

THE HEALTH IMPACTS OF COARSE PARTICULATE MATTER



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Air Resources Board

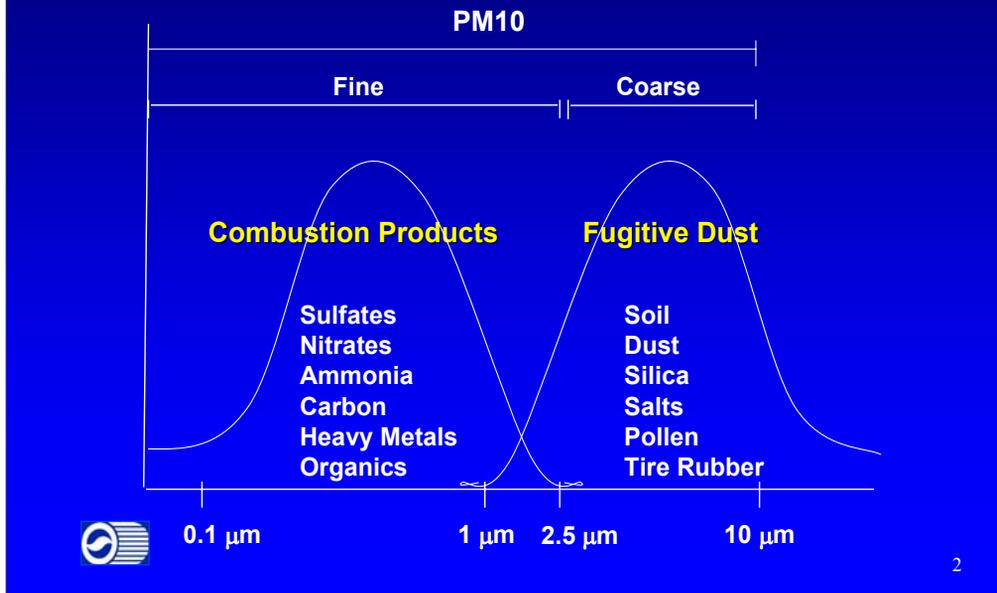


California Environmental Protection Agency

Thank you Ms. Witherspoon. Good morning, Dr. Sawyer and members of the Board.

In this health update, I will discuss the results from an important study evaluating the association between coarse particle air pollution and heart rate variability among older adults in California's Coachella Valley.

Particulate Matter 10 Air Pollution Size and Composition



Particulate matter of 10 microns or less (or PM10) is a mixture of coarse and fine particles. Coarse particles measure between 2.5 and 10 microns in diameter and are comprised of particles such as dust, sand, and nonexhaust vehicle emissions like tire rubber. Coarse particles can have biological substances such as pollen, fungi, and endotoxins on their surfaces. Endotoxins are toxic substances released by some bacteria. The source and composition of PM varies greatly by region. For example, coarse particulate matter is highly correlated with PM10 in desert and some agricultural regions but not in urban areas.

PREVIOUS STUDIES



- **Short-term exposure to coarse PM can increase:**
 - **Cardiovascular and total deaths (*PM source and composition dependent*)**
 - **Respiratory and cardiac related hospital admissions**
 - **Inflammatory effects**
- **No health effects from long-term exposure to coarse PM found**



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Although many peer reviewed studies have examined the effects of particulate matter on health, few have specifically addressed coarse particles. The health effects identified from these coarse particle studies appear to result from mainly short term exposures.

Some of these studies have found coarse particle-related increases in cardiovascular and total deaths. These findings were stronger in desert regions. A previous population-based study in the Coachella Valley found a 2% increase in daily cardiac-related deaths per 10 microgram per cubic meter increase in estimated Coarse PM levels. Similar results were found in another study in Phoenix, AZ. These increases in cardiac deaths could be due to the unique source and composition of particles in the desert. Studies examining coarse particles in urban areas have generally not found strong associations with death, perhaps because the pollution is dominated by combustion-generated fine particles. A study in Mexico City found an increase in daily deaths in relation to increases in coarse particles. It is thought that the toxicity of coarse particles in this urban area could be due to biological elements of these coarse particles.

Studies in several areas have found that coarse particles are a strong predictor of respiratory-related hospital admissions. Other research found that coarse particles are also associated with cardiac-related hospital admissions.

Some toxicological studies indicate some coarse particles are capable of eliciting inflammatory effects and oxidative damage.

Of the few studies examining long-term exposure to particulate matter and incidence of death, only one has found some evidence of association with Coarse particles. That study was conducted in a very specific and sensitive population.

I am now going to focus my discussion on this current study performed by Dr. Lipsett and colleagues in the Coachella Valley and its implications for public health protection.

THE COACHELLA VALLEY



- **400,000 permanent residents**
 - **At least 200,000 seasonal residents**
- **Air pollution dominated by coarse particulate matter**



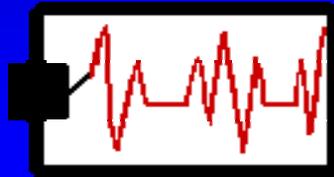
Lipsett MJ, Tsai FC, Roger L, Woo M, & Ostro BD. Coarse Particles and Heart Rate Variability among Older Adults with Coronary Artery Disease in the Coachella Valley, California. *Environmental Health Perspectives*, 114 (8), 1215-1220, Aug. 2006.

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The Coachella Valley is a popular desert resort and retirement community east of Los Angeles. This arid valley is home to over 400,000 year-round residents, hundreds of thousands of seasonal residents, and is also a popular vacation destination. Like much of the Southwest, particulate matter in the Coachella Valley is dominated by coarse particles. On windy days, up to 95% of particles are coarse. Approximately 60% of the PM mass is geologic in origin, that is dust and soil, while only 8% originates from vehicles.

HEART RATE VARIABILITY (HRV)

- **Measure of the heart's ability to respond to stress**
- **Decreased HRV linked with increased risk of cardiac disease and death**



The study focused on 19 senior citizens with heart disease who were living in the Coachella Valley. Participants wore heart monitors 24 hours a day, 1 day a week for up to 12 weeks during the spring of 2000. The heart monitor data was examined for changes in heart rate variability. Heart rate variability is a measure of the beat-to-beat changes in heart rate and is an indicator of the heart's ability to respond to stress. Decreased heart rate variability is associated with an increased risk of cardiac disease and death. In this study, ambient measurements of Coarse PM were compared to changes in heart rate variability.

Coarse Particle-Associated Decreases in Overall HRV per 10- $\mu\text{g}/\text{m}^3$ increase in PM



The researchers found a significant decrease in heart rate variability associated with Coarse PM levels. That is, on average, the heart of each senior was less able to adjust its rhythm in response to environmental stimuli. This graph shows decreases in heart rate variability in relation to pollutant averaging time. Notice how the strength of the effect between Coarse PM and overall variability increased as the pollutant averaging time was increased; this effect continued through 6 hour averaging, disappearing completely at 24 hours. All these averaging times except for 24 hours were statistically significant. It is important to note that the 4% decrease in variability at 6 hours would have been missed if only the 24 hour average had been used. This suggests that the effects from Coarse PM occur in a relatively close time period after exposure.

CONCLUSIONS



- Coarse PM poses health hazard
- Effects found when using short averaging time
- Regulated by PM10 standards
- Further coarse PM research needed



Findings from this small but elegant study underline the significance of exposure to coarse particulate air pollution and add to the growing body of evidence that short-term exposure to coarse particles can be hazardous to public health. The fact that the health effects were apparent only when using averaging times shorter than the standard 24 hours indicates the health effects may be short-term as well. Further study is needed to more clearly define risks to public health. In California, coarse particles are controlled to attain the PM10 standards. You may recall that last year the United States Environmental Protection Agency considered adopting a short-term Coarse PM standard for urban areas but not for rural areas. Ultimately, they dropped the idea and decided to rely on a short-term PM10 standard. When the ARB established its PM2.5 standard in 2002, it retained the State PM10 standards. European decision makers also left PM10 standards unchanged. Results from this and other studies demonstrate that some short-term effects from Coarse particles can have significant health effects. Coarse PM will be an important focus for future particulate pollution research efforts.

Thank you.