

CHILDREN'S HEALTH STUDY

Final Report and Major Findings

June 24, 2004

Air Resources Board



California Environmental Protection Agency

Thank you Ms. Witherspoon. Good morning Dr. Lloyd and members of the Board. Today I will be discussing the Children's Health Study, the ARB-sponsored investigation of the long-term health effects of air pollution on children. The investigators at the University of Southern California have submitted a final report that synthesizes the results of over a decade and \$18,000,000 of research. I will summarize major results from the 72 peer-reviewed publications from the study, along with a summary of the future of the study and ARB's continued involvement with it.

The Children's Health Study is a prospective study of nearly 6000 children living in 12 southern California communities of varying ambient air pollution levels. The primary purpose of the study was to determine whether air pollution causes chronic adverse respiratory health effects. Ozone, nitrogen dioxide, acid vapor, and several measures of particulate matter were monitored continuously in each community.

FINDINGS: LUNG FUNCTION GROWTH

- **1% per year deficits in lung function associated with mix of pollutants (PM, NO₂, acids)**
- **More recent study replicated results of the first (also EC and O₃)**
- **Relocation to lower PM10 areas associated with increase in lung function growth**

Gauderman WG et al. 2000. Association between air pollution and lung function growth in southern California Children. *Am J Respir Crit Care Med* 162:1383-1390.

Gauderman WG et al. 2002. Association between air pollution and lung function growth in southern California Children: Results from a second Cohort. *Am J Respir Crit Care Med* 166:76-84.



Avol EL et al. 2001. Respiratory effects of relocating to areas of differing air pollution levels. *Am J Respir Crit Care Med* 164:2067-2072.

In 2001, the investigators reported that children in the communities with the highest levels of PM, NO₂, and atmospheric acidity, as compared to those in the communities with the lowest levels, had reduced lung function growth, about 1% per year. Recently, USC reported results for a second cohort of children which replicate the results found in the first study. This analysis found that higher exposures to elemental carbon in PM_{2.5}, in addition to most of the pollutants from the first study, were significantly associated with slower lung function growth. In addition, ozone was associated with reduced growth in peak flow rate.

Confirmation of reduced lung function growth in the second group significantly strengthens the evidence supporting the adverse effects of air pollution on lung function growth. More importantly, the second cohort indicates that these adverse effects are still occurring at lower pollution levels. The slower lung growth associated with higher exposures to elemental carbon may indicate a specific respiratory effect of diesel PM or other combustion exhaust.

The investigators also found that lung function growth changed if the children in the study relocated to areas with different PM levels. If children moved from a community with high PM to an area with low PM, their lung function growth increased, although this increase may not make up for the adverse effects of their previous exposures.

Conversely, their lung function growth decreased if they moved to areas with higher particle levels. There was also a trend toward an increasing PM effect with increasing length of exposure.

FINDINGS: BRONCHITIS IN ASTHMATICS

- Bronchitic symptoms related to air pollution only in asthmatics
- Association with PM10, PM2.5, organic carbon, NO₂, and O₃

McConnell R, et al. 1999. Air pollution and bronchitic symptoms in southern California children with asthma. *Environ Health Perspec* 107:757-760.

McConnell R, et al. 2003. Prospective study of air pollution and bronchitic symptoms in children with asthma. *Am J Respir Crit Care Med* 168:790-797.



Among asthmatics, PM10 was associated with bronchitic symptoms. The nature of this analysis was cross-sectional, that is exposure to air pollution and reports of bronchitis were assessed at the same time. However, the strength of the Children's Health Study is that the children were followed over time, thus making it possible to evaluate relationships between current symptoms and past air pollution exposures. The investigators took advantage of this aspect of the study to delve further into the pollutants associated with bronchitis in asthmatics. The associations were strongest for PM2.5, organic carbon, nitrogen dioxide, and ozone.

FINDINGS: ASTHMA

- Asthma causation related to high O₃ and exercise
- School absenteeism associated with O₃
- Increases in asthma associated with highest freeway exposure

McConnell R, et al. 2002. Asthma in exercising children exposed to ozone: a cohort study. *Lancet*. 359:386-91

Gilliland FD, et al. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. *Epidemiology* 12:43-54.

McConnell R, et al. 2002. Traffic and asthma prevalence in children. *Amer J Respir Crit Care Med*. 165(8) A492



While we have known for some time that air pollution can exacerbate existing cases of asthma, the Children's Health Study is the first to indicate a possible causal role of air pollution in asthma development. Active children playing multiple team sports in high ozone communities were at three times greater risk of developing asthma. No other pollutants showed this relationship with the development of asthma. These results emphasize the importance of ozone advisories to reduce exposure in children, but need further confirmation.

Ozone exposure was also associated with a substantial increase in school absenteeism from both upper and lower respiratory illnesses. Reducing current ozone levels to meet the state 1-hour standard could prevent 1.3 million school absences annually.

Also of great interest is the relationship between exposure to traffic-related pollutants and asthma. In analyses where local traffic exposure was modeled, the investigators observed marginally significant associations between asthma and traffic-related pollutants at the home, but only when the analysis was restricted to children living at the same address since age 2. In these analyses, large increases in physician-diagnosed asthma reported by the parent were associated with the top 10% of exposure.

FUTURE DIRECTIONS

- **CHS II supported by NIEHS**
 “Childhood Determinants of Lung Susceptibility to Air Pollution”
- **Relationship of air pollution to adverse health outcomes modified by:**
 - **dietary and genetic factors**
- **Relationship to maximum lung function attained**



The investigators at USC have received \$17,000,000 for Children's Health Study II from the National Institute of Environmental Health Sciences. This research builds on the years of data collected by the ARB-funded study and will test the following hypotheses: 1) that dietary intake of fruits, vegetables, and antioxidants affect children's susceptibility for slow lung function growth and increased occurrence of respiratory illnesses from chronic exposure to air pollution, and 2) that polymorphisms in genes involved in lung defenses affect the same outcomes. The study has found preliminary evidence that low intake of antioxidant vitamins such as vitamin C can result in lung function deficits. Also, one of the questions to be answered is if the lung function deficits seen in the children continue into adulthood. Therefore, the investigators will attempt to determine if air pollution is associated with maximum lung function attained.

ARB'S FUTURE INVOLVEMENT

- **Air pollution monitoring equipment**
- **Data release agreement**
 - **Input into research with data collected**
 - **Opportunity for further data analysis**



The ARB will continue to be very involved in the Children's Health Study through two critical components of the study. The first of these is the air monitoring for the study. ARB will enter into an agreement with the investigators to loan them monitoring equipment to continue measuring air pollution in the 12 communities. We have a data exchange agreement with the investigators to remain informed on the latest findings from the ongoing research for the Children's Health Study II.

The second important role for ARB is a formal agreement with USC for a process by which health and exposure data from the Children's Health Study can be released to qualified investigators in order to expand upon our understanding of the relationship between air pollution and children's health.

We look forward to many years of continued useful results and interaction with the investigative team at USC.

Thank you for your attention. And we will be glad to answer any questions.