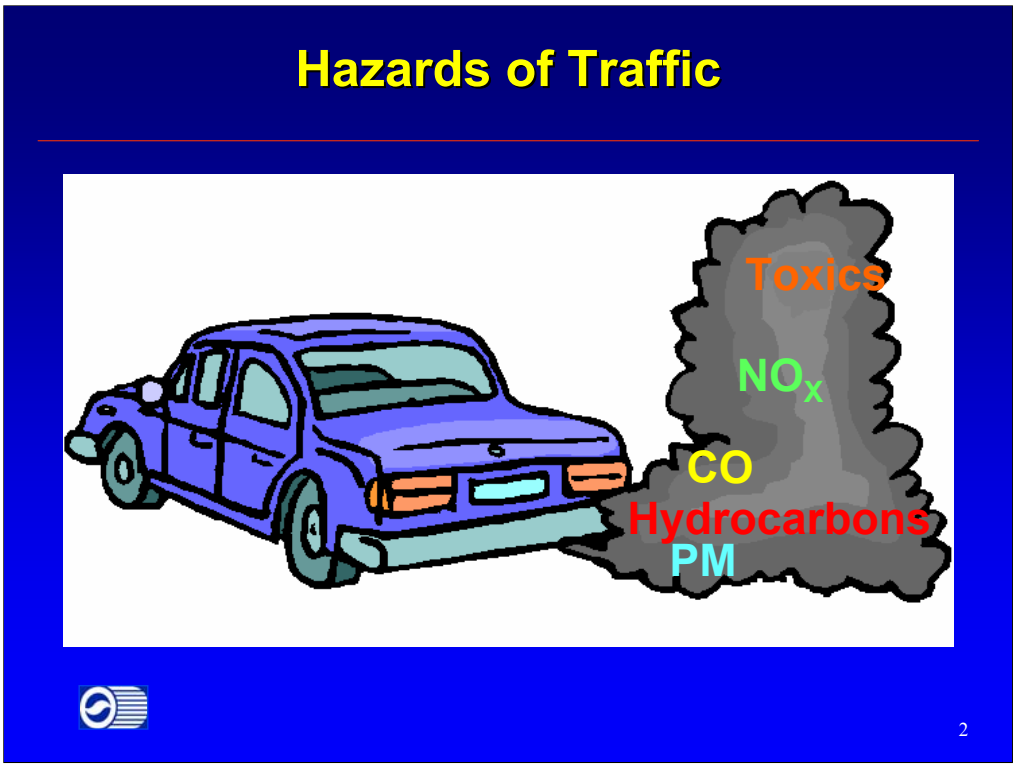
Health Effects Associated With Traffic-Related Air Pollution

March 22, 2007

Air Resources Board

California Environmental Protection Agency

Thank you Ms. Witherspoon. Good morning, Dr. Sawyer and members of the Board. In this health update, I am going to discuss the health effects of traffic-related air pollution. This subject has recently received much media attention and is an important research priority at ARB. I will focus the discussion on effects seen in one of our most vulnerable populations - our children. I will begin my presentation with a discussion on new findings from the Southern California Children's Health Study cohort relating traffic exposure to lung development. Then I will follow up with other recent studies that support the findings of adverse health effects in children. But first, I will talk about some of the things that make traffic pollution hazardous.



The power to move a vehicle comes from burning fuel. Pollution comes from by-products of this combustion and from evaporation of the fuel itself.

Incomplete combustion results in carbon monoxide and hydrocarbons.

Oxides of Nitrogen (or NOx) form after heat causes oxygen and nitrogen in the air to combine.

Diesel exhaust is one of the primary contributors to particulate matter.

Gasoline contains several toxics such as benzene and formaldehyde.

Motor vehicles also generate particles through wear and degradation of tires, brakes, and other components and contribute to dust pollution by resuspending dust in the air.

We know that all of these pollutants can be toxic to human health, particularly our children and other susceptible populations.

Southern California Children's Health Study

- 10+ year study followed ~ 5,500 children's chronic exposures to air pollution – ARB funded
- Landmark study on children's health effects
- Adverse effects on lung function growth, asthma, school attendance
- 100+ publications

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The findings I am going to discuss today are the latest to come from the Southern California Children's Health Study, the longest US investigation into air pollution and children's health. Originally funded by ARB, this study has tracked children's respiratory health since 1992 and is currently being funded by the National Institute of Environmental Health Sciences. The study looked at the air pollution impacts on over 5,500 children who were recruited from schools in 12 southern California communities which were chosen for their differing pollution profiles. Measurements from these children included annual lung function tests and the administration of questionnaires.

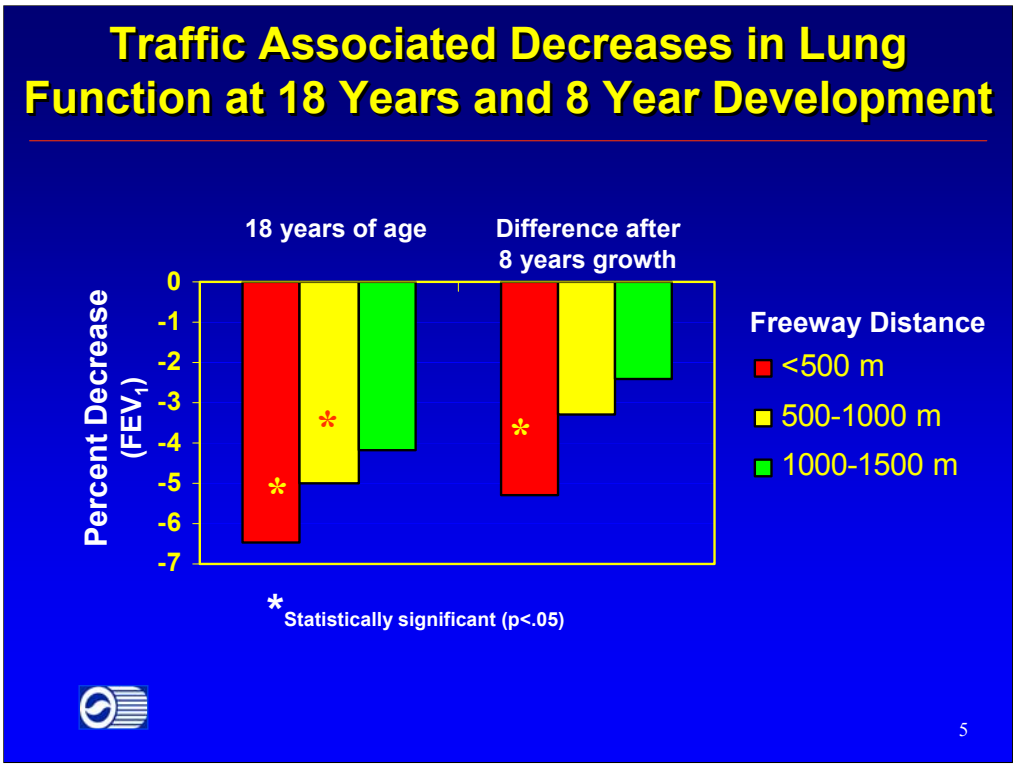
Several ground breaking results and over 100 peer-reviewed articles have emerged from this study. We now know that air pollution can affect children's lung function growth and the occurrence and severity of asthma. Children exposed to pollution miss more school days because of respiratory symptoms while children who relocate to cleaner regions experience improvements in their lung function

Traffic and Children's Health

"Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study". Gauderman WJ et al. Lancet, February 2007; 369 (9561): 571-7.

- Subset of 1,500 Southern California Children
- Followed for 8 years
- Traffic exposure on Lung Function Growth
  - Residential distance to freeways

Dr. Gauderman and his colleagues studied a subset of 1500 children that had complete follow up from 10 through 18 years of age. Residential proximity to freeways was compared to lung function development over an 8 year period.



The children's lung function measurements were categorized according to the distance of their homes from freeways. The red bar represents the lung function of those living within 500 meters of the freeway; the yellow bar shows the average function of those living 500-1000 meters away, while the green bar shows the function of those living 1000-1500 meters away. These are all in reference to the lung function of the those living further than 1500 meters from freeways. The asterisks indicate the differences that are statistically significant. The researchers found significant decreases in lung function in 18 year olds who lived within 500 meters of a freeway compared to those who lived more than 1500 meters away, shown by the bars on the left side of the graph. The bars on the right side of the graph show the average differences in lung development over the 8 years of follow-up. For example, 8 year lung growth in a child living within 500 meters of a freeway was about 5 percent less than an individual living more than 1500 meters away. Notice how the decreases in lung function and growth diminished as the children's residential distance from the freeway increased.

Health Implications

- Adverse effects of local traffic exposure
- Effects independent of regional air quality
- Enhanced vulnerability
- Changes likely permanent
- Long-term health implications
  - Greatest effect may occur later in life

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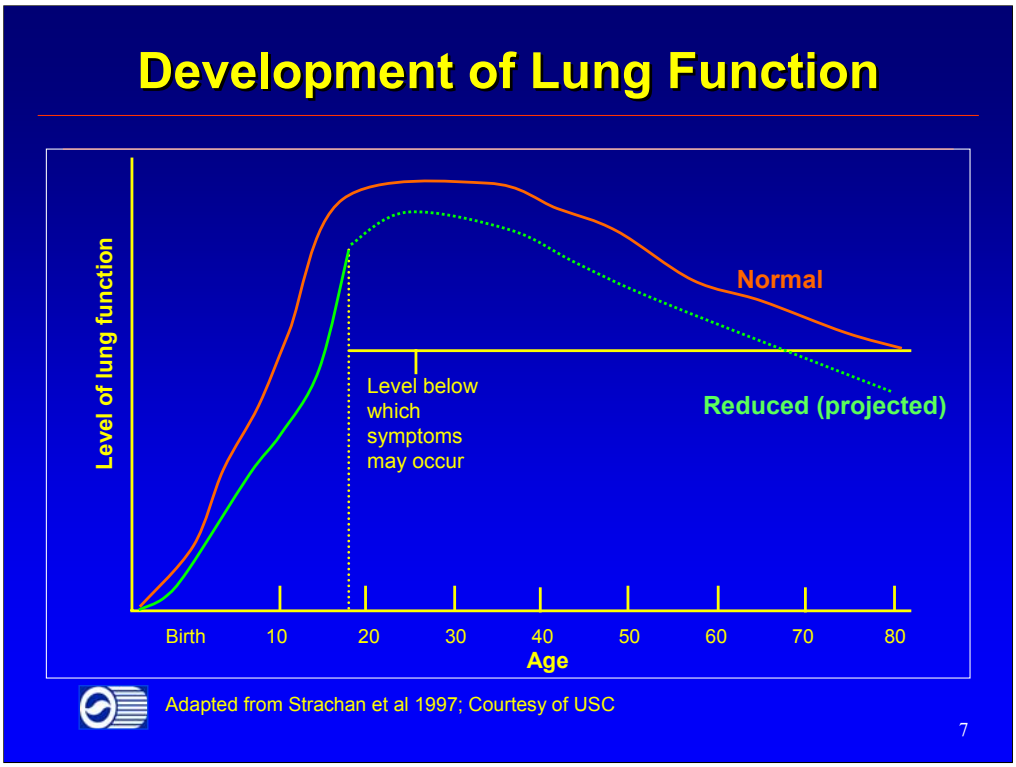
Further analyses of the data indicated that children exposed to traffic in highly polluted areas experience a combination of developmental effects. Even in areas with low regional pollution, children living near major roadways still suffered from lung growth deficits.

The lung function in 18 year olds living closest to the freeway was about 6 percent less than those living farthest away. Clinical symptoms are generally not apparent until a 10 to 20% reduction has occurred. Asymptomatic individuals will probably not attempt to limit their exposures, leaving them susceptible to further damage. In sensitive persons, reduced lung function may increase the risk of respiratory illness or increase the severity of symptoms.

18 years olds are near the end of their development and it is unlikely that they will ever regain the function that has been lost. They are starting out their adult life at a respiratory disadvantage and may have a greater risk of complications later in life.



This graph will demonstrate a little more about lung function.

This red line on the slide illustrates the generalized, average growth of a person's lung function during their life. Early lung function development shows rapid growth and naturally plateaus until a person's late 20s, after which a decline of about 1% per year occurs. The yellow line is an approximation of when symptoms will appear. The solid green line demonstrates the approximate deficit in lung function found in this current study. The dotted portion of this green line projects lung function in later life and assumes that future declines are not exacerbated by continued environmental insults. If the growth follows this projected pathway, when the children who lived near the freeways turn 40 years old, their lung function will be closer to that of a 50 year old.

To put the current Children's Health Study findings in context to other traffic studies, I am now going to briefly discuss how those studies are performed and share some important results from other traffic related pollution studies among children in California.

Methods to Measure Exposure to Traffic

- Measurements of traffic-related pollutants
- Freeways/Major Road Exposure:
  - Distance
  - Traffic volume and/or type
  - Traffic-modeled exposure
- In-vehicle studies

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Exposure to traffic pollution can be measured by examining ambient levels of traffic–related pollutants, residential distance to a freeway, the number of vehicles on the road, or the ratio of cars and trucks using the roads. Models have also been used to estimate personal exposure to traffic.

Another type of traffic study examines in-vehicle exposures. The Air Resources Board recently announced that, on average, Californians spend 6% of each day commuting and receive 60% of their exposures to harmful ultrafine particles during this time.

Health Effects Seen in the Infant (Pre- and Post-Natal)

- **Low birth weight: 36% increase in prevalence among those with traffic exposure and high CO [1]**
- **Premature birth: 27% increase in prevalence among those with traffic exposure and high CO [1]**
- **Cardiac birth defects: Up to 3X increase in risk with traffic-related pollutants [2]**

1. Wilhelm M, et al. 2005. Local variations in CO and particulate air pollution and adverse birth outcomes in Los Angeles County, California, USA.. Environ Health Perspect. 113(9) 212-21

2. Ritz B, et al. 2002 Ambient air pollution and risk of birth defects in Southern California. Am J Epidemiol, 155:17-25

One of our most vulnerable populations are infants and those children not yet born. A Los Angeles study on the prenatal effects of traffic by Wilhem and colleagues found that pregnant women living near heavy traffic areas with high levels of carbon monoxide were more likely to experience adverse birth outcomes. The proportion of low birth weight babies increased from a baseline of 7 percent to 9 percent and preterm births went from 11 to 14 percent among the most highly exposed women. Ritz and colleagues found that pregnant women with high traffic exposure were 3 times as likely to have a child with certain heart defects as women breathing the cleanest air.

Health Effects Seen in Children and Adolescents

- **Asthma: 89% increase in risk with close residence to freeway [1]**
- **With long-term close residence to traffic [2]**
  - **Ever had asthma: 85% increase in risk**
  - **Current treatment for asthma: ~2.5X increase in risk**
  - **Wheezing: ~2.7X increase in risk**
- **Acute respiratory symptoms: 5-8% increase in risk with schools close to traffic [3]**

1. Gauderman WJ, et al. 2005. Childhood Asthma and Exposure to Traffic and Nitrogen Dioxide. Epidemiology, 16:737-743

2. McConnell R, et al. 2006. Traffic, susceptibility, and childhood asthma. Environ Health Perspect. 114(5):766-72

3. Kim, et al. 2004. Traffic-related Air Pollution near Busy Roads, The East Bay Children's respiratory Health Study. Am J Respir Crit Care Med. 170(5):520-6

Children are active, spend more time outside, and their breathing rates are higher so they will receive more exposure to air pollution than adults under the same circumstances. In another report from the Children's Health Study, researchers found that children living close to the freeway were 89% more likely to have been diagnosed with asthma than those living farther away. 8.6% of children in the South Coast Air Basin have asthma. An 89% increase in risk would correspond to an asthma prevalence of 16% in children near freeways.

Another Southern California study published by McConnell and colleagues found that children living within 75 meters of a major road were 85% more likely to have ever been diagnosed with asthma, 2.5 times more likely to have used prescribed medication to treat their asthma within the past year and 2.7 times more likely to report wheezing than those children living greater than 300 meters away from traffic.

A study in the East Bay by Kim and colleagues found an increase in bronchitis symptoms and asthma among children attending schools in areas with higher levels of traffic related pollutants.

Current ARB Research Studies on Traffic and Health

- Refining Estimates of Exposure for the East Bay Children's Respiratory Health Study
- Cardiovascular Health Effects of Fine and Ultrafine Particles during Freeway Travel
- Air Pollution and Cardiovascular Disease in the California Teachers Study Cohort
- Future Studies

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ARB is currently funding several studies that will add to the growing body of literature on the effects of traffic on health. One of the studies is a refinement of the East Bay Children's Respiratory Health Study, examining the association between traffic pollution and respiratory health among children living and attending schools at varying distances from high-traffic roads.

Another study is examining the effects of traffic exposure on cardiovascular function in elderly subjects during freeway travel.

The third study listed explores the effects of long term exposure from air pollution, including traffic, in the development of cardiovascular and cardiopulmonary disease and mortality in a cohort of elderly teachers. At the May Board hearing you will hear proposals for some new traffic-related research.

Mitigation

- California's Diesel Risk Reduction Plan
  - Emission standards for heavy duty vehicles
  - Carl Moyer Program
- Motor vehicle standards for cars/light trucks
- Goods Movement Emission Reduction Plan
- Land use guidelines
- No new schools within 500 feet from freeways (SB 352, Escutia, 2003)

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The Air Resources Board has taken many regulatory actions to mitigate the health problems associated with traffic pollution. The Board approved the Diesel Risk Reduction plan to reduce particulate matter emissions from diesel fueled engines and vehicles in 2000. Tighter emission standards for heavy duty diesel trucks took effect this year. In February of this year, the Clean Air Task Force suggested that the rest of the United States follow California's lead in creating the Carl Moyer Program to provide the money necessary to retrofit existing dirty diesel fleets. Smog checks are used for passenger vehicles and tighter standards for cars and light trucks will be implemented in 2009. In April 2006, the ARB's Goods Movement Emission Reduction Plan was approved, which is a comprehensive plan to limit emissions from diesel engines associated with the goods movement industry. This plan is part of the State's overall Goods Movement Action Plan, unveiled by CalEPA in January of this year, to improve goods movement, reduce congestion, and improve air quality associated with moving goods via the state's highways as well as railways and ports. Land use guidelines were issued in 2005 to highlight the potential health impacts associated with proximity to air pollution sources so that planners can explicitly consider these issues in planning processes. Results from the East Bay Children's study helped support the passage of a School Siting Bill which amends the education code to ensure that new school sites are prohibited within 500 feet from the edge of the closest traffic lane of a freeway or other busy traffic corridors. Our continuing research and these measures will help protect our most vulnerable populations from traffic related air pollution. This concludes my presentation, I will be happy to answer any questions.

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