SUMMARY OF NEW SCIENTIFIC LITERATURE DOCUMENTING ADVERSE HEALTH EFFECTS IN PEOPLE EXPOSED TO HIGH-TRAFFIC ROADWAYS

John Balbus, MD, MPH
Environmental Defense
May 24, 2007

Introduction

Studies published in the scientific literature since March 2006 strengthen the evidence for harm to health from traffic-associated air pollution and extend our understanding of the nature of roadside exposures and the special susceptibility of children, the elderly, and those with underlying diseases. These studies indicate that exposure to the mixture of toxic pollutants coming from motor vehicles, even in regions that are considered to be in attainment of federal air quality standards, can worsen asthma, impair lung development, and contribute to heart disease and premature death . These effects are especially apparent in children, who have heightened susceptibility to traffic-associated air pollution because of their smaller size, increased respiratory rates, actively developing lungs, and greater and more active time spent outdoors. The studies indicate a zone that extends from approximately 500 to 1500 feet around major roads that contains elevated levels of traffic-related pollutants and describe increased risks of adverse health effects for people living or going to school inside this zone. While not all studies explicitly link actual traffic counts to exposure levels, several studies below associate elevated exposures with traffic counts as low as 10,000 cars per day. This report summarizes recent publications and other information relevant to determining the public health impact of population exposures to traffic-related air pollution.

As indicated below, the EPA notes over 1000 chemicals in the mixture of air pollutants emitted by motor vehicles, of which four are criteria air pollutants and 93 are toxic chemicals appearing in EPA's IRIS database due to carcinogenic or other well-documented health effects. While many of the studies cited below measure specific air pollutants as indicators of traffic-related pollutants, the majority of the studies associate adverse health effects with proximity to traffic-related sources of air pollution and do not implicate specific air pollutants as the sole or even dominant contributor to adverse health effects. In fact, because of similarities in toxic effects and toxic mechanisms, it is likely that many of the traffic-related pollutants known to be harmful, as evidenced by their inclusion in the IRIS database, jointly contribute to the observed adverse health effects.

Exposure-related studies

A recently published meta-analysis from the Harvard School of Public Health reviewed studies of pollution concentrations near roadways. The authors conclude that the spatial extent of significantly elevated levels depends on the type of air pollution, with ultrafine particle counts elevated as far out as 300 meters, elemental carbon or fine particulate mass elevated as far out as 400 meters, and nitrogen dioxide elevated as far out as 500 meters.[1]

In Amsterdam, researchers have also assessed outdoor and personal exposure to traffic-related air pollution among children living on streets with varying degrees of traffic intensity. The authors of a 2006 study monitored children aged 9-12 years who were exposed to soot and NOx and measured indoor/outdoor NOx levels at their homes and schools. Results demonstrate that children living near busy roads had 35 percent higher personal exposure to soot than those who lived at an urban background location, even when they attended schools away from busy roads. In this study, a

[1] Zhou Y, Levy JI. Factors influencing the spatial extent of mobile source air pollution impacts: A meta-analysis. BMC Public Health, in press.

busy road was defined as one having average daily traffic of more than 10,000 cars. The study supports using "living near a busy road" as a measure of exposure in epidemiological studies on the effects of traffic-related pollution in children.[2]

In 2006, the EPA released an updated master list of more than one thousand chemicals emitted by mobile sources.[3] This list includes, in Table 4, ninety-three chemicals emitted by mobile sources that are also in EPA's IRIS database and are well-recognized to have serious health effects from environmental levels of exposure, including cancer, respiratory irritation, and neurotoxicity. The large number of chemicals on this list underscores the complexity of the mixture of air pollutants to which people near roadways are exposed and the many opportunities for synergistic effects of similarly acting chemicals.

Studies of health effects in children

Several studies published recently have demonstrated serious effects of motor vehicle emissions on children living near roadways. A 2007 study published in the *European Respiratory Journal* looked at the relationship between traffic-associated air pollutants and the development of asthma, allergy, and infections in children during the first four years of life. The authors followed 4,000 children in the Netherlands, analyzing data on self-reported wheeze, dry-night-time cough, ear/nose/throat infections, skin rash and physician diagnoses of asthma, bronchitis, influenza and eczema. They found a positive association between traffic-related pollution and respiratory infections as well as certain measures of asthma and allergy.[4]

A 2007 *Lancet* study from California documented that both regional elevations of air pollution and local exposure to freeway traffic have harmful, independent effects on children's lung development. The authors followed 3,677 children living in 12 southern California communities with varying air quality over a period of eight years, recording annual lung-function measurements and identifying indicators of residential exposure to freeway traffic. Results from eight years of followup indicate that children living within 500 meters of freeways have substantial deficits in lung growth and development and pulmonary function compared with those living at least 1500 meters from freeways. [5] Subsequent testimony from the lead author on this study indicates that the effects were seen in association with exposure to pollutants from freeways with average daily traffic levels as low as 45,000 vehicles.[6]

A third study, published in 2006, examined the relationship between local traffic-related exposure and asthma and wheeze in children in southern California, ages 5-7 years. The authors assessed residential exposure by proximity to a major road and modeled exposure to local traffic-related pollutants. They found an association between living within 75 meters of a major road and increased risk of lifetime asthma, prevalent asthma, and wheeze, and determined that the effect of

---

[2] Van Roosbroeck et al. Long-term personal exposure to traffic-related air pollution among school children: a validation study. *Science of the Total Environment*, September 2006, 338(2-3):565-573.

[3] US EPA. Office of Air and Radiation. Expanding and Updating the Master List of Compounds Emitted by Mobile Sources - Phase III. Final Report. EPA420-R-06-005

[4] Brauer M et al. Air pollution and development of asthma, allergy and infections in a birth cohort. *European Respiratory Journal* 2007, 29(5): 879-888.

[5] Gauderman WJ et al. Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study. *The Lancet*, February 2007, 369(9561): 571-577.

[6] Gauderman WJ, Written responses to questions posed by members of the Colorado legislature, submitted to Colorado House Education Committee hearing, March 5, 2007. Text appended to this report.

residential proximity to roadways was more pronounced in girls. The authors conclude that living near a major road is associated with asthma.[7]

A study in 2007 estimated long-term exposure to traffic-related air pollutants and assessed adverse health effects, collecting particulate matter measurements at 40 sites in Munich, Germany. The authors found that estimated $PM_{2.5}$ exposures, $PM_{2.5}$ absorbance, and NO_2 were 12.8 $\mu g/m^3$, $1.7x10^{-5}$ m^{-1}, and 35.3 $\mu g/m^3$ respectively. There were significant associations between $PM_{2.5}$ and symptoms including sneezing, runny/stuffed nose during the first year of life, as well as between NO_2 and dry cough at night during the first year of life. Living within 50 meters of busy roads increased the risk of wheezing and asthmatic/spastic/obstructive bronchitis. In this study, a "busy" road was defined as one with traffic greater than 3000 automobiles per day.[8]

Lastly, a UCLA Health Policy Research Brief described a study from Southern California that found that children with asthma, especially in low-income groups, had three-fold higher rates of emergency room visits and more severe asthma exacerbations when exposed to high traffic density compared to low traffic density. Traffic density was estimated by multiplying average daily traffic counts within a 500 foot buffer zone around the residence by the miles of road segments within that zone, then dividing by the area. Effects were seen at the medium traffic density level (20,000-200,000 vehicle miles traveled per square mile) as well as the high traffic density level. The authors conclude that "further reduction of traffic related air pollution is needed to reduce the burden of asthma, especially among low-income and racial/ethnic minority groups."[9]

Studies in other susceptible subpopulations

Other recent studies have examined the effect of traffic-related air pollution on specific populations aside from children, such as women or the elderly. One 2006 study published in the *New England Journal of Medicine* followed 65,893 postmenopausal women without history of cardiovascular disease in 36 U.S. cities over the course of six years. The authors found an association between long-term exposure to fine particulate air pollution and the incidence of cardiovascular disease and death among this population.[10] While this study did not specifically measure traffic-related particulate exposures, it complements previous studies of traffic-related particulate matter effects on the heart and strengthens the findings of an association in women.

Another 2006 study looking at the association between hospital admissions for respiratory disease among the elderly and traffic intensity near the homes of the elderly in Montreal found that increased odds of being hospitalized for a respiratory versus control diagnosis were associated with higher road traffic levels near patients' homes, even after adjusting for the appraised value of those homes. The study's findings suggest that road traffic intensity might have an effect on the respiratory health of elderly residents, and this association is not just a reflection of socioeconomic status. Road traffic intensity was measured as the amount of estimated traffic during the 3 hour peak. The cutoof

---

[7] McConnell et al. Traffic, susceptibility, and childhood asthma. *Environmental Health Perspectives*, May 2006, 114(5):766-772.

[8] Morgenstern et al. Respiratory health and individual estimated exposure to traffic-related air pollutants in a cohort of young children. *Occupational and Environmental Medicine*, January 2007, 64(1): 8-16.

[9] Meng YY, Rull RP, Wilhelm M, Ritz B, English P, Yu H, Nathan S, Kuruvilla M and Brown ER. Living Near Heavy Traffic Increases Asthma Severity. Los Angeles: UCLA Center for Health Policy Research, 2006.

[10] Miller KA et al. Long-term exposure to air pollution and incidence of cardiovascular events in women. *New England Journal of Medicine*, February 2007, 356(5):447-458.

between medium and high intensity was 3160 vehicles per 3 hour peak. Effects were seen with both medium and high intensity traffic exposures.[11]

Conclusions

In summary, new scientific studies published since 2006 provide more robust evidence for serious health effects from exposure to traffic-related air pollution. The studies indicate that within a 500-1500 foot zone around major roadways, people are exposed to elevated levels of a complex mixture of air pollutants, many of which are known to cause significant health risks. The use of indicator pollutants to assess exposures is necessary but should not be interpreted as demonstrating that observed health effects are related only to exposures to the indicators. It is biologically plausible that exposure to the complex mixture of traffic-related pollution is more harmful than exposure to only one or two of the primary constituents of the mixture. The studies also suggest that health risks are elevated at traffic counts in the thousands and low ten thousands of vehicles per day. Strengths of the new studies include the fact that several involve following cohorts of children over time, which provides more certainty in the diagnosis of asthma and other conditions, and improved exposure assessments.[12] Taken together, these studies strongly suggest that complying with regional federal air standards under the Clean Air Act is not sufficient to protect public health. Federal agencies must provide greater protection for populations exposed to traffic-related pollution from major roadways.

[11] Smargiassi A et al. Traffic intensity, dwelling value, and hospital admissions for respiratory disease among the elderly in Montreal (Canada): a case-control analysis. *Journal of Epidemiology and Community Health*, 2006, 60:507-512.

[12] See, for example, Jerrett M. Does traffic-related air pollution contribute to respiratory disease formation in children? Eur Respir J. 2007 May;29(5):825-6.