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A case-crossover analysis of short-term PM_{2.5} exposure and COVID19-related hospitalizations in the National Clinical Cohort Collaborative



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Abstract

Background Studies show associations between air pollution exposure and coronavirus 2019 (COVID19) hospitalizations, but have not substantially explored regional differences. In this study, we estimate associations between shorter-term exposure to fine particulate matter (PM_{2.5}) and hospitalization among individuals with SARS-CoV-2 infection.

Methods This study utilized data from 72,385 patients (78,504 hospitalizations) with a hospital-confirmed SARS-CoV-2 infection between January 1, 2020 and December 31, 2020. Daily PM_{2.5} concentrations from ground-based monitors were averaged to generate 2, 5, and 21-day average exposures prior to hospitalization. We used a time-stratified case-crossover approach to estimate associations between PM_{2.5} and COVID19-related hospitalizations in 57 Core Based Statistical Areas (CBSAs) across the United States (US). We subsequently conducted nationwide and region-specific random effects meta-analysis.

Results In the random effects meta-analysis, a 1 µg/m³ increase in 2, 5, and 21-day average PM_{2.5} are associated with a 0.61% (95% Confidence Interval [CI] = 0.12, 1.11); 0.91% (CI = 0.15, 1.67); and 0.04% (CI = -2.70, 2.85) increase in COVID19-related hospitalization risk, respectively. We observe substantial heterogeneity in the associations by region with the largest adverse associations in the South.

Conclusions Higher concentrations of PM_{2.5} are associated with higher risk of COVID19-related hospitalizations. Given the geographic heterogeneity observed, studies exploring factors, such as PM_{2.5} exposure, that could explain differences in COVID19 risks may help to understand the COVID19 pandemic and aid in preparing for future ones.

Plain Language Summary

Exposure to air pollution is shown to have a negative impact on human health. For example, air pollution increases the risk of cardiovascular- and respiratory-related hospitalizations and deaths. Little is known about how air pollution might affect the health of individuals with COVID19. Using hospitalization data from 57 cities across the United States (US), we assess whether individuals who tested positive for COVID19 were more likely to be hospitalized after multiple days of higher air pollution exposures. We find that higher levels of fine particulate matter, a common air pollutant, are associated with increased likelihood of COVID19-related hospitalization, and that the relationship between particulate matter and COVID19 differs across the US regions and cities we examine. The short- and long-term health impacts of air pollution exposure in individuals with COVID19 merits further research and should be considered in public health interventions and planning health care capacity.

The public health impact of the SARS-CoV-2 global pandemic has been tremendous, and specific populations have been disparately impacted¹. In the United States (US) alone, there have been 96 million confirmed COVID19 cases and over 1 million COVID19-related deaths². At different phases of the pandemic, populations including, elderly individuals³ and rural communities⁴ in the US have borne a

disproportionate burden of the health consequences of COVID19 in terms of viral infections, hospitalizations, and mortality^{5,6}. Many of these same populations may also be exposed to environmental hazards such as air pollution⁷, vulnerable to adverse health effects of environmental exposures^{8,9}, or both¹⁰. As a ubiquitous and potentially modifiable exposure^{11,12}, understanding the role of air pollution with respect to

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