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Black:White disparities in lung cancer mortality in the 50 largest cities in the United States

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ABSTRACT

Introduction: This paper presents race-specific lung cancer mortality rates and the corresponding rate ratios for the 50 largest U.S. cities for the 5-year intervals 1990–1994 and 2005–2009.
Methods: The 50 largest cities in the U.S. were the units of analysis. Numerator data were abstracted from national death files where the cause was malignant neoplasms of trachea, bronchus, and lung (lung cancer) (ICD-9 = 162 and ICD-10 = C33–C34). Population-based denominators were obtained from the U.S. Census Bureau for 1990, 2000, and 2010. To measure the racial disparity, we calculated non-Hispanic Black:non-Hispanic White rate ratios (RRs) and confidence intervals for each 5-year period. We calculated correlation coefficients for 12 ecological variables and the RRs.
Results: At the final time point (2005–2009), 15 RRs were less than 1, but only 8 significantly so while 29 RRs were greater than 1, 16 of them significantly so. Of the 45 cities included in the analysis, 21 saw an increase in the Black:White RR between the first and second time points. Measures of socioeconomic status (SES) and inequalities therein were found to be associated with the RRs.
Conclusion: This analysis revealed large disparities in Black:White lung cancer mortality in the U.S. and many of its largest cities during the period 1990–2009. The data demonstrate considerable variation in the degree of disparity across cities, even among cities within the same state. These data can inform and motivate local health officials to implement targeted prevention and treatment strategies where they are needed most, ultimately contributing to a reduction in the disparity in lung cancer mortality rates.

1. Introduction

Despite recent decreases in lung cancer mortality, lung cancer remains the leading cause of cancer death for both men and women in the United States (US), accounting for more deaths than breast, prostate, and colon cancers combined [1]. A total of 221,200 new lung cancer cases and 158,040 lung cancer deaths are projected to occur within the US in 2015 alone [1].

Racial heterogeneity in lung cancer mortality is well documented [2–8]. In 2010, the lung cancer mortality rate for Black men was 75.6 per 100,000 population compared to 62.7 for Whites [9]. Among women, mortality rates were higher for Whites (41.7 per 100,000) than Blacks (37.3) [9]. Disparities in lung cancer incidence and mortality have been examined in some individual cities [6] as well as at the county [3], regional [10], and national levels [4,11]. However, to our knowledge, there is currently no study that systematically compares Black/White lung cancer mortality across US cities through consistent methodology and common sources of data. A methodical examination of disparities at the city-level, as opposed to the national level, reveals variation otherwise masked by the overall average, informing initiatives at a more local level, while also capitalizing on context-specific characteristics. This study aims to investigate Black/White differences in lung cancer mortality within the 50 most populous US cities to create city-wide comparisons across the US which may help guide the implementation of targeted preventive and treatment strategies where they are needed most.

2. Methods

2.1. City selection

The 50 most populous cities were determined using 2005 U.S. Census data [12]. Five cities were excluded from this analysis. Specifically, population data were not available at the city-level for two cities (Louisville/Jefferson County, KY and Nashville/Davidson, TN). An additional three cities (Albuquerque, NM; Arlington, TX; and Mesa, AZ) were excluded because at least one time point had

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fewer than 20 Black deaths due to small Black population size. These deletions are in accordance with research showing that mortality rates based on less than 20 deaths can be unreliable [13,14]. There were no cities for which there were fewer than 20 White deaths. This left 45 cities for the analysis of the total population. An additional two cities (El Paso, TX and Colorado Springs, CO) were excluded from the analysis of the male population due to there being fewer than 20 Black deaths. These same cities, as well as San Jose, CA were also excluded from the analysis of the female population for the same reason.

2.2. Age-adjusted lung cancer mortality rates

Five-year average age-adjusted lung cancer mortality rates per 100,000 population (using the 2000 US standard population [15] age distribution) were calculated by race/ethnicity and sex at the city-level for 1990–1994 (T1) and 2005–2009 (T2). The study period begins with 1990 because the prevalence of smoking has remained constant since then [16]. The study period ends with 2009 because this was the last year for which city-level data were available. Five-year averages are used to ensure that there are enough deaths to generate a reliable estimate.

Deaths where the cause was malignant neoplasms of trachea, bronchus, and lung (lung cancer) (ICD-9 = 162 and ICD-10 = C33–C34) were included in this analysis. Numerator data for 1990–2009 were abstracted from death files obtained from the National Center for Health Statistics [17]. Population-based denominators for the non-Hispanic White (White) and non-Hispanic Black (Black) populations were obtained from the U.S. Census Bureau for 1990, 2000, and 2010. Population-based denominators for years other than 1990, 2000, and 2010 were estimated using linear interpolation. For each of the two data sources – the census and the death files – Black and White classifications were obtained by cross-tabulating two self-report variables: Hispanic ethnicity and racial identity.

2.3. Statistical analyses

The disparity in lung cancer mortality was measured by calculating the Black:White rate ratio (RR) for each city at each time period. Confidence intervals for the RRs were calculated using a Taylor series expansion technique [18]. A change in T1–T2 RR was determined to be statistically significant if the confidence intervals for the two time points did not overlap.

Excess deaths due to the racial disparity in lung cancer mortality are calculated by multiplying the age-specific White mortality rates by the corresponding Black populations in each age category. The sum of these products is the number of Black deaths that would be expected if White death rates were applied to this population. We then subtracted the number of expected deaths from the number of observed deaths to obtain the excess number of deaths for each city [19].

2.4. Bivariate analyses

All data were analyzed using SAS v 9.2 [20]. Spearman correlation analyses were used to examine the relationship between 2005–2009 city-level lung cancer mortality rate ratios and 12 ecological variables (see Table 3 for full list). Eleven of the ecologic variables were obtained from 2005 to 2007 American Community Survey (ACS) 3-year estimates data. The Gini index is a measure of income inequality, with a score of 0 indicating complete equality and a score of 1 indicating complete inequality. The 2005–2009 ACS Index of Isolation, a measure of segregation, was obtained from Brown University's Spatial Structures in Social Sciences Databases [21].

For fifteen of the cities included in this analysis, data on median household income (MHHI) and the percent of the population living below the poverty line could not be obtained from the ACS due to data limitations. We thus averaged the 2000 and 2010 US Census estimates to calculate the 2005 MHHI and percent below poverty for these 15 cities.

3. Results

Table 1 displays the age-adjusted lung cancer mortality rates (LCMRs) for the Black and White total, male, and female populations for two time points: T1 (1990–1994) and T2 (2005–2009). Also shown are the rate ratios (RRs) and corresponding 95% confidence intervals.

For the total population, at T2, the LCMR among Blacks ranged from a low of 35.4 per 100,000 population in Colorado Springs to a high of 84.9 in Cleveland (range: 49.5). For Whites, the lowest LCMR was observed in Oakland at 29.4 and the highest rate was observed in Miami at 144.8 (range: 115.4).

Between T1 and T2, for the total population, 42 cities and the US saw a decrease in the Black LCMR. The largest decrease in the Black rate occurred in Colorado Springs where the T1 rate was 77.1 and this dropped to 35.4 by T2 (decrease: 41.7). Three cities saw an increase in the Black rate with the largest increase occurring in Las Vegas where the T1 rate of 66.2 rose to 80.8 at T2 (increase: 14.6). At the same time, 39 cities and the US saw a decrease in the White rate. Among Whites, the largest decrease in rates occurred in Oakland where the T1 rate of 58.8 dropped to 29.4 at T2 (decrease: 29.4). Six cities saw White rates increase and the largest increase occurred in Miami where the T1 rate of 104.9 jumped to 144.8 by T2 (increase: 39.9).

At T2, for the total population, 29 cities and the US displayed RRs greater than 1.00. Sixteen of these, along with the US, were statistically significant. At the same time, RRs below 1.00 were observed in 15 cities and 8 of these were statistically significant. The RR ranged from 0.56 in Miami to 2.22 in Oakland.

Between T1 and T2, the RR increased in 21 cities, 3 significantly so. The largest statistically significant increase in RRs occurred in Oakland where the T1 RR of 1.32 jumped to 2.22 by T2. The RR decreased in 24 cities and the US. This decrease was significant in only one city, New York, where the T1 RR of 1.2 dropped to 0.95 at T2.

At T2, for the male population, the Black rate ranged from 49.4 in San Jose to 122.8 in Cleveland (range: 73.4). For Whites, the lowest rate was observed in Oakland at 31.6 and the highest rate was observed in Miami at 169.8 (range: 138.2). Thirty-four cities and the US displayed RRs greater than 1.00 at T2 for the male population. Twenty-two of these, along with the US, were statistically significant. The largest male RR was observed in Oakland at 2.67 and the smallest in Miami at 0.67. Overall, the male RR decreased significantly in the US between T1 and T2 from 1.37 to 1.22.

Within the female population, at T2, the Black rate ranged from 24.1 in Raleigh to 66.2 in Portland (range: 42.1), while the White rate ranged from 30.3 in New York to 100.8 in Sacramento (range: 70.5). Eighteen cities displayed RRs greater than 1.00 at T2 for the female population, six significantly so. The largest female RR was observed in Oakland at 1.84 and the smallest in Miami at 0.46. Overall, the female RR did not change significantly in the US between T1 and T2.

Table 2 displays the percent decrease in T1 to T2 LCMRs for the Black and White total, male, and female populations. For the total population, among Blacks, the T1 to T2 change ranged from an increase of 22% in Las Vegas to a decrease of 54% in Colorado Springs. Among Whites the change ranged from a 38% increase in Miami to a 50% decrease in Oakland. Among Black males, there