

Health effects of Particulate Matter (PM) in Washington State

Koenig JQ, Larson TV, Hanley QS, et al.

Pulmonary function changes in children associated with fine particulate matter. Environ Res 1993; 63: 26-38.

This study was conducted to investigate the relationship between fine particulate matter and pulmonary function in young children. The subjects were 326 elementary school children, including 24 children with asthma, who lived in an area in north Seattle with high particulate concentrations predominately from residential wood burning during 1988 and 1989. Lung function was measured monthly from during the school year providing data before, during, and after the winter heating season. An increase in fine particle air pollution was associated with a decline in pulmonary function in the children with asthma. These results suggest that exposure to wood smoke is associated with acute respiratory irritation in young children with asthma.

PM metric was light scattering data from nephelometer. We converted this to PM2.5 (however neph probably measured PM1.0 or less). We used 7 pm to &am 12 hour averages rather than 24 hour averages to estimate better wood smoke exposure.

Schwartz J, Slater D, Larson TV, et al.

Particulate air pollution and hospital emergency room visits for asthma in Seattle. Am Rev Respir Dis 1993; 147: 826-831.

The objective of this study was to test for associations between daily visits to emergency departments for asthma and daily air pollution levels. The analysis found that daily counts of emergency department visits for asthma in persons under age 65 were significantly associated with PM10 exposure on the previous day. The relative risk for a 30 ug/m³ increase in PM10 was 1.12 (95% confidence intervals 1.04 to 1.20). During the period of the study (1989-90), the highest PM10 level recorded was 103, about 75% of the EPA standard for health (150 ug/m³).

We also calculated the relative risk using nephelometer data as our metric. The RR was 1.11 (based on light scattering converted to PM2.5). This suggests that PM10 in Seattle is primarily from combustion rather than the Coarse Fraction.

Norris G, YoungPong SN, Koenig JQ, et al. An association between fine particles and asthma emergency department visits for children in Seattle.

Environ Health Perspect 1999; 107: 489-493.

The objective of this study was similar to the earlier study, although during this time period (1995-96) we had access to PM2.5 data as well as PM10 data. This analysis found that a change in annual PM2.5 of 11 ug/m³ was associated with a 15% increase in emergency department visits in children under 18 years of age.

Sheppard L, Levy D, Norris G, et al. Effects of ambient air pollution on nonelderly asthma hospital admissions in Seattle, Washington, 1987-1994.

Epidemiology 1999; 10: 23-30.

Hospital admissions are a more serious health outcome than visits to emergency departments. The objective of this research was to evaluate whether hospital admissions for asthma were associated with air pollution in Seattle. We found an estimated the following relative risks associated with an increase in the rate of asthma hospital admissions associated with an interquartile range change all metrics;

PM10: IQR = (19 ug/m³), 5% (CI 1.02-1.08);

PM2.5: IQR = (11.8 ug/m³), 4 % (CI 1.02-1.07);

PM CF: IQR = (9.3 ug/m³) 4% (1.01-1.07)

Yu O, Sheppard L, Lumley T, et al. Effects of ambient air pollution on symptoms of asthma in Seattle-area children enrolled in the CAMP study.

Environ Health Perspect 2000; 108: 1209-1214.

We observed a panel of 133 children (5-13 years of age) with asthma residing in the greater Seattle area for an average of 58 days during screening for enrollment in the Childhood Asthma Management Program. Daily reports of symptoms were recorded. The population average symptom estimates indicated a 18% (5-33%) increase for a 10 ug/m³ increase in fine particles (PM_{2.5}). We conclude that there is an association between change in short-term air pollution levels and the occurrence of asthma symptoms among children in Seattle.

Koenig JQ, Mar TF, Jansen K, et al. Measurement of offline exhaled nitric oxide in an air pollution health effect study. Environ Health Perspect 111: 1625-1629, 2003.

Nineteen children with asthma participated in a panel study that required daily measures of PM exposure and daily measures of exhaled nitric oxide during two 10 day periods. Exhaled nitric oxide (eNO) is a marker of lung inflammation. We found a 10 ug/m³ increase in PM_{2.5} from **outdoor, indoor, and personal PM_{2.5} monitors** was associated with same day increases in eNO in subjects not using corticosteroid medication. **The effect was 4.3 (CI 1.4-7.2) ppb for the outdoor monitor; 4.2 (CI 1.02-7.4) ppb for indoor; 4.5 (CI 1.02-7.9) ppb; and central site monitor 3.8 (CI 1.2- 6.4) ppb. The highest daily PM_{2.5} value during the study (winter 2000-spring 2001) was 46 ug/m³ (NAAQS 24 hour standard is 65 ug/m³). The 24 hour EPA standard for PM_{2.5} is 65 ug/m³.** Our data indicate that the EPA standard does not protect children with asthma from air pollution-associated health effects. (unfortunately we didn't analyze the PM₁₀ data; will do so soon)

Koenig JQ, Mar TF, Allen RW, Jansen K, Lumley T, Sullivan JH, Trenga CA, Larson TV, Liu L-JS. Pulmonary effects of indoor- and outdoor-generated particles in children with asthma. Environ Health Perspectives 113: 499-503, 2005.

Investigators at the University of Washington have developed a model for estimating exposures to particles of outdoor or indoor origin based on paired continuous particle monitors and time activity diaries. We used these estimates to test for associations between changes in the concentration of nitric oxide in exhaled breath (FeNO). Our analysis found estimates of ambient exposures (E_a) associated with an increase in FeNO (5.6 ppb; 95%CI-0.6,11.9, p = 0.08. The estimates of indoor particles (E_i) were not

associated with changes in FeNO (-0.19 ppb; 95% CI 0.3, 0.9, $p = 0.15$). Effects were seen only in children who were not prescribed inhaled corticosteroids.