

AN EPIDEMIOLOGY PUBLICATION OF THE OREGON DEPARTMENT OF HUMAN SERVICES

## ASTHMA AND AIR POLLUTION: IS THERE A LINK?

**A**STHMA IS A common, chronic disease that affects nearly 10% of adults and 7% of children in Oregon.\* Oregon's adult asthma prevalence is among the highest in the country, but it is not clear why. Strong evidence supports the role of poor indoor air quality (e.g., tobacco smoke, animal dander, dust mites, mold) as well as certain elements of outdoor air quality (e.g., pollen, cold air) in causing asthma exacerbations. However, the role of outdoor air pollution in triggering asthma attacks is less clear. In this issue we review data on the role of air pollution in causing and exacerbating asthma, particularly in children, and describe efforts in Oregon to track links between asthma and the environment.

### THE DATA

Outdoor air pollution from industrialization and urbanization has long been known to cause respiratory problems.<sup>1</sup> In 2002, a panel of medical experts estimated that 10 to 35% of childhood asthma episodes resulted from exposure to outdoor, non-biologic pollutants.<sup>2</sup> Epidemiologic studies have linked air pollutants, including particulate matter, ozone, nitrogen dioxide, and carbon monoxide, to exacerbation of acute asthma.

Many of these pollutants are from vehicle exhaust, with diesel of particular concern. A Seattle area study of air

pollution's effects on children with asthma found symptoms were associated with carbon monoxide and particulate matter.<sup>3</sup> A Dutch study of 877 students reported a significant, inverse relationship between lung function and living within 300 and 1000 meters of a motorway with more than 10,000 trucks per weekday.<sup>4</sup>

In addition to exacerbating existing asthma, some air pollutants are suspected of causing asthma. Diesel exhaust is composed of ultrafine particles and a mixture of toxic chemicals and respiratory irritants. In addition to being an irritant at high levels, at low levels diesel exhaust promotes release of specific cytokines, chemokines, immunoglobulins and oxidants in the upper and lower airway, and may promote expression of the T-helper cell type 2 associated with developing asthma.<sup>5</sup>

Ozone is also associated with both causing and exacerbating asthma. A prospective cohort study in 12 California communities followed 3,535 children for up to five years. Children engaged in three or more team sports in high-ozone towns in the previous year were over three times more likely to develop asthma than those in low-ozone towns.<sup>6</sup> Similarly, lower ozone levels seem correlated with fewer asthma events. In a natural experiment created by the lower-than-usual traffic density and ozone concentrations during the 1996 Summer Olympic Games in Atlanta, GA, the number of acute asthma events among children diminished.<sup>7</sup> Acute care sought for other reasons during the same time period remained virtually unchanged.

Several studies have examined how environmental exposures might compound other risk factors for asthma, including genetics, infections, and allergens. A study in Taiwan found a

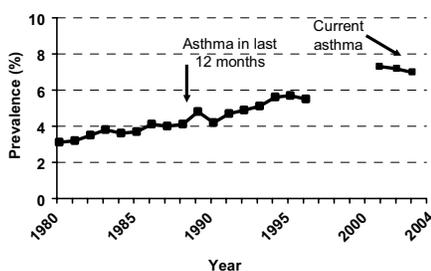
strong gene-environmental interaction between outdoor air pollution and GSTP1-105 genotypes on childhood asthma.<sup>8</sup> A UK study of 114 asthmatic children found that those with higher exposures to nitrogen dioxide in the week before contracting most viral infections had more severe asthma exacerbations.<sup>9</sup> In a California study, particulate pollutants were positively associated with the risk of bronchitis among children with asthma, but not those without.<sup>10</sup> Finally, air pollutants seem to increase sensitivity to common allergens: in one study asthma symptoms were exacerbated more by pollen in the presence of common levels of air pollutants than an additive effect would predict.<sup>11</sup> Diesel exhaust appears to have a greater respiratory effect in conjunction with allergens than alone,<sup>9</sup> and may even promote new allergic sensitization.

### OREGON'S AIR QUALITY

Oregon has relatively good air quality as measured by current norms: the state now consistently meets national ambient air quality standards.<sup>12</sup> In spite of this, 17 of the 19 cities for which Oregon's Department of Environmental Quality (DEQ) calculates an Air Quality Index (AQI) had at least one day per year classified as "Unhealthy for Sensitive Groups." Two others (Klamath Falls and Oakridge) each had more than seven days. At this AQI level, the EPA recommends that active children older adults and people with heart and lung disease, should reduce prolonged or heavy exertion if particulates are high.

Although relatively infrequent, high pollution days may explain why, in 2004, 34% of Oregon adults with current asthma reported that outdoor air pollution like smog, automobile exhaust or chemicals had affected their health in the past 12 months (versus 11% of those who did not have asthma).\*

Asthma Prevalence in the US  
1980-1996, 2001-2003



\* BRFSS data, 2004



If you need this material in an alternate format, call us at 503/731-4024.

IF YOU WOULD PREFER to have your CD Summary delivered by e-mail, zap your request to [cd.summary@state.or.us](mailto:cd.summary@state.or.us). Please include your full name and mailing address (not just your e-mail address), so that we can effectively purge you from our print mailing list, thus saving trees, taxpayer dollars, postal worker injuries, etc.

epidemiologic studies have linked exacerbations of asthma with outdoor air pollution levels below current air quality standards.<sup>13</sup>

### LINKING ASTHMA AND THE ENVIRONMENT IN OREGON

While many associations between asthma and outdoor air pollutants are known, much remains to be learned. Oregon is one of 20 states working to bridge the environment-health data gap, as part of the Centers for Disease Control and Prevention Environmental Public Health Tracking (EPHT) program. In Oregon, we are working to link air pollution data from the DEQ with asthma-related health data, both geographically and temporally. For more information about Oregon EPHT or to help set the environmental public health agenda in Oregon, please go to <http://www.healthoregon.org/epht>.

### INFORMATION FOR PROVIDERS

While substantial evidence exists that some components of air pollution worsen asthma symptoms, providers have less ability to influence air pollution in the short term than they do patients' behavior.<sup>†</sup> Unraveling the complicated question of how little air pollution is little enough, and then reducing air pollution to that level is clearly a long-term solution. In the interim however, studies have shown that inhaled corticosteroids may protect individuals susceptible to proinflammatory effects of air pollution.<sup>14</sup> An NIH expert panel recommends any patient (including a child) who displays clinical

features of persistent asthma before treatment should be taking inhaled corticosteroids on a daily basis.<sup>15</sup> In addition, for patients with moderate asthma who do not achieve clinical control on low-to-medium doses of inhaled corticosteroids, the best adjunct therapy is a long-acting inhaled beta<sub>2</sub>-agonist. Providers also have an important role in helping patients recognize and reduce or manage triggers that are under the patient's direct control: smoking or being exposed secondhand smoke, cold air, animal dander, dust mites, and so on.

Some resources to assist your patients with asthma include:

- The Oregon Asthma Resource Bank contains education handouts and provider tools: <http://www.healthoregon.org/asthma/resourcebank>.
- The U.S. EPA offers a fact sheet on asthma and outdoor air pollution: [http://www.airnow.gov/index.cfm?action=health\\_prof.index](http://www.airnow.gov/index.cfm?action=health_prof.index)
- The Oregon Department of Environmental Quality provides on-line and up-to-date air quality information: <http://www.deq.state.or.us/aq/api>

### REFERENCES

1. Schwartz J. Air pollution and children's health. *Pediatrics* 2004;113:1037-42.
2. Landrigan PJ, Schechter CB, Lipton JM et al. Environmental pollutants and disease in American children: estimates of morbidity, mortality and costs for lead poisoning, asthma, cancer and developmental disabilities. *Environ Health Perspect* 2002;110:721-8.
3. 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;108:1209-14.
4. Brunekreef B, Janssen NA, de Hartog J et al. Air Pollution from truck traffic and lung function in children living near motorways. *Epidemiology* 1997;8:298-303.

5. Pandya RJ, Solomon G, Kinner A and Balmes JR. Diesel exhaust and asthma: hypotheses and molecular mechanisms of action. *Environ Health Perspect* 2002;110(Suppl 1):103-12.
6. McConnell R, Berhane K, Gilliland FD et al. Asthma in exercising children exposed to ozone: a cohort study. *Lancet* 2002; 359:386-91.
7. Friedman MS, Powell KE, Hutwagner L et al. Impact of changes in transportation and commuting behaviors during the 1996 Summer Olympic Games in Atlanta on air quality and childhood asthma. *JAMA* 2001; 285:897-905.
8. Lee YL, Lin YC, Lee YC et al. Glutathione S-transferase P1 gene polymorphism and air pollution as interactive risk factors for childhood asthma. *Clin Exp Allergy* 2004;34:1707-13.
9. Chauhan AJ, Inskip HM, Linaker CH et al. Personal exposure to nitrogen dioxide and the severity of virus-induced asthma in children. *Lancet* 2003;361:1939-44.
10. McConnell R, Berhane K, Gilliland FD et al. Air Pollution and bronchitic symptoms in Southern California children with asthma. *Environ Health Perspect* 1999;107:757-60.
11. Tatum AG and Shapiro GG. The effects of outdoor air pollution and tobacco smoke on asthma. *Immunol Allergy Clin NA* 2005;25:15-30.
12. DEQ. 2004 Oregon Air Quality Annual Report. At: <http://www.deq.state.or.us/aq/data/amrpt.htm>
13. Peden DB. The epidemiology and genetics of asthma risk associated with air pollution. *J Allergy Clin Immunol* 2005;115:213-9.
14. Delfino RJ, Zeiger RS, Seltzer JM et al. Association of asthma symptoms with peak particulate air pollution and effect modification by anti-inflammatory medication use. *Environ Health Perspect* 2002;110:A607-17.
15. National Asthma Education and Prevention Program, Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma—Update on Selected Topics 2002. National Institutes of Health pub. no. 02-5075. Bethesda, MD, 2002.

### Erratum

In the July 26, 2005 (#5415) issue there was an error on the table which showed risk factors for campylobacteriosis. The odds ratio for contact with farm animals for persons age 2-11 years should be 21.0, not 1.0. No small difference, that. Don't kiss the livestock.

† Though providers may often feel otherwise!