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

Journal of Health Disparities Research and Practice

Volume 14 | Issue 1 Article 2

2021

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

Ritika Golechha , *Northwestern University*, ritikagolechha2020@u.northwestern.edu

Mickyas Hezekiel Eskender , *Northwestern University Feinberg School of Medicine*, mickyas.eskender@northwestern.edu

David D. Odell , *Northwestern University Feinberg School of Medicine*, dodell@nm.oeg

Joe Feinglass , *Northwestern University Feinberg School of Medicine*, j-feinglass@northwestern.edu

Abstract:
This study analyzes the extent of racial and ethnic disparities in lung cancer in Illinois as compared to national trends. Cancer registry data were used to compare lung cancer incidence, mortality and stage at diagnosis rates for non-Hispanic (NH) white, NH Black and Hispanic Illinois residents. Hospital discharge data were used to compare medical and surgical admission and screening rates. Smoking across race and ethnic groups was compared using data from the Illinois Behavioral Risk Factor Surveillance System to determine the extent to which disparities might be related to smoking prevalence. Rate ratios for NH Black and Hispanics compared to NH whites were used to determine the significance of differences and to compare to national data. Despite having a lower prevalence of ever smoking compared to NH whites, NH Blacks had higher lung cancer incidence, mortality, and diagnosis with distant stage disease. NH blacks had more lung cancer medical admissions, but lower surgical admission and screening rates as compared to NH whites. Hispanics had much lower rates of lung cancer incidence and hospital care but had the highest rate of diagnosis at distant stage (61.4% as compared to 50.3% for NH whites). Illinois NH Black versus NH white rate ratios were 1.17 for incidence and 1.24 for mortality as compared to national estimates of only 1.07 and 1.04,

respectively. Addressing lung cancer disparities will require a stronger effort to reduce tobacco use in minority communities where smoking is often a response to very high levels of chronic stress. This will require culturally sensitive, community-based messaging and cheaper, more accessible smoking cessation alternatives, plus more equitable access to high-quality preventive health care.
Keywords:
Lung Cancer Incidence, Lung Cancer Mortality, Health Disparities, Lung Cancer Screening, Smoking

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

Cover Page Footnote

Research reported in this publication was supported, in part, by the National Institutes of Health's National Cancer Institute, Grant Numbers U54CA202995, U54CA202997, and U54CA203000.

Journal of Health Disparities Research and Practice
Volume 14, Issue 1, Spring 2021, pp. 13-25

School of Public Health
University of Nevada, Las Vegas

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

Ritika Golechha, Northwestern University
Mickyas Hezekiel Eskender, Northwestern University Feinberg School of Medicine
David D. Odell, Northwestern University Feinberg School of Medicine
Joe Feinglass, Northwestern University Feinberg School of Medicine
Corresponding Author: Joe Feinglass, j-feinglass@northwestern.edu

ABSTRACT

This study analyzes the extent of racial and ethnic disparities in lung cancer in Illinois as compared to national trends. Cancer registry data were used to compare lung cancer incidence, mortality and stage at diagnosis rates for non-Hispanic (NH) white, NH Black and Hispanic Illinois residents. Hospital discharge data were used to compare medical and surgical admission and screening rates. Smoking across race and ethnic groups was compared using data from the Illinois Behavioral Risk Factor Surveillance System to determine the extent to which disparities might be related to smoking prevalence. Rate ratios for NH Black and Hispanics compared to NH whites were used to determine the significance of differences and to compare to national data. Despite having a lower prevalence of ever smoking compared to NH whites, NH Blacks had higher lung cancer incidence, mortality, and diagnosis with distant stage disease. NH Blacks had more lung cancer medical admissions, but lower surgical admission and screening rates as compared to NH whites. Hispanics had much lower rates of lung cancer incidence and hospital care but had the highest rate of diagnosis at distant stage (61.4% as compared to 50.3% for NH whites). Illinois NH Black versus NH white rate ratios were 1.17 for incidence and 1.24 for mortality as compared to national estimates of only 1.07 and 1.04, respectively. Addressing lung cancer disparities will require a stronger effort to reduce tobacco use in minority communities where smoking is often a response to very high levels of chronic stress. This will require culturally sensitive, community-based messaging and cheaper, more accessible smoking cessation alternatives, plus more equitable access to high-quality preventive health care.

Keywords: Lung Cancer Incidence, Lung Cancer Mortality, Health Disparities, Lung Cancer Screening, Smoking

INTRODUCTION

Related to the historic decline in smoking rates and improved care for those with lung cancer, there has been a 5% decline of lung cancer mortality in men and a 4% decline in women since 2013. However, around one quarter of all cancer related deaths in the United States and Illinois are still attributable to lung cancer. Data from 2017 indicate that there have been more lung cancer related deaths than deaths from breast, prostate, colorectal and brain cancer combined (Howlader et al., 2019; Siegel, Miller, & Jemal, 2020). When detected early, lung cancer has the potential to be effectively treated (Li et al., 2016). The five year survival rate is 57% when diagnosed at local stage, unfortunately, approximately 57% of diagnoses are made in distant stage, where the five-year survival rate is approximately 5% (Siegel et al., 2020).

The National Cancer Institute (NCI) funded the randomized control trial called the National Lung Screening Trial (NLST) in order to determine if screening using low dose computed tomography would result in decreased lung cancer mortality (Li et al., 2016; Team, 2011). The NSLT resulted in a 20% decrease in lung cancer mortality in the LDCT group when compared with the traditional chest by radiography group by detecting small early stage cancers. Current recommendations based on the United States Preventive Services Task Force (USPSTF) support annual LDCT lung screening 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 (Li et al., 2016). 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 (Richards, 2020).

Racial Disparities in Lung Cancer

Racial disparities in lung cancer incidence, mortality, surgical treatment and screening have been consistently reported in the literature dating to the late 1990s (P. B. Bach, Cramer, Warren, & Begg, 1999; Huang et al., 2018; Japuntich, Krieger, Salvas, & Carey, 2018; Mulligan et al., 2006; O'Keefe, Meltzer, & Bethea, 2015; Razaq, Geraghty, & Dipillo, 2005). There is evidence that non-Hispanic (NH) Blacks are both at higher risk for lung cancer than whites in the United States and have a worse probability of survival once diagnosed given that these patients typically present with more advanced disease when compared to other racial and ethnic groups (Mulligan et al., 2006; Underwood et al., 2012). Racial disparities in lung cancer are exacerbated by residential segregation (Hayanga, Zeliadt, & Backhus, 2013). For example, 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 (O'Keefe et al., 2015). Hispanic Americans, particularly those of Mexican origin, have lower smoking rates than white Americans and a younger population. Hispanics have a little more than half the lung cancer incidence and one-third the lung cancer mortality of NH whites (Miller et al., 2018).

Recent national Surveillance, Epidemiology, and End Results (SEER) on-line database findings demonstrated a substantial decrease in age-adjusted lung cancer incidence and mortality between NH Blacks and NH whites between 2000 and 2016. These national data suggest disparities related to lung cancer incidence and mortality are narrowing at the national level. We undertook this study to determine the extent to which disparities in Illinois have followed or diverged from these national trends. To assess the state of lung cancer disparities in Illinois we present recent publicly available Illinois smoking, cancer registry and hospital care information by

race and ethnicity. Our findings provide benchmarks for differences in diagnosis, treatment and screening rates that can serve to guide future efforts to achieve health equity in our state.

METHODS

Lung Cancer Incidence, Mortality and Stage at Diagnosis

The Illinois State Cancer Registry

We obtained data for incidence, mortality, and stage of diagnosis from the Illinois Department of Public Health's Illinois State Cancer Registry (ISCR) online database. Patients diagnosed with cancer are identified by the ISCR from hospital tumor registries, free standing clinics, radiation treatment facilities, laboratories, and physician offices. Cancer cases of Illinois residents identified outside of the state are 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. Lung cancer mortality data is available for 2016; there is a death certificate clearance process in place which serves to identify lung cancer deaths not reported directly to the ISCR. The ISCR also provides a description of the extent of disease at the time of diagnosis, categorized as local (if a malignancy limited to origin organ), regional (if tumor extends beyond origin organ's limits), distant (if tumor that has spread to distant sites, remote from primary tumor of body), or unknown stage. Stage at diagnosis is provided by race and ethnicity, with cases where patient ethnicity could not be determined reported as "other" or "unknown" included in the "all races" category.

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 patients undergoing lung resection, which were only performed at 87 Illinois 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 thoracoscopic surgery), Finally, we used Current Procedural Terminology (CPT) code 71250 to identify outpatient LDCT screening. Only 77 Illinois hospitals performed 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 among Illinois residents age 35 or older. These data were derived from the 2017 Illinois Behavioral Risk Factor Surveillance System (BRFSS) Questionnaire. The BRFSS sampling methodology has been adjusted to increase the representativeness of low income and minority populations. 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). Ever smoking rates were compared by race and ethnicity.

Statistical Analysis

To compute hospital admission, surgical admission and screening rates, we obtained population denominator estimates for Illinois residents age 35 and older for all Illinois residents, NH white, NH Black, and Hispanic residents from the 2017 five-year American Community Survey. We used the hospital use numerator data to construct medical admission, surgical admission, and screening rates per 10,000. We then compared rate ratios for the racial and ethnic groups described above for each lung cancer outcome and smoking. The significance of differences in rate ratios was determined using chi square tests. All analyses were done with Stata Version 15 (College Station, TX). All data were publicly available and de-identified and thus IRB exempt.

RESULTS

Disparities in Lung Cancer Incidence and Mortality

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 100,000 for Blacks and only 27.2 per 100,000 for Hispanics (Table 1). 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 $p<0.001$).

Table 1
Illinois State Cancer Registry Data on Lung and Bronchus Cancer Incidence, Mortality and Stage at Diagnosis by Race and Ethnicity:

	2012-2016 Number Diagnosed and Average Annual Age Adjusted Incidence Rate per 100,000 Population*		2016 Number of Decedents and Mortality Rate per 100,000		2012-2016 Percent for Stage			
	Number	**Rate (CI)**	**Number**	**Rate (CI)**	**Local**	**Regional**	**Distant**	**Unknown**
White	39,130	64.8 (64.1-65.4)	5,157	41.5 (40.3-42.6)	21.6	22.8	50.3	5.3
Black	6,939	75.7 (73.8-77.5)	967	51.3 (48.0-54.7)	17.8	21.4	54.3	6.6
Hispanic	1,373	27.2 (25.7 28.8)	n/a	n/a	12.7	19.3	61.4	6.6
All Illinois Residents	47,130	64.7 (64.1-65.3)	6,242	41.5 (40.5-42.6)	20.7	22.4	51.5	5.5

***p<0.001**

Disparities in Medical and Surgical Admissions and Screening

There were 52,523 lung cancer coded medical admissions, 3,649 surgical admissions, 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 NH Black patients (36.2 per 10,000 population) was 35% higher than for NH white patients (26.8 per 10,000 population). Conversely the rate of admission for medical treatment was 70% lower for Hispanic than for NH white patients (8.1 versus 26.8 per 10,000 population). In addition, surgical admissions, which are likely a surrogate for both more effective treatment and earlier disease presentation, were almost 25% lower for NH Black and extremely rare among Hispanic patients (0.46 per 10,000). There were 36,515 LDCT screenings at Illinois hospitals from 2016-2018. The rate of LDCT screenings was almost twice as high for NH whites as compared to NH Blacks; the rate for NHG whites was over seven times the rate for Hispanics (all comparisons $p<0.001$).

Table 2: Average Annual Rates per 10,000 for Hospital Admissions, Lung Resection Procedures and Low Dose CT Screening for Illinois Residents coded as having Lung Cancer (2016-2018)*

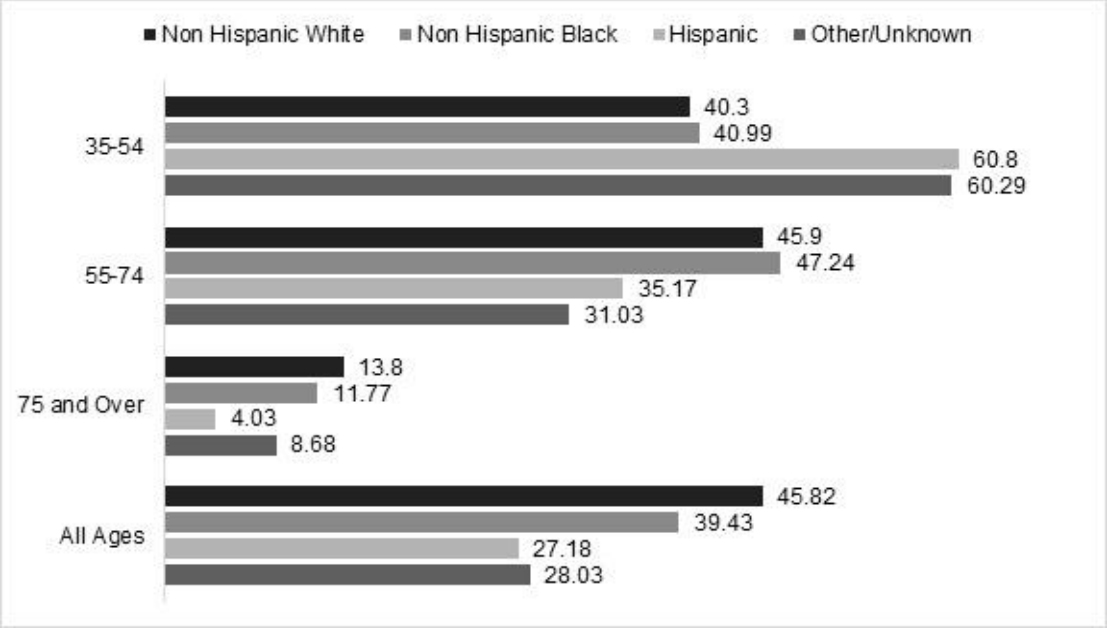
Age	Illinois Population*	Medical Admissions	Surgical Admissions	Screening
NH White				
35-54	2,118,172	3.86	0.26	0.98
55-74	1,971,939	36.78	2.94	48.95
75+	641,230	71.88	3.46	11.12
All Ages 35+	4,731,341	26.84	1.81	22.35
Black				
35-54	467,637	5.69	0.21	0.39
55-74	341,334	62.70	2.74	28.02
75+	86,621	94.93	2.35	8.74
All Ages 35+	895,592	36.21	1.38	11.73
Hispanic				
35-54	574,601	1.24	0.10	0.19
55-74	225,472	17.92	1.08	10.17
75+	42,930	46.35	1.55	4.04
All Ages 35+	843,003	8.07	0.43	3.05
All Illinois Residents**				
35-54	3,160,410	3.84	0.26	0.82
55-74	2,538,745	40.64	3.06	44.91
75+	770,781	77.00	3.52	10.92
All Ages 35 +	6,883,529	25.43	1.64	18.16

*Source: 2017 5-year American Community Survey Census Estimates
**Includes other or unknown race and ethnicity.

Smoking and Lung Cancer Risk

Because tobacco use is an established risk factor for the development of lung cancer, we examined whether disparities in lung cancer outcomes were potentially related to racial and ethnic differences in the prevalence of smoking in Illinois. Approximately 41% of the Illinois population age 35 or older were "ever smokers" as reported in the 2017 Illinois BRFSS (Figure 1). It is notable that overall ever-smoker rates for NH Blacks were lower than for NH whites (45.8% to 39.4%) and much higher than Hispanics (27.2%, $p<0.001$). NH Blacks did have slightly higher ever smoker rates in the 55-74 population.

Figure 1: Percent Ever Smokers* by Age 2017 Behavior Risk Factor Surveillance System Questionnaire N=1,856 Telephone interviews representative of 2,864,367 Illinois Residents

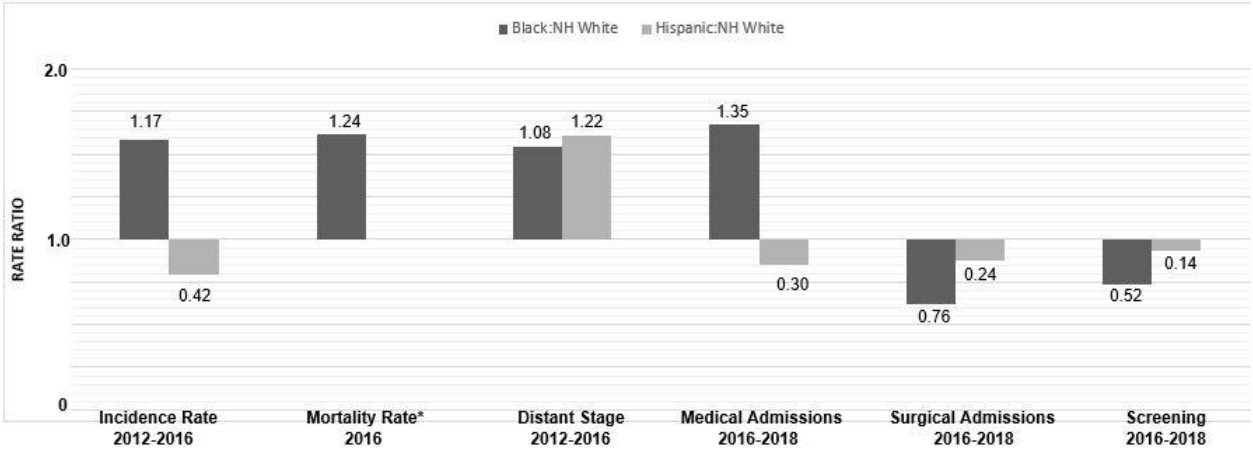


* "Ever smoked" defined as having smoked at least 100 cigarettes.

Lung Cancer Race and Ethnicity Rate Ratios

Figure 2 displays NH Black and Hispanic to NH white rate ratios for incidence, mortality, distant stage at diagnosis (for those with lung cancer), medical admissions, surgical admissions, and screening. The incidence, mortality, distant stage at diagnosis, and medical admissions rate ratios for NH Blacks to NH whites were all greater than 1.0, while the rate ratios for surgical admissions and screening were less than 1.0. For Hispanics to NH whites, the rate ratio was only higher than 1.0 for diagnosis at distant stage, with incidence, mortality, medical admissions, surgical admissions, and screening the rate ratios were all <1.0. Hispanic mortality rates were not available.

Figure 2: Rate Ratio for Illinois Lung Cancer Related Outcomes for Black:Non-Hispanic Whites and Hispanics:Non-Hispanic Whites*



*Mortality Rate information for Hispanics not available

DISCUSSION

Our study illustrates the continued presence of racial and ethnic disparities in lung cancer outcomes and care in Illinois. NH Blacks were found to have higher incidence of lung cancer and had increased risk for mortality, late-stage diagnosis, and medical hospitalization rates while having lower surgical admission and screening rates. Hispanics had the lowest lung cancer incidence and lung cancer related medical admissions rate, which may be related to much lower rates of smoking. However, the higher rate of advanced stage diagnosis may indicate that Hispanic Illinois residents may be less likely to have medical care encounters resulting in routine imaging for other indications, which might lead to the identification of clinically asymptomatic lung cancers. This is consistent with Hispanics' well-known differential access to primary care and health insurance (Velasco-Mondragon, Jimenez, Palladino-Davis, Davis, & Escamilla-Cejudo, 2016).

As compared to our Illinois findings, national on-line SEER data show a much narrower gap in incidence rates, mortality, and stage at diagnosis between NH Blacks and NH whites. Based on 2016 data from SEER, NH Blacks had a higher age-adjusted incidence rate (56.8 per 100,000) than NH whites (55.1 per 100,000)(Epidemiology, Surveillance, and End Results (SEER) Program) which reflects a significantly lower rate ratio (1.07) than what we found for Illinois (1.17). While NH Blacks also have a higher national lung cancer mortality rate (49.6 per 100,000) in comparison to NH whites (47.7 per 100,000),(Epidemiology. Surveillance, and End Results (SEER) Program) this again reflects a much lower national rate ratio (1.04) than what we found in Illinois (1.24). These findings indicate the urgent need for interventions at the state and local level to address disparities in lung cancer care, where most programs to address these gaps are ultimately enacted.

Our results indicated slightly lower self-reported smoking rates for NH Black Illinois residents. This is consistent with historical research indicating that going back 40-50 years, Black Americans have consistently consumed fewer cigarettes than whites (Ryan, 2018). owever, Black smokers have a longer duration of smoking and are diagnosed with lung cancer at an earlier age,

and smoking duration may be more closely associated with lung cancer incidence than pack years (Ryan, 2018). Smoking cessation may not be as successful in the Black population for reasons related to greater social stress, less medical assistance in quitting, and unequal access to healthcare (Bach, Pham, Schrag, Tate, & Hargraves, 2004; Shavers & Brown, 2002). Thus Black smokers do not benefit as much from the roughly 20 year linear decrease in the odds of lung cancer after a smoker quits (Ryan, 2018).

It is also been proposed 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 (Haiman et al., 2006). Blacks have higher rates of smoking more than 30 cigarettes per day, at which point metabolic pathways become saturated and toxicity increases (Haiman et al., 2006). This is supported by findings that Black smokers inhale higher amounts of nicotine per cigarette smoked when compared to whites, a marker for extraction of carcinogens (Trinidad, Perez-Stable, Messer, White, & Pierce, 2010). 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 (Stellman & Stellman, 1996).

Our findings on racial differences in lung cancer mortality mirror similar findings including a 20 year study of the largest cities in the United States (Hunt & Balachandran, 2015). 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 (Soneji, Tanner, Silvestri, Lathan, & Black, 2017). Just as residential segregation is associated with varying lung cancer incidence rates, an incremental increase in racial segregation is associated with a corresponding increase in lung cancer mortality among Blacks patients (O'Keefe et al., 2015).

Hispanic patients with early stage lung cancer were found to experience lower all-cause and lung cancer-specific mortality compared with their white counterparts (Soneji et al., 2017). This may be explained by a lower prevalence of chronic conditions such as coronary disease, hypertension, and COPD in Hispanic patients (Blackwell, Lucas, & Clarke, 2014). One study found that foreign-born Hispanics with lung cancer experienced better survival in comparison to NH whites, however US-born Hispanics experienced comparable survival to NH whites (Patel et al., 2016).

Our findings from Illinois that both Hispanics and NH Blacks were more likely to be diagnosed at a later stage in comparison to NH whites confirm previous studies which controlled for socioeconomic factors and tumor histology types (Chen et al., 2015). Diagnosis at later stage is likely related to poorer access to primary health care and much higher rates of lack of health insurance, with Hispanics having the highest rate of uninsurance. Bach and colleagues described how Black lung cancer patients were highly concentrated among a small subgroup of non-board certified physicians, and were more often treated by physicians who themselves reported challenges in gaining access to high quality services for their patients (Bach et al., 2004).

Our findings also indicate that NH Blacks with diagnosed lung cancer have a higher rate of medical admissions. It is possible that this finding was driven by a higher proportion of NH Black lung cancer patients hospitalized for treatment of other comorbid conditions. However, the proportion of patients with a principal diagnosis of lung cancer was virtually identical for NH Blacks and NH whites (27.8% versus 27.7%). Hispanic patients had a higher prevalence of medical admissions with a principal diagnosis of lung cancer (30.2%).

Illinois disparities in surgical admission rates echo a 1999 study done by Bach et al. on treatment for early stage non-small cell lung cancer (Bach et al., 1999). These findings were replicated in a 2009 study by Farjah et al. which found 14% racial difference among patients who were all recommended to receive surgical therapy,(Farjah et al., 2009) and in a 2015 study done by Chen et al. finding that both Hispanics and NH Blacks had lower odds for receiving treatment at earlier stages even after adjusting for socioeconomic factors and tumor histology (Chen et al., 2015). Findings from a study done by Soneji et al., found that Blacks and 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 (Soneji et al., 2017). Black patients may be less likely to consent to surgical therapy, reflecting a historic lack of trust in the US health care system (Corbie-Smith, Thomas, Williams, & Moody-Ayers, 1999; Cykert & Phifer, 2003; Gordon, Street Jr, Sharf, Kelly, & Souchek, 2006; Margolis et al., 2003). Black patients may also have less access to hospitals and surgeons providing the highest quality cancer care (Bach et al., 2004; Shavers & Brown, 2002).

Our results align with 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 (Japuntich et al., 2018). One barrier to screening is that former smokers may not believe they are susceptible to lung cancer (Delmerico, Hyland, Celestino, Reid, & Cummings, 2014). Furthermore, rates of primary care physician referral for screening continue to remain low (Coughlin, Matthews-Juarez, Juarez, Melton, & King, 2014; O'Keefe et al., 2015).

Limitations

This profile of lung cancer in Illinois is based on hospital and vital statistics data that are the only publicly available information that provides for analysis of multiple aspects of lung cancer epidemiology and care. The actual prevalence of (diagnosed) lung cancer in Illinois is unknown; there are no population-based data on clinical stage or the full range of treatment approaches, nor are there population-based data on the number of residents who meet LDCT screening criteria. While BRFSS smoking results do not reflect individuals who would meet age and pack year screening guidelines, they provide insight into the extent to which differences in overall smoking rates may be driving differences in lung cancer outcomes.

CONCLUSION

Our findings confirm that Illinois has failed to close the lung cancer racial disparities gap and lags behind the rest of the country. This is likely due to the presence in the Chicago area and some other Illinois cities of highly segregated communities with concentrated poverty and high rates of smoking. Lung cancer disparities, like health status disparities in general, are rooted in the social determinants of health and will likely remain to the extent that politically patterned social, economic, and environmental inequality, based on historic structural racism, continues to pervade American society.

This does not mean that life-saving public health interventions for lung cancer prevention and treatment should not be scaled up, especially in Illinois where outcomes significantly lag behind progress at the national level. This will require culturally sensitive, community-based public health messaging and cheaper, more accessible (free) smoking cessation alternatives,

available through safety net clinics and other institutions serving low-income communities. Equitable access to high-quality preventive healthcare will require tailored messaging. This was illustrated by the challenge of developing a lung cancer screening decision-aid support for a diverse population (Kaufman, Schnure, Nicholson, F., & Guerra, 2020), and will require considering how best to reach both men and women (Randhawa, Sferra, Das, Kaiser, & Erkman, 2020). Community based participatory research generally remains an underfunded model for health education. In Chicago, the NIH funded Supporting High Risk African American Men in Research, Engagement & Decision Making (SHARED) project focuses on increasing lung cancer screening among African American men, using citizen scientists as study partners. As documented by this study of outcomes in Illinois, the stakes remain high for raising awareness in communities and health care systems about the range of opportunities to improve lung cancer health equity.

ACKNOWLEDGEMENTS

Research reported in this publication was supported, in part, by the National Institutes of Health's National Cancer Institute, Grant Numbers U54CA202995, U54CA202997, and U54CA203000. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

REFERENCES:

Bach, P. B., Cramer, L. D., Warren, J. L., & Begg, C. B. (1999). Racial differences in the treatment of early-stage lung cancer. *N Engl J Med, 341*(16), 1198-1205. doi:10.1056/NEJM199910143411606

Bach, P. B., Pham, H. H., Schrag, D., Tate, R. C., & Hargraves, J. L. (2004). Primary care physicians who treat Blacks and whites. *New England Journal of Medicine, 351*(6), 575-584.

Blackwell, D. L., Lucas, J. W., & Clarke, T. C. (2014). Summary health statistics for US adults: national health interview survey, 2012. *Vital and health statistics. Series 10, Data from the National Health Survey*(260), 1-161.

Chen, Y., Chang, A., Chen, C., Chiu, H., Chiu, Y., Feng, Y., . . . Wu, C. (2015). 1036 Impact of race and ethnicity on stage at diagnosis of non-small cell lung cancer (NSCLC) and receipt of treatment in contemporary United States population: A SEER-based analysis. *European Journal of Cancer, 51*, S157.

Corbie-Smith, G., Thomas, S. B., Williams, M. V., & Moody-Ayers, S. (1999). Attitudes and beliefs of African Americans toward participation in medical research. *Journal of general internal medicine, 14*(9), 537-546.

Coughlin, S. S., Matthews-Juarez, P., Juarez, P. D., Melton, C. E., & King, M. (2014). Opportunities to address lung cancer disparities among African Americans. *Cancer medicine, 3*(6), 1467-1476.

Cykert, S., & Phifer, N. (2003). Surgical Decisions for Early Stage, Non–Small Cell Lung Cancer: Which Racially Sensitive Perceptions of Cancer Are Likely to Explain Racial Variation in Surgery? *Medical decision making, 23*(2), 167-176.

Delmerico, J., Hyland, A., Celestino, P., Reid, M., & Cummings, K. M. (2014). Patient willingness and barriers to receiving a CT scan for lung cancer screening. *Lung Cancer, 84*(3), 307-309.

Farjah, F., Wood, D. E., Yanez, N. D., Vaughan, T. L., Symons, R. G., Krishnadasan, B., & Flum, D. R. (2009). Racial disparities among patients with lung cancer who were recommended operative therapy. *Archives of Surgery, 144*(1), 14-18.

Gordon, H. S., Street Jr, R. L., Sharf, B. F., Kelly, P. A., & Souchek, J. (2006). Racial differences in trust and lung cancer patients' perceptions of physician communication. *Journal of Clinical Oncology, 24*(6), 904-909.

Haiman, C. A., Stram, D. O., Wilkens, L. R., Pike, M. C., Kolonel, L. N., Henderson, B. E., & Le Marchand, L. (2006). Ethnic and racial differences in the smoking-related risk of lung cancer. *New England Journal of Medicine, 354*(4), 333-342.

Hayanga, A. J., Zeliadt, S. B., & Backhus, L. M. (2013). Residential segregation and lung cancer mortality in the United States. *JAMA surgery, 148*(1), 37-42.

Howlader, N., Noone, A., Krapcho, M., Miller, D., Brest, A., Yu, M., . . . Lewis, D. (2019). SEER Cancer Statistics Review, 1975-2016. *National Cancer Institute*.

Huang, C.-Y., Au, K.-K., Chen, S.-L., Wang, S.-C., Liao, C.-Y., Hsu, H.-H., . . . Wang, Y.-C. (2018). Unfavorable Mortality-To-Incidence Ratio of Lung Cancer Is Associated with Health Care Disparity. *International journal of environmental research and public health, 15*(12), 2889.

Hunt, B., & Balachandran, B. (2015). Black: White disparities in lung cancer mortality in the 50 largest cities in the United States. *Cancer epidemiology, 39*(6), 908-916.

Japuntich, S. J., Krieger, N. H., Salvas, A. L., & Carey, M. P. (2018). Racial Disparities in Lung Cancer Screening: An Exploratory Investigation. *J Natl Med Assoc, 110*(5), 424-427. doi:10.1016/j.jnma.2017.09.003

Kaufman, M., Schnure, N., Nicholson, A., F., L., & Guerra, C. (2020). A lung cancer screening personalized decision-aid improves knowledge and reduces decisional conflict among a diverse population of smokers at an urban academic medical center. *Journal of Health Disparities Research and Practice, 13*(2), 26-35.

Li, Z., Luo, L., Hu, Y., Chen, H., Den, Y., Tang, L., . . . Zhang, X. (2016). Lung cancer screening: a systematic review of clinical practice guidelines. *International journal of clinical practice, 70*(1), 20-30.

Margolis, M. L., Christie, J. D., Silvestri, G. A., Kaiser, L., Santiago, S., & Hansen-Flaschen, J. (2003). Racial differences pertaining to a belief about lung cancer surgery: results of a multicenter survey. *Annals of internal medicine, 139*(7), 558-563.

Miller, K. D., Goding Sauer, A., Ortiz, A. P., Fedewa, S. A., Pinheiro, P. S., Tortolero-Luna, G., . . . Siegel, R. L. (2018). Cancer statistics for hispanics/latinos, 2018. *CA: a cancer journal for clinicians, 68*(6), 425-445.

Mulligan, C. R., Meram, A. D., Proctor, C. D., Wu, H., Zhu, K., & Marrogi, A. J. (2006). Unlimited access to care: effect on racial disparity and prognostic factors in lung cancer. *Cancer Epidemiology and Prevention Biomarkers, 15*(1), 25-31.

O'Keefe, E. B., Meltzer, J. P., & Bethea, T. N. (2015). Health disparities and cancer: racial disparities in cancer mortality in the United States, 2000–2010. *Frontiers in public health, 3*, 51.

Patel, M. I., Wang, A., Kapphahn, K., Desai, M., Chlebowski, R. T., Simon, M. S., . . . Adams-Campbell, L. L. (2016). Racial and ethnic variations in lung cancer incidence and mortality: results from the Women's Health Initiative. *Journal of Clinical Oncology, 34*(4), 360.

Randhawa, S., Sferra, S., Das, C., Kaiser, L. M. G., & Erkman, C. (2020). Examining gender differences in lungcancer screening *Journal of Community Health, 45*, 1038-1042.

Razaq, W., Geraghty, M., & Dipillo, F. (2005). Survival disparity in lung cancer among African American and white females: A population based study in LICH Brooklyn, NY. *Journal of Clinical Oncology, 23*(16_suppl), 9629-9629.

Richards, T. B. (2020). Screening for Lung Cancer—10 States, 2017. *MMWR. Morbidity and mortality weekly report, 69*.

Ryan, B. M. (2018). Lung cancer health disparities. *Carcinogenesis, 39*(6), 741-751. doi:10.1093/carcin/bgy047

Shavers, V. L., & Brown, M. L. (2002). Racial and ethnic disparities in the receipt of cancer treatment. *Journal of the National Cancer Institute, 94*(5), 334-357.

Siegel, R. L., Miller, K. D., & Jemal, A. (2020). Cancer statistics, 2020. *CA: A Cancer Journal for Clinicians, 70*(1), 7-30.

Soneji, S., Tanner, N. T., Silvestri, G. A., Lathan, C. S., & Black, W. (2017). Racial and ethnic disparities in early-stage lung cancer survival. *Chest, 152*(3), 587-597.

Stellman, J. M., & Stellman, S. D. (1996). Cancer and the workplace. *CA Cancer J Clin, 46*(2), 70-92. doi:10.3322/canjclin.46.2.70

Surveillance, Epidemiology, and End Results (SEER) Program. SEER*Stat Database: Incidence-Based Mortality - SEER 18 Regs (Excl Louisiana) Research Data, Nov 2018 Sub (2000-2016) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2019, based on the November 2018 submission. Retrieved from www.seer.cancer.gov. www.seer.cancer.gov

Surveillance, Epidemiology, and End Results (SEER) Program SEER*Stat Database: Incidence - SEER 18 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2018 Sub (2000-2016) <Katrina/Rita Population Adjustment> - Linked To County Attributes - Total U.S., 1969-2017 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, released April 2019, based on the November 2018 submission. Retrieved from www.seer.cancer.gov. www.seer.cancer.gov

Team, N. L. S. T. R. (2011). Reduced lung-cancer mortality with low-dose computed tomographic screening. *New England Journal of Medicine, 365*(5), 395-409.

Trinidad, D. R., Perez-Stable, E. J., Messer, K., White, M. M., & Pierce, J. P. (2010). Menthol cigarettes and smoking cessation among racial/ethnic groups in the United States. *Addiction, 105 Suppl 1*, 84-94. doi:10.1111/j.1360-0443.2010.03187.x

Underwood, J. M., Townsend, J. S., Tai, E., Davis, S. P., Stewart, S. L., White, A., . . . Fairley, T. L. (2012). Racial and regional disparities in lung cancer incidence. *Cancer, 118*(7), 1910-1918.

Velasco-Mondragon, E., Jimenez, A., Palladino-Davis, A. G., Davis, D., & Escamilla-Cejudo, J. A. (2016). Hispanic health in the USA: a scoping review of the literature. *Public Health Rev, 37*, 31. doi:10.1186/s40985-016-0043-2