Racial and Ethnic Disparities in Illinois Lung Cancer Incidence, Mortality Stage at Diagnosis, Surgical Treatment, and Screening

ABSTRACT

Objectives

To determine the extent of lung cancer racial and ethnic disparities in Illinois.

Methods

We used census data to compute race and ethnic rate ratios for publicly available Illinois lung cancer registry and hospital admissions data comparing incidence, mortality, stage at diagnosis, medical admissions, surgical admissions, screening and smoking prevalence by race and ethnicity.

Results

Despite having a lower prevalence of smoking compared to non-Hispanic whites, non-Hispanic blacks had the highest lung cancer incidence, mortality, diagnosis at distant stage, and lung cancer related hospital admission rates, as well as a lower screening rate and fewer surgical admissions. Hispanics had lower rates of lung cancer incidence and hospital care but had a much higher rate of diagnosis at distant stage.

Conclusions

Non-Hispanic blacks in Illinois continue to have a disproportionate burden of lung cancer morbidity and mortality. Disparities in lung cancer outcomes appear to be driven by social determinants of health rather than smoking rates.

INTRODUCTION

Related to the historic decline in smoking rates and improved care for those with lung cancer,[1-4] there has been a 5% decline of lung cancer mortality in men and a 4% decline in women since 2013.[1-3] However, around one quarter of all cancer related deaths in the United States and 26% of cancer related deaths in Illinois are still attributable to lung cancer.[2,3,5,6] Data from 2017 indicate that there have been more lung cancer related deaths than deaths from breast, prostate, colorectal and brain cancer combined.[2,5] When detected early, lung cancer has the potential to be effectively treated.[2,5,7] The five year survival rate is 57% when diagnosed at local stage,[3] however, approximately 57% of diagnoses are made in distant stage, where the five-year survival rate is approximately 5%.[1,3,8-10]

Screening for early detection using low-dose computed tomography (LDCT) can detect small pulmonary nodules.[10,11] LDCT has the potential to decrease lung cancer mortality by 20% as it allows for earlier diagnosis and treatment.[12,13] Current recommendations based on the United States Preventive Services Task Force (USPSTF) state that LDCT lung screening should be done for both current and recent former smokers (defined by smokers that quit less than 15 years ago) between the ages of 55 to 80 years old who have a 30 pack year history of smoking.[5] However, recent data from 10 states from the Behavioral Risk Factor Surveillance System found that only one in eight current or former smokers who met USPTSF criteria for screening reported lung cancer screening in the last year.[14]

Racial Disparities in Lung Cancer

There has been a historic racial disparity in lung cancer incidence, mortality, surgical treatment and screening with literature dating to the late 1990s.[5,7,15-23] There is evidence that non-Hispanic blacks are at higher risk for lung cancer than whites in the United States and have lower survival rates related to a later stage of diagnosis in comparison to other race and ethnic groups.[2,5,7,15-18,22-24] Racial disparities in lung cancer are greatest in the most racially segregated neighborhoods.[16] Black residents in the most racially segregated neighborhoods in the United States, had a 10% higher lung cancer mortality rate compared Blacks living in the least racially segregated neighborhoods.[24] However, Hispanics, with lower smoking rates and a younger

population, have a little more than half the lung cancer incidence and one-third the lung cancer mortality of non-Hispanic whites.[25]

Based on national Surveillance, Epidemiology, and End Results (SEER) data, there has been a substantial decrease between 2000 and 2016 in the age-adjusted lung cancer incidence and mortality rate ratios between non-Hispanic Black and non-Hispanic Whites.[26,27] These national data suggest a narrowing of the disparities related to lung cancer incidence and mortality. This study of lung cancer in Illinois was undertaken to see the extent of current racial and ethnic disparities in our state, including disparities in hospital admissions for lung cancer patients and lung cancer screening. We present the most recent publicly available Illinois lung cancer hospital and cancer registry information by race and ethnicity, comparing incidence, mortality, stage at diagnosis, medical admissions, surgical admissions, and screening rates in the state of Illinois. We also provide data on comparative rates of ever having smoked by race and ethnicity.

METHODS

Lung Cancer Incidence, Mortality and Stage at Diagnosis

The Illinois State Cancer Registry

We obtained data for incidence rate, mortality rate, and stage of diagnosis from the Illinois Department of Public Health's Illinois State Cancer Registry (ISCR) online database [6]. Cancer cases in the ISCR were identified from hospitals, free standing clinics, radiation treatment facilities, laboratories, and physician offices. Cancer cases that were identified outside of the state but belonging to Illinois state residents included. The incidence rate was calculated as the average annual age-adjusted (to the 2000 U.S. standard population) incidence rate per 100,000 Illinois residents for the years 2012 to 2016, the most recently available data. The most recent lung cancer mortality data is from 2016; there is a death certificate clearance process that serves to identify lung cancer deaths not reported directly to the ISCR. The ISCR also provides the percent local, regional, distant, and unknown stage at diagnosis by race and ethnicity with cases reported as "other" or "unknown" included in the "all races" category.[28]

Hospital Care for Lung Cancer Patients

Illinois Hospital Association Comparative Health Care and Hospital Data Reporting Services (COMPdata) administrative discharge data from 199 non-federal Illinois hospitals were obtained for all patients with lung cancer coded admissions from 2016-2018. All admissions for patients with a diagnosis code for malignant neoplasm of the bronchus or lung, defined as International Classification of Diseases, 10th revision (ICD-10) diagnosis codes C34.00 – C34.92 were analyzed. We also identified all lung resection surgeries from 87 of the 199 hospitals for patients coded as having lung cancer based on ICD-10 procedure codes for lobectomy (0BTC – 0BTJ), including coding for all operative approaches (open, video assisted thoracoscopic surgery or robotic assisted), Finally, we used Current Procedural Terminology (CPT) code 71250 to identify outpatient LDCT screening. [29] Only 77 Illinois hospitals provided LDCT in 2016, increasing to 114 by 2018; only nine of these hospitals had >1000 LDCT screens in the study period.

Smoking

Because smoking history is integrally related to lung cancer incidence, we also present survey data on current or past smoking in Illinois residents age 35 or older. These data were derived from the 2017 Illinois Behavioral Risk Factor Surveillance System (BRFSS) Questionnaire. Data were collected from 1,856 telephone interviews representative of 2,864,367 Illinois residents age 35 and older. Ever smoking was defined as having smoked at least 100 cigarettes (approximately five packs is equivalent to 100 cigarettes) in their entire life. Ever smoking rates were compared by race and ethnicity.[30] While this does not reflect the much smaller number of individuals who would meet pack year screening guidelines, it provides insight into the extent to which differences in smoking rates may be driving differences in lung cancer outcomes.

Statistical Analysis

To compute hospital admission, surgical admissions and screening rates, we obtained population denominator estimates for Illinois residents age 35 and older for all Illinois residents, non-Hispanic White, non-Hispanic Black, and Hispanic residents from the 2017 five-year American Community Survey. We used the hospital use numerator data to construct per capita admission, surgical admissions and screening rates. We

then compared rate ratios for the racial and ethnic groups we are studying for each lung cancer and smoking. The significance of differences in rate ratios was determined using chi square tests. The study is exempt from IRB review as all data was publicly available and de-identified. All analyses were done with Stata Version 15, College Station, TX.

RESULTS

ISCR Data

Table 1 provides data from the ISCR. The age adjusted annual incidence of lung cancer in Illinois between 2012-2016 was 64.7 per 100,000 overall, but it was 75.7 per 1000 for Blacks and only 27.2 per 100,000 for Hispanics. There were 6,242 total Illinois lung cancer deaths in 2016. The age-adjusted mortality rate was 16.8% higher for black versus white Illinois residents. Black and especially Hispanic residents had higher proportions of patients diagnosed at distant stage. All comparisons were $p<.001$.

Hospital Care Data

There were 52,523 lung cancer coded medical admissions, 3,649 surgical admissions, and 36,515 LDCT screenings at Illinois hospitals between 2016 and 2018 for patients age 35 and older. Table 2 presents the 2016-2018 average annual rate per 10,000 displayed for each type of care. The overall medical admission rate for non-Hispanic Black patients (36.2 per 10,000 population) was 35% higher than for non-Hispanic white patients (26.8 per 10,000 population), however the Hispanic lung cancer medical admission rate (8.1 per 10,000 population) was 70% lower than for non-Hispanic white patients. On the other hand, surgical admissions, which reflect early stage treatment, were almost 25% lower for non-Hispanic Black and very rare for Hispanic patients. The rate of lung cancer LDCT screenings was almost twice that for Non-Hispanic whites as compared to non-Hispanic Blacks and over seven times the rate for Hispanics. All comparisons were $p<.001$.

Smoking

Because smoking rates are the primary driver of lung cancer rates, it was of interest to see how if disparities in Illinois lung cancer outcomes were related to differences in smoking prevalence. Figure 1 state population weighted self-reported smoking data by age and race. Approximately 41% of the Illinois population age 35 or

older were “ever smokers” in 2017. The overall percent ever smokers for Non-Hispanic Whites (45.8%) in 2017 was higher when compared to non-Hispanic Blacks (39.43%) and much higher than Hispanics (27.2%), p<.001. Non-Hispanic Blacks did have slightly higher ever smoker rates in the 55-74 population.

Lung Cancer Race and Ethnicity Rate Ratios

Figure 2 displays Non-Hispanic Black and Hispanic to Non-Hispanic White rate ratios for incidence, mortality, distant stage at diagnosis (for those with lung cancer), medical admissions, surgical admissions, and screening rates. The incidence, mortality, distant stage at diagnosis, and medical admissions rate ratios for non-Hispanic Blacks to non-Hispanic Whites were all greater than 1.0, while the rate ratios for surgical admissions and screening were less than 1.0. For Hispanics to non-Hispanic Whites the rate ratio was unavailable for mortality, but only higher than 1.0 for diagnosis at distant stage. Incidence, mortality, medical admissions, surgical admissions, and screening the rate ratios were all <1.0.

DISCUSSION

Our findings show that Illinois continues to have significant racial and ethnic disparities in lung cancer outcomes and care. Non-Hispanic Blacks have higher incidence, mortality, late stage diagnosis and medical hospitalization rates while having lower surgical admission and screening rates. Hispanics have the lowest lung cancer incidence and lung cancer related medical admissions rate, which reflects much lower rates of smoking. However, the rate of lung cancer diagnosed at distant stage indicates that Hispanic Illinois residents are less likely to have incidental findings, usually from other types of medical care, that would lead clinicians to refer an asymptomatic patient with suspicious lung imaging findings for a lung cancer work up. This undoubtedly reflects Hispanics’ well known differential access to primary care and health insurance.

Comparison of Illinois to National Data

As compared to Illinois data presented here, SEER national data shows much narrower gap in incidence rates, mortality, and stage at diagnosis between Non-Hispanic Blacks and Non-Hispanic Whites.[26,27] Table 3 presents nationally representative SEER data. Based on 2016 data from SEER, non-Hispanic Blacks had a

higher age-adjusted incidence rate (56.8 per 100,000) than Non-Hispanic Whites (55.1 per 100,000)[26] which reflects a significantly lower rate ratio (1.07) than what we found for Illinois (1.17). While non-Hispanic Blacks also have a higher national lung cancer mortality rate (49.6 per 100,000) in comparison to Non-Hispanic Whites (47.7 per 100,000),[27] this again reflects a much lower national rate ratio (1.04) than what we found in Illinois (1.24).

Lung Cancer Incidence

Our results indicated lower self-reported ever smoker rates for non-Hispanic Black Illinois residents. It should be noted that smoking cessation may not be as successful in the Black population for a variety of reasons related to stress and less medical assistance in quitting, unequal access to healthcare services, and/or subspecialty care.[31,32] It is also possible that Black smokers are more susceptible to the development of smoking-induced lung cancer due to differing nicotine metabolism pathways which lead to differences in the uptake of carcinogens.[33] Blacks have higher levels of smoking more than 30 cigarettes per day, at which point metabolic pathways become saturated.[33] This is supported by findings reporting that Blacks inhale higher amounts of nicotine per cigarette smoked when compared to whites.[34] In one study, a higher serum level of cotinine and 30% higher nicotine levels were found in Blacks despite smoking the same number of cigarettes as Whites.[35-37] Black populations also smoke mentholated cigarettes more often which may also contribute to higher rates of lung cancer incidence.[38,39] Mentholated cigarettes may contribute to higher levels of nicotine addiction and attenuate the effectiveness of sustained release bupropion[40,41]

Areas with high levels of residential segregation have higher Black lung cancer rates, potentially related to differing environmental exposures.[16,18] Certain communities or residential areas may be more susceptible to radon exposure[42] which may be more prevalent in racially segregated communities. Occupational exposures such as asbestos, chromium, diesel exhaust, certain types of silica, and ionizing radiation may also contribute to higher lung cancer incidence.[43] Finally, the toll of workplace exposure to carcinogens may play a role in so far as Black workers are disproportionally represented in the least safe occupations.

Lung Cancer Mortality

Our findings on racial differences in lung cancer mortality mirror similar findings including a 1990-2009 study of the largest cities in the United States.[22] Higher rates of comorbid conditions in the Black population likely plays a significant role; Black patients with early stage lung cancer who received surgical treatment experienced higher all-cause mortality but not higher mortality from lung cancer.[17] Just as residential segregation is associated with lung cancer incidence, an incremental increase in racial segregation is associated with a corresponding increase in lung cancer mortality among Blacks patients.[24]

Conversely, Hispanic patients with early stage lung cancer were found to experience lower all-cause mortality compared with their White counterparts due to lower lung cancer mortality and other causes.[17] Hispanic patients with lung cancer may have a lower prevalence of chronic conditions such as coronary heart disease, hypertension, and COPD.[44] One study found that foreign born Hispanics with lung cancer experienced better survival in comparison to non-Hispanic Whites, however US born Hispanics experienced comparable survival to Non-Hispanic Whites.[45]

Screening

Our results replicate previous findings of racial and ethnic disparities in lung cancer screening. A survey conducted by Japuntich et al. found that of among patients meeting USPSTF criteria, non-Black patients were 2.8 times more likely to report having been screened, despite screening being covered by the Affordable Care Act.[5] One barrier to screening is that former smokers may not believe they are susceptible to lung cancer.[46] Rates of primary care physician referral for screening remain low.[24,38]

Stage at Diagnosis

Our findings from Illinois that Hispanics and Blacks were more likely to be diagnosed at a later stage in comparison to Non-Hispanic Whites confirm previous studies which controlled for socioeconomic factors and tumor histology types.[23] Diagnosis at later stage may be related to lack of prior health care. Bach et al. described how Black patients were highly concentrated among a small subgroup of non-Board certified physicians, and were more often visiting physicians reporting challenges in gaining access to high quality services for their patients.[32]

Medical Admissions Disparities

Our findings indicate that Non-Hispanic Blacks with diagnosed lung cancer have a higher medical admission rate. It is unlikely that this finding was driven by a higher proportion of non-Hispanic Black lung cancer patients hospitalized for treatment of other comorbid conditions in so far as the proportion of patients with a principal diagnosis of lung cancer (n=15,280, 28.2%) within each group was virtually identical (27.8% versus 27.7%). However, Hispanic patients had a higher prevalence of medical admissions with a principal diagnosis of lung cancer (30.2%).

Surgical Admissions

Our results on disparities in surgical admission rates echo a study done by Bach et al. that was published in 1999 on treatment for early stage non-small cell lung cancer.[7] These findings were replicated in a 2009 study by Farjah et al. which found disparities among patients who were recommended to receive surgical therapy,[21] and in a 2015 study done by Chen et al. finding that both Hispanics and Non-Hispanic Blacks had lower odds for receiving treatment at earlier stages even after adjusting for socioeconomic factors and tumor histology.[23] Findings from a study done by Soneji et al., found that Blacks Hispanics with early stage lung cancer had lower surgical resection rates and that Black patients who did receive early stage lung cancer treatment experienced worse overall survival than White patients.[17] Black patients may be less likely to consent to surgical therapy, reflecting a historic lack of trust in the US health care system.[47-50] Black patients may also have less access to hospitals and thoracic surgeons providing the highest quality cancer care.[31,32]

Limitations and Conclusion

This profile of lung cancer in Illinois is based on hospital and vital statistics data that provide only a ‘satellite photo’ of lung cancer care. The actual prevalence of (diagnosed) lung cancer in Illinois is unknown, there are no population-based data on clinical stage or treatment approaches, nor are there population-based data on the number of residents who meet LDCT screening criteria. Nevertheless, our findings confirm that Illinois has failed to close the lung cancer racial disparities gap and lags behind the rest of the country.

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