Disparities in lung cancer survival and receipt of surgical treatment

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ABSTRACT

Background: Lung cancer accounts for the greatest proportion of cancer deaths in the United States. This study aims to characterize lung cancer survival by racial/ethnic group and ascertain any modifiable determinants of identified disparities in the newly diverse Mountain West by using the state of Nevada.

Materials and methods: 12,964 first primary lung cancer cases diagnosed between 2003 and 2010 were identified for analysis from the Nevada Central Cancer Registry and followed for vital status until December 31, 2011. Standardized age-adjusted five-year survival stratified by race/ethnicity was computed using life table methods. Hazard ratios adjusted for covariates were estimated using Cox proportional hazards regression modeling. Adjusted odds of receiving surgical treatment for localized non-small cell lung cancer by region of Nevada were compared using logistic regression.

Results: By the end of the follow-up period, 86% of lung cancer cases in Nevada were deceased. Five-year overall survival was 12.3% (95%CI: 11.5–13.1) for males and 18.9% (95%CI: 17.9–19.9) for females. Compared to cases in Northwestern Nevada, patients in Southern and Rural Nevada had 9% (HR:1.09; 95% CI:1.04–1.14) and 10% (HR:1.10; 95% CI:1.02–1.19) higher risk of dying from lung cancer, respectively. For localized non-small cell lung cancer (NSCLC), which is potentially curable, Southern Nevadans had 67% higher odds of not receiving surgical treatment than Northwestern Nevadans (OR 1.67; 95%CI: 1.30–2.13).

Conclusions: While the prognosis for lung cancer survival in Nevada is poor for all populations, there is no racial/ethnic disparity. However, there is a considerable survival disparity by geographic region, with Southern Nevadans disproportionately impacted. Potential modifiable factors include treatment differences, particularly in receipt of surgery for potentially curative tumor types such as localized NSCLC. Further studies are required to identify barriers to receipt of surgery in Southern Nevada.

1. Background

Lung cancer, the deadliest cancer for both men and women in the United States (US), is projected to account for 26% of all 2017 cancer deaths [1]. While lung cancer mortality has decreased steadily in the past few decades, partially attributed to favorable changes in smoking trends, the prognosis for survival remains very poor, at only 18% [1]. Survival differences from lung cancer, which is complex to treat, have been associated with both sociodemographic factors, including age, sex, race/ethnicity, health insurance status, socioeconomic status, as well as clinical factors, including stage at diagnosis, histological type, and presence of comorbidities [2–5]. As with other major cancers, the burden of lung cancer is not shared equally between racial/ethnic groups. Non-Hispanic Black (NHB) males have the highest incidence

and mortality from lung cancer than any other race/ethnicity in the US. [1,6].

Like many Mountain West states, Nevada, with a population of 2.9 million, has experienced rapid growth in the past few decades [7], and has consistently ranked low in cancer-related mortality outcomes when compared to other states [1,8]. Moreover, within state disparities in survival have been found in Nevada for other cancers, including breast [9], colorectal [10], and cervical [11]. However, there has yet to be an accurate characterization of lung cancer survival among Nevadans, leaving a critical gap in the baseline data available for clinicians, researchers and policy makers on the leading cause of cancer death. Therefore, this study aims to use data from Nevada's cancer registry, enhanced by multiple death linkages, to describe the lung cancer survival experience of Nevadans, examined by racial/ethnic group.

Further, we aim to ascertain the determinants of any identified disparities in the diverse Mountain West state of Nevada.

2. Materials and methods

2.1. Study population

Cases were men and women diagnosed in Nevada with a first primary lung and bronchial cancer between 2003 and 2010, identified through the Nevada Central Cancer Registry (NCCR), a population-based registry that collects and maintains cancer incidence data in Nevada in accordance with the National Program for Cancer Registries (NPCR) and the North American Association of Central Cancer Registries (NAACCR) Standards [12,13]. Death records, routinely linked to the NCCR data, were obtained from the Nevada Office of Vital Records. To minimize missed deaths, we conducted additional linkages to the National Death Index and the Social Security Administration Masterfile. Lung cancer cases were followed for vital status until December 31, 2011.

The lung cancer site codes included were C34.0–34.3, C34.8–34.9; morphology codes were 8000–8576 as described in the International Classification of Diseases for Oncology, third edition [14]. Excluded cases were those diagnosed at autopsy or by death certificate only, as well as cases with a negative or missing survival period (n = 690).

2.2. Covariates

Demographic variables included as covariates, determined at date of diagnosis, included sex, age, race/ethnicity, and place of residence in Nevada. Age at diagnosis was categorized into the following 5 groups: 15–44, 45–54, 55–64, 65–74, and 75+, based on the International Cancer Survival Standards age classification [15]. Race/ethnicity was classified into the following mutually exclusive groups: non-Hispanic white (NHW), non-Hispanic black (NHB), Hispanic, Asian/Pacific Islander (API), American Indian/Alaska Native (AIAN), and Unknown/Other. Place of residence in Nevada was classified into three regions: Southern, Northwestern and Rural. Southern Nevada was comprised of Clark County, the largest population center in Nevada, 2.1 million people and 72% of the state's population. Northwestern Nevada encompassed the counties of Douglas, Lyon, Storey, and Washoe as well as Carson City. The remaining eleven sparsely populated counties were classified as Rural Nevada.

Insurance status, marital status, and socioeconomic status (SES) were also included in the study. Insurance status was classified into four categories: private insurance and those insured under Veteran Affairs and Medicare; Medicaid and those cases covered by Indian Health Service; the uninsured; and unknown. Marital status was coded as single, married, widowed, divorced/separated, or unknown. SES information, not directly collected on individual cases by the NCCR, was based on ecological data from poverty proportions in the patient's zip code, based on 2011 US Census Bureau data [16]. Three categories were considered: high SES, defined as less than 5% of the population of that zip code in poverty, middle SES, with 5–10% in poverty, and low SES, with greater than 10% in poverty.

Clinical factors considered included stage at diagnosis, treatment type received, and histology. SEER Program summary staging – localized, regional, or distant – was used to categorize the extent of the disease at diagnosis [17]. Data regarding treatment, whether by surgery, chemotherapy, or radiation, were categorized into binary yes/no outcomes. For initial analyses, lung cancer was classified into five histological categories: Squamous Cell Cancer (SCC), Small Cell Lung Cancer (SCLC), Adenocarcinoma (ADK), Carcinomas Not Otherwise Specified (NOS), and Others. The final analysis on receipt of surgery examined only stage and morphology combinations with potential for curative treatment: localized Non-Small Cell Lung Cancer (NSCLC), including ADKs and SCCs. These accounted for 15.5% of all lung

cancers.

2.3. Data analyses

Likelihood ratio chi-square tests were conducted to compare demographic and clinical characteristics by race/ethnicity. Age-adjusted lung cancer incidence rates for the state of Nevada were calculated for each category. Cumulative 5-year survival, with a primary endpoint of observed all-cause mortality, was computed by the actuarial life table method, stratified by race/ethnicity and adjusted for age. Survival time was measured in months from the date of diagnosis until either the date of death or the end of the study period, Dec. 31, 2011, whichever occurred first. US survival from the SEER-18 registries was used for comparison. Cox proportional hazards regression models for multivariate survival analysis were constructed to compute hazard ratios with corresponding 95% confidence intervals (CI) showing risk of all-cause death. The multivariate model was adjusted for all covariates significant in previous univariate analyses (data not shown). Differences in receipt of treatment for localized NSCLC by region of residence in Nevada were compared using a chi-square test; odds of not receiving compared to receiving surgical treatment were computed using an adjusted multivariate logistic regression model.

Statistical tests with *p*-values < 0.05 were considered statistically significant. Data were analyzed with SPSS v22. The Institutional Review Board at the University of Nevada, Las Vegas approved this study.

3. Results

12,964 new cases with a primary diagnosis of lung cancer from 2003 through 2010 were identified (Table 1). Across all race/ethnicities, females accounted for a lower proportion of total cases than males. Most cases among minority populations were diagnosed in Southern Nevada, including 93% of all NHBs, 86% of APIs, and 80% of Hispanics. By the end of the follow-up period, 86.3% of the cases had died.

The overall age-standardized 5-year observed survival for Nevada lung cancer cases was 15.6% (95%CI: 14.9–16.2), lower than but not statistically different from overall US survival of 16.4% (95%CI: 16.2–16.5). Similar to patterns seen in US-SEER-18, Nevada males had lower 5-year survival (12.3%; 95%CI: 11.5–13.1) than Nevada females (18.9%; 95%CI: 17.9–19.) (Table 2).

In hazards regression models, risk of death from lung cancer increased steadily with age: those diagnosed at ages above 75 had 2.62 times the risk of death than those under age 45 after adjustment for covariates (Table 3). Females in Nevada had an 18% lower risk of death compared to males (HR 0.82, 95%CI: 0.79–0.86). Compared to NHWs, Hispanics and Asian/Pacific Islanders had 19% and 25% lower risk of death, respectively. The risk difference between NHBs and NHWs was not statistically significant. Cases diagnosed with distant stage disease were 3.6 times more likely to die over time compared to those with localized lung cancer. For histology, compared to cases with SCC, those with ADK had better survival (HR 0.91, 95%CI: 0.86–0.97), while those with SCLC and Carcinoma NOS had 28% and 67% greater risk of death, respectively. After controlling for all other factors, diagnosis in Southern Nevada and Rural Nevada conferred a 9% and 10% higher risk of death from lung cancer, respectively, than diagnosis in Northwestern Nevada (Table 3).

Examining receipt of surgical treatment for localized NSCLC, a higher proportion of cases in rural and southern Nevada did not receive surgery than cases in Northwestern Nevada. After adjustment for age, sex, race/ethnicity, SES level, marital status, insurance status, chemotherapy and radiation treatment, rural and southern Nevadans had 65% (OR 1.65; 95%CI: 1.07–2.53) and 67% (OR 1.67; 95%CI: 1.20–2.13) higher odds, respectively, than Northwestern Nevadans to not have surgical treatment for localized NSCLC (Table 4).