*Project E.N.S.O.R. News

Volume 11, No. 4 Fall 2000

Outdoor Air Pollution and Asthma

Episodes of acute mortality from air pollution were documented in the 1950s from Donora, Pennsylvania (a city south of Pittsburgh); Meuse Valley, Belgium and London (State of the Art, 1996). As a consequence of these acute episodes, regulations for six "criteria" pollutants [Particulate Matter (PM_{10}) particles <10 microns in diameter, Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), and Lead (Pb)] were implemented and air quality has improved in the last 40 years. However, studies in the 1990s documented adverse health effects from current air pollution levels. This led to the promulgation in 1997 of new and tighter regulations for three of the "criteria" pollutants, nitrogen dioxide, ozone and particulates. These new regulations are currently being contested in court.

Ground-level ozone, or smog, and fine particulates (particulate matter <2.5 microns, $PM_{2.5}$) are the two pollutants which have been associated with adverse effects among asthmatics (State of the Art, 1996; Wilson and Spengler, 1996). The Environmental Protection Agency (EPA) has issued regulations that would lower the levels for particulates and ozone. Over a 10 year phase-in period a new standard for $PM_{2.5}$ would be implemented for an annual standard of 15 $\mu g/m^3$ and a 24-hour standard of 65 $\mu g/m^3$. These finer particulates are felt to be more of a hazard than the large 10 micron particles. Both mortality and morbidity studies have shown adverse outcomes with existing air levels of particulates. Summaries of recent morbidity studies on asthma are shown in Tables I and II. Studies also show increased hospitalizations for pneumonia, COPD, coronary artery disease, congestive heart failure and dysrhythmias and emergency room visits for COPD and all respiratory diseases in relation to increased particulate levels. A summary of the effects shown as a percent change per 10 $\mu g/m^3$ increase in particulates smaller than 10 microns is shown in Table III.

Oxides of nitrogen created by the combustion of fuel react with hydrocarbons in the air and sunlight and are the major source of ground level ozone. The EPA regulation for an 8-hour 0.08 ppm standard for ozone has been set aside by the courts. The decision has been appealed to the Supreme Court by the EPA. An EPA regulation to lower the emission of oxides of nitrogen has also been challenged in the courts. The EPA won in the lower courts but the state of Michigan, along with business entities, is challenging the regulation.

Table I. Summary of Asthma Morbidity Studies of Hospital and Emergency Department Usage

	Location	Reference	Measure	% increase in morbidity per 10 *ug*/m^3 increase in PM_{10} (95% CI)
Hospital Visits	New York City;	Thurston et al. (1992)	SO_4	1.9 (0.4, 3.4)
	Buffalo			2.1 (-0.6, 5.0)
	Toronto, Ontario	Thurston et al. (1993)	$PM_{2.5}$	2.1 (-0.8, 5.1)
	Detroit, MI	Schwartz (1994)	PM_{10}	0.5 (-3.3, 4.4)
	Southern Ontario	Burnett et al. (1995)	SO_4	1.0 (0.4, 1.6)
Emergency Department Visits	Seattle, WA	Schwartz et al. (1993)	PM_{10} (daily mean)	3.4 (0.9, 6.0)

(Modified, Dockery and Pope, 1994)

Table II. Summary of Acute Effects of Particles on Exacerbation of Asthma

Location	Reference	Particulate	Subjects	% increase in asthma per *ug*/m increase $_{10}$ (95% CI)
Utah Valley	Pope et al. (1991)	PM_{10}		11.2 (2.4, 20.7)
use				12.0 (4.7, 19.7)
2 Dutch cities		PM_{10} (daily mean)		2.3 (0.7, 3.8)
2 Dutch cities	Roemer et al. (1993)	$_{10}$ (3-day mean)	School panel	
attacks				
	Ostro et al. (1991)	PM	Asthma panel	11.5 (8.9, 14.3)

(Wilson and Spengler, 1996)

Additionally, several Northeastern states are suing Midwest utility companies to reduce their oxide of nitrogen emissions so as to reduce ozone levels on the East Coast. In 1999, the EPA promulgated regulations that new minivans, sports utility vehicles and light trucks meet the same tailpipe emission standards as cars, beginning in 2004. This new regulation of emissions from vehicles would markedly reduce nitrogen oxide emissions.

Ozone has been shown to decrease lung function, increase airway reactivity, elicit markers of lung inflammation assessed via bronchoalveolar lavage, decrease exercise capacity and increase reactivity to allergens in asthmatics with known sensitivities. Two weeks of pretreatment with steroids has not reduced the adverse effects of ozone (Nightingale et al., 2000). Ozone levels typically peak in the summer. Table IV shows the estimated adverse health effects of current ozone levels in Michigan and selected cities in Michigan.

There continues to be a large research effort underway to study the effects of air pollution. One priority has been to elucidate the mechanism(s) for the increased morbidity and mortality

Table III. Approximate Range of Estimated Effects Measure as Percent Change in Health Endpoint per 10 *ug*/m^3 Increase in PM_{10} for the Different Basic Study Designs

	--------Acute Exposure----------		---------Chronic Exposure----------	
Health Endpoints	**Population-Based**	**Cohort-Based**	**Population-Based**	**Cohort- or Sample-Based**
Mortality	Total: 0.5-1.5 Resp: 1.5-4.0 Cardio: 0.5-2.0		Total: 0-5	Total: 3-9 Cardiopulmonary: 5-9 Lung cancer: 0-9
Respiratory Health Care	Hospit. Admit: 0.5-4.0 Emergency Visits: 0.5-3.5			
Decrease in Lung Function		FEV: 0.05-0.35 PEF: 0.04-0.25		Lung function: 0-2
Respiratory Symptoms, Disease		Lower: 0-15 Upper: 0-7 Cough: 0-25 Asthmatic attacks: 1-12		Emphysema, Chronic bronchitis or cough: 10-25
Restricted Activity	Grade school absences: 1.0-4.0	Restricted activity days: 1.0-5.0		

(Wilson and Spengler, 1996)

that have been documented, particularly in reference to fine particulates (<2.5 microns).

Improvement of asthmatics' health from the adverse effects of air pollution will depend on new emission controls which will in turn depend on the outcome of multiple court decisions. In the absence of an overall improvement in air quality, individual high risk patients are advised to reduce their time spent outdoors, particularly doing exercise or other strenuous activity during ozone alerts. Patients can determine the ozone level by accessing the following web site: www.deq.state.mi.us/aqd, or calling the following number: (517) 373-7023 from 8am-5pm, Monday through Friday. Ozone levels in different areas of the state are updated hourly.

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Table IV. Ozone-Related Adverse Health Effects in Michigan and Selected Michigan Cities, 1997

	Michigan	Detroit	Grand Rapids	Kalamazoo	Muskegon
Hospital Admissions					
Respiratory	2,100	930	160	47	46
Cardiovascular	670	290	56	16	14
Emergency Department Visits					
Respiratory	6,300	2,790	480	142	137
Asthma Only	660	310	53	15	13
Symptoms					
Minor	3,600,000	1,800,000	290,000	93,000	68,000
Shortness of Breath	20,000	14,000	810	350	400
Asthma Attacks	280,000	130,000	22,000	6,700	5,300

(Clean Air Task Force, 1999)

The Project SENSOR News is published quarterly by Michigan State University-College of Human Medicine with funding from the Michigan Department of Consumer and Industry Services and is available at no cost. Suggestions and comments are welcome.

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The Symposium will highlight new research related to silica's role in causing silicosis, TB, lung cancer and other workplace malignancies. The program will also focus on regulatory policies, risk assessments, and methods for prevention of all silica-related diseases.

For more information or to preregister, contact the Scuola Superiore di Oncologia e Scienze Biomediche at:

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In this issue: Outdoor Air Quality and Asthma

*PS ***Remember to report all cases of occupational disease!***

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