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## Thirty Nine Studies Link Highway Pollution to Health Risks July 6, 2005 update

Sprawling communities have caused people to drive further distances, which in turn has caused more air pollution. The average American driver spends 443 hours per year (equivalent of 55 eight-hour workdays) behind the wheel of an automobile. EPA's National Air Toxics Assessment shows that a significant amount of cancer-causing pollutants like benzene come from trucks, cars, and other "mobile sources." See study number 38. According to the American Cancer Society's annual statistical report, cancer is the now the number one killer of Americans younger than 85 followed by heart attacks.

The following 39 peer-reviewed and/or published medical studies conclude that there is a link between traffic-related air pollution and health risks such as asthma, cancer, heart attacks, premature and low birth weight babies, and generally higher risk of death.

The studies also show there are solutions, like increasing public transportation to reduce asthma attacks. These studies show the need to consider health risks when expanding highways in urban areas near homes and schools, especially when roads have more than 50,000 vehicles per day.

For more information, contact Brett Hulseley at (608) 257-4994 or [brett.hulseley@sierraclub.org](mailto:brett.hulseley@sierraclub.org). For a copy of the Highway Health Hazard, report go to [www.sierraclub.org/sprawl](http://www.sierraclub.org/sprawl). We have noted the new studies that were not included in HHH with an \*. We have also broken the studies down into solutions, cancer, asthma and other health risks.

### Solutions

1. This CDC study shows that increasing public transportation along with other traffic control measures during the 1996 Atlanta Olympics reduced acute asthma attacks by up to 44% in children and traffic by 22%, *Journal of the American Medical Association (JAMA, 2000)*

### Cancer Risks

2. A Denver study shows children living near busy roads are 6-8 times more likely to develop leukemia and other forms of cancer, *Journal of Air and Waste Management. (2000)*
3. Italian study finds same association between traffic and curbside concentrations of cancer causing benzene as Denver study, *International Journal of Cancer. (2004)*

4. This JAMA study shows that fine particulate matter in diesel exhaust linked lung cancer, heart attacks, and all cause death. (2002)
5. Johns Hopkins study shows association between traffic and curbside concentrations of cancer-causing benzene, 1,3-butadiene, and particulate matter, *Journal of Air & Waste Management*. (2003)
6. Study shows cancer causing soot particulate pollution 25 times greater near highway, *Atmospheric Environment*. (2002)
7. South Coast Air Quality Management District study shows that 90% of cancer risk from toxic air pollution comes from trucks and cars. (1999)
8. Study links high traffic density with increased blood levels of benzene in children, *Zentralblatt für Hygiene und Umweltmedizin*. (1989)
9. British study shows cancer risk is higher near highways, power plants and airports, *Journal of Epidemiology and Community Health*. (1997)
10. Bay Area Air Contaminant Control Program found inhalation cancer risk from diesel pollution 550 times safe levels. (2004)

#### Asthma

11. Study shows that heavy truck traffic causes increased risk of asthma for children, *Environmental Research*. (2002)
12. Study links air pollution with reduced lung function in children, *Epidemiology*. (1997)
13. Dutch study associated higher levels of traffic-related air pollution with respiratory symptoms in two-year olds, *American Journal of Respiratory and Critical Care Medicine*. (2002)
14. Study determined a connection between asthma symptoms and truck pollution, *Epidemiology*. (1996)
15. British study showed that living near major roads increased the risk of hospital admission from asthma for children, *Archives of Environmental Health*. (1994)
16. Study shows asthma is more common for children living near highways, *American Journal of Respiratory and Critical Care Medicine*. (2001)
17. British study links nitrogen dioxide pollution from vehicles with asthma attacks, *Lancet*. (2003)
18. Study shows that school's proximity to highway associated with asthma prevalence, *Archives of Environmental Health*. (1997)
19. Study shows a link between diesel exhaust and asthma, *Environmental Health Perspectives*. (2002)
20. New England study shows low levels of air pollution cause asthma attack, *JAMA*. (2003)

21. California EPA Oakland study shows associations between respiratory symptoms in children and traffic-related pollutants. (2004)\*
22. Harvard Medical School study shows the combination of air pollutants, aeroallergens, heat waves, and unhealthy air masses – increasingly associated with a changing climate – causes damage to the respiratory systems, particularly for growing children. (2004)\*
23. Southern California study finds current levels of air pollution have chronic, adverse effects on lung development in children age 10 to 18, New England Journal of Medicine. (2004)\*

### **Other Health Impacts**

24. California Air Resources Board study finds several chronic respiratory effects caused by ambient air pollutants in southern California. (2004)\*
25. Study shows association between exposure to traffic and the onset of a heart attack within one hour after driving, New England Journal of Medicine. (2004)\*
26. Los Angeles area study links traffic pollution with risk of premature birth and low birth weight for infants, Environmental Health Perspectives. (2002)
27. Report shows in-car air pollution more polluted than outside air in Southern California, International Center for Technology Assessment. (2000)
28. North Carolina study shows that healthy young state troopers have in-vehicle exposure to PM<sub>2.5</sub> that may cause inflammation, coagulation, and cardiac rhythm, American Journal of Respiratory and Critical Care Medicine. (2008)
29. West Oakland Diesel Truck emissions cause high pollution levels inside homes, Pacific Institute. (2003)
30. Danish study found that schizophrenia risk is increased by air pollution from traffic, Schizophrenia Research. (2004)\*
31. British study found brain diseases such as Alzheimer's have increased in five western countries since 1970's, evidence that air pollution and environmental factors are the cause, Journal of Public Health. (2004)\*
32. German study shows that five times more deaths due to air pollution than traffic accidents, Gesundheitswesen. (2000)\*
33. This Canadian study found traffic air pollution shortens lives by 2.5 years and increased death risk by 18%, American Journal of Epidemiology. (2004)
34. Dutch study associates busy roads with shorter life span in nearby residents, Lancet. (2002)

## New Studies

35. America's pediatricians warn of highway health hazards to children and others, *Pediatrics*. (2004)\*
36. Air pollution probable cause of most childhood cancers according to a British study, *Journal of Epidemiology and Community Health*. (2005)
37. New Study of New York City Residents Shows That Newborns are More Susceptible to DNA Damage from Pollution than Their Mothers, *Environmental Health Perspectives*. (2004)\*
38. EPA's National Air Toxics Assessment shows that the majority of cancer-causing pollutants like benzene and 1,3 Butadiene come from onroad mobile sources like trucks, SUVs and cars. (2002)\*
39. Air pollution exposure from cars is worst of five different modes of transportation according to an Australian study. (2004)\*

## Highway Health Study Summaries

### **1. Increasing Public Transportation and Cutting Traffic Reduces Asthma Attacks**

This 2001 *Journal of the American Medical Association* study by Centers for Disease Control and Prevention researchers found that increasing public transportation along with other traffic control measures during the 1996 Atlanta Olympics reduced acute asthma attacks by up to 44% in children, reduced ozone concentrations by 28%, and morning peak traffic by 22.5%. These data provide support for efforts to reduce air pollution and improve health via reductions in motor vehicle traffic.

Friedman, Michael; Kenneth Powell MD; Lori Hutwagner; Leroy Graham; Gerald Teague. "Impact of Changes in Transportation and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma." *Journal of the American Medical Association*, 2001; 285:897-905. Contact: Michael S. Friedman, Center for Disease Control and Prevention, email: [mff7@cdc.gov](mailto:mff7@cdc.gov).

### **2. Children Living Near Busy Roads More Likely to Develop Leukemia, Cancer**

A 2000 Denver study showed that children living within 250 yards of streets or highways with 20,000 vehicles per day are six times more likely to develop all types of cancer and eight times more likely to get leukemia. The study looked at associations between traffic density, power lines, and all childhood cancers with measurements obtained in 1979 and 1990. It found a weak association from power lines, but a strong association with highways. It suggested that Volatile Organic Compound (VOC) pollution from the roadway may be the cancer promoter causing the problem.

Robert L. Pearson, Howard Wachtel, and Kristie Ebie. "Distance-weighted traffic density in proximity to a home is a risk factor for leukemia and other childhood cancers." *Journal of Air and Waste Management Association* 50:175-180. 2000.

Contact: Professor Howard Wachtel, Department of Electrical Engineering, University of Colorado. Phone: (303) 492-7713, e-mail: [wachtel@colorado.edu](mailto:wachtel@colorado.edu).

### **3. Road Traffic Contributes to the Origin of Childhood Leukemia**

A 2004 Italian study found that Childhood Leukemia is partially caused by roadside emissions in the Province of Varese. The authors conducted a population-based, case-control study in the Province of Varese, northern Italy, which was covered by a population-based cancer registry. Their study found that the risk of childhood leukemia was almost four times higher for heavily exposed children compared to children whose homes were not exposed to road traffic emissions of benzene. Children either inhale Benzene as a gas or particulate matter, which has absorbed benzene. Their model included traffic density divided into two groups: one greater and one less than 10,000 vehicles per day, distance, and weather conditions to estimate benzene concentration. The researcher's data suggests that motor vehicle traffic emissions are involved in the origin of childhood leukemia.

Crosignani P; Tittarelli A; Borgini A; Codazzi T; Rovelli A; Porro E; Contiero P; Bianchi N; Tagliabue G; Fissi R; Rossitto F; Berrino F. "Childhood Leukemia and Road Traffic: A Population-Based Case- Control Study." *International Journal of Cancer*, 2004, V108, N4 (FEB 10), P 596-599 2004-02-10.

### **4. Soot Particulate Matter Linked to Lung Cancer, Cardiopulmonary Mortality**

A Journal of the American Medical Association study found that day-to-day exposure to soot or fine particulate matter, a major component of diesel exhaust increased the risk of various adverse health effects. More specifically the study shows that each 10-microgram/meter elevation in soot fine particulate air pollution leads to an 8% increased risk of lung cancer deaths, a 6% increased risk of cardiopulmonary mortality (heart attacks) and 4% increased risk of death from general causes.

Pope, Clive Arden III; Richard P. Burnett, et al. "Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution." *Journal of the American Medical Association*, March 6 2002-Vol. 287, No. 92. Contact: Clive Arden Pope, Brigham Young University. Phone: (801) 422-2157, e-mail: [cap3@email.byu.edu](mailto:cap3@email.byu.edu).

### **5. Traffic Increased Cancer-Causing Pollution Levels at Tollbooth**

A 2003 study shows that there is a "significant association between vehicle traffic and curbside concentrations of the carcinogens benzene, 1, 3 - butadiene, and particle-bound polycyclic aromatic hydrocarbons (PAH)." The measurements, which were taken at the Baltimore Harbor Tunnel tollbooth, show that much of the daily pollutant variability was explained by traffic volume, class, and meteorology. The study provides a model for estimating curbside pollution levels associated with traffic that may be relevant to exposures in the urban environment.

Sapkota, Amir and Buckley, Timothy J. "The Mobile Source Effect on Curbside 1,3 Butadiene, Benzene, and Particle-Bound Polycyclic Aromatic Hydrocarbons Assessed at a Tollbooth." *Journal of Air & Waste Management*. 53:7400748. Contact: Dr. Timothy J.

## **6. People Who Live Near Highways Exposed to 25 Times More Soot Particulate Pollution**

Studies conducted in the vicinity of Interstates 405 and 710 in Southern California found that the number of ultra-fine soot particles in the air was approximately 25 times more concentrated near the highways and that pollution levels gradually decrease back to normal (background) levels around 300 meters, or nearly 330 yards, downwind from the highway. The researchers note that motor vehicles are the most significant source of ultra-fine particles, which have been linked to increases in mortality and morbidity. Recent research concludes that ultra-fine soot particles are more toxic than larger particles with the same chemical composition. More over, the researchers found considerably higher concentrations of carbon monoxide pollution near the highways.

Zhu, Yi fang; William C. Hinds; Kim Seongheon; Si Shen; Constantinos Sioutas. "Concentration and size distribution of ultra fine particles near a major highway." *Journal of the Air and Waste Management Association*. September 2002. And, "Study of ultra-fine particles near a major highway with heavy-duty diesel traffic." *Atmospheric Environment*. 36,4323-4335. 2002.

## **7. Motor Vehicle Pollution Dominates Cancer Risk**

The most comprehensive study of urban toxic air pollution ever undertaken shows that motor vehicles and other mobile sources of air pollution are the predominant source of cancer-causing air pollutants in Southern California. Overall, the study showed that motor vehicles and other mobile sources accounted for about 90% of the cancer risk from toxic air pollution, most of which is from diesel soot (70% of the cancer risk). Industries and other stationary sources accounted for the remaining 10%. The study showed that the highest risk is in urban areas where there is heavy traffic and high concentrations of population and industry.

South Coast Air Quality Management District. "Multiple Air Toxics Exposure Study-II." March 2000, [www.aqmd.gov/matesiidf/matestoc.htm](http://www.aqmd.gov/matesiidf/matestoc.htm). Contact: Steve Barbosa. Phone: (909) 396-2171, email: [sbarbosa@aqmd.gov](mailto:sbarbosa@aqmd.gov) or Barbara Weller, California Air Resources Board. Phone: (916) 324-4816.

## **8. Exposure to Cancer-Causing Benzene Higher for Children Living Near High Traffic Areas**

German researchers compared 48 children who lived in a central urban area with high traffic density, with 72 children who lived in a small city with low traffic density. They found that the blood levels of benzene in children who lived in the high-traffic density area were 71% higher than those of children who lived in the low-traffic-density area. Blood levels of toluene and carboxyhemoglobin (formed after breathing carbon monoxide) were also significantly elevated (56% and 33% higher, respectively) among children regularly exposed to vehicle pollution. Aplastic anemia and leukemia were associated with excessive exposure to benzene.

Jermann E., H. Hajimiragha, A. Brockhaus, I. Freier, U. Ewers, A. Roscovanu. "Exposure of children to benzene and other motor vehicle emissions." *Zentralblatt für Hygiene und Umweltmedizin* 189:50-61,1989.

### **9. Cancer Risk Higher Near Major Sources of Air Pollution, Including Highways**

A 1997 English study found a cancer corridor within three miles of highways, airports, power plants, and other major polluters. The study examined children who died of leukemia or other cancers from the years 1953-1980, where they were born and where they died. It found that the greatest danger lies a few hundred yards from the highway or pollution facility and decreases as you get further away from the facility.

Knox, EG and AE Gilman. "Hazard proximities of childhood cancers in Great Britain from 1953-1980." *Journal of Epidemiology and Community Health*.51:151-159. 22. 1997.

### **10. Bay Area Air Contaminant Control Program Finds Inhalation Cancer Risk From Diesel Emissions\***

The Bay Area Air District, in a report just being issued, has estimated the inhalation cancer risk in the Bay as 173 per million from lifetime exposure (up from 167 in the previous report) from a limited set of toxics. They also estimated the risk at 440 per million from diesel particulates. The total risk from motor vehicles would be about 555 per million or 1 in 1800. The pollutants from diesel, such as 1,3-butadiene and benzene, may contribute to a cancer risk that is greater than all of the other measured toxic air contaminants.

Bay Area Air Quality Management District (BAAQMD), "Toxic Air Contaminant Control Program. Annual Report 2002, Vol. 1." June 2004.  
[www.baaqmd.gov/pmt/air\\_toxics/annual\\_reports/index.asp](http://www.baaqmd.gov/pmt/air_toxics/annual_reports/index.asp).

### **11. Truck Traffic Linked to Childhood Asthma Hospitalizations**

A study in Erie County, New York (excluding the city of Buffalo) found that children living in neighborhoods with heavy truck traffic within 220 yards of their homes had increased risks of asthma hospitalization. The study examined hospital admission for asthma amongst children ages 0-14, and residential proximity to roads with heavy traffic.

Lin, Shao; Jean Pierre Munsie; Syni-An Hwang; Edward Fitzgerald; and Michael R. Cayo; (2002). "Childhood Asthma Hospitalization and Residential Exposure to State Route Traffic," *Environmental Research, Section A*, Vol.88, pp. 73-81.

### **12. Lung Function Reduced Among Children Living Near Truck Traffic**

A European study determined that exposure to traffic-related air pollution, "in particular diesel exhaust particles," may lead to reduced lung function in children living near major motorways.

Brunekreef, B; N.A. Janssen; J. DeHartog; H. Harssema; M. Knape; P. Van Vliet. "Air pollution from truck traffic and lung function in children living near motorways." *Epidemiology*. 8(3):298-303. 1997.

### **13. Traffic-Related Air Pollution Associated with Respiratory Symptoms in Two-Year Old Children**

This cohort study in the Netherlands found that two year old children who are exposed to higher levels of traffic-related air pollution are more likely to have self-reported respiratory illnesses, including wheezing, ear/nose/throat infections, and reporting of physician-diagnosed asthma, flu or serious cold.

Brauer, Dr. Michael J. et al. "Air Pollution from Traffic and the Development of Respiratory Infections and Asthmatic and Allergic Symptoms in Children." *American Journal of Respiratory and Critical Care Medicine*. Vol.166 pp 1092-1098. 2002. Contact: Dr Michael Brauer, School of Occupational and Environmental Hygiene, University of British Columbia, Vancouver, British Columbia, Canada. Phone: (604) 822-9585, email:brauer@interchange.ubc.ca.

#### **14. Asthma Symptoms Caused by Truck Exhaust**

A study was conducted in Munster, Germany to determine the relationship between truck traffic and asthma symptoms. In total, 3,703 German students between the ages of 12-15 years completed a written and video questionnaire in 1994-1995. Positive associations between both wheezing and allergic rhinitis and truck traffic were found during a 12-month period. Potentially confounding variables, including indicators of socio-economic status, smoking, etc., did not alter the associations substantially.

Duhme, H.; S.K.Weiland, et al. "The association between self reported symptoms of asthma and allergic rhinitis and self-reported traffic density on street of residence in adolescents." *Epidemiology* 7(6):578-82. 1996.

#### **15. Proximity of a Child's Residence to Major Roads Linked to Hospital Admissions for Asthma**

A study in Birmingham, United Kingdom, determined that living near major roads was associated with the risk of hospital admission for asthma in children younger than 5 years of age. The area of residence and traffic flow patterns were compared for children admitted to the hospital for asthma, children admitted for non-respiratory reasons, and a random sample of children from the community. Children admitted with an asthma diagnosis were significantly more likely to live in an area with high traffic flow (> 24,000 vehicles/ 24 hrs) located along the nearest segment of main road.

Edwards, J; S.Walters, et al. "Hospital admissions for asthma in preschool children: relationship to major roads in Birmingham, United Kingdom." *Archives of Environmental Health*. 49(4):223-7. 1994.

#### **16. Asthma More Common for Children Living Near Highways**

A study of nearly 10,000 children in England found that wheezing illness, including asthma, was more likely with increasing proximity of a child's home to main roads. The risk was greatest for children living within 90 yards of the road.

Venn et al. "Living Near A Main Road and the Risk of Wheezing Illness in Children." *American Journal of Respiratory and Critical Care Medicine*. Vol.164, pp. 2177-2180. 2001.

#### **17. Exposure to Nitrogen Dioxide (NO<sub>x</sub>) from Vehicles Exacerbates Asthma Attacks**

Researchers at St. Mary's Hospital in Portsmouth, England determined that while 80 percent of asthma attacks are initially caused by viral infections, exposure to traffic pollution can

increase symptoms as much as 200 percent. The team measured the exposure of 114 asthmatic children between ages 8- 11 from nonsmoking families over almost a whole year. They found a strong correlation between higher NO<sub>2</sub> pollution and the severity of an attack.

Chauhan, A.J., et al. "Personal exposure to nitrogen dioxide (NO<sub>2</sub>) and the severity of virus-induced asthma in children." *Lancet*. Volume 361 Issue 9373 Page 1939. 2003.

### **18. A School's Proximity to Highways Associated with Asthma Attacks**

A study of 1,498 children in 13 schools in the Province of South Holland found a positive relationship between school proximity to highways and asthma occurrence. Truck traffic intensity and the concentration of pollutants measured in schools were found to be significantly associated with chronic respiratory symptoms.

Van Vliet, P., M. Knape, et al. "Archives of Environmental Health.26," (6):313-8. 1997.

### **19. Diesel Exhaust Linked to Asthma**

This study found that particulate matter from diesel trucks can act as an irritant in the airway causing asthma. The authors show that diesel exhaust can trigger asthma attacks in individuals with no pre-existing asthmatic history. When a natural allergen, such as pollen, was added to the situation, the reaction was even more dramatic.

Pandya, Robert, et al. "Diesel Exhaust and Asthma: Hypothesis and Molecular Mechanisms of Action." *Environmental Health Perspectives Supplements* Volume 110, Number 1, February 2002.

### **20. Low Levels of Air Pollution Cause Asthma Attacks**

Exposure to ozone and soot particulate matter of 2.5 µm or less (PM<sub>2.5</sub>) in air at levels above current US Environmental Protection Agency (EPA) standards is a risk factor for respiratory symptoms in children with asthma.

Daily respiratory symptoms and medication use were examined prospectively for 271 children younger than 12 years with physician-diagnosed, active asthma residing in southern New England. Exposure to ambient concentrations of ozone and PM 2.5 from April 1 through September 30, 2001, was assessed using ozone (peak one-hour and eight-hour) and 24-hour PM 2.5. Mean (SD) levels were 59 ppb (one-hour average) and 51 ppb (eight-hour average) for ozone and 13 (8) µg/m<sup>3</sup> for PM<sub>2.5</sub>.

Ozone level, not PM 2.5 was significantly associated with respiratory symptoms and rescue medication use among children using maintenance medication; a 50-ppb increase in one-hour ozone was associated with increased likelihood of wheeze by 35% and chest tightness by 47%. The highest levels of ozone (one-hour or eight-hour averages) were associated with increased shortness of breath and rescue medication use. No significant, exposure-dependent associations were observed for any outcome by any pollutant among children who did not use maintenance medication. Asthmatic children using maintenance medication are particularly vulnerable to ozone, controlling for exposure to fine particles, at levels below EPA standards.

Gent, Janneane, Elizabeth W. Triche, Theodore R. Holford, Kathleen Belanger, Michael B. Bracken, William S. Beckett, Brian P. Leaderer, "Association of Low-Level Ozone and Fine

Particles With Respiratory Symptoms in Children With Asthma,” Journal of the American Medical Association. 2003; 290:1859-1867.

<http://jama.ama-assn.org/cgi/content/abstract/290/14/1859>.

### **21. Traffic-Related Air Pollution near Busy Roads Cause Asthma: the East Bay Children’s Respiratory Health Study\***

This study conducted a school-based cross-sectional study in the San Francisco Bay Area in 2001. Information on current bronchitis symptoms and asthma, home environment, and demographics were obtained by parental questionnaire (n=1,109). Concentrations of traffic pollutants (particulate matter (PM<sub>10</sub>, PM<sub>2.5</sub>), black carbon (BC), and nitrogen oxides (NO<sub>x</sub> and NO<sub>2</sub>)) were measured at ten school sites during several seasons. Although pollutant concentrations were relatively low, there were observed differences in concentrations between schools nearby versus those more distant (or upwind) from major roads. Associations were found between respiratory symptoms and traffic-related pollutants. The researchers findings support the hypothesis that traffic-related pollution is associated with respiratory symptoms in children.

Kim, Janice, S. Smorodinsky, M. Lipsett, B. Singer, A. Hodgson, and Bart Ostro; “Traffic-related air pollution near busy roads: the East Bay Children’s Respiratory Health Study.” CA EPA and Lawrence Berkeley National Laboratory. 2001. For more information, contact Bart Ostro, phone: (510) 622-3157, Email: [Bostro@oehha.ca.gov](mailto:Bostro@oehha.ca.gov)

### **22. Roadside Pollution Forms Smog that Causes and Exacerbates Asthma, while Diesel Particulates Help Deliver and Present Pollen and Mold Allergens to the Lungs\***

Car, truck, and bus pollution form photochemical smog that causes and exacerbates asthma, while diesel particulates help deliver and present pollen and mold allergens to the immune system in the lungs. The combination of air pollutants, aeroallergens, heat waves, and unhealthy air masses – increasingly associated with a changing climate – causes damage to the respiratory systems, particularly for growing children, and these impacts disproportionately affect poor and minority groups in the inner cities.

Traffic patterns and automotive exhaust, power plants, airports and industrial emissions are the primary sources, while wind patterns can bring in pollution and unhealthy air masses originating in other regions.” Air pollution in highly populated areas can compound the impacts of airborne allergens. The impacts of air pollution can also be compounded by extreme weather events, whose intensity and frequency is increasing as climate changes.

Dr. C. Rogers, Dr. G. Benjamin, Dr. P. Epstein; “The Impacts of CO<sub>2</sub> and Climate Change on Public Health in the Inner City,” Center for Health and Global Environment at the Harvard Medical School. April, 2004. [www.med.harvard.edu/chge/green.pdf](http://www.med.harvard.edu/chge/green.pdf)

### **23. Air Pollution Effects Lung Development for Children Ages 10 to 18\***

Current levels of air pollution have chronic, adverse effects on lung development in children from the ages 10 to 18 years, leading to clinically significant deficits in attained forced expiratory volume in one second (FEV<sub>1</sub>). Deficits in the growth of FEV<sub>1</sub> were associated with exposure to nitrogen dioxide, acid vapor, particulate matter (PM<sub>2.5</sub>), and elemental carbon, and the data was clinically and statistically significant to deficits at the age of 18.

W. James Gauderman, Edward Avol, Frank Gilliland, Hita Vora, Duncan Thomas, Kiroos Berhane, Rob McConnell, Nino Kuenzli, Fred Lurmann, Edward Rappaport, Helene Margolis, David Bates, and John Peters. "The Effect of Air Pollution on Lung Development from 10 to 18 Year of Age," *The New England Journal of Medicine*. 2004; 351:1057-67.

#### **24. Several Adverse Respiratory Outcomes Associated with Breathing Polluted Air in Southern California\***

Breathing polluted air in Southern California is associated with significant chronic deficits in lung function among adolescent children. Air pollution also not only exacerbates children with existing asthma, but also a cause to the onset of new asthma. The pollutants that were correlated with several serious health effects include particulates, NO<sub>2</sub>, and acids, but not including ozone. The vehicle-related pollution is likely to have life-long adverse health effects.

Peters, John M., "Epidemiologic Investigation to Identify Chronic Effects of Ambient Air Pollutants in Southern California." California Air Resources Board and California Environmental Protection Agency. May 14, 2004.

#### **25. Transient Exposure to Traffic May Increase the Risk of Myocardial Infarction in Susceptible Persons. \***

Association was found linking exposure to traffic and the onset of a heart attack (myocardial infarction) within one hour afterward, the number one cause of death from cardiovascular disease. Subject's use of a car was the most common source of exposure to traffic, but there was also an association between time spent on public transportation as well.

Annette Peters, Stephanie von Klot, Margit Heier, M.D., Ines Trentinaglia, Allmut Hörmann, H. Erich Wichmann, M.D., Ph.D., Hannelore Löwel, M.D., "Exposure to Traffic and Onset of Myocardial Infarction." *The New England Journal of Medicine*, 2004, 351:1721-30. <http://content.nejm.org/cgi/content/abstract/351/17/1721>, Address requests to Dr. Peters at [peters@gssf.de](mailto:peters@gssf.de).

#### **26. Pregnant Women Who Live Near High Traffic Areas More Likely to Have Premature and Low Birth Weight Babies**

Researchers observed an approximate 10-20% increase in the risk of premature birth and low birth weight for infants born to women living near high traffic areas in Los Angeles County. In particular, the researchers found that for each one part-per-million increase in annual average carbon monoxide concentrations where the women lived, there was a 19% and 11% increase in risk for low birth weight and premature births, respectively.

Wilhelm, Michelle and Beate Ritz. "Residential Proximity to Traffic and Adverse Birth Outcomes in Los Angeles County, California, 1994-1996." *Environmental Health Perspectives*. doi: 10.1289/ehp.5688. 2002.

Contact: Beate Ritz, Department of Epidemiology, UCLA School of Public Health, Phone: (310) 206-7458, e-mail: [britz@ucla.edu](mailto:britz@ucla.edu).

#### **27. Air inside Cars Typically Contains More Dangerous Air Pollutants than Outside**

The results of 23 separate scientific studies shows that in-car air pollution levels frequently reach concentrations that may threaten human health. The reports show that the air inside of cars typically contain more carbon monoxide, benzene, toluene, fine pollution than anywhere else in Southern California. Motor vehicles and other mobile sources of air pollution are the predominant source of cancer-causing air pollutants in Southern California. Overall, the study showed that motor vehicles and other mobile sources accounted for about 90% of the cancer risk from toxic air pollution, most of which is from diesel, soot, particulate matter, and nitrogen oxides than ambient air at nearby monitoring stations. These pollutants are particularly dangerous for children, the elderly and people with asthma or other respiratory conditions.

Kimbrell, Andrew. "In-Car Air Pollution: The Hidden Threat to Automobile Drivers. International Center for Technology Assessment." July 2000.

[www.icta.org/projects/trans/incar.pdf](http://www.icta.org/projects/trans/incar.pdf). Contact: Andrew Kimbrell, Phone: (202) 547-9359, email: [kimbrell@icta.org](mailto:kimbrell@icta.org)

### **28. Study Finds that In-Car Soot Caused Changes in Heart and Lung Function\***

Exposure to fine soot (PM<sub>2.5</sub>) is associated with cardiovascular events and mortality in older and cardiac patients. Potential physiologic effects of in-vehicle, roadside, and ambient PM<sub>2.5</sub> were investigated in young, healthy, nonsmoking, male North Carolina Highway Patrol troopers. Nine troopers were monitored with air-quality monitors in their patrol cars. In-vehicle PM<sub>2.5</sub> (average of 24 µg/m<sup>3</sup>) was associated with increased markers of inflammation and blood clotting proteins, variations in heart rate, and other cardiovascular changes. Specifically, decreased lymphocytes and increased red blood cell indices, neutrophils, C-reactive protein, next-morning heart beat cycle length and variability parameters. The observations in these healthy young men suggest that in-vehicle exposure to PM<sub>2.5</sub> may cause pathophysiologic changes that involve inflammation, coagulation, and cardiac rhythm.

M. Reidiker, W. Cascio, T. Griggs, M. Herbst, P. Bromberg, L. Neas, R. Williams, R. Devlin; "Particulate Matter Exposure in Cars Is Associated with Cardiovascular Effects in Healthy Young Men." *American Journal of Respiratory and Critical Care Medicine*. February 12<sup>th</sup>, 2004. Vol 169. pp. 934-940. Michael Riediker, Institut de Santé au Travail (Institute of Occupational Health Sciences), Rue du Bugnon 19, CH-1005 Lausanne, Switzerland. E-mail: [michael.riediker@alumni.ethz.ch](mailto:michael.riediker@alumni.ethz.ch).

### **29. Motor Vehicle Air Toxins Cause High Pollution Levels Inside Homes**

An air pollution study was done as a part of the West Oakland Diesel Truck Emissions Reduction Initiative. Researchers measured diesel particulates near mobile and idling trucks at the West Oakland Port. An aethalometer was used to measure indoor toxins and a high level of diesel particulates was found. The people who lived in these homes were exposed indoors to five times the level of diesel particulates that people were exposed to outdoors in other areas of Oakland.

W. Buchan, M.D. and M. Chan Jackson; Container Truck Traffic Assessment and Potential Mitigation Measures for the West Oakland Diesel Truck Emission Reduction Initiative, from "Clearing the Air, Reducing Diesel Pollution in West Oakland," a Report to Pacific Institute, 654 13th Street, Preservation Park, Oakland, California 94612, by TIAX LLC, 1601 S. De Anza Blvd., Suite 100, Cupertino, California 95014, November, 2003 The following technical reports are online at: <http://www.pacinst.org/diesel/>

### **30. Schizophrenia Risk is Increased by Air Pollution from Traffic\***

Factors such as urbanicity at birth and during upbringing are associated with increased risk of schizophrenia and causal factors underlying this association may account for a much higher proportion of the population occurrence of the disease. Although the causes of these urban-rural differences have been hypothesized to include, e.g., infections, diet, toxic exposures, household crowding, and social class, no studies have been able to confirm this. This study investigates the hypothesis that air pollution from traffic increases schizophrenia risk, and whether this potential effect can explain the urban-rural differences in schizophrenia risk.

Carsten Bøcker Pedersen, Ole Raaschou-Nielsen, Ole Hertel and Preben Bo Mortensen. "Air pollution from traffic and schizophrenia risk." *Schizophrenia Research* 66 (2004) 83-85.

### **31. Brain Diseases Such as Alzheimer's Have Increased in Five Western Countries Since 1970's, Evidence that Air Pollution and Environmental Factors are the Cause\***

The 1990s data indicate substantial increases compared with the 1970s data for 'other neurological deaths' (ONDs) (especially amongst 65-74 year olds), and rises in 'mental disorder deaths' (MDDs) in 55-64 year olds in five countries, including England and Wales and Germany, and in 65-74 year olds in most countries, suggesting earlier onsets of the underlying conditions. Further country-specific research is required to explain the emerging morbidity and mortality, but if the trend in mortality truly reflects a rapid increase it provides powerful evidence that environmental factors are decisive in determining the risk of the disease. Placed in this context, the rises in ONDs in 65-74-year olds and MDDs require detailed country-specific research to explain the changing pattern of neurological mortality and the underlying morbidity, which suggests a potential major public health problem in the not-too-distant future.

C. Pritchard, D. Baldwin, A. Mayers. "Changing patterns of adult (45-74 years) neurological deaths in the major Western world countries 1979-1997." *Public Health* (2004) 118, 268-283.

### **32. Five Times More Deaths Due to Air Pollution than Traffic Accidents**

This study analyzed the affect of traffic-related air pollution and traffic accidents on life expectancy in the area of Baden-Wurtemberg, Germany. It estimated that almost five times more deaths in this region resulted from motor vehicle pollution than from traffic accidents.

Szagan and Seidel.(2000). "Mortality due to road traffic in Baden-Aurttemberg." *Gesundheitswesen*. 62(4):225-33.

### **33. Traffic Air Pollution Shortens Lives, Increases Death Risk\***

Chronic exposure to air pollution is associated with increased mortality rates. The impact of air pollution relative to other causes of death in a population is of public health importance and has not been well established. In this study, the rate advancement periods associated with traffic pollution exposures were estimated. Study subjects underwent pulmonary function testing at a clinic in Hamilton, Ontario, Canada, between 1985 and 1999. Cox regression was used to model mortality from all natural causes during 1992-2001 in relation to lung function, body mass index, a diagnosis of chronic pulmonary disease, chronic ischemic heart disease, or diabetes mellitus, household income, and residence within 50 m of

a major urban road or within 100 m of a highway. Subjects living close to a major road had an increased risk of mortality (relative risk = 1.18, 95% confidence interval: 1.02, 1.38). The mortality rate advancement period associated with residence near a major road was 2.5 years (95% confidence interval: 0.2, 4.8). By comparison, the rate advancement periods attributable to chronic pulmonary disease, chronic ischemic heart disease, and diabetes were 3.4 years, 3.1 years, and 4.4 years, respectively.

Murray M. Finkelstein, Michael Jerrett, Malcolm R. Sears. "Traffic Air Pollution and Mortality Rate Advancement Periods," *American Journal of Epidemiology*, 2004; 160:173-177. <http://aje.oupjournals.org/cgi/reprint/160/2/17>.

#### **34. Air Pollution from Busy Roads Linked to Shorter Life Spans for Nearby Residents**

Dutch researchers looked at the effects of long-term exposure to traffic-related air pollutants on 5,000 adults. They found that people who lived near a main road were almost twice as likely to die from heart or lung disease and 1.4 times as likely to die from any premature cause compared with those who lived in less-trafficked areas. The authors say traffic emissions contain many pollutants that might be responsible for the health risks, such as ultra-fine particles, diesel soot, and nitrogen oxides, which have been linked to cardiovascular and respiratory problems.

Hoek, Brunekreef, Goldbohn, Fischer, van den Brandt. "Association between Mortality and Indicators of Traffic-related Air Pollution in the Netherlands: A Cohort Study." *Lancet*, 360 (9341):1203-9. 2002.

#### **35. America's Pediatricians Warn of Highway Health Hazards.\***

In a revised policy statement by the American Academy of Pediatrics (AAP) advises that not only can outdoor air pollution exacerbate asthma in some children, but recent studies have found that pollution has the potential to negatively affect lung growth and function, and to increase cases of respiratory tract illness, preterm birth and infant mortality. The elderly and adults with cardiovascular disease are populations also at higher health risk from air pollution due to fine particles, such as soot and smoke. According to the policy statement, exposure to traffic-related pollution, such as exhaust emissions from cars and diesel exhaust from trucks and even school buses, increases a child's risk of respiratory complications as well as lifetime risk of cancer.

The Academy also makes the following recommendations in the policy statement (that include):

- Areas with poor air quality should alert local residents about potential health hazards.
- Local and federal government should encourage mass transit and car pooling.
- Programs that exempt some passenger vehicles (e.g., SUV's, minivans, and light-duty trucks) from fuel-economy standards should be eliminated.
- New schools should be built away from "hot spots" of localized pollution.

The policy adds that pediatricians who serve as physicians for schools or for team sports should be aware of the health implications of pollution alerts to provide appropriate guidance to school and sports officials, particularly in communities with high ozone levels.

American Academy of Pediatrics Committee on the Environment, "Ambient Air Pollution:

### **36. Childhood cancers caused by cancer-causing air pollution.**

This was a follow up to study # 9 and retested previous findings that childhood cancers are probably initiated by prenatal exposures to combustion process gases and to volatile organic compounds (VOCs); and to identify specific chemical hazards. The study looked at birth and death addresses of fatal child cancers in Great Britain between 1966 and 1980, were linked with high local atmospheric emissions of different chemical species.

It used pollution maps from the National Atmospheric Emissions Inventory and "hotspots" for 2001. Child cancer addresses were extracted from an earlier inquiry into the carcinogenic effects of obstetric radiographs; and their postcodes translated to map references.

The study found significant birth proximity relative risks within 1.0 km (0.62 miles) of hotspots for carbon monoxide, PM10 particles, VOCs, nitrogen oxides, benzene, dioxins, 1,3-butadiene, and benz(a)pyrene. Calculated attributable risks showed that most child cancers and leukaemias are probably initiated by such exposures.

The reported associations of cancer birth places with sites of industrial combustion, VOCs uses, and associated engine exhausts, are confirmed. Newly identified specific hazards include the known carcinogens 1,3-butadiene, dioxins, and benz(a)pyrene. The mother probably inhales these or related materials and passes them to the fetus across the placenta.

E G Knox, "Childhood cancers and atmospheric carcinogens." *Journal of Epidemiology and Community Health* 2005; 59:101-105.

<http://jech.bmjournals.com/cgi/content/full/59/2/101#top#top>. Correspondence to: Professor E G Knox, Mill Cottage, Front Street, Great Comberton, Pershore, Worcestershire WR10 3DU, UK

### **37. New Study of New York City Residents Shows That Newborns are More Susceptible to DNA Damage from Pollution than Their Mothers\***

A study of the effects of combustion-related air pollutants in New York City reveals that babies in the womb are more susceptible than their mothers to DNA damage from such pollution. Despite the protection provided by the placenta, which reduces the fetal dose to an estimated one-tenth the dose of the mother, the levels of DNA damage in the newborns were similar to those found in their mothers.

These findings are especially notable since evidence from previous studies of laboratory rodents suggests that the fetus is more susceptible to the carcinogenic effects of the same pollutants than the adult.

The study was designed to measure the effects of prenatal and maternal exposure to combustion-related pollutants, known as polycyclic aromatic hydrocarbons (PAH), on DNA damage. PAHs are carcinogenic air pollutants that are released into the environment as a result of combustion from car, truck, or bus engines, residential heating, power generation, or tobacco smoking. According to the researchers, PAHs are able to cross the placental barrier.

Researchers collected blood samples from 265 pairs of mothers and newborns living in New York City. The mothers were non-smoking African American or Latina women in

Washington Heights, Central Harlem and the South Bronx. The researchers then analyzed the samples for the presence of two key biomarkers -- carcinogen-DNA adducts, which are protein complexes formed when a chemical binds to molecules of DNA, and cotinine, a measure of secondhand tobacco smoke exposure, since the mothers were all nonsmokers. Previous research has shown an association between DNA adducts and increased cancer risk.

Despite the estimated 10-fold lower dose of the pollutants to the fetus as compared to the mother, the researchers found that levels of DNA damage were comparable in newborns and mothers, while cotinine levels were higher in newborns than in mothers.

Frederica P. Perera, Deliang Tang, Yi-Hsuan Tu, Linda Ali Cruz, Mejico Borjas, Tom Bernert, and Robin M. Whyatt. "Biomarkers in Maternal and Newborn Blood Indicate Heightened Fetal Susceptibility to Procarcinogenic DNA Damage." *Environmental Health Perspectives*, 112:1133-1136 (2004),

<http://ehp.niehs.nih.gov/members/2004/6833/6833.pdf>

For more information or a copy of the study, contact Heather Ross at 212-576-2700 x243.

### **38. EPA's National Air Toxics Assessment Shows High Levels of Dangerous Pollution from Onroad Mobile Sources.**

EPA compiled the existing information about the 1996 emissions of the 32 air toxics plus diesel particulate matter (diesel PM) used in the national-scale assessment. The site has emission density maps and county emission inventories. It shows that 50% of the national emissions of cancer causing benzene and 45% of the national emission of 1,3 butadiene came from on-road mobile sources.

For more information, go to the site at [www.epa.gov/ttn/atw/nata/natsa1.html#emission](http://www.epa.gov/ttn/atw/nata/natsa1.html#emission).

### **39. Comparison of air pollution exposure for walking, bicycling, and commuting by bus, train and car.\***

A 2004 Australian study compared the exposure to toluene, benzene, ethylbenzene, xylene (BTEX), and nitrogen dioxide for commuters in Sydney for five transportation modes. The results indicated that the highest levels of exposure to the four contaminants were found in car commuters, and train commuters were found to have the lowest contamination levels. Bus transportation had the highest levels of nitrogen dioxide contamination. Bicyclists and walkers had less benzene contamination than car drivers, and less nitrogen dioxide contamination than bus commuters.

Michael Chertok, Alexander Voukelatos, Vicky Sheppard, and Chris Rissel. "Comparison of air exposure for five commuting modes in Sydney-car, train, bus, bicycle, and walking." *Health Promotion Journal of Australia* 2004; 15:63-7.

[http://www.bfa.asn.au/bfanew/pdf/HPJA air pollution exposure.pdf](http://www.bfa.asn.au/bfanew/pdf/HPJA_air_pollution_exposure.pdf)

\*Studies added since Highway Health Hazards report was published.