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Socioeconomic factors related to surgical treatment for localized, non-small cell lung cancer

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ABSTRACT

Various socioeconomic factors were reported to be associated with receiving surgical treatment in localized, non-small cell lung cancer (NSCLC) patients in previous studies. We wanted to assess the impact of residential poverty on receiving surgical treatment in a state-wide population of localized NSCLC, adjusting for demographic, clinical, residence and tumor factors. Data on 970 patients with primary localized NSCLC were collected from the Nebraska Cancer Registry (NCR), and linked with the Nebraska Hospital Discharge Data (NHDD) between 2005 and 2009, as well as the 2010 Census data. Characteristics of patients with and without surgery were compared using Chi-square tests. Unadjusted and adjusted odds ratios (ORs) of receiving surgery for low versus high poverty were generated based on the series of logistic regression models controlling for demographics, comorbidity, residence and tumor histology. Patients who were 65 year old or younger, without comorbidities, single or married, and with adenocarcinoma histologic type were more likely to receive surgery. Without adjustment, poverty was negatively associated with receiving surgery. Patients who resided in low poverty neighborhoods (less than 5% of the households under poverty line) were twice more likely to receive surgery than those who lived in high poverty neighborhoods (more than 15% of the households under poverty line) (OR 2.13, 95% CI 1.33–3.40). After adjustment, poverty was independently and negatively associated with receiving surgery treatment. Residents in low poverty neighborhoods were still about twice more likely to receive surgery than those in high poverty neighborhoods when the other demographic, urban/rural residency and clinical factors were adjusted (ORs 2.01–2.18, all $p < 0.05$). The mechanism of how living in poverty interacts with other factors and its impact on patient's choice and their chance of getting surgical treatment invites future studies.

1. Background

Despite the decline in lung cancer incidence over the past decade, lung cancer remains to be the leading cause of cancer deaths among both males and females in United States (US). Lung cancer accounts for an estimated 27% of total cancer deaths and 13% of new cancer cases in the United States (ACS, 2014). Advances in medical science have contributed to the increase of 1-year survival rates for lung cancer patients; however, the overall 5-year survival for non-small cell lung cancer is still around 18%(ACS, 2014).

Studies in Australia, Canada and U.S. all found differences in relative survival for lung cancers between geographic categories and socioeconomic status (SES), with a significant 5-year relative survival rate ratios ranging from 1.40 to 1.69 in favor of the most affluent quintile of relative SES among lung cancer patients (AIHW; Gorey et al., 1997; Woods et al., 2006). Although stage of disease at diagnosis explains much of the socio-economic differentials in survival in some studies, it cannot explain all the differences (Woods et al., 2006).

There is increasing evidence that cancer treatment disparities among different socioeconomic groups could potentially explain much of the survival disparities among cancer patients in different SES groups. For example, linkage of hospital discharge records with

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population-based cancer registry data in Washington State, US, showed that adjuvant chemotherapy or radiotherapy following surgery for stage II or III colon cancer, recommended by national guidelines, was significantly less likely to be given to patients aged over 65 years, to those in the poorest quartile of zip (postal) code areas (VanEenwyk et al., 2002). The study in south-east England showed that affluent patients have been shown to be more likely to receive surgery for lung cancer (Pollock and Vickers, 1998). It has also been suggested that differences in treatment largely explain SES differences in cancer survival in the USA. Greenwald et al. found that in stage-I NSCLC in Detroit, San Francisco, and Seattle, patients in the highest income decile were 45% more likely to receive surgical treatment and 102% more likely to attain 5-year survival than those in the lowest decile (Greenwald et al., 1998).

Lung cancer is classified as small cell (14%) or non-small cell (84%) types for the purposes of treatment. For early stage non-small cell lung cancers (NSCLC), surgery is still the predominant treatment of choice (ACS, 2014). Cancer Institute report commented that surgery results in the 5-year survival (which generally indicates cure of the original neoplasm) in 40% of patients with NSCLC, and virtually all such patients who live 5 years have undergone surgical resection (Lin and Ihde, 1992).

Relatively low income predicts a diminished chance of surgery and survival. Lack of surgical treatment apparently explains a large part of the increased mortality experienced by individuals in neighborhoods with lower income or SES (Greenberg et al., 1988; Greenwald et al., 1998; Ou et al., 2008; Polednak, 2001), although the studies of this kind were often based on population-based cancer registry database without comorbidity information, hospital based, limited to Medicare patients, or failed to adequately control for comorbidities, tumor characteristics or other neighborhood factors. In this study, we assessed the impact of residential poverty on receiving surgical treatment in a state-wide population of localized NSCLC patients, adjusting for demographic, clinical, residential, and tumor factors.

2. Materials and methods

Data on a total of 986 patients with primary localized NSCLC were identified from the Nebraska Cancer Registry (NCR) linked with the Nebraska Hospital Discharge Data (NHDD) between 2005 and 2009, and the 2010 Census by the Nebraska Department of Health and Human Services. The NCR, NHDD data and the linkage methodology have been described previously in detail and demonstrate a linkage rate of 97% for all cancer patients (Lin et al., 2013). Similar to the Surveillance, Epidemiology and End Results (SEER)-Medicare–linked database that combines clinical information from population-based cancer registries with claims information from the Medicare program, linked NCR data and NHDD resulted in a population-based data source but also included both Medicare and non-Medicare patients (Lin et al., 2013). For each patient in the NCR, the linkage provided important comorbidity information that was not available in a regular cancer registry database. The 2005, 2006 NHDD only had 10 diagnosis codes originally, while 25 diagnosis codes were included in the other years. The sensitivity of identifying the comorbidities of our interest using diagnosis codes included in 2005–2006 was over 99% in years where 25 diagnosis codes were provided. In the secondary data used in the current study, nine diagnoses were provided by the Nebraska Hospital Association under the limited data use request agreement and used to identify the comorbidities of each patient in this study.

Since we were only interested in the surgery treatment among patients with localized NSCLC, we included patients whose lung cancer were categorized as *localized* based on 2000 SEER summary staging (Young et al., 2001). Histology code information was obtained from NCR to identify the NSCLC patients and the specific cancer histologic types, and patient with histology code for small-cell lung cancer (8041, 8042, 8043, 8044, 8045 and 8246) were excluded (Egevad et al., 2007). Patient demographic information such as sex, age and marital status at diagnose (single, married, separated/divorced, widowed or unknown), and surgery to the primary site performed as the first course of treatment were also gained in the NCR. The vast majority of the population in Nebraska was consist of non-Hispanic whites (NHWs). Based on our current study population, 96.19% of the patients were whites, and 98.45% were NHWs. The patient's age at diagnosis was categorized into 3 age groups (<65, 65–74, 75). We excluded transsexual patients and those have missing values for stage or were recorded as 'un-staged'. If a patient had two or more records in the cancer registry database, only the first lung cancer diagnosis record was retained. Patients with surgery information or hospital discharge records missing were excluded from this analysis, and the final 970 patients were analyzed in the current study analysis.

Comorbidity at the time of the lung cancer diagnose were obtained from the linked HDD through extracting primary to ninth diagnosis codes according to the International Classification of Diseases, 9th revision (ICD-9) similarly as the previous study of comorbidities based on administrative database (Deyo et al., 1992). When studying the receipt of surgery in localized NSCLC patients, comorbidities were controlled in two ways: (1) categorized overall comorbidity counts of the individual in 3 levels: none, with 1 comorbidity and 2 or more conditions; (2) 14 comorbidities each as an individual dummy variable. The 14 comorbidities included myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, peptic ulcer disease, mild liver disease, diabetes without complications, diabetes with complications, paraplegia and hemiplegia, renal disease and moderate or severe liver disease. These conditions were chosen based on the adaptation of the Charlson comorbidity index used in other studies based on administrative databases (Deyo et al., 1992). Two of the comorbidities (malignancy and metastatic carcinoma) could have been the result of the lung cancer itself, and none of AIDS patients were captured using this database; hence these three conditions were not included.

Census tract poverty information was classified into 3 categories (proportion of households living under poverty <5%, 5%–15%, >15%) for each patient to estimate patients' socioeconomic status. In addition, rural-urban residence status was provided according to metropolitan and non-metropolitan the census 2010 definition. The study is considered a secondary data analysis because a patient can only be identified at the state level.

Descriptive statistics were used to examine the baseline characteristics, including SES, residential and clinical factors among surgery recipient and non-recipient. The proportions of surgery recipient were compared using the chi-squared tests. Unadjusted odds ratios (OR) and 95% confidence intervals (CI) of receiving surgery for different patient characteristics and socioeconomic factors were estimated using the maximum likelihood method and logistic regression. Adjusted ORs of receiving surgery for poverty were generated using 8 logistic regression models sequentially controlling for demographics (Model 2–8), comorbidity (Model 3–8), residence (Model 5–8) and tumor histology (Model 7 & 8). Stepwise model selection were used to choose the variable with independent effect on the receipt of surgery. A probability value less than 0.05 (two-sided) was used as the cutoff point for statistical significance. All statistical analyses were performed by SAS version 9.4.