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Causal relationships between particulate matter and COVID-19 cases in USA cities

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Recent studies have shown that increased outdoor concentrations of particulate matter (PM) enhances the transmission of the novel Coronavirus (COVID-19). Although the viability of this causal relationship has been established indoors, outdoor correlations are contested based on potential confounding effects, such as urban mobility. Testing the hypothesis of PM-assisted airborne viral transmission is important to support the decision-making process and mitigation of future airborne epidemics. In a recent study we have shown that Granger causality analysis supports a causal relationship between outdoor PM concentrations and COVID-19 new cases. In this study, we aim to further explore this causal link by considering urban mobility as a common driver and a mediator in a set of causal networks based on lagged multivariate linear regressions. Causal networks are graphical models designed to help distinguishing and quantifying correlation and causation relationships. We quantify the strength at which PM increases COVID-19 new cases directly and the strength of urban mobility as a driver of both PM and COVID-19 new cases. We also quantify the effect of COVID-19 new cases in urban mobility that causes the PM concentration. We employ a dataset of daily air quality measurements in 52 cities in the United States of America (USA) considering PM concentrations in two particle size ranges, smaller than 2.5 μm (PM2.5), and between 10 and 2.5 μm (PMC). PMC is related to soil dust resuspension in most cities. So, we used the PMC as an urban mobility proxy. We also employ carbon monoxide (CO) along with the Apple dataset of IPhone users mobility which shows the relative volume of satellite navigation requests by city in the USA.