

Health Update

Association Between Exposure to Traffic and Heart Disease

February 24, 2005



Air Resources Board
California Environmental Protection Agency

Good morning Madam Chairman and members of the Board.

Our Health Update today will be on the Association between Exposure to Traffic and Heart Disease.

Background

- Long-term exposure to PM associated with increased deaths from heart and lung disease, including lung cancer
- Living near a major roadway associated with increased death from heart and lung disease
- Particle counts and black carbon increase by a factor of 30 near 405 and 710 freeways
- In-vehicle exposures important to overall exposure to vehicle-related pollutants



2

In previous presentations, we reported that investigators of several studies found that long-term exposure to particulate air pollution is associated with increased death from heart and lung disease, and from lung cancer. This finding was the foundation for the Board's new annual-average PM10 and PM2.5 ambient air quality standards, adopted in 2002.

The investigators compared many cities with different ambient air pollution levels, using the assumption that exposure is approximately uniform within each city. This assumption, however, may not accurately reflect exposure to pollutants with important local sources. One of these sources is traffic. For example, investigators in the Netherlands reported that traffic density and distance to major roadways are associated with death from heart and lung disease within a city.

Traffic in California is a source of local pollutants. For example, studies by UCLA and USC investigators found a large increase of approximately 30-fold in the levels of particulate matter from vehicle exhaust immediately adjacent to and downwind of the 405 and 710 freeways. There was a rapid decrease in concentration on the downwind side of the freeways to near background levels within about 500 feet.

In December, ARB staff presented results showing that for a typical commuter, the in-vehicle exposure to traffic-related pollutants while travelling on freeways can represent more than 50% of their daily exposure to ultrafine PM.

Since pollutant levels are highest on the freeways themselves, a natural question to ask is what is the risk of heart disease associated with daily commutes, which is the subject of the two recent studies we will present today.

Heart Attack Study

- 691 heart attacks in Augsburg, Germany
- Activities for previous four days before heart attack
- Traffic exposure – time spent in cars, public transportation, motorcycles, bicycles
- Traffic exposure results in threefold increase in risk of heart attack within one hour



Peters et al., "Exposure to Traffic and Onset of Myocardial Infarction (MI)"
New England Journal of Medicine. 351: 1721-1730, 2004

3

In the first study, German investigators focused on residents of Augsburg, a city of about 280,000 residents located near Munich, who experienced non-lethal heart attacks over a two-year period. Air pollution exposure information was not reported and the subjects were interviewed and asked to recall in detail their activities that preceded the heart attack.

The investigators found that there was a significant association between heart attacks and traffic exposure – whether traveling in a vehicle, using public transportation, or on a motorcycle or bicycle. The risk was greatest – a threefold increase – when traffic exposure occurred one hour before the heart attack.

This is an intriguing result although it measures only one health endpoint. Other symptoms of heart disease, such as angina and ischemia, may also be occurring but were not studied. In addition, the authors indicate that confounding factors such as stress and noise can also contribute to the reported effects.

State Trooper Study

- Nine healthy North Carolina State troopers
- Studied 3 p.m. to midnight shift for 4 consecutive days
- In vehicle air pollutants measured, heart measurements, blood chemistry measured



Riediker et al., "Particulate Matter Exposure in Cars is Associated with Cardiovascular Effects in Healthy Young Men" *American Journal of Respiratory and Critical Care Medicine*, 169: 934-940, 2004.

4

Investigators of the next study measured PM exposure and its association with cardiovascular effects. Nine healthy North Carolina State Troopers were monitored using real-time electrocardiographs. The volunteers were males ages 23 to 30, non-smokers, and had shifts from 3 pm to midnight. They were asked not to consume alcohol or medications during the 5-day study period. Real-time measurements of PM_{2.5} and other pollutants were conducted in three locations – inside the vehicles, on the roadside, and in the community.

State Trooper Study Results

- In-vehicle PM2.5 associated with:
 - changes in blood markers for inflammation and coagulation (up to 20%)
 - increase in heart rate variability
 - seen a few hours after exposure
- Most health endpoints associated with braking, accelerations, and possibly diesel emissions*



* Riediker et al. Cardiovascular effects in patrol officers are associated with fine particulate matter from brake wear and engine emissions, *Particle and Fibre Toxicology*, 1: 1-10, 2004.

5

In-vehicle PM2.5 levels were associated with significant changes in markers of inflammation, blood coagulation, and cardiac rhythm, which are possible indicators for increased risk of heart disease. These effects were observed a few hours after the pollution exposure period. The PM2.5 levels were below the federal 24-hour average standard of 65 micrograms per cubic meter of air.

In a companion publication, these investigators also reported that most health endpoints were associated with the components of PM2.5 containing copper, aldehydes, and sulfur – which reflect the wear of brakes, the acceleration of vehicles, and possibly diesel combustion, respectively. The results from this study are important since this establishes a link between PM2.5 and its source--vehicular traffic.

Concluding Remarks

- Traffic exposure associated with heart attacks
- In-vehicle exposure to PM_{2.5} associated with heart disease risk factors
- ARB-funded study to determine if gasoline and diesel PM_{2.5} and ultrafine particles associated with health-related effects
- Diesel and other particle controls for vehicles will improve health for commuters and those living near roadways



6

The studies presented today provide evidence for an association between exposure to traffic and its pollutants and increased risk of heart attacks and heart disease risk factors, even in healthy, young adults.

An important question is how these effects translate to the California environment, where traffic pollution is typically high and commutes are relatively long. Last month, the Board approved a study that will examine cardiovascular health effects from exposure to fine and ultrafine particles during freeway travel. Investigators from UCLA will study sixteen healthy volunteers, greater than 50 years of age, who will be exposed to normal traffic pollutants while riding on the freeway. One commute will be on a freeway that has primarily gasoline-fueled vehicles, while another commute will be on the 710 freeway, with midday peaks of approximately 25 percent diesel traffic. To separate out the effects of stress and noise, identical commutes with the same volunteers will be conducted using an air filter on the vehicle to remove particles. Detailed blood chemistry, markers for inflammation, as well as electrocardiograms will be evaluated for all scenarios for the volunteers. Results are expected in about two and a half years.

In summary, traffic appears to be an important source of PM that can be associated with cardiovascular health effects. It is becoming clear that diesel and other particle controls for vehicles may improve the health of commuters and those living near freeways and other major roadways.

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

Thank you very much.