The following document was submitted “for the record” to the Intermodal Container Transfer Facility (ICTF) Joint Powers Authority (JPA) during the Notice of Preparation/Initial Study (NOP/IS) comment period for the ICTF Modernization and Expansion Project.

The document was submitted by:

Andrea M. Hricko
Assoc Prof Prev Med
Keck School of Med &
Director, Community Outreach and Education
Southern CA Env Health Sciences Ctr
1540 Alcazar Street CHP 236
L.A. CA 90033
323-442-3077

--- End Page ---

USC
UNIVERSITY OF SOUTHERN CALIFORNIA

Keck School of Medicine

Summary of Results from the Children's Health Study
October, 2008

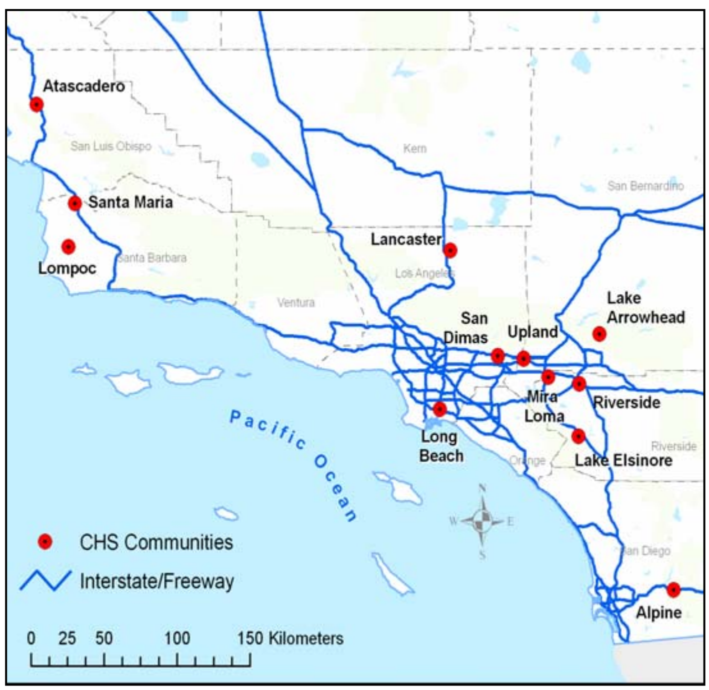
Prepared by: W. James Gauderman, Ph.D.,
Professor, U.S.C. Department of Preventive Medicine

This document is derived from testimony provided by Dr. Gauderman for two different occasions, 1) a field briefing held by Senator Barbara Boxer on October 10, 2007, and 2) a hearing held by California state senator Jenny Oropeza on August 14, 2008.

To breathe or not to breathe? Residents in California and elsewhere have good reason to be worried about the air they breathe. It has long been known that air pollution can adversely affect human health. A classic example is the London fog of 1952, which was characterized by five days of sharply elevated pollution levels, followed by large increases in mortality and respiratory and cardiac disease. Since 1952, we have learned a great deal about the effects of air pollution on health, through both controlled trials and large-scale epidemiologic studies.

Controlled studies, typically conducted in laboratory settings, have demonstrated that air pollution is associated with acute respiratory symptoms (coughing, shortness of breath, etc.) and short-term reductions in lung function. These are the types of health effects one might experience after a day with particularly bad air quality. Large epidemiologic studies, conducted mostly in the United States and Europe, have confirmed the acute effects observed in the lab, but have also demonstrated that air pollution has much longer-term, chronic health effects. In adults, these effects include increased risk of cardiovascular outcomes and mortality, while in children they include increased risk of asthma, respiratory symptoms, and decreased lung function. I will focus on children's health effects in this testimony.

Figure 1: CHS Study Communities



The USC Children's Health Study (CHS)

Since 1993, USC has been conducting the Children's Health Study, a study examining the health effects of breathing polluted air in over 11,000 southern-California children. This research has been supported over the last 14 years by the California Air Resources Board (CARB), National Institute of Environmental Health Sciences (NIEHS), National Heart Lung and Blood Institute (NHLBI), U.S. Environmental Protection Agency (USEPA), and the South Coast Air Quality Management District (SCAQMD). Our initial cohorts of children were recruited from 12 southern California communities (see inset map). These included four communities (Riverside, Mira Loma, Upland, and San Dimas, abbreviated RV, ML, UP, and SD below) in the Inland Valleys, with some of the worst air quality in the nation. We also included lesser-polluted communities outside the Los Angeles Basin to serve as controls.

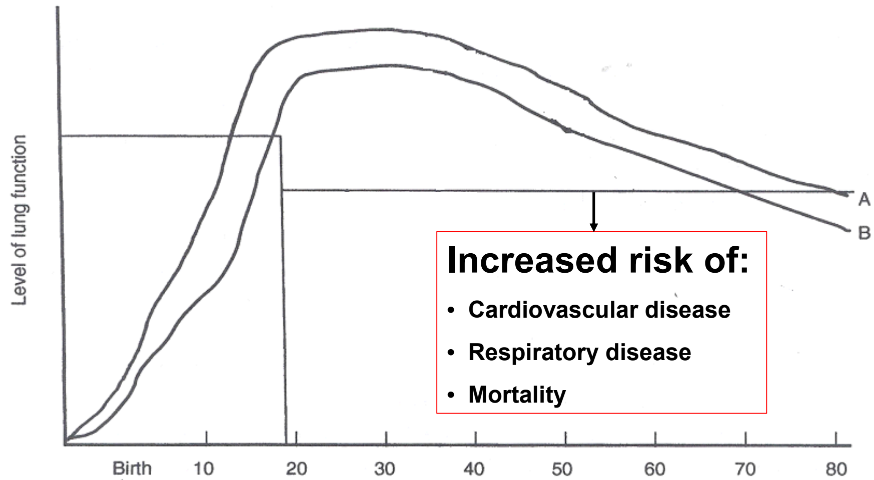
James Gauderman, Ph.D.
Professor

Department of Preventive Medicine

University of
Southern California,
1540 Alcazar St., CHP-220
Los Angeles,
California 90033-9011
Tel: 323 442 1567
Fax: 323 442 2349
JimG@usc.edu

We recruited school-aged children (4th grade or older) and followed them annually through 12th grade to track their asthma status and whether they experienced regular respiratory symptoms (bronchitis, cough, phlegm, etc.). We also tested lung function annually to determine how the children's lungs were developing over their adolescent growth period. As background, the inset figure shows the normal pattern of lung function development throughout life (Curve A), and the pattern for a typical child that experiences reduced development in childhood (Curve B).[1] Lung function is critically important to lifetime health. In fact, reduced lung function later in life has been described as second only to exposure to tobacco smoke as a risk factor for death.[2]

Figure 2: Lung Function over Time



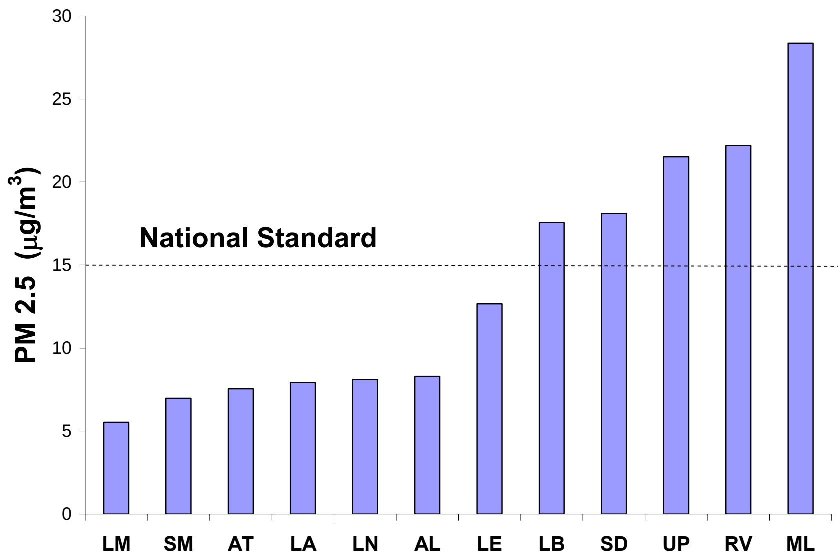
Since the inception of the CHS, we have monitored levels of many air pollutants in each of the 12 study communities, including both gaseous and particulate-matter pollutants. The former includes nitrogen dioxide (NO_2) and ozone (O_3). The latter includes particulate matter with varying aerodynamic diameters defined by cutoffs—for example, diameters of less than 10 microns (PM_{10}) or less than 2.5 microns ($PM_{2.5}$). In southern California, a variety of factors conspire to make levels of these pollutants the highest in the nation (see inset map). These include a large number of sources (ports, traffic, industries), warm temperatures, a generally west-to-east wind pattern, and local mountains that serve to trap the air mass in the valleys. The combination of polluting sources, geography, and meteorology also produce high levels of air pollution in other areas of California, such as the San Joaquin Valley.

Figure 3: Formation of Inland-Valley Pollution

To quantify the issue in southern California, the inset figure shows the long-term average levels of fine particulate matter ($PM_{2.5}$) in our 12 communities. The Los Angeles Basin areas (LB, SD, UP, RV, ML) have substantially higher levels than the outlying study communities, and they exceed the current USEPA standard for $PM_{2.5}$.

But does daily breathing of polluted air adversely affect children's health? The evidence, based on our long-term investigation as well as studies by many other groups, suggests that the answer to this question is "Yes". Some examples from the CHS follow:

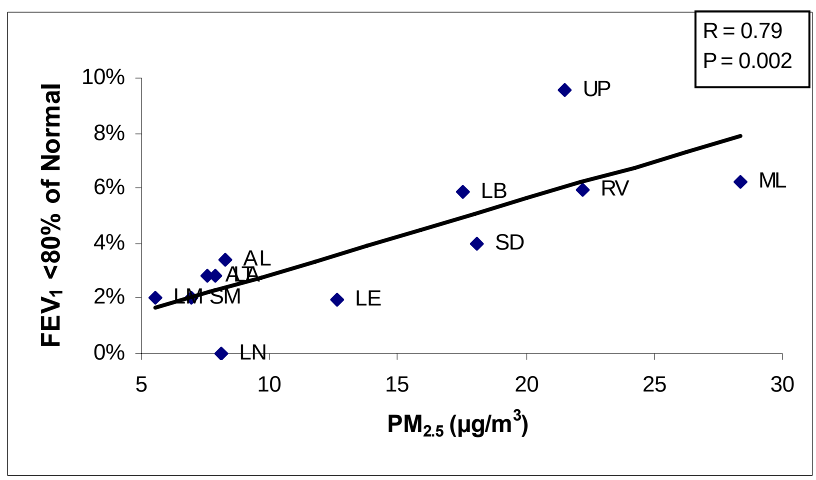
Figure 4: Average $PM_{2.5}$ Levels in 12 CHS Communities



Asthma: Children who play team sports and live in a community with high ozone have a three-times greater risk of developing asthma.[3] In those that have asthma, higher levels of NO_2 and PM are associated with significantly more bronchitic symptoms, including chronic cough and phlegm.[4, 5]

Lung Function: From 4th grade (average age 10 years) to 12th grade (average age 18 years), children living in more polluted communities have significant deficits in their lung function development.[6] These deficits in adolescent growth lead to *clinically significant deficits in attained lung function at age 18*, i.e. lung function that is at least 20% below normal, a deficit that could cause concern to a physician. The inset figure shows the proportion of children at age 18 with clinically (abnormally) low lung function in each community, plotted against that community's average levels of $PM_{2.5}$. The Los Angeles Basin communities (LB, SD, UP, RV, ML) have more children with abnormally low lung function than any of the other, lower-pollution communities. Given the natural course of lung function (see Figure 2), it is likely that those with reduced lung function at age 18 will continue to have low lung function throughout their life, increasing their risk in adulthood of respiratory diseases and mortality.

Figure 5: Abnormally Low Lung Function vs. $PM_{2.5}$



What About Local Exposure to Air Pollution?

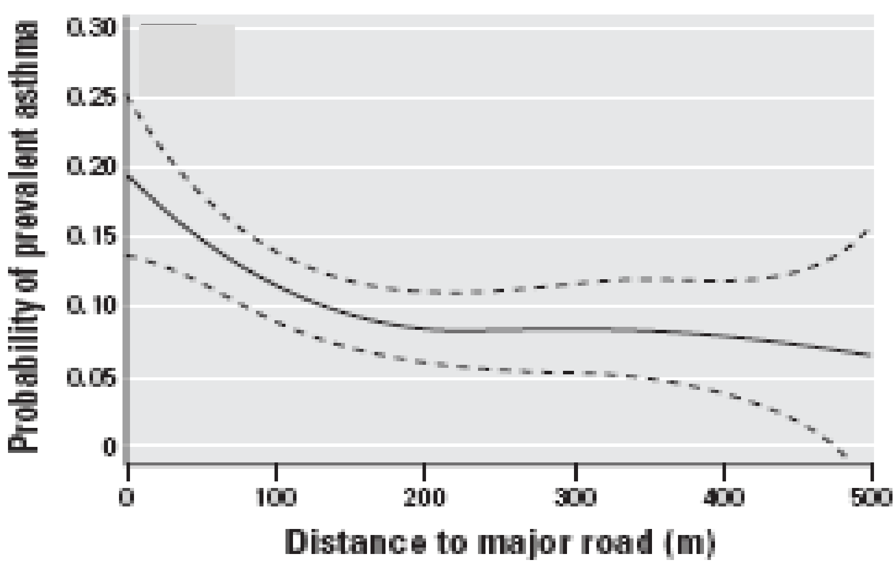
The health effects described above were based on comparisons of polluted communities to unpolluted communities, and implicated the importance of general, regional air quality on health. However, within a given community, there may be important differences in air quality due to local sources. For example, those living near this busy freeway (see inset picture) will be exposed to higher levels of air pollution than those living at greater distances from this road,[7, 8] regardless of the general air quality in this region. There are many specific pollutants known to be elevated near busy roads, including NO_2 and PM. Of special concern are elevated levels of 'ultrafine' particles ($PM_{0.1}$), which are closely linked to exhaust, especially from diesel vehicles. As compared with PM_{10} and $PM_{2.5}$, ultrafine particles have a higher carbon content, larger total surface area, and greater potential for carrying toxic compounds. Because of their small size, these particles can be inhaled deeply into the lung and deposited in the alveoli (smallest sacs) of the lung. Studies have also discovered these ultrafine particles in the bloodstream and the brain. In addition to respiratory disease, ultrafine particles are currently being investigated for their role in cardiovascular disease and neurological conditions such as autism.

Figure 6: Housing Near a Busy So. Cal. Freeway

Most of our 12 CHS study communities are traversed by at least one major freeway. For a child living near a busy road in the Inland Valley, he/she is exposed regularly to direct emissions from vehicles, on top of the high regional air pollution from upwind sources. But does living near a busy road affect children's health? The scientific evidence, both from the CHS and several other studies, suggests that the answer to this question is "Yes". Following are some examples from the CHS.

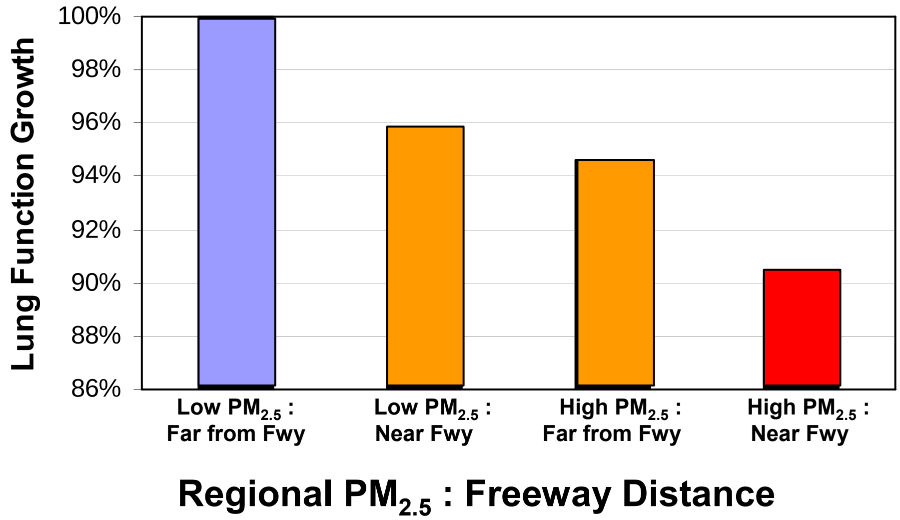
<u>Asthma</u>: We have shown that living near a busy road is associated with significantly increased childhood prevalence of asthma.[9, 10] For example, Figure 7 shows the prevalence of asthma (solid line, with dashed confidence bounds) based on residential distance to a major (freeway or large non-freeway) road. Asthma prevalence was above 15% for children living within 50 meters of a busy road their whole life, nearly double the prevalence for children living at least 200 meters away.

Figure 7: Asthma Prevalence vs. Proximity to Traffic



Lung Function: In a recent report, we demonstrated that children living within 500 meters (about 1/3 of a mile) of a freeway had significant deficits in their lung function development from age 10 to age 18, compared to children living at least 1,500 meters (about 1 mile) from a freeway.[11] Importantly, these deficits due to local exposure added to the deficits due to regional air quality (see inset figure). For example, children living in an L.A. basin community (high regional pollution) and near a freeway (high local pollution) had a 10% average deficit in lung function growth, compared to children in a low pollution area and far from a freeway.

Figure 8: 8-yr Lung Growth for Children in a Low or High Regional $PM_{2.5}$ Area, and Living Far (>1,500m) or Near (<500m) to a Freeway (Relative to "Low" and "Far" Category)



Summary

Many areas of California have poor air quality, with levels of pollution that currently exceed the federal EPA standards. In recent years, there has been increasing activity at the Ports of Los Angeles and Long Beach, with corresponding increases in truck traffic on roadways both in and out of the L.A. basin. Added to this is expansion in population density, further clogging roadways with traffic and resulting in pressure to build homes and schools near busy freeways. The planned expansion of the Ports over the next decades will have an adverse effect on southern California air quality, including both regional air pollution (from upwind port activities) and local air pollution (from increased trucks and other vehicles on local roads).

The Children's Health Study has demonstrated that a variety of important health outcomes in children, including asthma and lung function development, are adversely affected by poor air quality. Our work adds to a growing body of evidence, both from the U.S. and from other countries, that long-term exposure to urban air pollution affects children's health and increases risk of adult disease and mortality. These health effects are occurring at current levels of ambient pollution.

To smoke or not to smoke? To super-size a meal or not to super-size? Decisions about these and many other exposures with potential health impacts are in the hands of the individual. To breathe (polluted air) or not to breathe? Air pollution is an unavoidable exposure for many residents of California. The only way to effectively reduce this exposure at a population level is through general improvements in air quality. This relies on a combination of federal, state, and local regulations, with international considerations also of importance. There have been great improvements over the last several decades in some markers of air quality,[12] and yet negative health effects continue to be observed at current pollution levels. To protect human health, EPA Administrator Stephen Johnson has recently proposed the tightest ozone standard ever. The EPA will also be reviewing the NO_2 and PM standards in coming years and has recognized that local exposures to traffic will be an additional important consideration. Reducing levels of both regional and local air pollution in California is essential. Our health and our children's health depend on it.

References

1. Strachan D. Respiratory and allergic diseases. In A Life Course Approach to Chronic Disease Epidemiology. In: Kuh D, Ben-Shlomo Y, eds. Oxford: Oxford University Press, 1997:101-20.
2. Hole DJ, Watt GC, Davey-Smith G, Hart CL, Gillis CR, Hawthorne VM. Impaired lung function and mortality risk in men and women: findings from the Renfrew and Paisley prospective population study. Bmj 1996; 313:711-5; discussion 715-6.
3. McConnell R, Berhane K, Gilliland F, et al. Asthma in exercising children exposed to ozone: A cohort study. Lancet 2002; 359:386-91.
4. McConnell R, Berhane K, Gilliland F, et al. Air Pollution and Bronchitic Symptoms in Southern California Children with Asthma. Environ Health Perspect 1999; 107:757-760.
5. McConnell R, Berhane K, Gilliland F, et al. Prospective Study of Air Pollution and Bronchitic Symptoms in Children with Asthma. Am J Respir Crit Care Med 2003.
6. Gauderman WJ, Avol E, Gilliland F, et al. The effect of air pollution on lung development from 10 to 18 years of age. N Engl J Med 2004; 351:1057-67.
7. Zhu Y, Hinds WC, Kim S, Sioutas C. Concentration and size distribution of ultrafine particles near a major highway. J Air Waste Manag Assoc 2002; 52:1032-42.
8. Zhu Y, Kuhn T, Mayo P, Hinds WC. Comparison of daytime and nighttime concentration profiles and size distributions of ultrafine particles near a major highway. Environ Sci Technol 2006; 40:2531-36.
9. Gauderman WJ, Avol E, Lurmann F, et al. Childhood asthma and exposure to traffic and nitrogen dioxide. Epidemiology 2005; 16:211-220.
10. McConnell R, Berhane K, Yao L, et al. Traffic, susceptibility, and childhood asthma. Env Health Perspect 2006; 114:766-72.
11. Gauderman W, Vora H, McConnell R, et al. The Effect of Exposure to Traffic on Lung Development from 10 to 18 Years of Age. Lancet 2007; 367:571-77.
12. Anonymous. Air Emission Trends - Continued Progress through 2004: www.epa.gov/airtrends.

13. Thanks to Dr. Cheryl Faucett, Andrea Hricko, and Jennifer Grodsky for helpful comments.