity among men in the Philadelphia, PA region. The residential addresses of prostate cancer patients from the SCORE Study at the University of Pennsylvania are geocoded. Census tract data are downloaded from the Census Bureau website and merged with patient data. Outcomes for this study include tumor stage, tumor grade, age at diagnosis and treatment failure. We will build multivariate models to examine the effects of obesity on prostate cancer outcomes stratified by neighborhood variables focusing on SES. Analyses are also stratified by race to determine if the observed effects differ by ethnicity.

Results: Preliminary results showed differences in neighborhood characteristics by race and identified associations with prostate cancer severity. Obesity was also associated with tumor characteristics. Among 924 patients who underwent radical prostatectomy, obesity was associated with higher tumor stage among men residing in low SES neighborhoods, regardless of ethnicity. Obesity increased the odds of high Gleason Score at diagnosis among European Americans, but in a less consistent manner than observed for tumor stage.

Conclusions: Obesity increases the risk for poor prognosis from prostate cancer, but this relationship is modified by neighborhood SES. Future research will determine other neighborhood factors that are important in prostate cancer outcomes and examine risk factor interactions with neighborhood context.

Supporting Data

Table 1: Demographics of Southeastern Pennsylvania Cancer Registry Prostate Cancer Patients (1995-2007)

	Caucasian (N=16672)	African- American (N=5136)	P-value
Patient-Level Variables			
Age at Diagnosis, Mean (SD)	67.6 (8.94)	66.0 (9.21)	<.001
Married	12826 (77%)	2931 (57%)	<.001
High Stage (III/IV)	2040 (12%)	785 (15%)	<.001
Gleason Score (7+)	3697 (22%)	1441 (28%)	<.001
Aggressive Tumor	1053 (6%)	423 (8%)	<.001
Neighborhood-Level Variables			
≥ Median % neighborhood poverty	6381 (38%)	4582 (89%)	<.001
≥ Median % household income <\$30,000	6401 (38%)	4482 (87%)	<.001
< Median % high school education	6478 (39%)	4412 (86%)	<.001
≥ Median % female head of household with dependent child(ren)	6307 (38%)	4607 (90%)	<.001
≥ Median % households with no car	6341 (38%)	4595 (89%)	<.001
≥ Median % public assistance	6319 (38%)	4583 (89%)	<.001

Table 2: Stratified Analysis -- Associations of Neighborhood SES Characteristics with Indicators of Prostate Cancer Severity (GEE) adjusted for age, and diagnosis year

Effect	Tumor Aggressiveness		High Stage		High Gleason	
	Caucasian OR (95% CI)	African-American OR (95% CI)	Caucasian OR (95% CI)	African-American OR (95% CI)	Caucasian OR (95% CI)	African-American OR (95% CI)
≥ Median % neighborhood poverty	0.98 (0.86, 1.12)	1.08 (0.79, 1.48)	0.92 (0.83, 1.03)	0.97 (0.78, 1.22)	1.05 (0.97, 1.14)	1.39*** (1.15, 1.67)
≥ Median % household income <\$30,000	1.06 (0.93, 1.22)	0.98 (0.74, 1.29)	1.01 (0.91, 1.12)	0.99 (0.80, 1.23)	1.08 (0.99, 1.17)	1.26* (1.05, 1.51)
< Median % high school education	1.12 (0.99, 1.28)	1.14 (0.87, 1.48)	1.01 (0.91, 1.13)	1.02 (0.84, 1.24)	1.07 (0.98, 1.15)	1.34** (1.13, 1.60)
≥ Median % female head of household with dependent child(ren)	1.03 (0.90, 1.18)	0.97 (0.71, 1.32)	0.94 (0.84, 1.04)	1.00 (0.79, 1.27)	1.07 (0.99, 1.16)	1.18 (0.97, 1.44)
≥ Median % households with no car	1.02 (0.89, 1.16)	0.99 (0.74, 1.33)	0.94 (0.84, 1.04)	0.91 (0.73, 1.14)	1.09* (1.01, 1.19)	1.46*** (1.20, 1.78)
≥ Median % public assistance	0.96 (0.84, 1.10)	1.02 (0.75, 1.40)	0.89* (0.80, 0.99)	0.95 (0.76, 1.19)	1.04 (0.96, 1.13)	1.32** (1.08, 1.62)
Deprivation quartile 2 vs. 1	1.04 (0.89, 1.21)	1.84 (0.98, 3.46)	0.98 (0.87, 1.11)	1.28 (0.82, 2.01)	1.05 (0.96, 1.15)	1.32 (0.89, 1.95)
Deprivation quartile 3 vs. 1	0.91 (0.76, 1.08)	1.45 (0.81, 2.58)	0.90 (0.78, 1.04)	0.97 (0.65, 1.45)	1.01 (0.90, 1.13)	1.36 (0.96, 1.94)
Deprivation quartile 4 vs. 1	1.27* (1.01, 1.59)	1.62 (0.93, 2.81)	0.98 (0.82, 1.18)	1.13 (0.77, 1.64)	1.34*** (1.19, 1.52)	1.71** (1.21, 2.40)
Deprivation quartile, p-value for overall effect	p =0.055	p =0.227	p =0.512	p =0.239	p <.001***	p<.001***

* <.05, ** <.01, *** <.001

Table 3: Unstratified Analysis -- Associations of Neighborhood SES Characteristics with Indicators of Prostate Cancer Severity (GEE) adjusted for age, race, and diagnosis year

Effect	Tumor Aggressiveness		High Stage		High Gleason	
	OR (CI)	P-value	OR (CI)	P-value	OR (CI)	P-value
African-American race/ethnicity	1.31 (1.16, 1.47)	<.001	1.27 (1.17, 1.39)	<.001	1.37 (1.27, 1.47)	<.001
≥ Median % neighborhood poverty	0.99 (0.87, 1.12)	0.853	0.93 (0.84, 1.02)	0.126	1.09 (1.01, 1.17)	0.028
African-American race/ethnicity	1.32 (1.15, 1.50)	<.001	1.32 (1.20, 1.46)	<.001	1.31 (1.21, 1.42)	<.001
≥ Median % household income <\$30,000	1.05 (0.93, 1.19)	0.446	1.00 (0.91, 1.10)	0.998	1.10 (1.02, 1.19)	0.014
African-American race/ethnicity	1.28 (1.12, 1.46)	<.001	1.27 (1.15, 1.41)	<.001	1.31 (1.20, 1.42)	<.001
< Median % high school education	1.12 (1.00, 1.27)	0.054	1.01 (0.92, 1.11)	0.802	1.10 (1.02, 1.19)	0.010
African-American race/ethnicity	1.24 (1.09, 1.41)	<.001	1.27 (1.15, 1.39)	<.001	1.31 (1.21, 1.42)	<.001
≥ Median % female head of household with dependent child(ren)	1.02 (0.90, 1.16)	0.727	0.94 (0.85, 1.04)	0.217	1.09 (1.01, 1.1)	0.030
African-American race/ethnicity	1.29 (1.13, 1.48)	<.001	1.31 (1.19, 1.45)	<.001	1.31 (1.21, 1.42)	<.001
≥ Median % households with no car	1.01 (0.90, 1.14)	0.845	0.93 (0.85, 1.03)	0.161	1.13 (1.05, 1.22)	0.001
African-American race/ethnicity	1.30 (1.14, 1.48)	<.001	1.32 (1.19, 1.45)	<.001	1.28 (1.18, 1.40)	<.001
≥ Median % public assistance	0.97 (0.85, 1.09)	0.576	0.89 (0.81, 0.99)	0.026	1.08 (1.00, 1.16)	0.063
African-American race/ethnicity	1.33 (1.17, 1.52)	<.001	1.34 (1.22, 1.49)	<.001	1.32 (1.21, 1.43)	<.001
Deprivation quartile		0.064		0.245		<.001
Deprivation quartile 2 vs. 1	1.07 (0.92, 1.24)	0.390	0.99 (0.88, 1.12)	0.882	1.06 (0.98, 1.16)	0.165
Deprivation quartile 3 vs. 1	0.94 (0.80, 1.11)	0.470	0.89 (0.78, 1.02)	0.083	1.03 (0.93, 1.15)	0.543
Deprivation quartile 4 vs. 1	1.19 (0.99, 1.43)	0.068	0.99 (0.86, 1.14)	0.927	1.36 (1.22, 1.51)	<.001
African-American race/ethnicity	1.20 (1.03, 1.39)	0.020	1.27 (1.14, 1.42)	<.001	1.16 (1.06, 1.26)	<.001

Table 4: Neighborhood Effects on the Association Between Obesity and Prostate Cancer Severity in the Study of Clinical Outcomes, Risk and Ethnicity (SCORE) – Odds Ratios (95% CI)

Neighborhood Deprivation	Tumor Stage		Tumor Grade	
	European American	African American	European American	African American
---	1.48 (1.06-2.08)	2.23 (0.94-5.29)	1.64 (1.19-2.27)	1.89 (0.85-4.22)
Low Deprivation	1.29 (0.75-2.21)	7.78 (0.82-73.54)	1.33 (0.80-2.23)	1.32 (0.16-10.96)
High Deprivation	2.90 (1.20-7.01)	2.49 (0.71-8.66)	2.05 (0.88-4.76)	3.81 (1.14-12.75)