Long-Term Exposure to PM$_{2.5}$ and Ozone and Hospital Admissions for Medicare Participants in the Southeast USA

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**Background**

Air pollution has long been associated with mortality and morbidity. However, few studies have examined the long-term effects of PM$_{2.5}$ and ozone on cause-specific hospital admissions. Mortality studies have found greater effect sizes with long-term exposure than short-term exposure. Furthermore, the studies that currently exist often do not utilize causal modeling methods or account for the competing risk of death.

**Objectives**

We examined the relationship between long-term exposure to PM$_{2.5}$ and ozone and cause-specific hospital admissions in the southeast USA among Medicare participants.

**Methods**

- We fit a marginal structural Cox proportional hazards model, using stabilized inverse probability weights (IPWs) to account for the competing risk of death and confounding.
- This model examined the association between average annual PM$_{2.5}$ and ozone and first hospital admissions of Medicare participants in the southeast region of the US for stroke, chronic obstructive pulmonary disease (COPD), pneumonia, myocardial infarction (MI), lung cancer, and heart failure (HF).
- Analyses were then restricted to levels below the current U.S. standard: average annual measurements of PM$_{2.5}$ below 12 $\mu$g/m$^3$ and zip codes and years in which ozone levels were below 70 parts per billion (ppb) on all days.

**Results**

- PM$_{2.5}$ was associated with an increased hazard of admissions for all studied outcomes; the highest observed being a 6.1% (95% CI: 6.0%- 6.2%) increase in the hazard of admissions with pneumonia for each $\mu$g/m$^3$ increase in particulate levels.
- This was true even when the analysis was restricted to observations with average annual PM$_{2.5}$ levels below 12 $\mu$g/m$^3$ for each ppb increase in the ozone level.
- The estimated effect sizes were well above those reported for short-term exposure.

**Conclusions**

- Exposure to PM$_{2.5}$ and ozone was associated with an increased hazard of first hospital admission in all outcome conditions even at levels below standards.
- Studies of short-term exposure may underestimate the true effect of air pollution.
- The results of this study, combined with the conclusions from other studies, warrants an examination of current federal standards.

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