

Assessing the short-term effect of PM_{2.5} on cardiovascular hospitalizations in the

Medicaid population: A case-crossover study

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Background

- Short-term PM_{2.5} exposure consistently linked with cardiovascular (CVD) events
- Estimates vary across space/region, and cause-specific CVD events
- Differences also reported in the critical exposure window for different cause-specific CVD events

Motivation: The National Ambient Air Quality Standards (NAAQS) should protect “sensitive subgroups”

- Need for large dataset with wide geographical coverage (nationwide)

Objective: To assess the association between PM_{2.5} and CVD hospitalizations among low income and disabled Americans

Methods

Study Population

- Medicaid beneficiaries (2010 – 2011) in the continental United States
 - Federal and state program helping with medical costs for people with limited income or disability
- Residential information available at zip-code

Outcome Assessment

- Total and cause-specific CVD hospital admissions
 - Acute Myocardial Infarction (AMI); Ischemic Heart Disease excluding AMI (IHD); Ischemic Stroke; Congestive Heart Failure (CHF)
 - Identified using ICD-9 codes

Exposure Assessment

- Daily PM_{2.5} predicted at 1 km² grid cells, aggregated at zip-code (Di et al., 2016)

Other Variables

- Confounding: Air and dew point temperature
- Effect modification: sex, race, age, disability, geographic region

Statistical Analysis

- Time-stratified case-crossover design
- Exposure window: average(lag 0-1)
 - Also DLNM to simultaneously assess effects for lags 0 – 2
- Natural splines (3 df) for air and dewpoint temperature
- Stratified models for effect modification

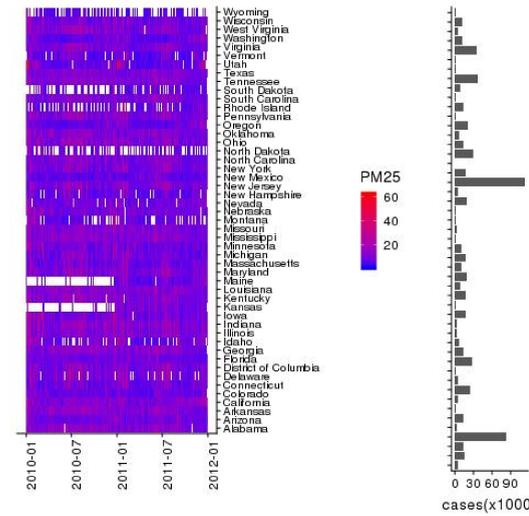
Results

Case days: 691,714
Control days: 2,343,372

Exposure Distribution:

Average PM_{2.5} 10.6 μg/m³
(SD = 5.5 μg/m³)

Figure: State-specific daily average



Medicaid Study Population Characteristics:

Baseline Characteristics	Number	%
Age < 18	16,235	2.3
18 ≥ Age < 45	91,612	13.2
45 ≥ Age < 65	292,104	42.2
Age ≥ 65	291,763	42.2
Sex		
Male	293,881	42.5
Female	397,833	57.5
Race/Ethnicity		
White	349,649	50.5
Black	189,439	27.4
Hispanic	93,619	13.5
Disability		
Disabled only	247,135	35.7
Disabled & low-income	42,373	6.1
Census Region		
South	240,105	34.7
Midwest	135,779	19.6
West	134,391	19.4
Northeast	181,438	26.2
Cause-Specific CVD (≥ 18 years)		
AMI	64,991	9.4
CHF	103,535	15.0
IHD	143,671	20.8
Ischemic stroke	73,016	10.6

Results (cont'd)

Estimated Effects:

- Significantly positive association between PM_{2.5} and CVD hospitalizations
 - Robust to sensitivity analyses
- No evidence of effect modification by age, sex, disability, geographic region or race

Analysis	% Change	95% CI
Medicaid (above 18 years of age)	1.4	0.8, 2.0
Medicaid (above 65 years of age)	1.8	0.9, 2.7
Medicare (2010-2011)	1.0	0.7, 1.3
Cause-specific CVD		
AMI	1.1	-0.8, 3.1
IHD	1.6	0.3, 2.9
CHF	2.6	1.1, 4.1
Ischemic Stroke	1.3	-0.5, 3.2
Disability		
Disability and low-income	1.2	-1.2, 3.7
Disability only	1.3	0.3, 2.3
Sex*		
Females	1.2	0.4, 2.0
Males	1.7	0.8, 2.6
Race/ethnicity*		
Whites	1.9	1.1, 2.8
Blacks	1.4	0.3, 2.5
Hispanics	0.8	-0.9, 2.4
Non-white	0.9	0.0, 1.7
Census Region*		
Northeast	1.2	0.0, 2.3
Southeast	1.9	0.5, 3.2
Midwest	2.2	1.0, 3.5
West	1.2	-0.2, 2.7
Southwest	-1.0	-3.5, 1.6

Figure: Percent change in CVD rates by 10 μg/m³ increase in PM_{2.5}. *Age ≥ 18 years of age

Conclusions

- Higher effect estimates among elderly Medicaid enrollees (vs. Medicare)
 - Potentially increased vulnerability among low-income elderly
 - Albeit overlapping confidence intervals
- No effect modifications detected
 - Among low-income other factors may not impact vulnerability

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