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Lung cancer incidence trends in California by race/ethnicity, histology, sex, and neighborhood socioeconomic status: An analysis spanning 28 years☆

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ABSTRACT

Objectives: Lung cancer incidence trends by histology, sex, race/ethnicity, and neighborhood socioeconomic status (nSES) have not been previously reported. We conducted a population-based study of lung cancer incidence over three *peri*-censal periods: 1988–1992, 1998–2002, and 2008–2012.
Materials and methods: We abstracted lung cancer cases from the California Cancer Registry and used US Census and American Community Survey data to develop multidimensional nSES indices for each census period. We calculated nSES tertile-specific incidence rates and rate ratios for each *peri*-censal period and used incidence rate ratios (IRR) to assess changes in rates from 1988 to 1992 to 1998–2002 and 2008–2012.
Results: There were a total of 231,205 lung cancer cases. Males: Among males, incidence rates of lung cancer decreased over time, all race/ethnicities, and all nSES tertiles, with larger declines among males in higher nSES areas. Rates either declined or were stable for adenocarcinoma, with larger declines for other histologic subtypes. Females: Among females, declines in incidence rates of lung cancer were more pronounced for females in higher nSES areas, but diverged more so than for males, with variations by histology and race/ethnicity. Incidence rates of adenocarcinoma increased over time among all females, with greater increase among females in low nSES areas.
Conclusions: Our findings demonstrate differences in incidence trends over three decades by histology, gender, race/ethnicity, and nSES. While incidence rates consistently declined over time for males, there were greater declines in incidence for high nSES populations. In contrast, among females, there was evidence of increases in lung cancer incidence among low SES API females, and for adenocarcinoma.
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1. Introduction

Lung cancer is one of the most common cancer and cause of cancer death worldwide [1]. Variations in incidence trends largely reflect smoking patterns globally. In contrast to several nations where tobacco use has peaked such as China, Korea, and Africa, lung cancer incidence has decreased steadily in nations such as the United States, United Kingdom, Canada, and Australia where tobacco consumption has waned [1]. In the United States, despite declines in lung cancer incidence, lung cancer remains the second leading cancer diagnosis (222,500 estimated new cases in 2017) and the leading cause of death (155,870 estimated deaths in 2017 [2]. Thus, the identification of high-risk subgroups continues to be an important global health goal.

In the United States, as in other nations, there are variations in lung cancer incidence by sex, race/ethnicity, and histology [3–5]. Over the past 37 years, there have been consistent declines in incidence among males, while declines among females have only recently been reported [2]. Incidence rates also vary by

Abbreviations: NHW, Non-Hispanic White; NHB, Non-Hispanic Black; API, Asian Pacific Islander; SES, socioeconomic status; nSES, neighborhood socioeconomic status; ACS, American Community Survey; IR, incidence rate; IRR, incidence rate ratio.

☆ This data was presented as a poster presentation at the September 2015 World Lung Conference in Denver, Colorado.

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race/ethnicity, with almost 50% greater incidence among non-Hispanic black males (NHB) as compared to non-Hispanic white (NHW) males [6]. Previous studies show no differences in incidence rates over time between NHB and NHW females [2,6]. Variation in histology-specific incidence trends have also been reported with increasing incidence of adenocarcinoma among both males and females and increasing incidence of squamous cell carcinoma among females from 2004 to 2009 [7]. These trends in histology may be due to differences in exposures, such as smoking. Yet, there are little data on how these patterns have changed over time by race/ethnicity, sex, and socioeconomic status (SES). The state of California has one of the largest and most racially/ethnically diverse populations in the US [8] and a 25-year history of pioneering tobacco control efforts [9]. Therefore, we leveraged California's population-based cancer registry data to characterize and compare lung cancer incidence patterns by sex, race/ethnicity, and neighborhood SES over 5-year *peri*-censal periods from 1988 to 1992 to 1998–2002 and 2008–2012.

2. Materials and methods

2.1. Source of data

We abstracted incident invasive lung cancer cases (ICD-O-3 C34) among those ages 18 and older from the population-based California Cancer Registry (CCR) during three discrete *peri*-censal time periods (1988–1992, 1998–2002 and 2008–2012) surrounding the Census years 1990, 2000 and 2010, respectively. For all cases, we obtained registry data routinely abstracted or derived from the medical record on age, sex, race/ethnicity, stage of diagnosis (using the Surveillance Epidemiology and End Results Summary Stage [10]), and tumor histology coded to ICD-O-3. We geocoded and assigned addresses at diagnosis for cases to a census tract and then linked cases to tract-level census measures. Neighborhood SES (nSES), a composite index developed previously from principal component analyses, incorporated tract-level information on education, occupation, employment, household income, poverty, housing value, and rental value from the Census 1990 and 2000 Summary Files, and American Community Survey (ACS) 2007–2011 data (as ACS replaced the decennial Census long form after 2000) [11,12]. We grouped lung cancer histology coded to ICD-0-3 into subtypes of small cell lung cancer (SCLC) (ICD-0-3 8002, 8041–8045); adenocarcinoma (ICD-0-3 8015, 8050, 8140–8141, 8143–8145, 8147, 8190, 8201, 8211, 8250–8255, 8260, 8290, 8310, 8320, 8323, 8333, 8401, 8440, 8470–8471, 8480–8481, 8490, 8503, 8507, 8550, 8570–8572, 8574, 8576); squamous cell carcinoma (SCC) (ICD-0-3 8051–8052, 8070–8076, 8078, 8083–8084, 8090, 8094, 8120, 8123); large cell + other specified carcinoma (LC + OSC) (8003–8004, 8012–8014, 8021–8022, 8030–8035, 8082, 8200, 8240–8241, 8243–8246, 8249, 8430, 8525, 8560, 8562, 8575); and unspecified carcinoma (8000–8001, 8010–8020, 8046, 8230) [13]. This study is covered under the Greater Bay Area Cancer Registry protocol approved by the Institutional Review Board of the Cancer Prevention Institute of California.

2.2. Statistical analysis

We used April 1, 1990; April 1, 2000 and April 1, 2010 Census data to represent the population denominators. We calculated incidence rates (IRs) as cases per 100,000, age-adjusted to the 2000 U.S. Standard, for overall lung cancer and histologic-specific subtypes for each racial/ethnic group, time period, and nSES statewide tertile. We used SEER*Stat software (version 8.2.1) [10] to calculate incidence rates (IR) and incidence rate ratios (IRR) and 95% confidence intervals (CIs) using previously established methods [14]. To summarize the overall magnitude of change in lung cancer incidence by time period, race/ethnicity, and nSES, we calculated IRRs using the earliest time period (years 1988–1992) as the reference period. Using two-sided tests, we considered p-values < 0.05 significant.

Table 1
Distribution of patient sociodemographic and tumor clinical factors by sex and time period.

	Men			Women		
	1988–1992	1998–2002	2008–2012	1988–1992	1998–2002	2008–2012
Total N	45,176	41,980	39,336	32,140	35,775	36,798
Race	Percentage of Total N (Men)			Percentage of Total N (Women)		
Non-Hispanic White	79.6%	74.1%	67.6%	83.7%	78.7%	71.1%
Non-Hispanic Black	8.2%	8.2%	8.2%	6.2%	6.7%	7.4%
Hispanic	6.7%	8.5%	11.1%	6.1%	7.6%	10.7%
Non-Hispanic Asian/Pacific Islander	5.0%	8.7%	12.3%	3.6%	6.4%	10.0%
Other/unknown	0.4%	0.5%	0.8%	0.4%	0.6%	0.8%
Tertile (statewide) of nSES						
Tertile 1-Low nSES	35.3%	29.9%	29.8%	31.5%	26.6%	27.7%
Tertile 2-Mid nSES	36.6%	38.6%	37.6%	37.2%	38.3%	36.8%
Tertile 3-High nSES	28.2%	31.5%	32.7%	31.4%	35.1%	35.5%
Age						
< 50 years	5.9%	5.1%	3.5%	7.0%	5.5%	4.1%
50–59 years	16.4%	14.8%	13.6%	16.5%	14.6%	13.2%
60–69 years	35.4%	28.6%	29.1%	34.4%	27.4%	27.6%
70–79 years	31.8%	36.4%	33.1%	32.1%	35.8%	33.1%
80+ years	10.5%	15.1%	20.8%	10.0%	16.8%	22.0%
Histology						
Small Cell Carcinoma	15.3%	12.4%	10.8%	18.7%	14.3%	11.4%
Adenocarcinoma	31.4%	34.4%	43.3%	38.7%	41.3%	51.8%
Squamous Cell Carcinoma	29.3%	23.1%	23.5%	18.9%	15.6%	15.5%
Large Cell + Other Unspecified	12.1%	9.0%	7.0%	12.4%	9.6%	7.8%
Unspecified	11.9%	21.1%	15.5%	11.4%	19.3%	13.5%
Stage at presentation						
Localized	16.1%	15.7%	16.7%	19.0%	19.0%	21.1%
Regional	21.4%	21.2%	21.8%	21.3%	21.2%	21.8%
Distant	48.1%	56.2%	58.6%	45.4%	52.7%	54.1%
Unstaged	14.5%	7.0%	2.8%	14.3%	7.2%	3.0%

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