Association Between Long-term Exposure to Ambient Air Pollution and Hospitalization With Aortic Aneurysm or Aortic Dissection

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Disclosure

- None

Background

- **Air pollution is associated with increased risks of cardiovascular diseases**
  - **Hypertension**
  - **Coronary heart disease/Myocardial infarction**
  - **Cardiac arrest**
  - **Stroke**

- **Correlation between air pollution and aortic aneurysm are biologically plausib**
  - **Hypertension**
  - **Inflammation**
  - **Oxidative stress**
  - **Apoptosis of smooth muscle cells -> Degeneration of aortic media**

- **Short-term $PM_{2.5}$ exposure can increase aortic dissection hospitalization**
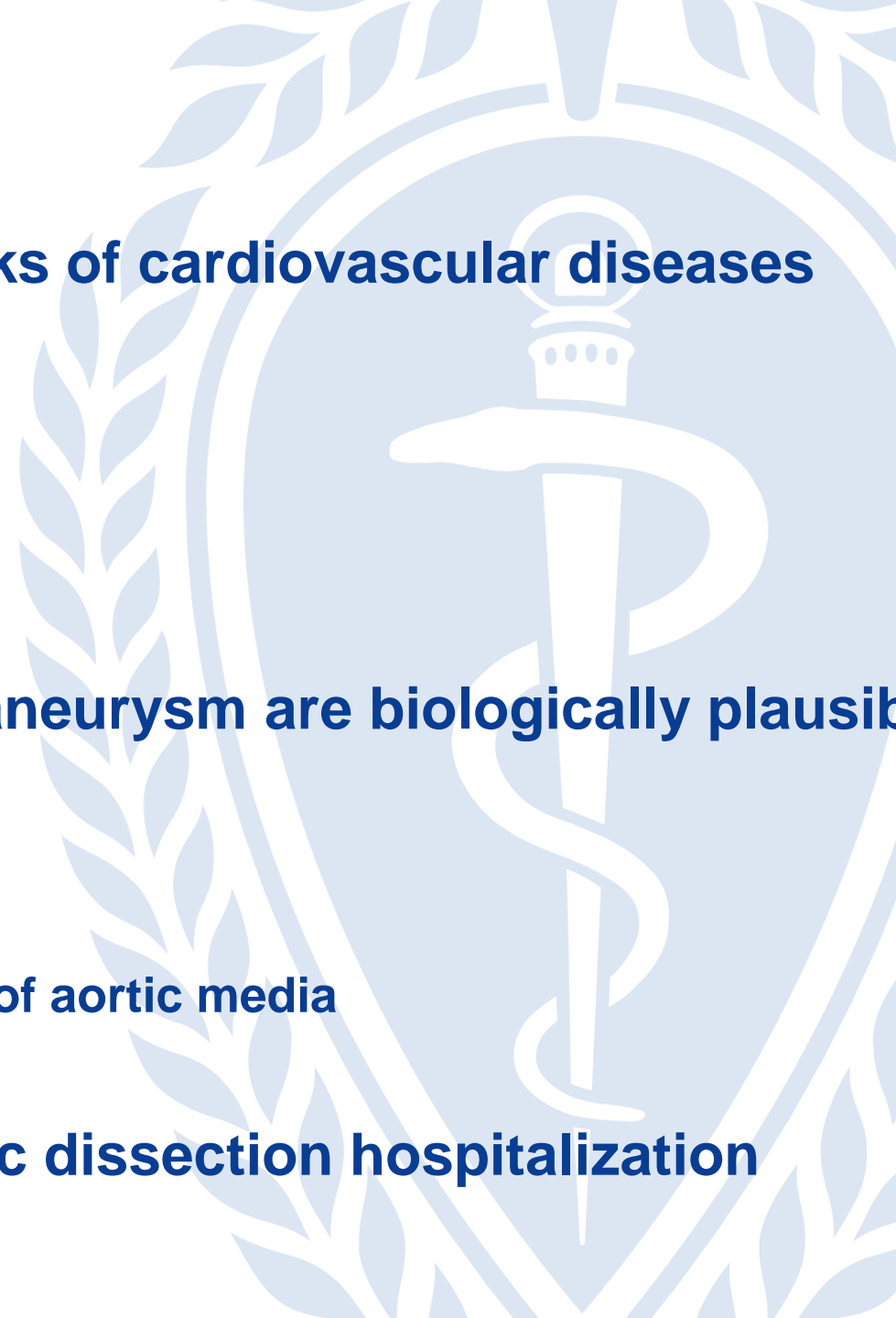
Research gaps

- **Lack of high granularity air pollution exposure models**

- **Prior aortic aneurysm-related studies were mostly small-scale, single-center studies**

- **<u>Long-term</u> effects of air pollution on aortic aneurysm have never been assessed**
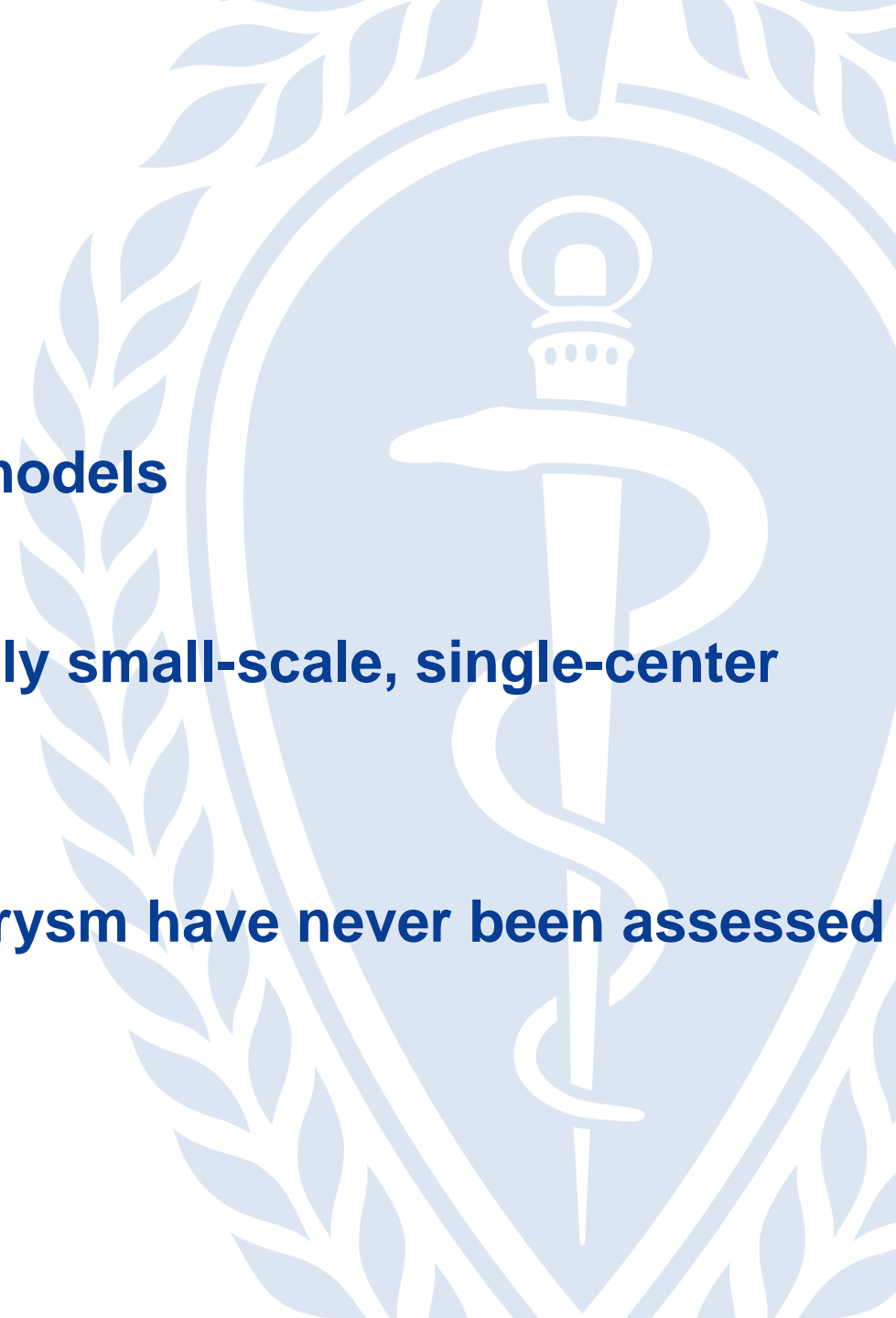
Methods – Exposure and Outcomes

- **Exposure models**
  - $PM_{2.5}$, ozone, and nitrogen dioxide (NO_2) – 3 pollutants regulated by EPA
  - Satellite data, land use, meteorological, and ancillary variables
  - Granularity: 1 km^2 grid cell; link to ZIP codes
  - Three machine-learning models used to estimate annual concertation levels

- **Hospitalization data**
  - State Inpatient Databases – Hospitalization data on ZIP code level
  - 14 states – AZ, CO, DE, FL, GA, KY, MD, MI, NC, NJ, NY, RI, WA, WI
  - 2000-2016 (limited by exposure data)
  - Aortic aneurysm/dissection related hospitalizations – ICD 9 (441), ICD 10 (I71)

Methods – Analysis and Modeling

- **Potential confounders adjusted**
  - **Patient demographics – Age, sex, race,**
  - **Neighborhood-level covariates – Population density, age, poverty rate, …**
  - **Seasonal temperatures during summer and winter**

- **Linear regression analysis**
  - **Point estimates of the effects of three pollutants**

- **Penalized cubic splines**
  - **Estimate nonlinear exposure-response relationships**

Results – Study Population and Exposure Levels

- **338, 381 aortic aneurysm or aortic dissection–related hospitalizations**
  - **Mean age = 70.8 years**
  - **Male = 71.8%**
  - **Caucasian = 70.0%**

- **Average annual levels of air pollutants**
  - **$PM_{2.5}$ = 9.2 μg/m^3**
  - **Ozone = 44.7 parts per billion (ppb)**
 - **NO_2 = 17.1 ppb**

Results – Point Estimates

- **PM$_{2.5}$ (each unit increase in annual exposure)**
  - **16.7 additional hospitalizations (95% CI: 10.5, 22.9, p < 0.001)** per ten million person-years

- **NO$_2$ (each unit increase in annual exposure)**
  - **1.85 additional hospitalizations (95% CI: 0.03, 3.7, p < 0.05)** per ten million person-years

- **Ozone (each unit increase in annual exposure)**
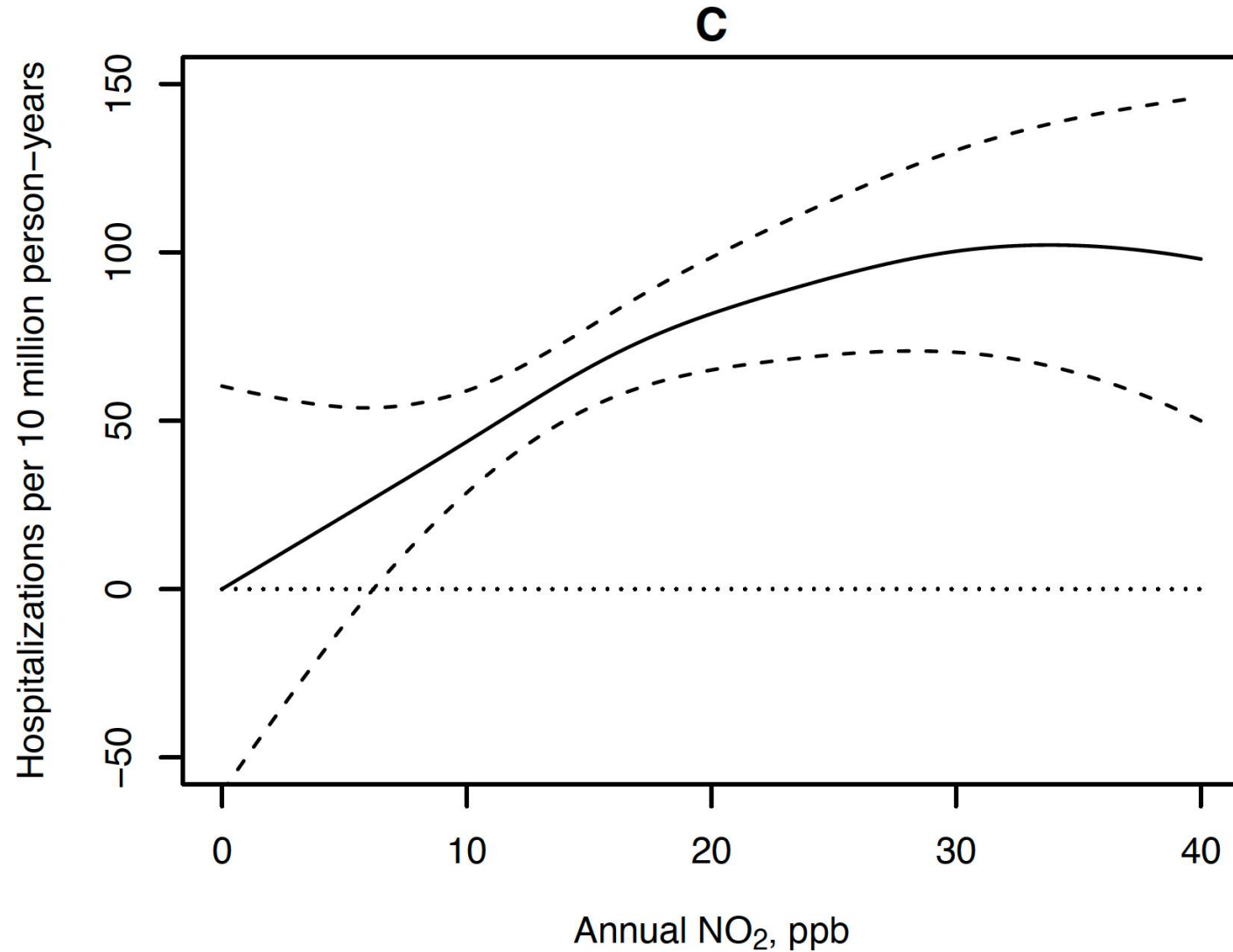 - 0.86 additional hospitalizations (95% CI: -2.0, 3.7, p = 0.55) per ten million person-years

Results – PM_{2.5} Exposure-Effect Relationships
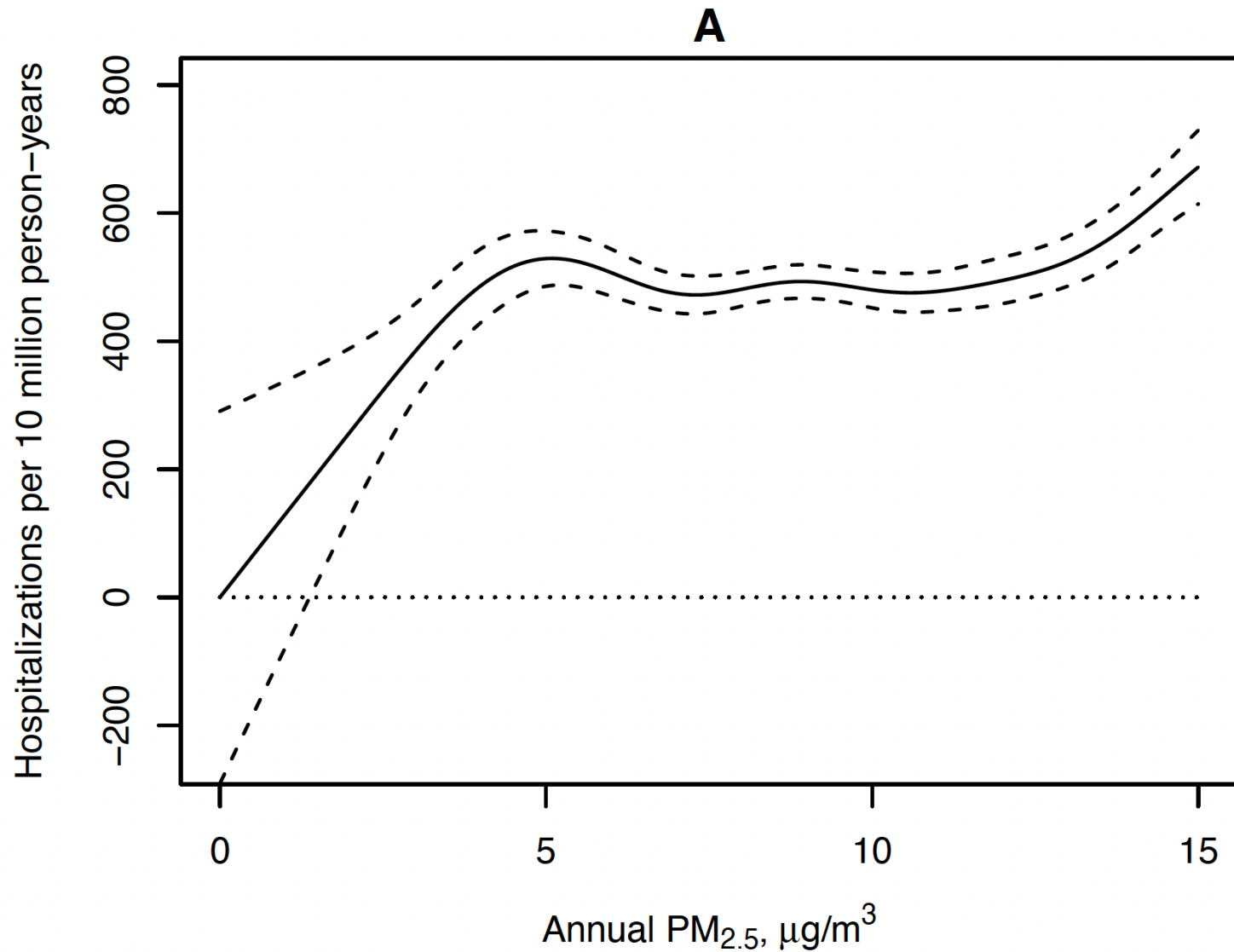
Results – Ozone Exposure-Effect Relationships
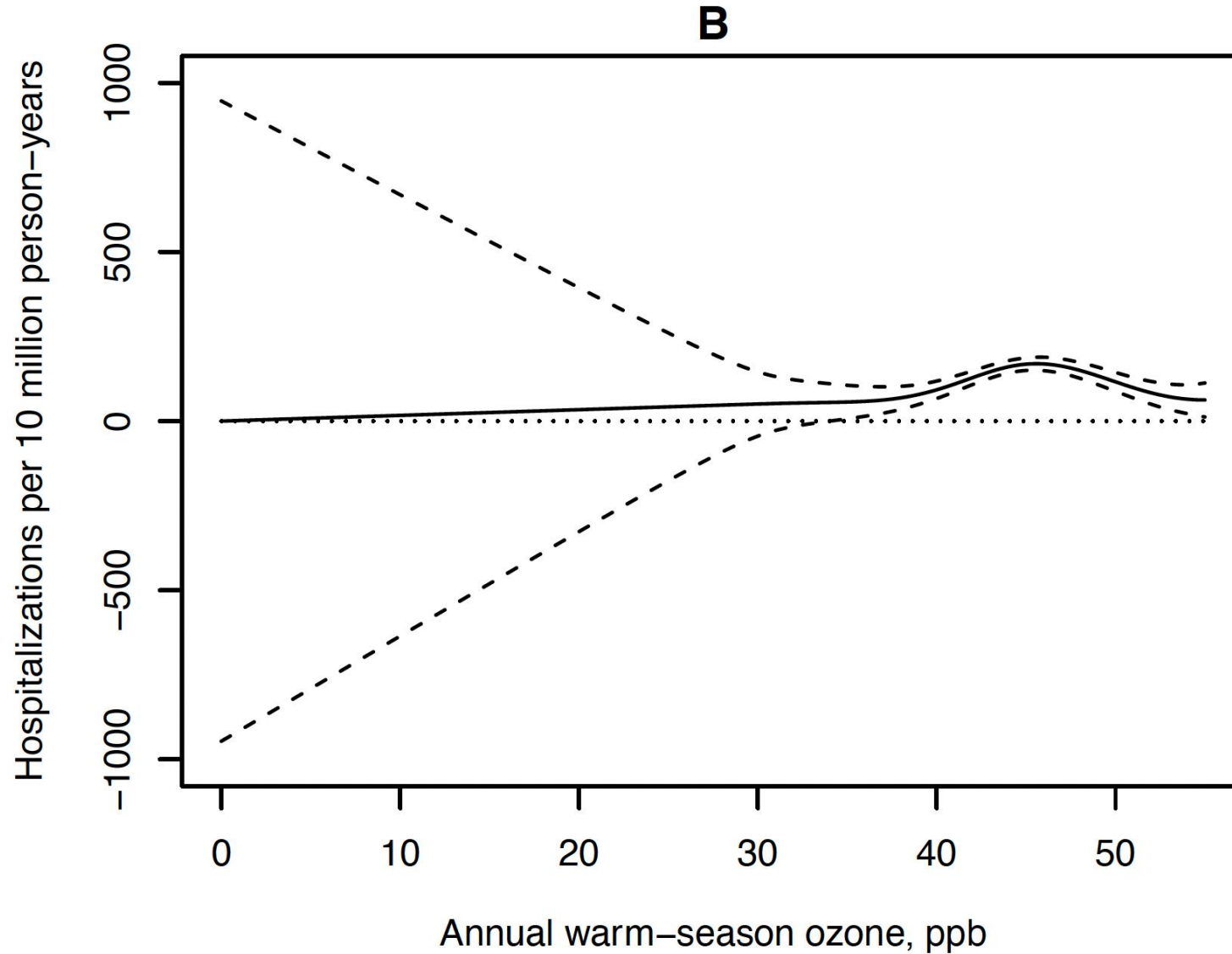
Results – NO$_2$ Exposure-Effect Relationships

Conclusions

- **Long-term exposures to $PM_{2.5}$ and NO_2 are independently associated with an elevated risk of aortic aneurysm/dissection hospitalizations**

- **A clear exposure-effect relationship is observed for $PM_{2.5}$ and NO_2**

- **Air pollution may be associated with the development or progression of aortic aneurysm/dissection**