Associations between RSEI estimated exposure to metals (lead, mercury, cadmium) and children's blood and urine biomarkers and cardiovascular risk

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TRI: Identifying Potential Health Impacts

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Introduction

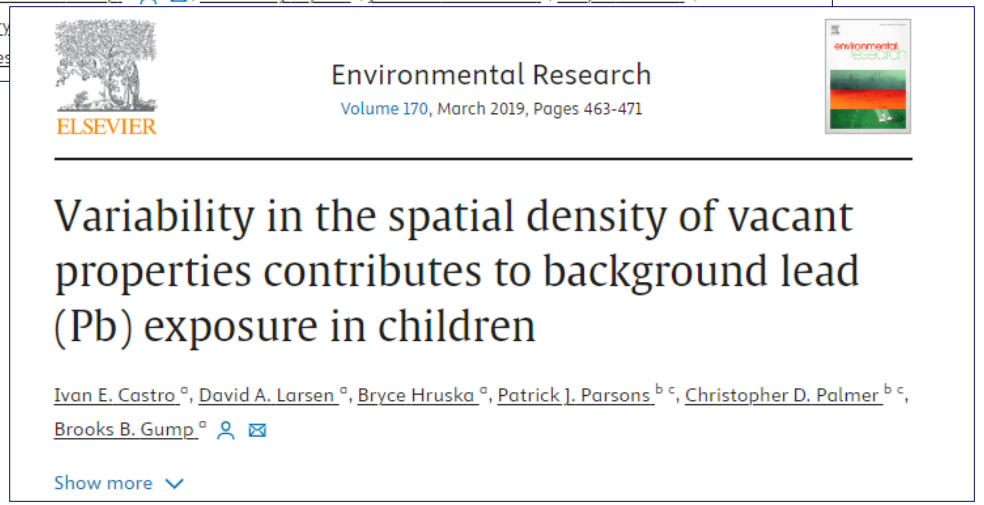
- Interest in understanding the totality of environmental exposures that children might experience
- What role might air pollution exposure play in human health effects?
- Research objective: Link air pollution exposure estimates to children's health
  - Biomarkers of exposure: blood and urine metal concentrations
  - Cardiovascular health risk measures

Cohort overview

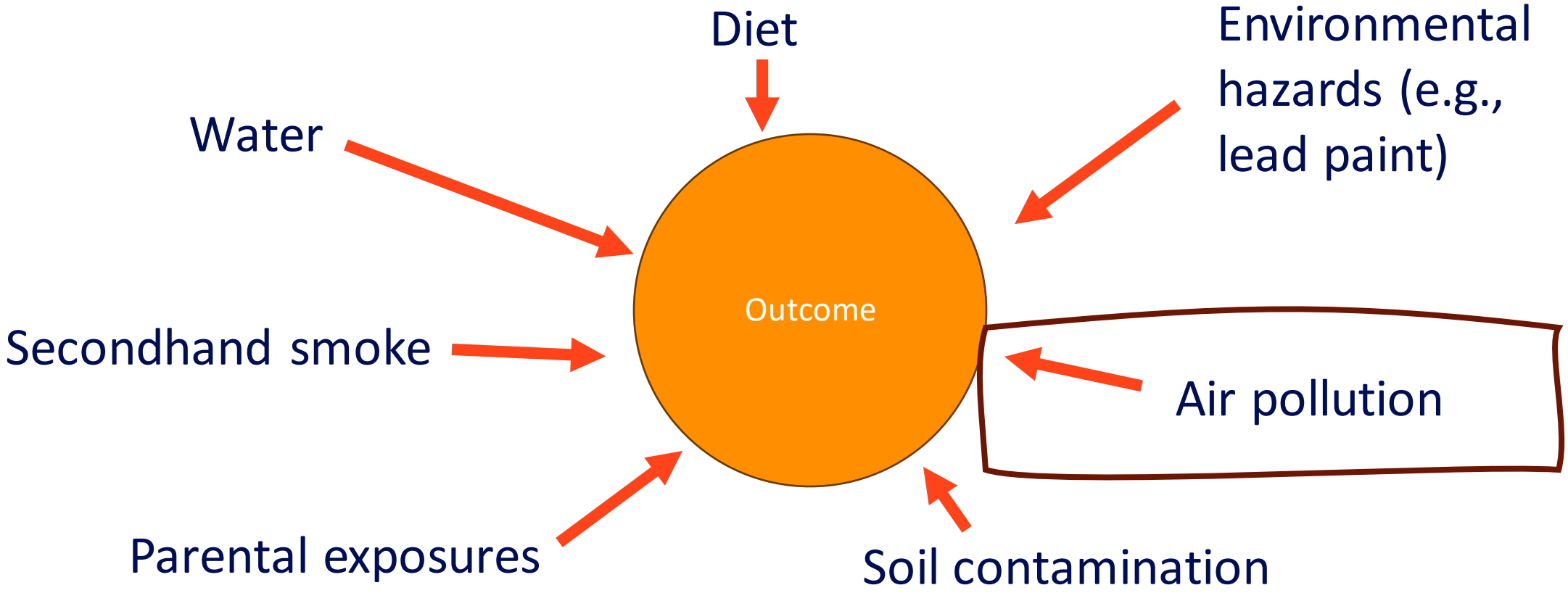
- Environmental Exposures and Child Health Outcomes (EECHO) Syracuse, NY cohort
- 300 children
- Aged 9-11 years old
- Collected between 2012 and 2017

What has been studied before?

- Lead (Pb) paint
- Psychological and behavioral influences of toxicant exposure



Exposures and risk

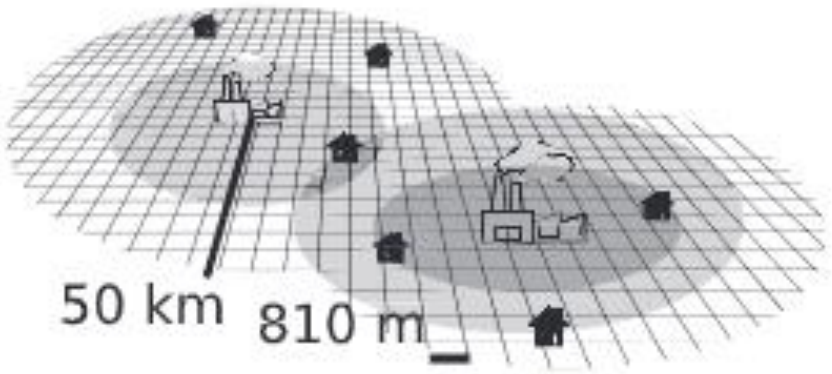


Methods

- Problem: air pollution data was not collected at the time of the study
- Solution: use estimated air pollution data from the Risk Screening Environmental Indicators (RSEI) data

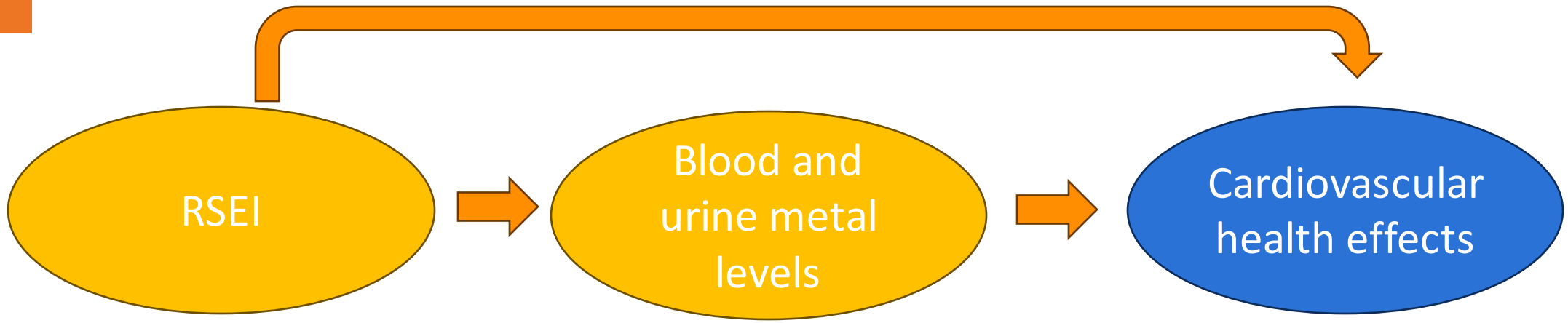
Methods

- RSEI
- Includes Toxics Release Inventory (TRI) facilities only
- Geospatial microdata (GM) available at 800 m^2
- Measure of *risk* not measure of *exposure*



Ash and Boyce 2018.

Methods



Measure of risk of exposure

Actual exposure (many potential sources)

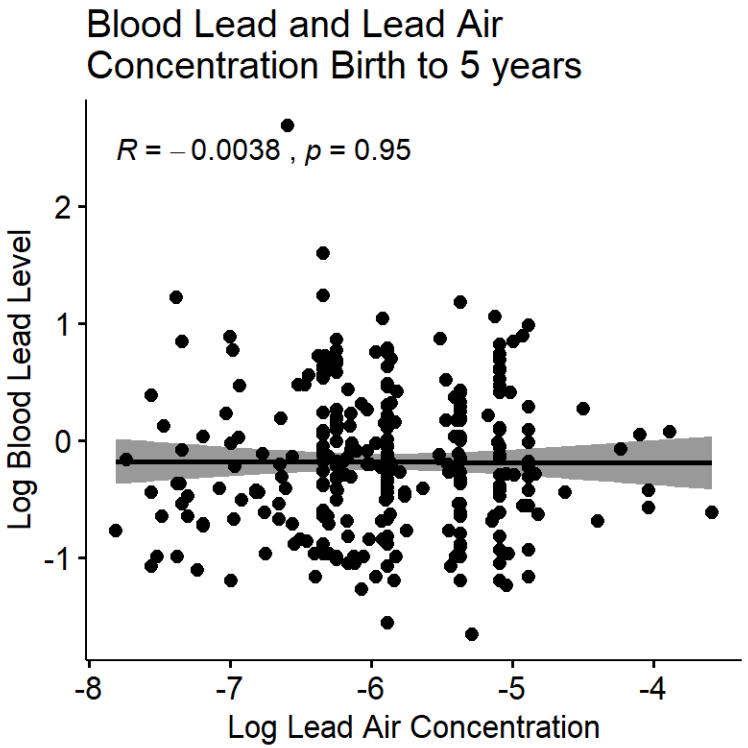
Health outcome

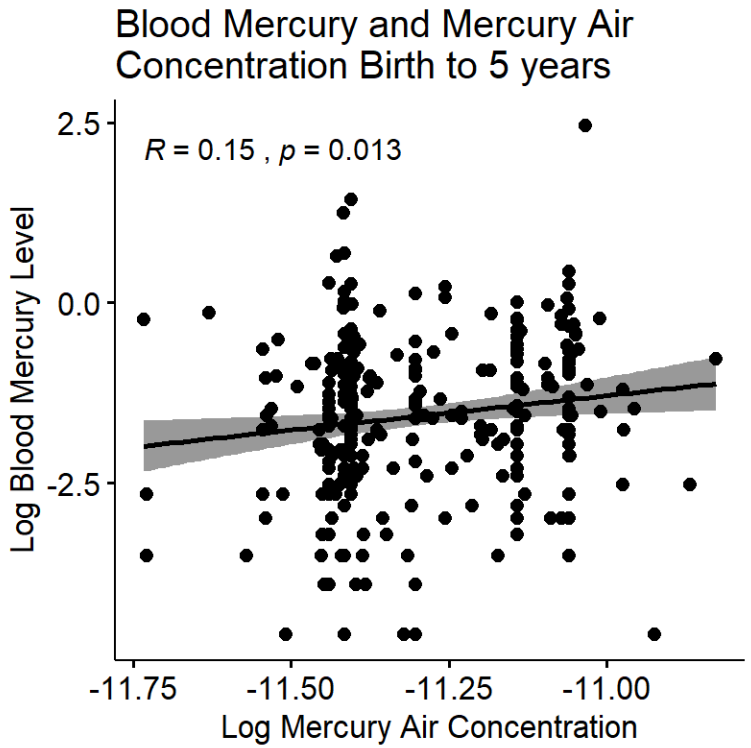
Can we identify the contribution of air pollution as a route of exposure using RSEI-GM data?

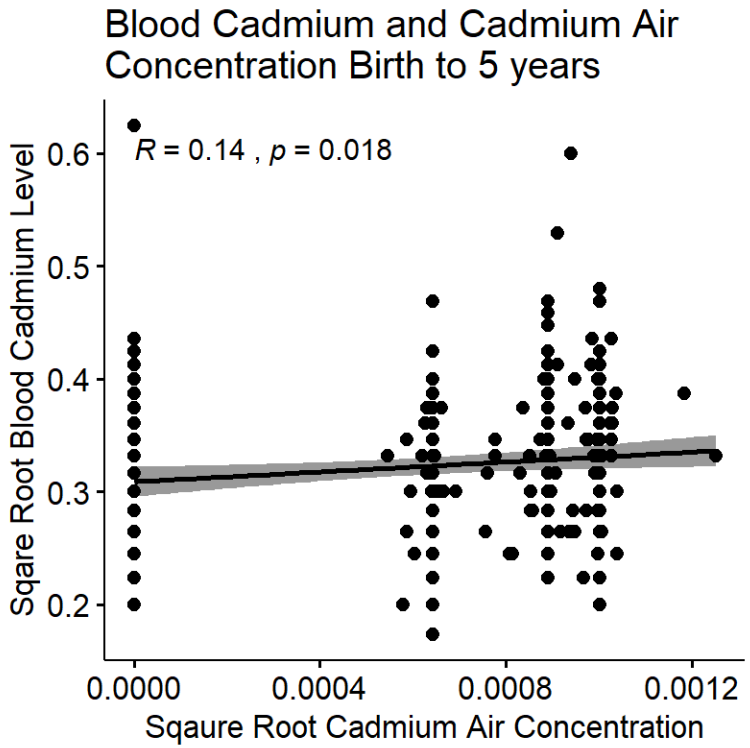
Methods

- Pearson correlations
- Linear regression
- Spatial error adjusted regressions
- Controls for
  - Socioeconomic status
  - Height and weight
  - Diet
  - Proximity to highways

Results

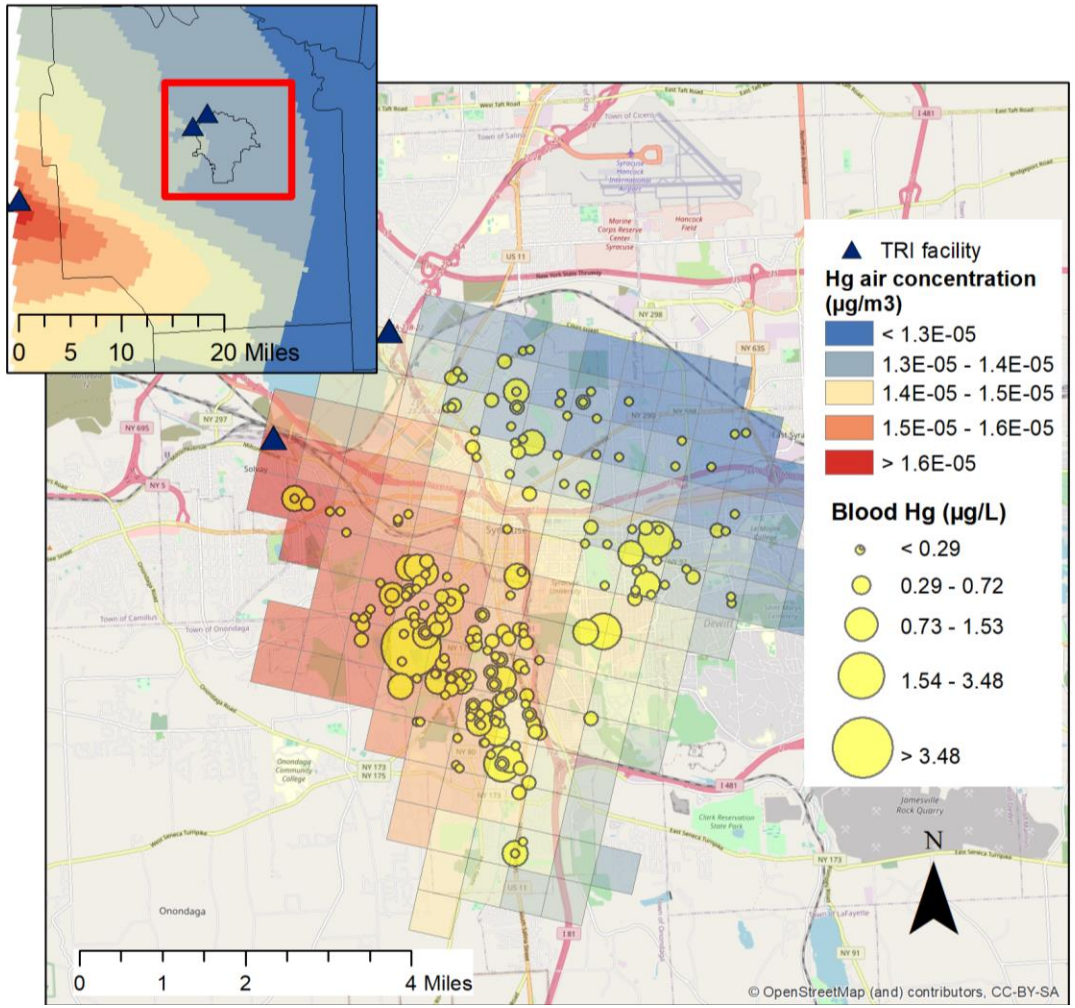

Blood Lead and Lead Air Concentration Birth to 5 years
R = −0.0038 , p = 0.95
Log Blood Lead Level
2
1
0
-1
-8
-7
-6
-5
-4
Log Lead Air Concentration


Blood Mercury and Mercury Air Concentration Birth to 5 years
R = 0.15 , p = 0.013
Log Blood Mercury Level
2.5
0.0
-2.5
-11.75
-11.50
-11.25
-11.00
Log Mercury Air Concentration


Blood Cadmium and Cadmium Air Concentration Birth to 5 years
R = 0.14 , p = 0.018
Sqare Root Blood Cadmium Level
0.6
0.5
0.4
0.3
0.2
0.0000
0.0004
0.0008
0.0012
Sqaure Root Cadmium Air Concentration

Results

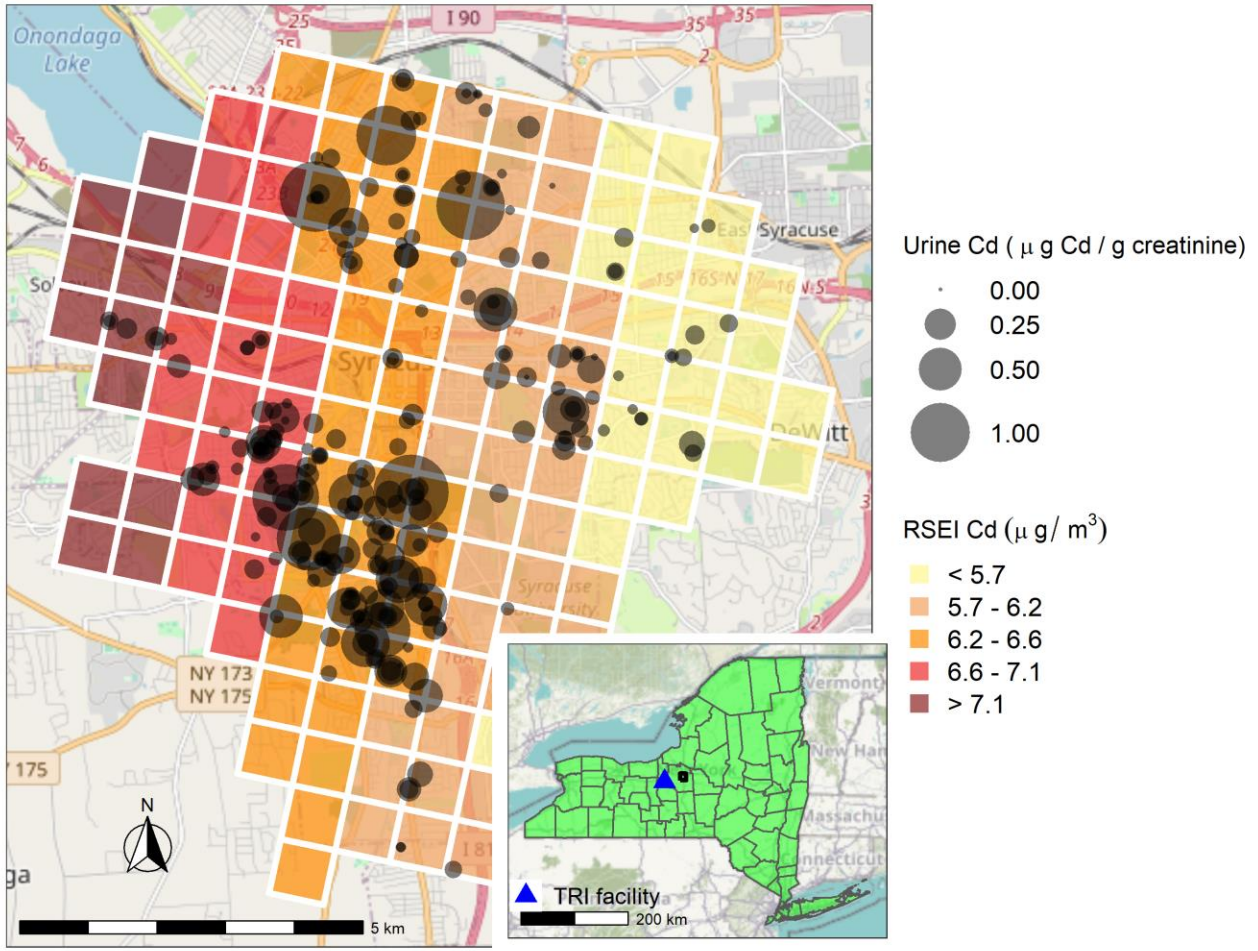
- Significant positive correlations for blood-mercury and RSEI-GM mercury concentrations
- About 3% of variance was explained



Results

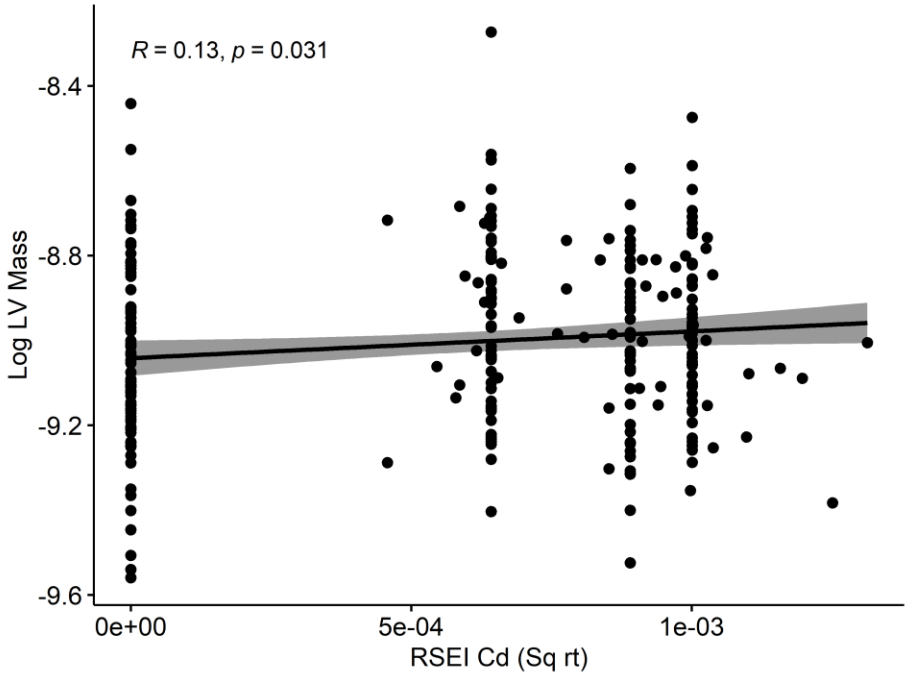
- Blood-cadmium was also significantly linked to cadmium air pollution levels
- Blood-cadmium is not the best biomarker, urine-cadmium is better metric
- Urine-cadmium was also measured and had a stronger, positive association
- Matches our biological understanding that urine is the better biomarker for cadmium
- RSEI-GM supported this

Urine Cd levels among children and modelled cumulative Cd air pollution levels
Syracuse, NY, USA



Results: Cardiovascular risk

- Significant associations between Cd and greater left-ventricular mass
- Significant associations between Hg and greater intima-media thickness



Discussion points

- Positive and significant findings for Cd and Hg, but not Pb
- What can RSEI tell use? What can TRI be used for?
  - Children living in areas of *higher risk of exposure* have higher blood and urine concentration of those metals
  - Note – we did not measure actual exposure
- Limitations:
  - Home location v. other movement
  - Indoor v. outdoor variation
  - Parental exposure and other missing exposure routes

Closing remarks

- Linking cohort data to RSEI-GM can open new avenues of research into risk and human health
- RSEI-GM is a rich dataset that offers chemical and metal specific data on air exposure not available elsewhere
- While potential exposure does not equal actual exposure, it does indicate potential problem areas

Acknowledgements

- Contact information: dthill@syr.edu

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References

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