

# Childhood Asthma & Exposure to Traffic

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Air Resources Board



**California Environmental Protection Agency**

Thank you Ms. Witherspoon and good morning Dr. Sawyer and members of the Board. Today's health update will discuss a study on Childhood Asthma and Exposure to Traffic. This study was designed to explore the associations between asthma and exposures to traffic-related air pollutants among children living in southern California.

# Background



## Deaths Associated with Traffic

- ◆ **Dutch** - living near roadways doubled the risk of death from heart or lung disease

## Prenatal Impacts

- ◆ **Los Angeles** - infants born to women living near high traffic areas increased risk of premature birth and low birth weight

## Cardiovascular Effects

- ◆ **North Carolina** - PM exposure in cars is associated with cardiovascular effects in young men

## Children & Respiratory Effects

- ◆ **Bay Area** - children in schools nearby freeways have more respiratory symptoms

A growing body of literature is emerging which links exposure to traffic related air pollution and health effects. We have brought health updates before the Board highlighting studies which show an association between traffic pollution and health impacts including mortality, prenatal, cardiovascular and respiratory effects.

Staff highlighted a Dutch study by Hoek and Brunekreef on the link between traffic and premature mortality. This study examined the effects of long-term exposure to traffic-related air pollutants on people living near roadways and found a doubling of the risk of death from heart or lung disease compared with those who lived in less trafficked areas.

Staff also highlighted a Los Angeles study on the prenatal effects from traffic by Wilhem and Ritz. This study found that infants born to women living near high traffic areas showed an increase in risk of premature birth and low birth weight.

Another investigation presented to the board was a North Carolina study on the cardiovascular effects from particulate matter exposure in cars on Highway Patrol Troopers by Riediker et al. This study found that in young, healthy, nonsmoking, males the in-vehicle exposure to PM<sub>2.5</sub> may cause changes that involve inflammation, coagulation, and cardiac rhythm.

Finally, staff also highlighted, "The East Bay Children's Respiratory Health Study" by Kim et al. Although pollutant concentrations in this study were relatively low, the investigators were able to observe an increase in asthma and bronchitis symptoms in children that attended schools nearby freeways versus those more distant or upwind from freeways and major roads. The results of this study helped support the passage of a School Siting Bill authored by Senator Martha Escutia in 2003. This bill 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.

# Introduction



- ◆ Previous studies many in Europe
- ◆ A growing body of literature from the US
- ◆ Different indicators used for traffic
- ◆ Compare and validate traffic indicators
  - same study subjects
- ◆ Today's Study:
  - Gauderman WJ, et al. "Childhood Asthma and Exposure to Traffic and Nitrogen Dioxide". *Epidemiology*, 16:737-743, 2005.

Although, there are a significant number of studies investigating traffic air pollution exposure and its relationship to asthma, many of these studies have been done in Europe. How well these studies can be extrapolated to the U.S. is of concern since factors such as the relative proportion of diesel to gasoline powered vehicles may differ. Recently, a number of these studies have been completed in the US and in California.

Even though this link of outdoor traffic air pollution and asthma symptoms in children has been studied, the results are not consistent. A reason for the inconsistency could be the use of different indicators for traffic, such as, centralized ambient monitoring, residential proximity, traffic volume, monitoring at homes and modeling. Therefore, there is a need to understand how representative these traffic surrogates are and to compare and validate these different estimates of traffic against measured pollution for the same study subjects .

The study presented to you today evaluates asthma impacts from several indicators of traffic exposure and compares them with outside measurements of NO<sub>2</sub> for the same study subjects within California.

# Population



- ◆ 208 children - from 10 Southern California cities
  - 15 % of children had asthma
  - USC-led Children's Health Study



The investigators studied the pollution asthma link in 208 children selected at random from 10 Southern California communities. 15 percent of these children had asthma.

The communities studied include the cities of Alpine, Atascadero, Lake Elsinore, Lancaster, Long Beach, Mira Loma, Riverside, San Dimas, Santa Maria and Upland. These communities have differing mixtures of traffic air pollution sources and concentrations.

The children in this study are part of the University of Southern California Children's Health Study, which has been funded by the Air Resources Board. The Children's Health study is the longest US investigation into air pollution and children's health. This study has tracked the children's respiratory health since 1993 and is currently being funded by National Institute of Environmental Health Sciences.

# Methods



## MEASURED

- ◆ Distance from nearest freeway to child's home
- ◆ Volume of vehicles 150 meters from home
- ◆ NO<sub>2</sub> samplers outside homes

## MODELED AT EACH CHILD'S HOME

– include weather conditions, vehicle counts

- ◆ Modeled freeway pollution
- ◆ Modeled non-freeway road pollution

## POTENTIAL CONFOUNDERS

- ◆ Included gas stove, maternal smoking, and ETS

In order to study the association between asthma and traffic, the investigators determined the distance from the nearest local freeway to each child's home, as well as how many vehicles traveled within 150 meters of the child's residence.

They placed air samplers outside the homes to measure nitrogen dioxide levels.

They estimated traffic-related air pollution levels using models that include weather conditions, vehicle counts and other important factors. The Model based estimates were done for traffic pollution from freeways and for pollution from non-freeway roads.

The investigators also adjusted for all of the potential confounders that are known to significantly affect respiratory health outcomes including gas stove, maternal smoking, and environmental tobacco smoke.

# Results



<i>Outcome</i>	<i>Measured NO<sub>2</sub></i>	<i>Distance to Freeway</i>	<i>Modeled Freeway</i>
<b>Asthma Prevalence</b>	1.83 (1.04-3.22)	1.89 (1.19-3.02)	2.22 (1.36-3.63)

This study investigated the effects of traffic pollution on asthma prevalence, recent wheeze and medication use by examining associations with different traffic indicators. Asthma prevalence in this study was defined as a reported doctor's diagnosis of asthma during the child's life time. Recent wheeze and medication use were determined by asking whether the child had wheezed or used medication within the last 12 months.

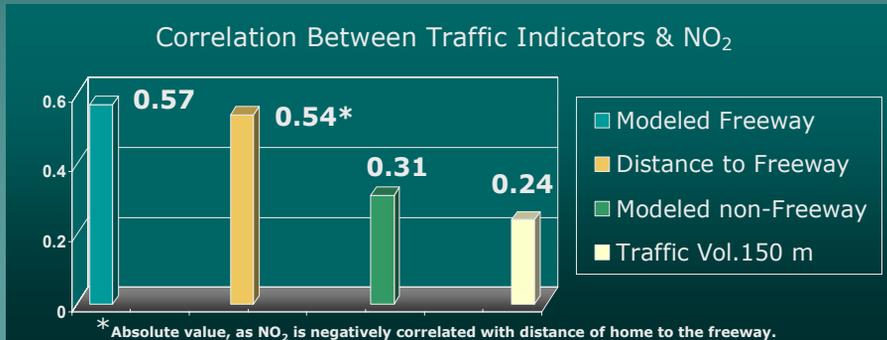
The investigators found an association between asthma prevalence and three indicators of traffic pollution; outdoor NO<sub>2</sub> measurements at the home, proximity to a freeway, and modeled freeway pollutant exposure. Asthma prevalence was not associated with traffic volumes within 150 meters of homes or with modeled pollutant exposure from non-freeway roads.

The investigators also found robust associations between these same three traffic indicators and recent wheeze, and medication use. Again, traffic volumes within 150 meters of homes and modeled non-freeway exposures did not show these associations. Traffic volumes within 150 meters of homes were primarily comprised of traffic from smaller streets.

# Evaluation of Traffic Indicators



- ◆ Estimates of freeway indicators were strongly correlated with measured NO<sub>2</sub> at home
- ◆ NO<sub>2</sub> a product of combustion engines



The study found that NO<sub>2</sub> levels could be used as a traffic indicator. The investigators evaluated the different traffic metrics by correlating these to the measured NO<sub>2</sub> levels at homes. The investigators found that at each community the measured NO<sub>2</sub> concentration was more strongly correlated with estimates of freeway related pollution than with non-freeway road pollution.

As you can observe from the graph, the modeled freeway metric had the highest correlation of 0.57. In addition, as the distance from the home to the freeway increases, the level of NO<sub>2</sub> decreases, just as one would expect, resulting in a correlation of 0.54.

A weaker correlation was seen between measured NO<sub>2</sub> and modeled non-freeway roads and the traffic volume within 150m.

NO<sub>2</sub> is a product of pollutants emitted from combustion engines, such as those in cars and trucks.

# Summary of Results



- ◆ Higher asthma prevalence near freeways
- ◆ Proximity to freeways linked with increased wheezing & asthma medication use
- ◆ Freeway traffic has a strong influence on NO<sub>2</sub> concentrations at homes
- ◆ A traffic indicator - NO<sub>2</sub>

In summary, Dr. Gauderman and his co-investigators found that the closer the child lived to a freeway, the higher the child's asthma prevalence. Children who lived 400 meters from the freeway had an 89 percent higher risk of asthma than children living 1,600 meters away from the freeway.

The proximity to freeway was linked with increased wheezing and current asthma medication use, as well as, with increased measured NO<sub>2</sub> levels.

The researchers determined that air pollution from freeway traffic influenced NO<sub>2</sub> concentrations at homes more strongly than pollution from other types of roads.

The investigators caution that researchers do not know that NO<sub>2</sub> is the cause of asthma. NO<sub>2</sub> travels together with other airborne traffic pollutants, such as particulate matter and other toxics, so NO<sub>2</sub> may be an indicator for other asthma impacting pollutants.

# ARB Ongoing Traffic Studies



## Children

- ◆ Traffic-Related Air Pollution and Asthma in Economically Disadvantaged and High Traffic Density Neighborhoods in Los Angeles County, California
- ◆ Traffic Pollution and Children's Health: Refining Estimates of Exposure for the East Bay Children's Respiratory Health Study

## Elderly

- ◆ Cardiovascular Health Effects of Fine and Ultrafine Particles during Freeway Travel
- ◆ Air Pollution and Cardiovascular Disease in the California Teachers Study Cohort

It is becoming clear that the closer children live to a freeway, the higher the traffic pollution levels are outside their homes. The impact of traffic pollution on children's health is a research priority for the Air Resources Board. The ARB also recognizes that there is a need to study children who live in economically disadvantaged neighborhoods since they may be more susceptible to adverse health impacts from air pollution exposure.

Therefore, ARB is currently funding four studies that will add to the growing body of literature on the effects of traffic on health. The first two studies will investigate the effects of traffic on childhood asthma at the community level mostly in economically disadvantaged neighborhoods. The other studies will examine cardiovascular impacts from traffic in the elderly.

The first study is researching the association between childhood asthma and traffic-related air pollution. This study's objective is to investigate the effects of exposure of the traffic-related pollutants on lung function and asthma by using geostatistical models. This study taps into the Los Angeles Family and Neighborhood Survey. Most of the children participating in this survey live in economically disadvantaged and high traffic density neighborhoods in Los Angeles County, California.

The second study is a refinement of the East Bay Children's Respiratory Health Study. This study will examine the association between traffic pollution and respiratory health among children living and attending schools at varying distances from high-traffic roads in Alameda County, California. This study will address issues of environmental justice for subpopulations who are often highly exposed to traffic. This study will also investigate how well differing traffic indicators correlate and determine which indicator is more representative of traffic pollution.

The last two studies examine the effects of traffic exposure on cardiovascular function in elderly subjects during freeway travel and 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.

We hope to bring the findings of these studies to the board within the near future.

# Concluding Remarks



- ◆ Traffic air pollution associated with asthma in children
- ◆ Freeway a major pollution source in a community
- ◆ Continued research on traffic effects

In conclusion, today's study strengthens an emerging body of evidence that traffic air pollution is associated with childhood asthma and that a freeway is a major source of air pollution within a community.

The Air Resources Board will continue to investigate the impact of traffic pollution on children one of our most sensitive populations.

This concludes our presentation. We will be happy to answer any questions.

Thank you very much.