Association of Air Quality with Incidence of Lung Cancer in a Large Urban/Suburban County

Objective: Lung cancer is the leading cause of cancer-related death in the United States. The incidence of lung cancer varies geographically, but the association of environmental inequities with these disparities requires further study. Our goal was to determine the association of air quality with lung cancer over a 40-year period in a large urban/suburban county, Wayne, in Michigan.

Methods: Lung cancer data was queried from the Michigan Cancer Registry from 1985 to 2018. Air pollutant data were obtained from the United States Environmental Protection Agency from 1980 to 2018. Patient demographics and cancer incidence were recorded. SatScan (V9.7) was used to detect spatial and space-time clusters of lung cancer cases. Sensitivity analysis on maximum percentage of population at risk was conducted by using the Gini index. Phillips-Perron Unit Root Test was used to test stationary levels of both lung and air data. Akaike information criterion was used to find max lag length and bounds testing was used to test significance of cointegration between lung incidence and air quality. Autoregressive Distributed Lag Model (ARDL) was used to identify relationships between air pollutants and incidence of lung cancer.

Results: A total of 58,882 new cases of lung cancer were identified in Wayne County. Mean age was 67.8 years. Thirty-seven percent of patients identified as a racial minority. The Gini index demonstrated 5% was the optimal scanning window for spatial clusters detection and a total of 7 significant clusters were detected in the county (Figure 1). Most clusters were in downtown Detroit and in the heavily industrialized downriver area. Both lung cancer incidence and carbon monoxide (CO) levels showed similarly decreasing temporal trends from 1985 to 2018. Phillips-Perron Unit Root Tests showed both lung cancer (p=0.1463) and CO (0.99) were non-stationary. The ARDL bound testing showed lung cancer and CO levels correlated with at least 1 cointegration with max lag length of 15 (F-statistic = 25.58).

Conclusions: Poor air quality correlated with lung cancer incidence over a four-decade period. A 6 year lag between changes in air quality and lung cancer incidence was observed. Specific regions in Wayne County demonstrated an elevated relative risk of lung cancer when correlated with air pollution. Resident health in areas with poor air quality may benefit from targeted interventions such as campaigns for lung cancer screening and reduction of pollutants.

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Legend:

Wayne_5Percent_clusters

DetroitCity

Wayne_5Percent

REL_RISK

- 0.169917 - 0.477174
- 0.477175 - 0.864442
- 0.864443 - 1.109241
- 1.109242 - 1.467764
- 1.467765 - 2.015438

Zip_Codes

0   1.75   3.5   7   10.5   14
Miles

SEMCOG, Esri Canada, Esri, HERE, Garmin, GeoTechnologies, Inc., USGS, METI/NASA, NGA, EPA, USDA