

**Residential Proximity to the Hudson River  
and Hospitalization Rates for Ischemic  
Heart Disease and Stroke: Westchester,  
Rockland, Putnam, Orange, Dutchess,  
Ulster, Columbia, Greene, Rensselaer,  
Albany, Washington and Saratoga  
Counties, New York: 1990-2005**

**Prepared by:**

**The New York State Department of Health  
Center for Environmental Health  
Troy, New York**

**Under a Cooperative Agreement with  
The U.S. Department of Health & Human Services  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Superfund and Program Assessment Branch  
Atlanta, Georgia**

# NYS DOH Authors

- Elizabeth L. Lewis-Michl, Ph.D.
- June Moore, M.P.H.
- Marta Gomez, M.S.

Community Exposure Research Section  
Bureau of Environmental & Occupational Epidemiology  
Center for Environmental Health  
New York State Department of Health

# Overarching Issues

- **Difficulties of studying humans -**
  - **Lack of information on specific exposures**
  - **Lack of information on specific health problems**
- **Hypothesis-generating studies –**
  - **Assume exposure based on residential location**
  - **Compare disease rates among geographic areas**

# Overarching Issues (cont.)

- **Limitations of these types of studies:**
  - **Cannot draw strong conclusions**
  - **Many factors are related to residential location that may also affect health**
  - **No cause-effect conclusions from any one hypothesis-generating study**

# Study Request

- 3 studies authored by colleagues and students of Dr. David Carpenter, Director of the University at Albany's Institute for Health and the Environment:
- October 2006 request by Member of Congress Maurice Hinchey to ATSDR

# Prior Studies Summary

- **Exposure indicator:**
  - Hazardous waste sites with persistent organic pollutants, including PCBs in ZIP Codes of residence
  
- **Disease indicator:**
  - Hospitalization rates for cardiovascular disease in ZIP Codes of residence
    - Ischemic heart disease
    - Stroke
    - Hypertension

## Table 1: Previous Study Results\*: Statewide Analyses and Hudson River Specific Analyses\*\*

\* Table adapted from Sergeev et al. 2005, Shcherbatykh et al. 2005 and Huang et al, 2006

Principal Diagnosis of Hospitalization	Adjusted Rate Ratio <sup>a</sup> Lower 95%CI - Upper 95% CI)	
	NYS analysis	Hudson River Subset analysis
Ischemic Heart Disease <sup>b</sup>	1.15 (1.03-1.29)	1.36 (1.18-1.56)
Acute Myocardial Infarction	1.20 (1.03-1.39)	1.39 (1.18-1.63)
Cerebrovascular Disease <sup>c</sup>	1.15 (1.05-1.26)	1.20 (1.10-1.32)
Ischemic Stroke	1.17(1.04-1.39)	---
Hemorrhagic Stroke	1.10 (0.99-1.22)	---
Hypertension <sup>c</sup>	1.19 (1.08-1.31)	1.14 (1.05-1.23)

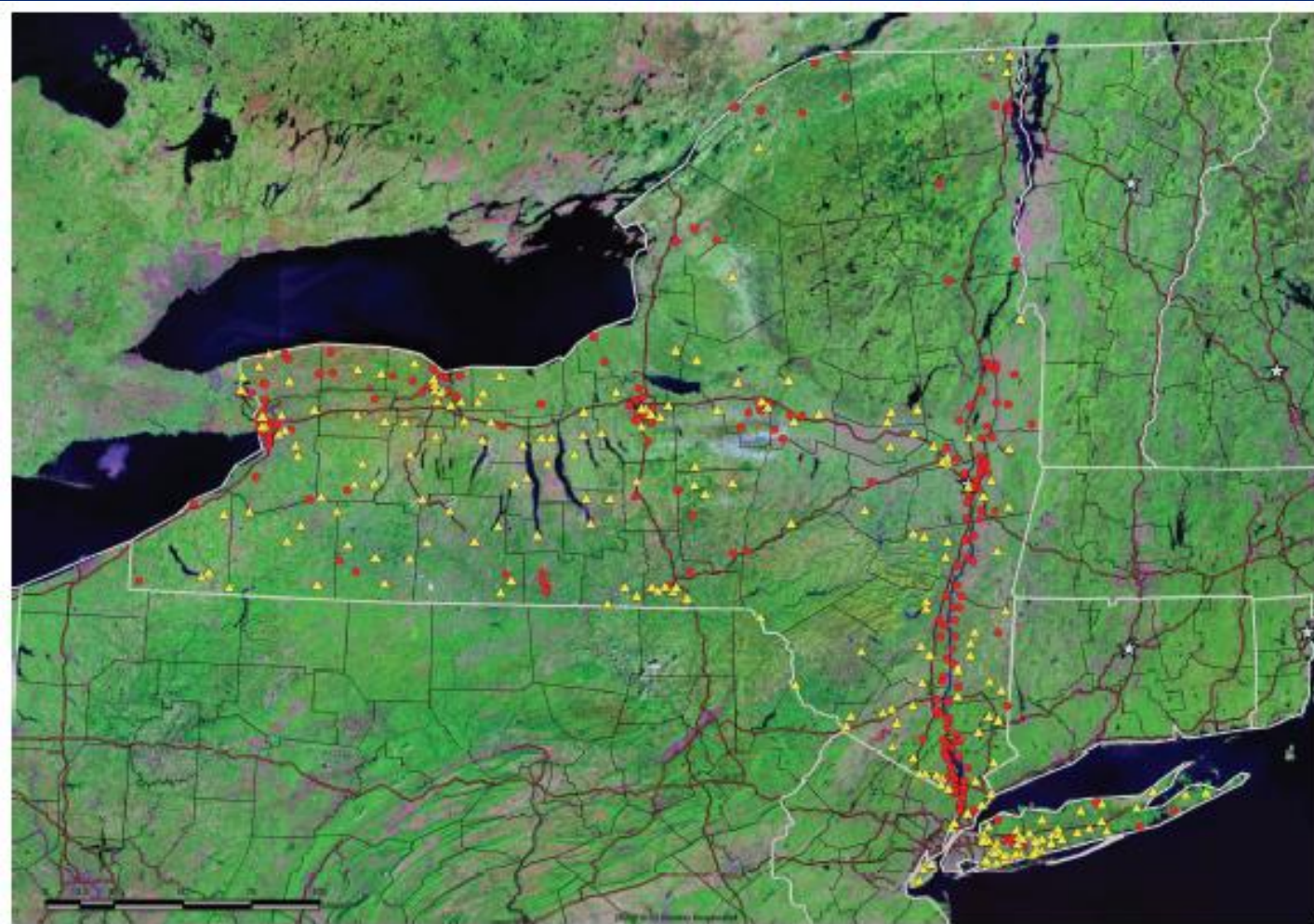
\*\* Ischemic heart disease and stroke hospitalization rates for NYS ZIP codes containing (or adjacent to) inactive hazardous waste sites with persistent organic pollutants compared to ZIP codes without (or not adjacent to) such sites

a. All analyses include a 2<sup>nd</sup> exposure category for other types of inactive hazardous waste sites and adjust for age, race and sex.

b. Ischemic heart disease analyses include all ages over 25. Ischemic heart disease analyses adjust for quartiles of median household income and health insurance coverage.

c. Cerebrovascular disease and hypertension analyses include ages 25-64.

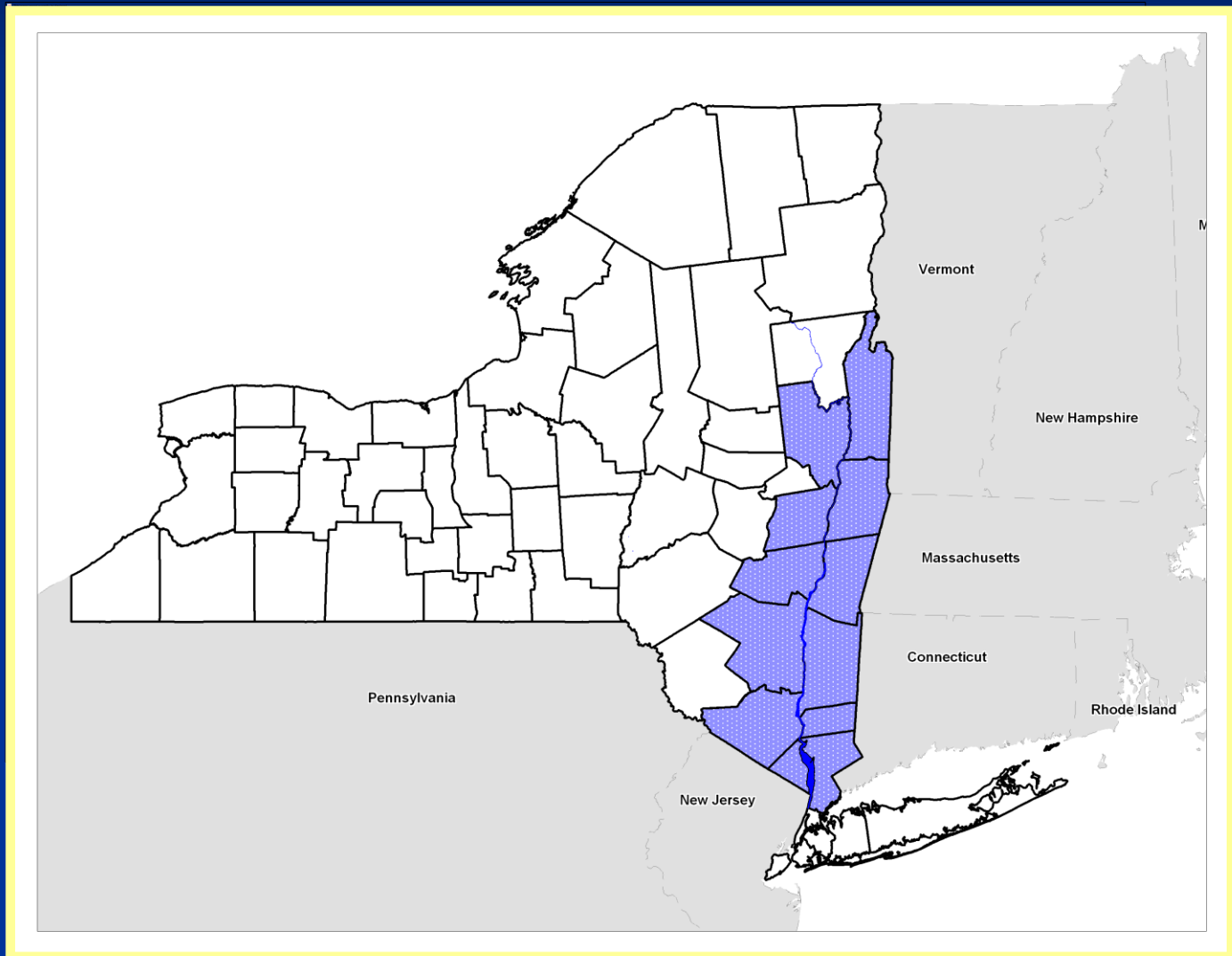
# Statewide ZIP Code Analysis Map showing POP & Other Sites [from Sergeev AV and Carpenter DO. EHP 113(6)2005]



**Figure 1.** Map of New York State showing the locations of POP sites in red and other-waste sites in yellow. Map prepared by Rick Crowsey, Crowsey Incorporated.



# Our follow-up: 12 County Hudson River Study Area



# 12 County Study Area: Adjacent and non-adjacent block groups



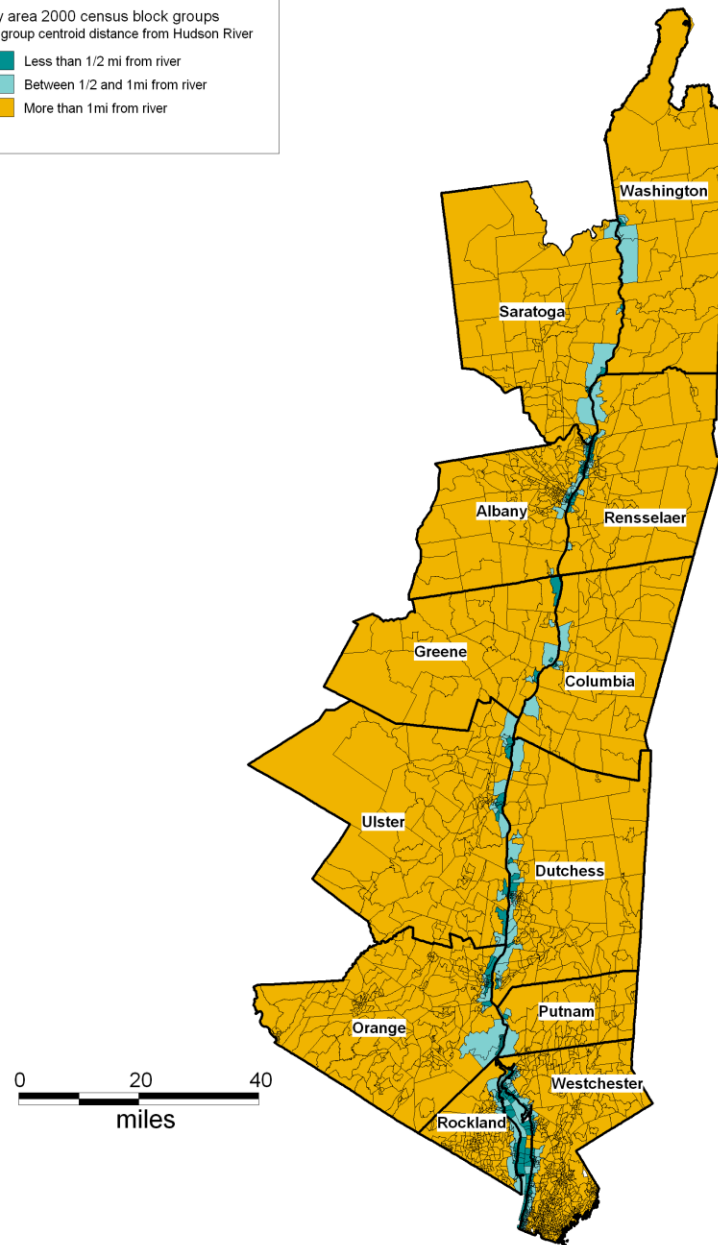
# ZIP Codes versus Block Groups



Study area  
distance  
categories  
use  
population-  
weighted  
block  
group  
centroids

Study area 2000 census block groups  
Block group centroid distance from Hudson River

- Less than 1/2 mi from river
- Between 1/2 and 1mi from river
- More than 1mi from river



# Study Design

- **Block-group level analysis**
- **No exposure measures**
- **Health outcomes from hospitalization records; repeat hospitalizations included**
- **Census data are used for population numbers and demographic characteristics such as income and education**

# CVD Outcomes

- **CVD: any disease of circulatory system**
  - **IHD: restricted blood flow in arteries supply heart**
    - **AMI: heart attack, blood flow to heart suddenly reduced or stopped**
    - **Angina: severe constricting pain in the chest**
  - **Stroke: interruption of blood circulating to brain**
    - **Ischemic Stroke: blockage of artery to brain**
    - **Hemorrhagic Stroke: ruptured artery**

# CVD Risk Factors

- **The widely known risk factors for cardiovascular disease**
  - Age
  - elevated serum cholesterol, atherosclerosis (plaque build-up in arteries)
  - high blood pressure, diabetes
  - tobacco use
  - genetic factors
  - diet, being overweight, being physically inactive
  - stress
- **In the United States and NYS, cardiovascular disease rates are higher among people with lower socio-economic status and lower education levels.**

# Health Disparities

- **Additional factors related to CVD incidence and prevalence include sex, race, socioeconomic status and education**
  - **Psychosocial stress**
  - **Limited resources**
  - **Discrimination**
    - **Differential healthcare provision**
  - **Access to health care**



# CVD Trends

- **Declining mortality**
  - Improved treatment
  - Declining incidence –
    - primarily due to reduced smoking rates
- **Differential decline and counter-trends**
  - Increased diabetes and obesity rates

# Other factors affecting hospitalizations

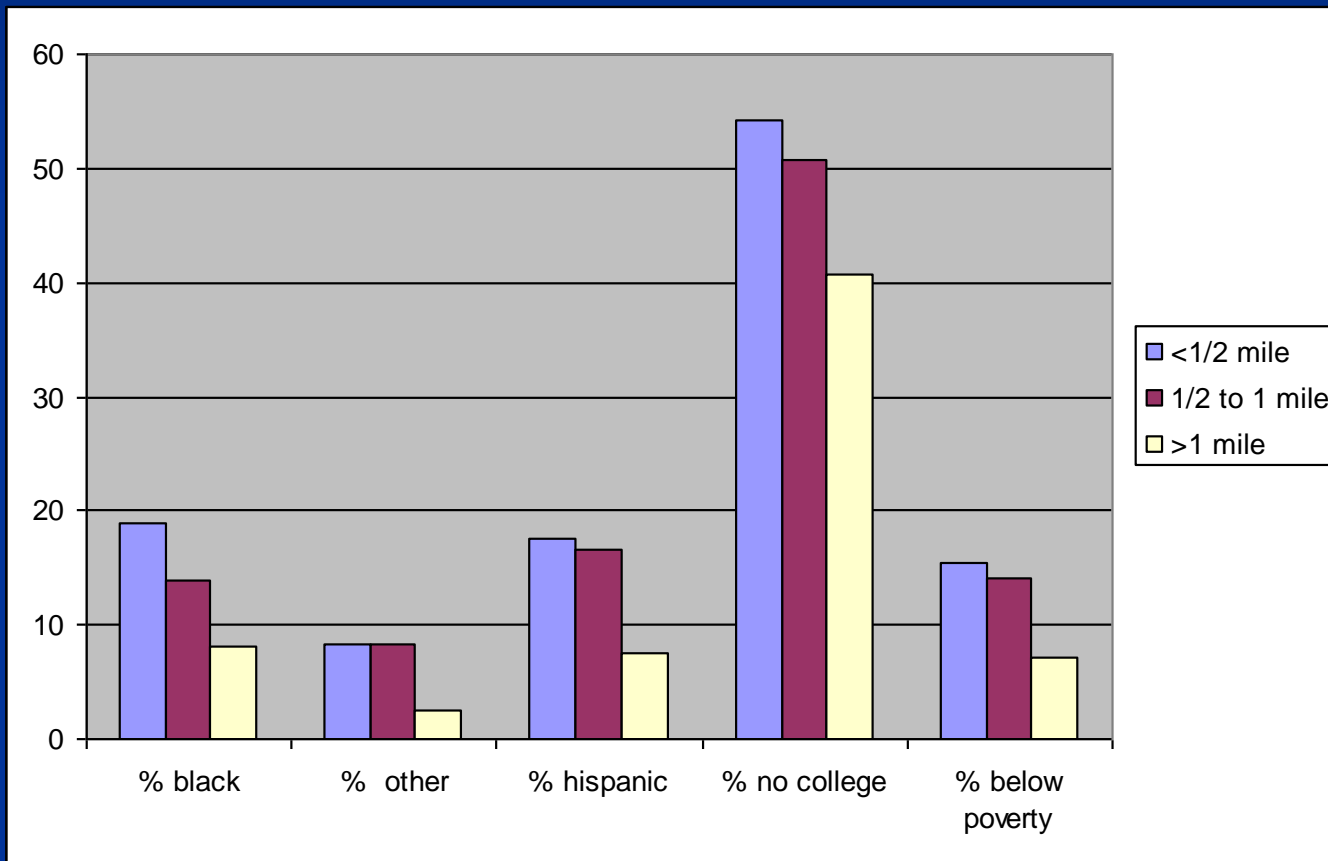
- **Mortality before reaching the hospital**
  - Distance to the hospital
  - Marital status
  - Knowledge of warning signs
- Lack of primary care
- Health insurance status

# Statistical Methods

- **Multivariable regression – to evaluate hospitalization rates relative to residence near the River**
  - **Adjusts for age, sex, race**
  - **Adjusts for median income, education, population density, Hispanic ethnicity, distance to nearest hospital**

# Socio-Economic & Demographic Indicators and Distance to the River

## Indicators for Block Group Distance from River



**Table 1a. Exposure Area Distributions and Adjusted Rate Ratios for Ischemic Heart Disease Hospitalizations**

Exposure Category	Person-Years in Study Area N= 30,219,001	Ischemic Heart Disease Hospitalizations					
		Total		AMI		Angina	
		No. (%)	RR (95% CI)	No. (%)	RR (95% CI)	No. (%)	RR (95% CI)
<b>Adjacent Block Group</b>							
Yes	3,269,547 (10.8)	12,327 (12.2)	1.07 (1.04-1.11)	4,398 (12.3)	1.06 (1.01-1.10)	591 (12.5)	1.06 (0.96-1.17)
No	26,949,454 (89.2)	88,611 (87.8)	1.00 Reference	31,380 (87.7)	1.00 Reference	4,137 (87.5)	1.00 Reference
<b>Distance From River</b>							
< 1/2 mile	2,380,477 (07.9)	9817 (9.7)	1.02 (0.98-1.06)	3,399 (09.5)	1.03 (0.98-1.09)	542 (11.5)	1.09 (0.98-1.21)
1/2 - 1 mile	2,834,956 (09.4)	11,236 (11.1)	1.03 (0.99-1.08)	4,048 (11.3)	1.06 (1.01-1.11)	610 (12.9)	1.13 (1.02-1.25)
> 1 miles	25,003,569 (82.7)	79,885 (79.1)	1.00 Reference	28,331 (79.2)	1.00 Reference	3,576 (75.6)	1.00 Reference

**Table 1b. Exposure Area Distributions and Adjusted Rate Ratios for Ischemic Heart Disease Hospitalizations**

Exposure Category	Person-Years in Study Area N= 30,219,001	Stroke Hospitalizations					
		Total		Ischemic		Hemorrhagic	
	No. (%)	No. (%)	RR (95% CI)	No. (%)	RR (95% CI)	No. (%)	RR (95% CI)
<b>Adjacent Block Group</b>							
Yes	3,269,547 (10.8)	6,276 (11.8)	1.07 (1.03-1.12)	2,334 (12.1)	1.10 (1.04-1.16)	635 (10.8)	0.97 (0.88-1.06)
No	26,949,454 (89.2)	46,748 (88.2)	1.00 Reference	16,989 (87.9)	1.00 Reference	5,263 (89.2)	1.00 Reference
<b>Distance From River</b>							
< ½ mile	2,380,477 (07.9)	5,280 (09.9)	1.06 (1.01-1.10)	1,925 (10.0)	1.08 (1.01-1.15)	518 (08.8)	0.89 (0.81-0.99)
½ - 1 mile	2,834,956 (09.4)	6,023 (11.4)	1.06 (1.02-1.11)	2,227 (11.5)	1.11 (1.04-1.17)	658 (11.1)	1.08 (0.99-1.19)
> 1 mile	25,003,569 (82.7)	41,721 (78.7)	1.00 Reference	15,171 (78.5)	1.00 Reference	4,722 (80.1)	1.00 Reference

**Table 2. Adjusted Rate Ratios\* for CVD Hospitalizations Stratified by Income Quartile\*\***

Rate Ratio for < ½ mile versus > 1 mile from River	IHD	AMI	Angina	Stroke	Ischemic Stroke	Hemorrhagic Stroke
	RR (95%CI)	RR (95%CI)	RR (95%CI)	RR (95%CI)	RR (95%CI)	RR (95%CI)
Lowest Income 1	1.14 (1.07-1.20)	1.14 (1.06-1.23)	1.12 (0.97-1.30)	1.16 (1.09-1.24)	1.20 (1.10-1.31)	1.09 (0.95-1.25)
Income 2	1.10 (1.02-1.18)	1.11 (1.01-1.23)	1.36 (1.08-1.72)	1.10 (1.01-1.19)	1.12 (0.99-1.28)	0.95 (0.76-1.19)
Income 3	0.85 (0.77-0.94)	0.86 (0.75-0.97)	0.93 (0.68-1.26)	0.97 (0.87-1.08)	0.96 (0.82-1.12)	0.46 (0.33-0.66)
Highest Income 4	0.68 (0.60-0.78)	0.69 (0.57-0.85)	0.28 (0.12-0.62)	0.69 (0.59-0.81)	0.58 (0.44-0.77)	---

# Table Notes

\*Adjusted for age (25-34, 35-44, 45-54, 55-64, 65-74, 75+ years), race (white, black, other), and sex (male, female) and quartiles of population density (6.1-506.6, 506.6<-2102.0, 2102.0<-6410.2, 6410.2<-94371.6 persons per square mile), % with less than a college education (0-30.6, 30.6<-42.7, 42.7<-55.5, 55.5<-100.0), % with Hispanic ethnicity (0-2.1, 2.1<-4.7, 4.7<- 9.6, 9.6<-86.0) and distance to nearest hospital.

\*\*Population-weighted block group median income quartile ranges: \$2499.00-40,968.00, \$40968.00<-54650.00, \$54650.00<-72944.00, \$72944.00<-200001.00.

\*\*\*Results are based on 50% random sample of the hospitalizations.



# Conclusions

- **Must keep limitations in mind**
- **Findings provide evidence that the role of income in hospitalizations for CVD was not able to be completely controlled in the multivariable regression**
- **Strong associations with socio-economic status likely affected the prior studies as well**

# Contact Information

**Elizabeth Lewis-Michl**

**[ell01@health.state.ny.us](mailto:ell01@health.state.ny.us)**

**518-402-7950**