Effects of Ambient Air Pollution on Childhood Asthma Exacerbation in the Philadelphia Metropolitan Region, 2011 - 2014

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Fine particulate matter (PM2.5) and ozone (O3) air pollutants are known risk factors for asthma exacerbation. We studied the association of these air pollutants with pediatric asthma exacerbation in the Philadelphia metropolitan region, and evaluated potential effect modification by children's characteristics (e.g., race/ethnicity, atopic conditions) and environmental factors (e.g., neighborhood tree canopy, meteorological factors, aeroallergens). We conducted a time-stratified case-crossover study of 54,632 pediatric (age ?18 years) asthma exacerbation cases occurring from 2011-2014, identified through electronic health records (EHR) of the Children's Hospital of Philadelphia (CHOP) health system. We applied conditional logistic regression to estimate associations between air pollution and asthma exacerbation, using daily census-tract level pollutant concentrations estimated from the EPA Fused Air Quality Surface Using Downscaling (FAQSD) files. The associations were estimated within warm (Apr - Sep) and cold (Oct - Mar) months for unlagged exposure and for cumulative effects up to 5 days after exposure, with adjustment for temperature, relative humidity, and holidays. We found small increases in odds of asthma exacerbation with higher pollutant concentrations, with positive associations (OR, comparing concentrations of 75th to 25th percentile) observed for PM2.5 during both warm (1.03, 95% CI: 0.98 - 1.08) and cold months (1.05, 95% CI: 1.02 - 1.07), and for O3 during cold months (1.08, 95% CI: 1.02 - 1.14). The exposure-response relationship with PM2.5 during the cold months was essentially linear, whereas thresholds of effect were observed for the other associations at low-medium pollutant concentrations. Results were robust to multi-pollutant modeling and adjustment for additional covariates. We found no effect modification by most children's characteristics, while effect sizes were higher on days with detected tree and grass pollens during warm months. Our results suggest that even small decreases in pollutant concentrations could potentially reduce risk of childhood asthma exacerbation - an important finding, given the high burden of childhood asthma and known disparities in asthma control.

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Authors: Chén Kenyon

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