Particulate matter and emergency visits for asthma: a time-series study of their association in the presence and absence of wildfire smoke in Reno, Nevada, 2013-2018

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Abstract

Background: Health risks due to particulate matter (PM) from wildfires may differ from risk due to PM from other sources. In places frequently subjected to wildfire smoke, such as Reno, Nevada, it is critical to determine whether wildfire PM poses unique risks. Our goal was to quantify the difference in the association of adverse asthma events with PM on days when wildfire smoke was present versus days when wildfire smoke was not present.

Methods: We obtained counts of visits for asthma at emergency departments and urgent care centers from a large regional healthcare system in Reno for the years 2013-2018. We also obtained dates when wildfire smoke was present from the Washoe County Health District Air Quality Management Division. We then examined whether the presence of wildfire smoke modified the association of PM 2.5 , PM 10-2.5 , and PM 10 with asthma visits using generalized additive models. We improved on previous studies by accounting for possible non-linearity in the association between PM concentration and asthma visits: wildfire-smoke days where the PM concentration exceeded the maximum PM concentration on other days were excluded.

Results: Air quality was affected by wildfire smoke on 188 days between 2013 and 2018. We found that the presence of wildfire smoke increased the association of a 5 $\mu\text{g}/\text{m}^3$ increase in daily and three-day averages of PM 2.5 with asthma visits by 6.1% (95% confidence interval (CI): 2.1-10.3%) and 6.8% (CI: 1.2-12.7%), respectively. Similarly, the presence of wildfire smoke increased the association of a 5 $\mu\text{g}/\text{m}^3$ increase in daily and three-day averages of PM 10 with asthma visits by 5.5% (CI: 2.5-8.6%) and 7.2% (CI: 2.6-12.0%), respectively. We did not observe any significant increases in association for PM 10-2.5 or for seven-day averages of PM 2.5 and PM 10 .

Conclusions: Since we found significantly stronger associations of PM 2.5 and PM 10 with asthma visits when wildfire smoke was present, our results suggest that wildfire PM is more hazardous than non-wildfire PM for patients with asthma.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

Map of the Reno-Sparks area showing the locations of air quality monitors, urgent care centers, emergency departments, and the KRNO weather station.

Figure 2

Time series of particulate matter and asthma visits from January 1, 2013, to December 31, 2018 in Reno, Nevada. Daily values of $\text{PM}_{2.5}$ and $\text{PM}_{10-2.5}$ are weighted averages across all air quality monitors. The width of the blue ribbon indicates the number of asthma visits, and the orange-shaded regions below the time series for $\text{PM}_{2.5}$ indicate days where the air quality was determined by WCHD-AQMD to be affected by wildfire smoke.

Figure 3

Rate ratios for asthma visits to the ED and UC centers in the presence or absence of wildfire smoke. PM was scaled to 5 $\mu\text{g}/\text{m}^3$ for all fractions and lags. Numeric labels between points are estimates of the change in the rate ratio when wildfire smoke is present compared to when it is not present, presented as a factor. This change can also be presented as a percent (i.e., the factor 1.028 is equivalent to an increase of 2.8%), which is how the changes are presented in the body of the paper. Rate ratios and the differences between them are presented in tabular form in Table S1.

Figure 4

Percent increase in asthma visits due to wildfire smoke, at given levels of PM_{2.5} and PM_{10-2.5}. Estimates were constrained to the regions within 5 µg/m³ of a wildfire data point to limit extrapolation. Shaded regions indicate estimates that were significant at the 0.05 level.

Supplementary Files

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