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Racial Disparities in Prostate Cancer Mortality in the 50 Largest US Cities

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ABSTRACT

Introduction: This paper presents race-specific prostate cancer mortality rates and the corresponding disparities for the largest cities in the US over two decades.
Methods: The 50 largest cities in the US were the units of analysis. Data from two 5-year periods were analyzed: 1990–1994 and 2005–2009. Numerator data were abstracted from national death files where the cause was malignant neoplasm of prostate (prostate cancer) (ICD9 = 185 and ICD10 = C61). Population-based denominators were obtained from US Census data. To measure the racial disparity, we calculated non-Hispanic Black: non-Hispanic White rate ratios (RRs), rate differences (RDs), and corresponding confidence intervals for each 5-year period. We also calculated correlation and unadjusted regression coefficients for 11 city-level variables, such as segregation and median income, and the RDs.
Results: At the final time point (2005–2009), the US and all 41 cities included in the analyses had a RR greater than 1 (indicating that the Black rate was higher than the White rate) (range = 1.13 in Minneapolis to 3.24 in Los Angeles), 37 of them statistically significantly so. The US and 26 of the 41 cities saw an increase in the Black:White RR between the time points. The level of disparity within a city was associated with the degree of Black segregation.
Conclusion: This analysis revealed large disparities in Black:White prostate cancer mortality in the US and many of its largest cities over the past two decades. The data show considerable variation in the degree of disparity across cities, even among cities within the same state. This type of specific city-level data can be used to motivate public health professionals, government officials, cancer control agencies, and community-based organizations in cities with large or increasing disparities to demand more resources, focus research efforts, and implement effective policy and programmatic changes in order to combat this highly prevalent condition.

One in seven American men will be diagnosed with prostate cancer in their lifetime, making it the most commonly diagnosed form of cancer among this demographic [1,2]. While incidence rates remain relatively high, mortality rates decreased over the past 20 years due to preventive screening and early treatment [3]. Although the risk of mortality decreased for both Black and White men, a large disparity remains between the two groups. The prostate cancer mortality rate per 100,000 is 17.9 for White men and 38.7 for Black men in the US [4]. Unfortunately, there is no evidence to suggest the racial gap is closing [5,6].

The higher mortality rate among Black men may result from multiple factors, including biological/genetic differences, patient characteristics and behaviors, and access to care. To begin, Black men may be more prone to a more aggressive type of prostate cancer [7,8], which could contribute to their later stage of diagnosis [5,9]. Social factors may also play a role. For example, mistrust of the health care system by the Black community, due to years of exploitation by medical researchers, may contribute to fewer or delayed screenings among this population [6]. In addition, access to healthcare and treatment factors likely explain a portion of the disparity. A recent study found that, compared to the privately insured, the uninsured and those with Medicaid had significantly higher Prostate-Specific Antigen (PSA) levels at the time of a prostate cancer diagnosis [10]. Moreover, once diagnosed, Black

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men have a significantly lower chance of being treated with the goal of curing the disease compared to White men, even after controlling for stage of the disease [5].

Finally, geography also appears to be related to prostate cancer mortality. One study, which presented prostate cancer mortality rates for all US states, revealed extensive variation with Southern states exhibiting some of the highest mortality rates [11]. Other studies examined the prostate cancer belt (from Washington, DC to Louisiana) [12] and county-level data [13–15] in an attempt to understand racial differences in prostate cancer risk, incidence, mortality, and stage at diagnosis. However, no previous studies were found that specifically looked at prostate cancer mortality rates by race across US cities or that have examined racial disparities in these rates at the city-level in the US.

The purpose of this paper is to better understand racial disparities in prostate cancer mortality by examining disparities in the 50 largest US cities and looking at trends over the past 20 years. The analysis, which uses vital statistics and US Census data, provides important documentation of racial disparities in prostate cancer mortality at the city level. The results have numerous practical implications related to the planning, funding, and implementation of city-level initiatives to reduce racial disparities in mortality for this highly prevalent condition.

1. Methods

Mortality rates were calculated for non-Hispanic White (White) and non-Hispanic Black (Black) men for two 5-year periods: 1990–1994 and 2005–2009 (data for 1995–1999 and 2000–2004 available upon request). These years were selected to cover the two decade time period immediately following the introduction of the PSA screening test. Numerator data for prostate cancer deaths for the years 1990–1994 and 2005–2009 were abstracted from National Center for Health Statistics' death files [16], which are a reliable source of mortality data for cancer overall, as well as for prostate-specific cancer mortality [17,18]. Deaths where the cause was malignant neoplasm of prostate (prostate cancer) (ICD–9 = 185 and ICD–10 = C61) were included in this analysis. Denominator data were obtained from the US Census Bureau for 1990, 2000, and 2010. Population-based denominators for years other than 1990, 2000, and 2010 were estimated using linear interpolation. Black and White classifications were obtained by cross-tabulating two variables: Hispanic ethnicity and racial identity. Five-year age-adjusted rates per 100,000 males were calculated employing the year 2000 standard US population [19].

Five-year average annual rates were calculated for the periods 1990–1994 (T1) and 2005–2009 (T2). We used an age-specific comparability ratio formula designed specifically for transforming age-adjusted rates from the ICD-9 to ICD-10 coding so that the rates were comparable across the time points [20].

The 50 most populous cities were determined using 2005 US Census data [21]. Nine cities were excluded from this analysis. Population data were not available at the city level for two cities (Louisville/Jefferson County, KY and Nashville/Davidson, TN). An additional seven cities (Albuquerque, NM; Arlington, TX; Colorado Springs, CO; El Paso, TX; Mesa, AZ; Tucson, AZ; San Jose, CA) were excluded because at least one time point had fewer than 20 Black deaths [22,23].

The disparity in prostate cancer mortality was measured by calculating the Black:White rate ratio (RR) and rate difference (RD) for each of the remaining 41 cities at each time period. Both a RR and RD were used since they quantify the Black:White disparity in distinct ways; the RR provides the proportional disparity in Black and White deaths while the RD provides the absolute difference in Black and White deaths. An RR >1 indicates higher Black than White mortality. Similarly, a positive RD indicates higher Black than White mortality. Confidence intervals for the RRs and RDs were calculated using a Taylor series expansion technique [24]. All data were analyzed using SAS v 9.2 [25].

Changes between rates from 1990–1994 to 2005–2009 were calculated by race within each of the cities. Excess deaths due to the racial disparity in prostate cancer mortality were calculated for the 2005–2009 time period by multiplying the age-specific White mortality rates by the corresponding Black populations in each age category. The sum of these products was the number of Black deaths that would be expected if White death rates were applied to this population. The number of expected deaths was then subtracted from the number of observed deaths to obtain the excess number of deaths for each city [26,27].

Several city-level variables were used to examine potential ecological associations with the Black:White prostate cancer mortality disparity at T2. City-level population indicators included race-specific indices of isolation (IOI), overall and race-specific median household income, the Gini Coefficient, percent with a high school education, percent without health insurance, and population size. All ecologic data were obtained from the US Census Bureau with the exception of IOI, which was obtained from Brown University's Spatial Structures in Social Sciences Databases [28]. Black and White age-adjusted prostate cancer mortality rates were also included in order to assess how each rate was independently associated with the disparity.

Spearman's rank correlation coefficient was calculated for the correlation of the RD and city-level population indicators. The RD was chosen for bivariate analysis instead of the RR since it is easier to interpret in the context of correlations and linear regression. Bivariate linear regression was performed using rescaled population indicators as appropriate. For example, the index of isolation ranges from 0 to 1.0 and represents the probability of being exposed only to those in your own race group [29]. This variable was divided by 10 to assess the impact of a 10% change in the isolation index, rather than a 1% change. All changes to population indicators are noted in the tables. A linear relationship was present between all population indicators and the RD except for population size, which was log transformed. Multivariate regression was not performed as a minimum of 20 observations are required for each independent variable in multivariate linear regression [30]. The relatively small sample size (n = 41) thus limited the number of independent variables we could include to 2.

A sensitivity analysis was performed to examine whether the city of Miami, an outlier for mortality rates, should be dropped from the bivariate analysis. Both the White and Black age-adjusted mortality rates in Miami at T2 were substantially higher than the rates in the other 40 cities (in the current study as well as in studies of other causes of death [31,32]) leading to uncertainties about the reliability of city-level data for Miami. Based on these previous findings and the results of the sensitivity analysis, Miami was excluded.

This study was exempt from IRB review due to the use of public, de-identified data.

2. Results

At the national level, the age-adjusted prostate cancer mortality rates (PCMRs) were significantly higher among Blacks than Whites at T1 (RR = 2.16, 95% CI 2.13–2.19) and T2 (RR = 2.38, 95% CI 2.35–2.42) (Table 1). This disparity widened significantly between T1 and T2, as evidenced by the non-overlapping CIs.

At the city level, the Black PCMRs were statistically significantly higher than White rates in 39 of the 41 cities examined at T1 and in 37 of the 41 cities at T2. At T1, Austin, TX displayed the largest (RR = 3.07, 95% CI 2.17–4.35) and San Antonio, TX the smallest disparity (RR = 1.53, 95% CI 1.16-2.03). At T2, Los Angeles, CA