

# Is the Link between Fine Particulate Matter Air Pollution and Cognitive Function Stronger among Stroke Survivors?

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# Background: Stroke

- Brain's equivalent of a heart attack
- **Second** leading cause of death globally
- Estimated **14 millions DALYs lost** among ages 75+ in high income countries
- About **half of stroke survivors** experience some degree of physical/cognitive impairment
- Incidence of stroke is declining as a result of treatment, but total numbers increasing due to aging

## Sources:

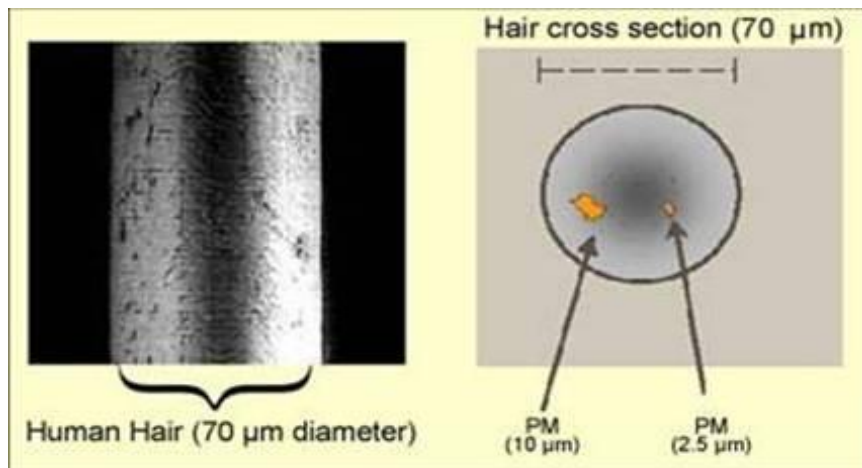
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Leys D, Hénon H, Mackowiak-Cordoliani MA, Pasquier F. Poststroke dementia. *Lancet Neurol* 2005;4:752-9.

Young J, Forster A. Review of stroke rehabilitation. *BMJ* 2007;334:86-90.

# PM<sub>2.5</sub>, Cognitive Function, Stroke

- Residential concentrations of fine particulate matter air pollution (PM 2.5) associated with:
  - Worse cognitive function (Ailshire & Crimmins 2014; Gatto et al. 2014; Weuve et al. 2012)
  - Increased risk of cardiovascular events, including stroke (Miller et al. 2007; Wellenius et al 2012)



PM<sub>2.5</sub> = 2.5 micrometers in diameter and smaller

Small diameter particles inhaled deep into lungs; can also pass through olfactory cells and deposit in brain

Produced mainly by combustion of fossil fuels from traffic-related and industrial sources

# Role of Stroke?

- Older adults with cardiovascular conditions and respiratory problems are more adversely affected by pollution
  - Prior stroke history => worse cog function among those in polluted areas
- Some conditions and diseases have an impact on cognitive function – stroke known to have large impact on functioning
  - Post-stroke recovery is a critical period for maintaining function/preventing short and long-term decline
- Very little research on role of pre-existing conditions in the pollution-cognition relationship, and nothing on role of stroke
  - ❖ Most studies exclude people with history of stroke

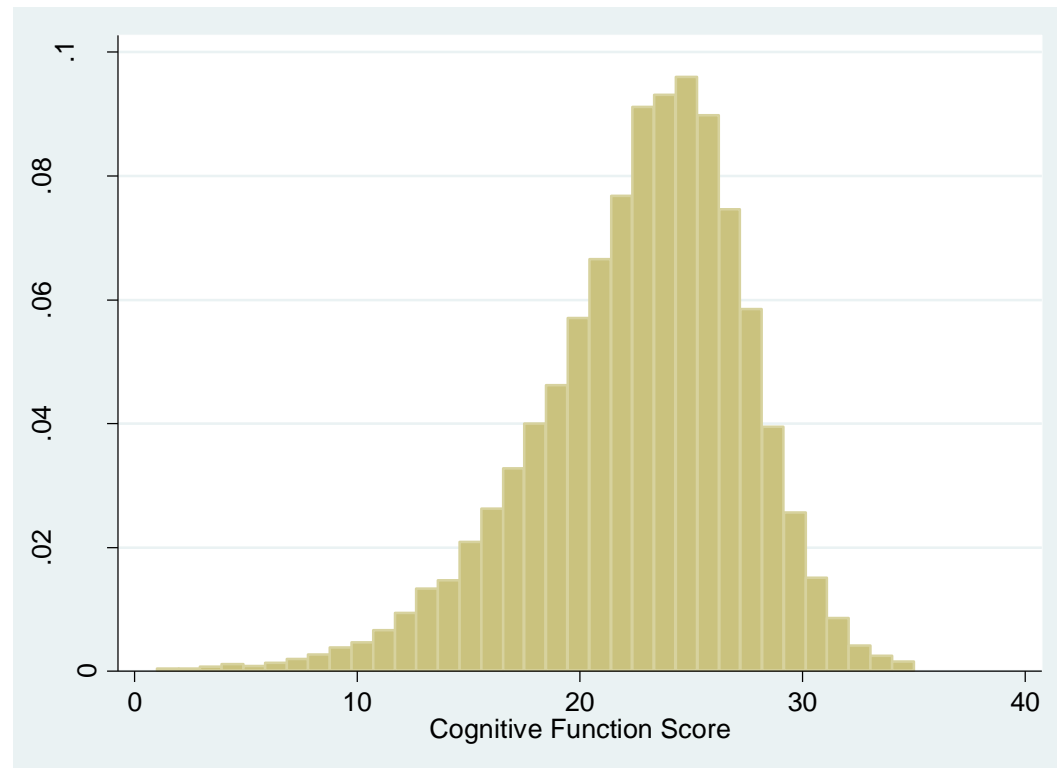
# National Data on Adults Ages 50+

- Health and Retirement Study (2004)
  - Nationally-representative, longitudinal (1992-)
  - Americans over age 50
  - Non-Hispanic whites and blacks, Hispanics, other race/ethnicity
  - Community-dwelling

~N=16,344
- Linked geographic identifiers
  - Census tract id
- Census 2000 tract characteristics
- EPA/AQS criteria pollutant data (2004)
  - Levels of PM<sub>2.5</sub> recorded at EPA monitoring stations

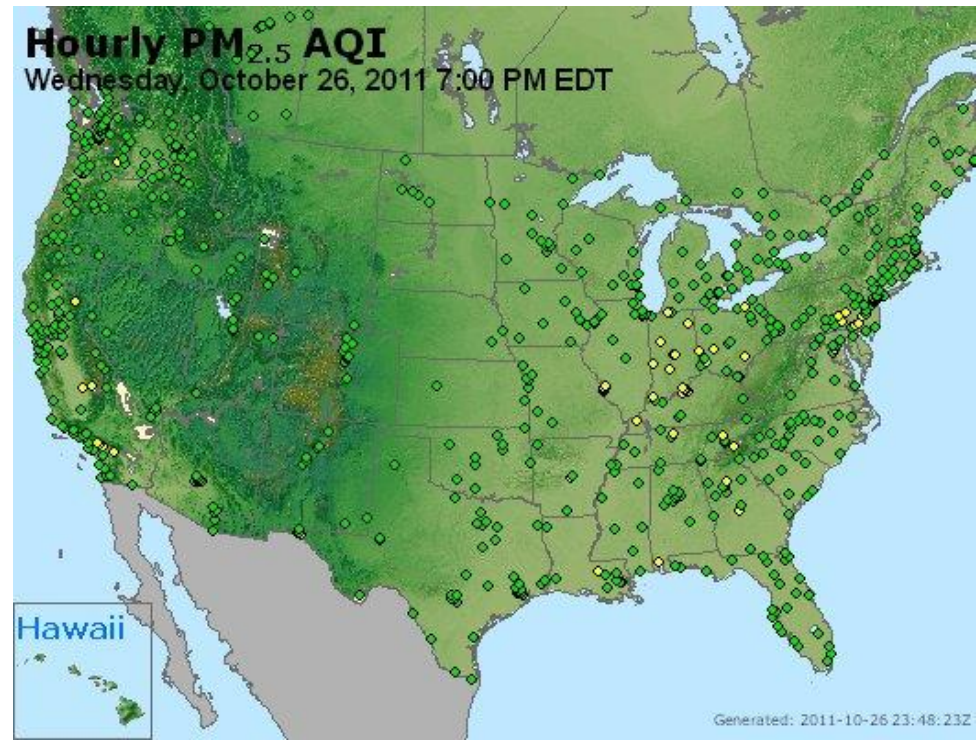
# Cognitive Function

- Immediate and delayed recall of 10 nouns (0-20 pts)
- Serial 7's subtraction test (0-5 pts)
- Backward counting from 20 (0-2 pts)
- Current date (0-4 pts)
- Object naming (0-2 pts)
- Pres/VP naming (0-2 pts)
  
- Combined total cognitive function score (0-35)

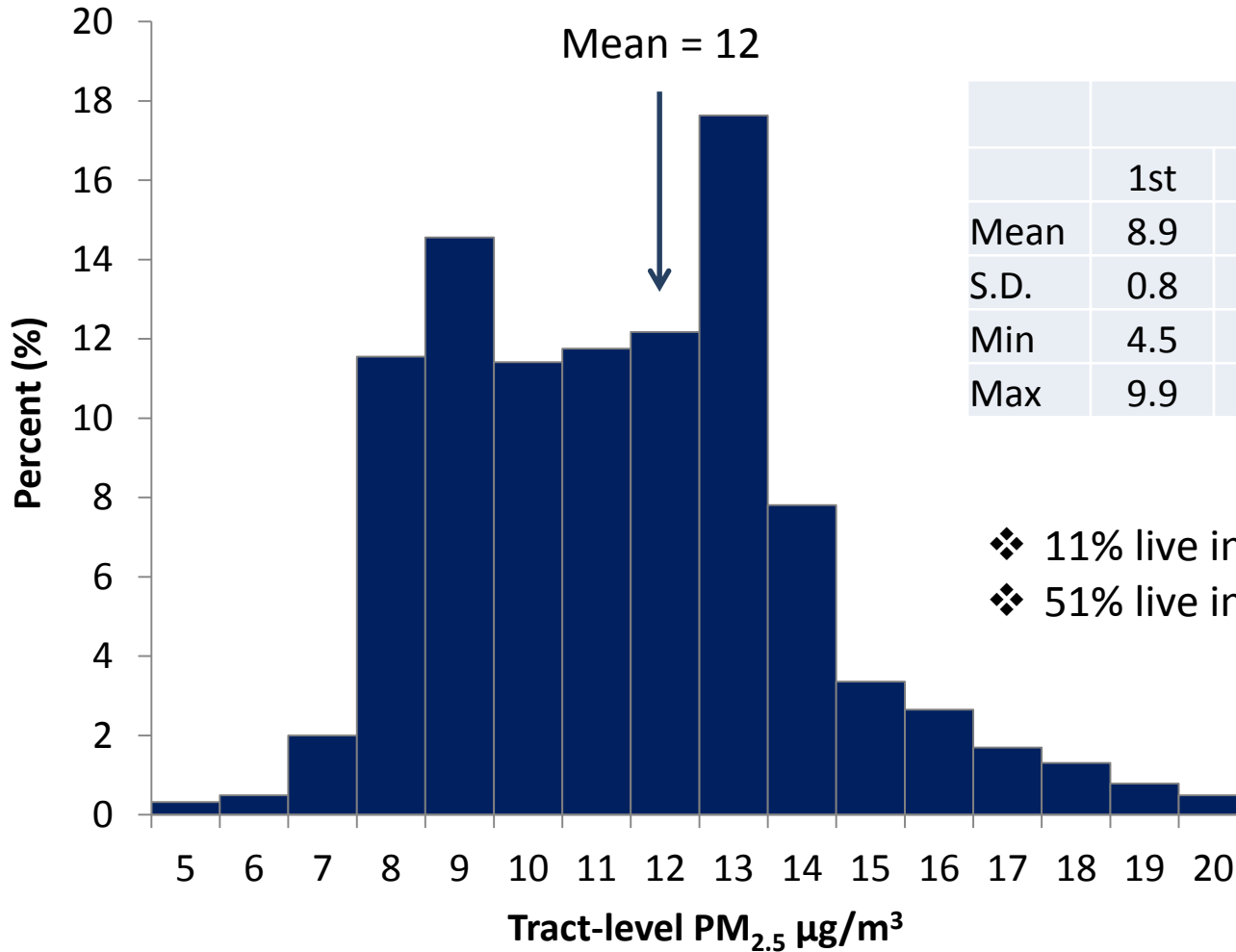


# Air Pollution

- Annual average  $PM_{2.5}$  from monitors located within 60km of Census tract centroid
- HRS respondents linked to Year 2004 tract-level  $PM_{2.5}$  using tract ids
- N=270 respondents with no tract id
- N=1,689 respondents who did not live within 60km of a monitor



# Distribution of PM<sub>2.5</sub> $\mu\text{g}/\text{m}^3$ in Study Sample

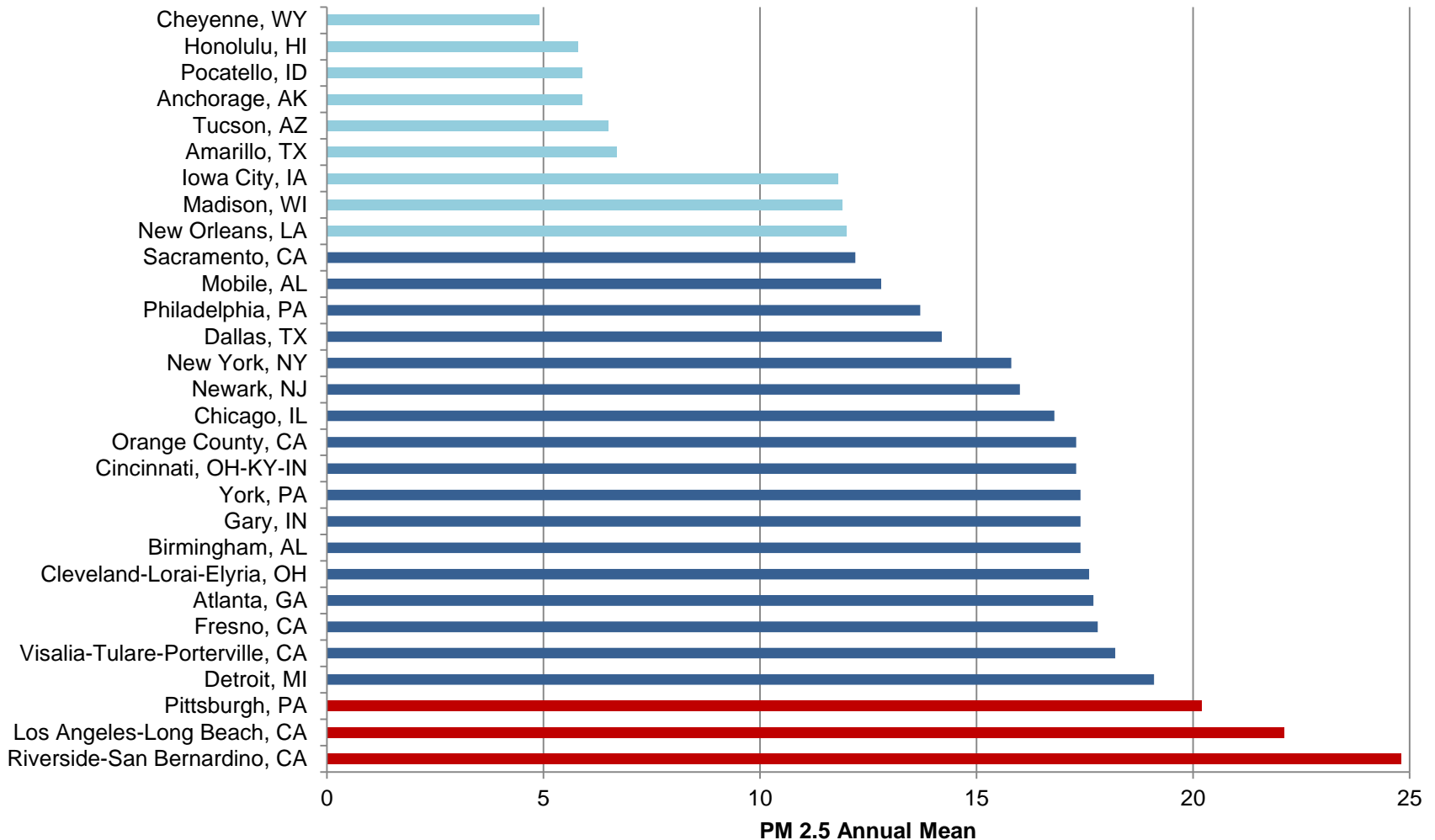


	Quartiles			
	1st	2nd	3rd	4th
Mean	8.9	11.1	13.0	15.4
S.D.	0.8	0.7	0.5	1.6
Min	4.5	9.9	12.2	13.8
Max	9.9	12.2	13.8	20.7

- ❖ 11% live in areas  $\geq 15 \mu\text{g}/\text{m}^3$
- ❖ 51% live in areas  $\geq 12 \mu\text{g}/\text{m}^3$



# PM<sub>2.5</sub> μg/m<sup>3</sup> by Select Metro Area



# HRS - Sample Characteristics

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Quartiles of Annual Average PM 2.5 $\mu\text{g}/\text{m}^3$				
	1st	2nd	3rd	4th
	[4.5-9.9]	[9.9-12.2]	[12.2-13.8]	[13.8-20.7]
Cognitive Function	22.7	22.1	21.7	22.0
Age, years	65.3	64.4	64.3	64.3
Stroke	<b>5.70%</b>	<b>6.97%</b>	<b>6.83%</b>	<b>6.91%</b>

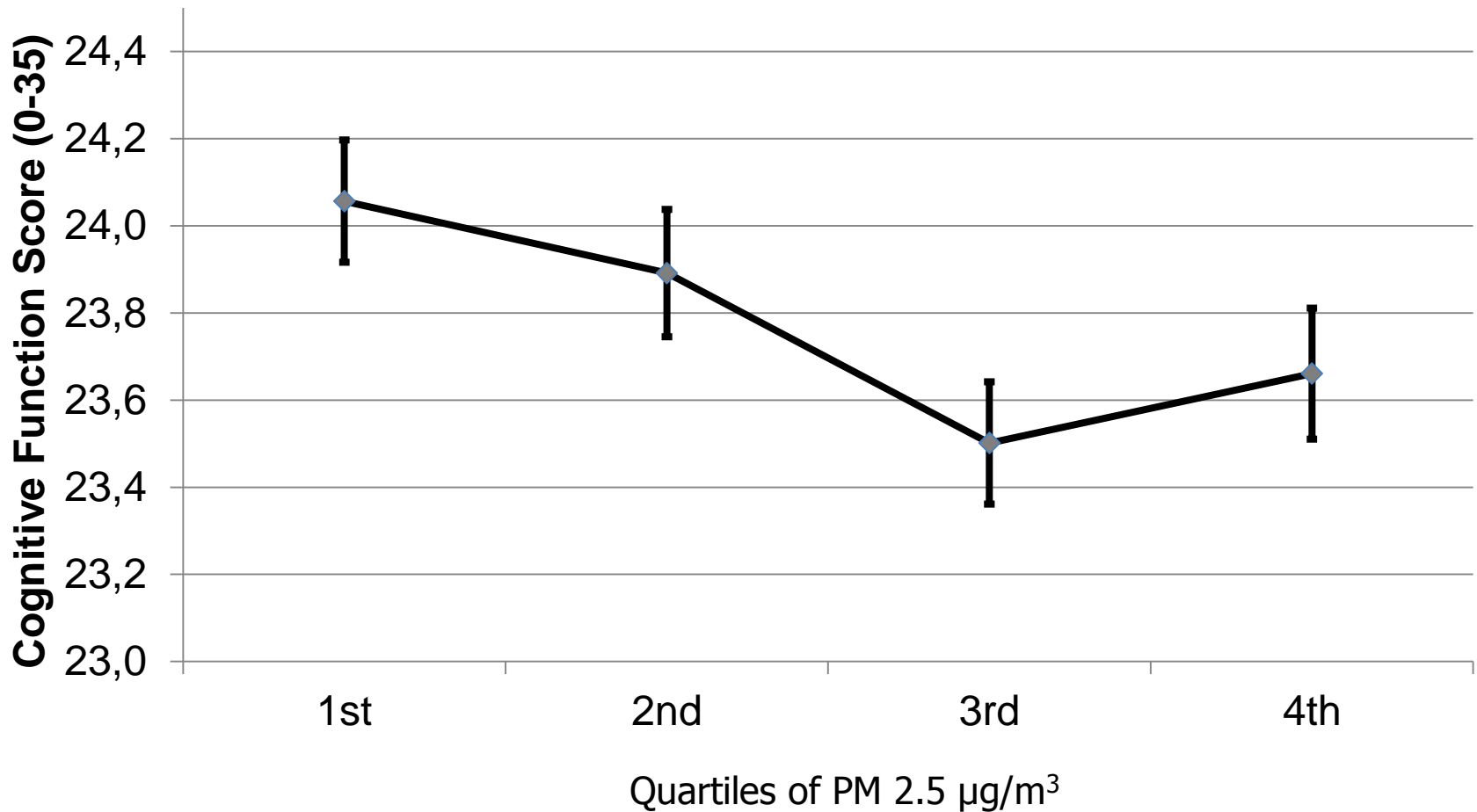
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\*Statistically significant differences,  $p < .05$

# Statistical Methods

- Multilevel linear regression with random intercept
  - Accounts for spatial clustering of observations
- Models adjusted for:
  - Individual level - age; sex, race/ethnicity; education; income; marital status; working status; smoking status; residential tenure
  - Tract level - % college educated adults; median income; % non-white
- Analyses weighted to account for complex sample design

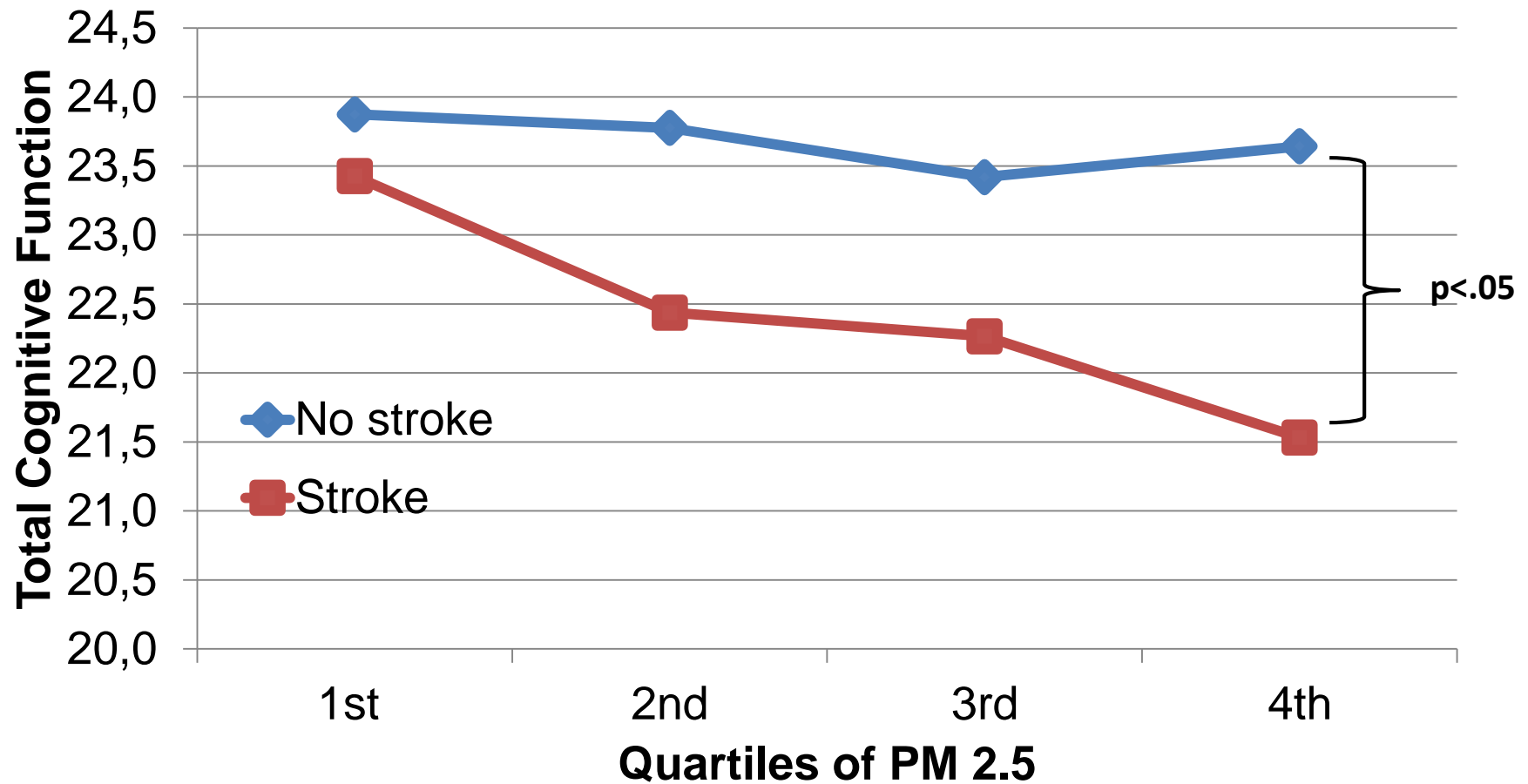
# Cognitive Function by PM<sub>2.5</sub> Quartile



Adjusted for age; sex, race/ethnicity; education; income; marital status; working status; smoking status; residential tenure; tract level - % college educated adults; median income; % non-white

**Source:** Ailshire, JA, Crimmins, EM. 2014. *Am J Epidemiology*

# Assoc. between PM 2.5 and Cognitive Function by Stroke



# Conclusions

- Growing evidence for the importance of air pollution exposure for brain health and functioning in older adults
- Not all older adults will experience the same adverse effects of air pollution
  - Stroke survivors represent particularly vulnerable population
- Need for further investigation of pollution as risk factor in stroke and post-stroke recovery/well being

Thank you.

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