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RESEARCH LETTER

Pandemic-Related Pollution Decline and ST-Segment–Elevation Myocardial Infarctions

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The reason for the reduction in ST-segment–elevation myocardial infarctions (STEMI) during the COVID-19 pandemic[1] remains a mystery. Increased particulate matter 2.5 (PM 2.5) is a known risk factor for STEMI,[2] although evidence of the reciprocal relationship (decreased PM 2.5 associated with decreased STEMI incidence) has not been shown. Given the rare circumstances of the pandemic, where pollution across the United States substantially diminished,[3] we sought to perform a natural experiment to determine if decreased PM 2.5 was associated with a decrease in STEMIs.

Requests to access the data can be made through the NEMSIS (National Emergency Medical Services Information System) registry after submitting a proposal: https://nemsis.org/using-ems-data/request-research-data.

We abstracted daily STEMI events between January 1, 2019 to April 30, 2020 (shelter-in-place orders began in March) from the NEMSIS database, a national registry with contributing emergency medical services (EMS) agencies from 47 states and territories.[4] STEMI events were identified by EMS personnel. Incidence rates (events per 10 000 person-years) were calculated using US Census population denominators by US Census Divisions (https://www.ncdc.noaa.gov/monitoring-references/maps/us-census-divisions.php). We abstracted average daily PM 2.5 data from across the US from the Environmental Protection Agency website. NEMSIS and Environmental Protection Agency data were linked by calendar date and US Census Division. Negative binomial regression models were used to estimate the relationship between levels of PM 2.5 and STEMI rates, adjusting for US Census Division, calendar day of week, calendar month, and calendar year. An adjusted regression line was plotted from the fitted model across the entire range of PM 2.5 levels during the study period. We did not find evidence of substantial non-linearity when relaxing the linearity assumption for the adjusted regression line using a cubic spline. Subgroup analyses were performed for each US Census Division alone and for each individual sex. Effect-modification analyses were conducted to investigate a possible interaction by sex. Sensitivity analyses were performed after excluding all cases with signs or symptoms suggestive of active viral and/ or respiratory infection, including fever, sepsis, pneumonia, respiratory distress, and respiratory failure. Statistical analyses were performed using Stata, version 17 (College Station, TX). Certification to use de-identified NEMSIS data was obtained from the University of California, San Francisco Institutional Review Board.

There were 60 722 total STEMI events recorded during the study period. After adjustment for US Census Division, the day of the week, and calendar month, there were 6% less STEMIs per each 10 μg/m^3 reduction in PM 2.5 (rate ratio, 0.94; 95% CI, 0.90–0.99; P=0.016; Figure). Using the same multivariate adjustment, there were 373.8 less STEMIs per 10 000 person-years for each 10 μg/m^3 decrease in PM 2.5 (95% CI, 69.4–678.1). When examining each US Census Division individually, 8 out of 9 exhibited

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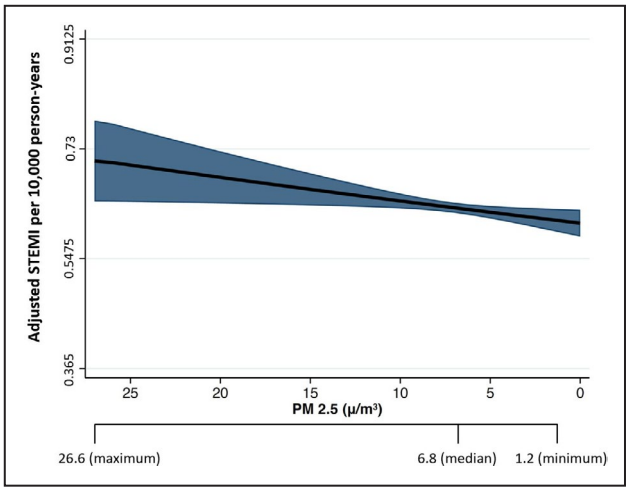

Figure. Multivariable-adjusted incidence rates of STEMI per 10 000 person-years across decreasing concentrations of particulate matter 2.5.
STEMI rates were adjusted for US Census Division, calendar month, and calendar year. Blue shading indicates 95% CIs. Line brackets below the x-axis indicates the maximum, median, and minimum particulate matter 2.5 concentrations during the study period. PM indicates particulate matter; and STEMI, ST-segment–elevation myocardial infarction.

point estimates favoring a lower STEMI rate with declining PM 2.5 concentrations, although none alone achieved statistical significance. Point estimates were not meaningfully different for men or women individually, and statistical significance was maintained in men only. No significant interaction related to sex was observed. In sensitivity analyses excluding all cases with EMS impressions for fever, sepsis, pneumonia, respiratory distress, or respiratory failure, none of the results were meaningfully different.

Pandemic-related declines in PM 2.5 levels were associated with significantly less STEMIs across the United States. While more pollution is known to increase STEMI risk,[2] this demonstration of the reciprocal relationship provides the most direct evidence that efforts to reduce ambient pollution can prevent the most severe forms of myocardial infarctions.

We observed a similar association of declining PM 2.5 levels with less STEMIs in 8 out of 9 US Census Divisions alone, although none alone achieved statistical significance likely because of a reduction in power. No meaningful differences in point estimates were observed for each sex alone, although statistical significance was lost when restricting the analyses to women alone. None of our findings were meaningfully changed in sensitivity analyses excluding primary EMS impressions of respiratory or infectious phenomena occurring in the EMS activations.

While a strength of the current study is the national-level assessment of PM 2.5 and STEMI trends across heterogeneous and broad geographic regions, we acknowledge that we cannot exclude residual or unmeasured confounding in this observational study. We also relied on EMS personnel to correctly identify STEMI events, though there is evidence demonstrating that this occurs with reliable accuracy.[5]

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Disclosures

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