June 2022

The Short-term Effects of Fine Airborne Particulate Matter and Climate on COVID-19 Disease Dynamics

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Background: Despite more than 60% of the United States population being fully vaccinated, COVID-19 cases continue to spike in a temporal pattern. These patterns in COVID-19 incidence and mortality may be linked to short-term changes in environmental factors.

Methods: Nationwide, county-wise measurements for COVID-19 cases and deaths, fine-airborne particulate matter ($PM_{2.5}$), and maximum temperature were obtained from March 20, 2020 to March 20, 2021. Multivariate Linear Regression was used to analyze the association between environmental factors and COVID-19 incidence and mortality rates in each season. Negative Binomial Regression was used to analyze daily fluctuations of COVID-19 cases and deaths with those of environmental factors in New York, NY.

Results: In Spring 2020, a 1 $\mu g/m^3$ increase in average county $PM_{2.5}$ concentration was associated with a 15.7% increase in incidence rate and a 9.3% increase in death rate. In Summer 2020, a 1 K increase in maximum temperature was associated with a 11.5% increase in incidence rate, but a 1.7% decrease in incidence rate in Fall 2020. For each 1 $\mu g/m^3$ and 1 K increase in daily PM2.5 concentration and maximum daily temperature in New York, NY, daily COVID-19 cases increase by 5.2% and decrease by 2.3%, respectively.

Discussion: The effect of $PM_{2.5}$ concentration and maximum temperature on COVID-19 incidence and mortality rates varied greatly between different seasons. The temporality of COVID-19 could be linked to the seasonality of these effects. Furthermore, the significant association of daily measurements of environmental factors with COVID-19 cases and deaths warrants further analysis across multiple counties.

Keywords: Regression; Coronavirus; Environmental Factors; COVID-19; Temporality; $PM_{2.5}$; Climate; Particulate matter