LUNG CANCER AIR POLLUTION AND ENVIRONMENTAL INJUSTICE IN OHIO: WHO IS EXPOSED?

Winnie N. Ngare
Geography Department
Binghamton University

Introduction

- In 2016, Ohio was the 2nd most polluted state in the U.S.
- Power plants in Ohio emit approximately 12% of all U.S. industrial pollution
- Particulates found in industrial air pollution are known to cause lung cancer

Figure 1. Conceptual Diagram of the impacts of air pollution on lung cancer incidence

- Toxic facility siting is not random but tends to occur more often in poorer and nonwhite communities
- African Americans individuals of lower socioeconomic status (SES) have higher rates of lung cancer than non-Hispanic Whites and those of higher SES
- Greater exposure to industrial air pollution may lead to higher risk of lung and all-site cancer among nonwhite and low SES populations in Ohio

Methods

Data sets.

- Rate of cancer deaths and Cancer incidence data (2015) – Behavioral Risk Factor Surveillance System, CDC Website
- Total Toxins data (2011) – The EPA's Toxic Release Inventory.
- 2011-2015 ACS 5-Yr Estimates: Median Income, Race/Ethnicity

Dependent Variable(s)
- Rate of lung Cancer Deaths

Explanatory Variables.
- Median Income
- Race/Ethnicity
- Total amount of Toxic wastes

Age (Covariate)

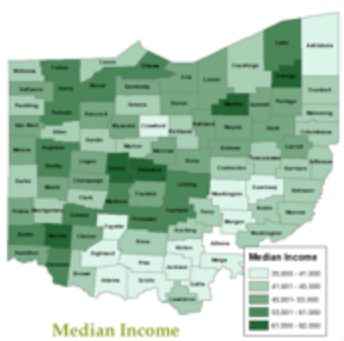
Data Analysis.

- The study uses **(1)** Pairwise correlation to check for existence of a linear relationship among the explanatory variables.

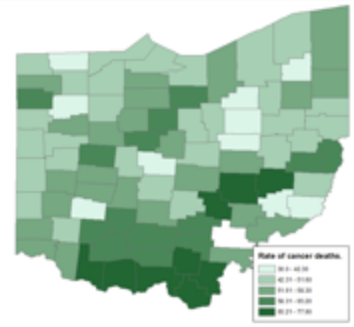
(2) Linear regression model to predict the relationship between the dependent and independent variables.

- Maps and table(s) to display the results.

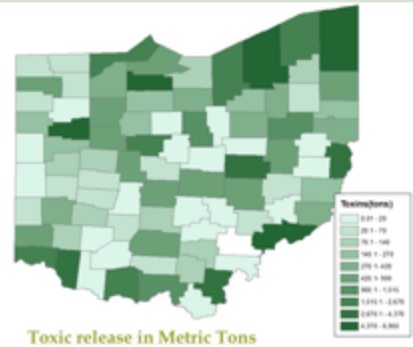
Results



Median Income



Age-Adjusted rate of Lung cancer Deaths (50+)



Toxic release in Metric Tons

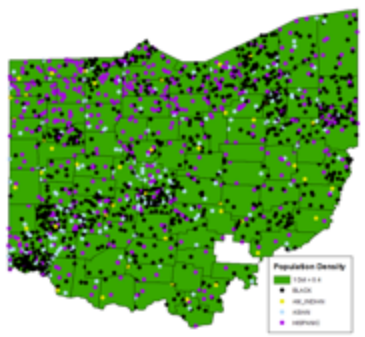
- Southern Ohio exhibits a low median income level and higher rates of lung cancer
- Descriptively, total toxic released shows a different spatial pattern than income or race/ethnicity

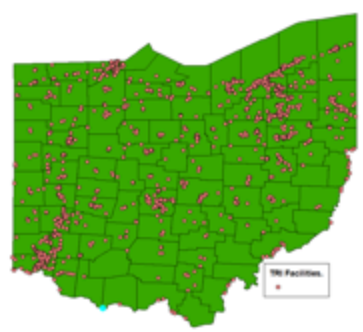
Associations between lung cancer mortality, race/ethnicity & income

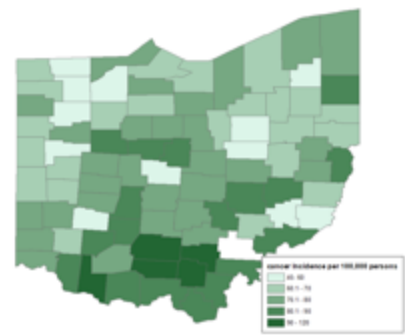
Independent Variables	Coefficient	P - value
Black Americans	-.3252	0.137
American Indians	-7.981	0.562
Asian	2.816	0.101
Hispanic	-1.372	0.007**
Median Income	-.0007	0.000***
Total amount of toxins	5.2e-07	0.055

- Lower median household income is associated with higher lung cancer mortality
- Greater levels of toxic release are associated with lung cancer mortality in Ohio
- Latinos have lower lung cancer mortality rates than non-Hispanic Whites

General distribution of racial/ethnic groups in relation to TRI Facilities and cancer incidence rate







- African Americans and Low Income populations are spatially concentrated in the south-west and north-east regions of Ohio
  - These are the same regions containing large numbers of Industrial facilities
- Lung cancer incidence is highest in Southern Ohio
- Latinos dominate the northern region of Ohio, which also contains a large number of industrial facilities
- The amount of toxic waste released in Southern Ohio is high relative to the rest of the state

Discussion & Conclusions

- Persons of lower income are more likely to die from lung cancer than high income earners
- Hispanics cluster in highly polluted regions, but do not have higher rates of lung cancer mortality
- Exposure to industrial air toxins is a determinant of lung cancer in Ohio
- Level of toxic emissions into the air is more important for predicting lung cancer than spatial clustering of toxic facilities
- Industrial facilities in Ohio are more clustered in areas with high concentrations of racial/ethnic minority groups
- The results of this study are consistent with several previous environmental justice studies that reveal the disproportionate exposure of race/ethnic minority groups and persons with low SES, to air pollution
- **Policy implication:** health education campaigns should inform the public of lung cancer risk due to toxic air emissions and promote cancer screening

Future Directions

- Although the variables form a noticeable pattern at the county level, disaggregating into smaller geographies (census tracts) will yield more refined results. Given that census tracts contain approximately 2,500-8,000 people displaying homogenous population characteristics, it will be easier to monitor the intensity of air pollution and cancer burden among the different racial/ethnic groups
- Examine the relationship between the aforementioned variables at the census tract level
- Examine and control for tobacco consumption in southern Ohio as a primary predictor of lung cancer incidence and mortality
- Measure all-site cancer incidence and mortality to evaluate overall cancer risk by race/ethnicity & household income
- Account potential effects from water contamination in addition to air

References

1. Pastor, Manuel & Morello-Frosch, Rachel & Sadd, James. The Air is Always Cleaner on the Other Side: Race, Space, and Ambient Air Toxics Exposures in California. *Journal of Urban Affairs*. 27.127-148, 2005.
2. Giannadaki D, Lelieveld J, Pozzer A.: Implementing the US air quality standard for PM2.5 worldwide can prevent millions of premature deaths per year. *Environmental Health* (2016).
3. Milojevic, A. et al: Socioeconomic and urban-rural differentials in exposure to air pollution and mortality burden in England. *Journal of Environmental Health* (2017).
4. Mallach, A & Brachman, L): Ohio's cities at a turning point: finding the way forward. (2010)
5. A, Michael, et al: Who Lives on The Wrong side of The Tracks? Evidence from The EPA's Risk Screening Environmental Indicators Model, (2004).
6. Andersen, Z. et al.: Air pollution from traffic and cancer incidence: A Danish cohort study. *Journal of Environmental Health*,2011.
7. The American Lung Cancer Association Website.