Identifying Characteristics of Air Pollutants Associated with Heart Disease Indicators

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Air Resources Board
California Environmental Protection Agency

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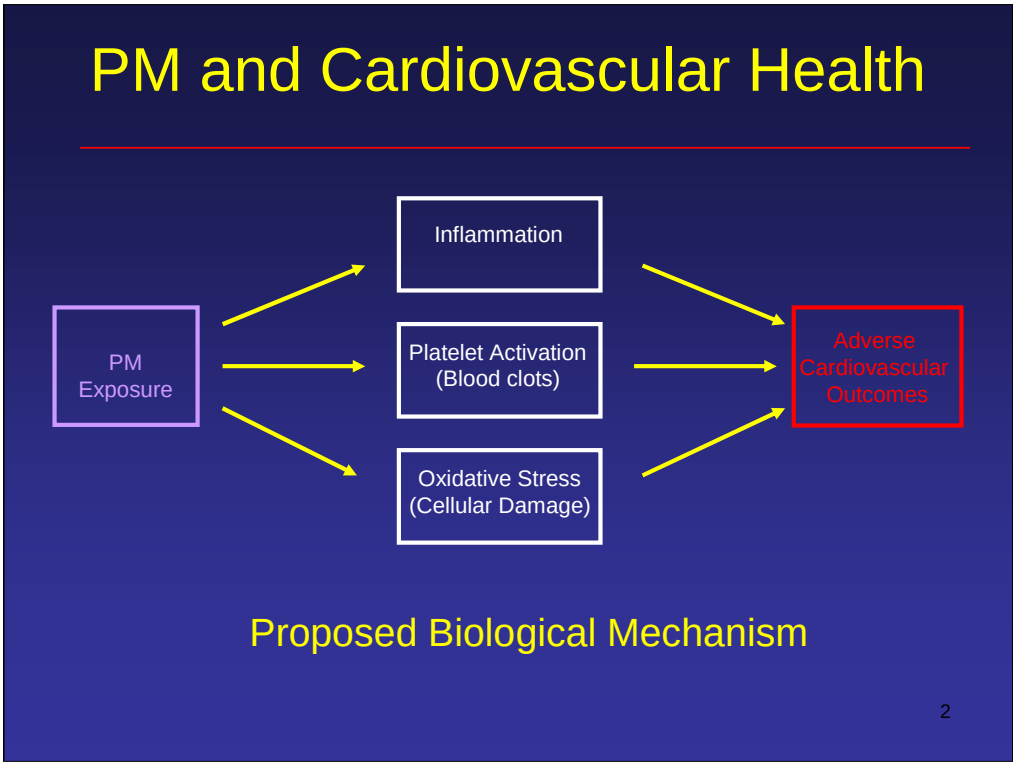
Thank you Mr. Goldstene.

Good morning, Chairman Nichols and members of the Board.

As discussed in previous health updates, many studies have shown that environmental exposure to particulate matter air pollution is associated with increases in cardiovascular related hospitalization and mortality.

One of the most susceptible populations includes elderly individuals with preexisting cardiovascular disease that places them at a high risk for heart attacks or stroke.



The exact molecular mechanisms linking particulate matter or “PM” exposure to cardiovascular health are not known.

However, many recent studies are beginning to suggest possible pathways.

First, it has long been known that the risk of cardiovascular disease is associated with increased inflammation, platelet activation, which may lead to blood clots, and oxidative stress, which is linked to cellular damage. **(CLICK).**

The degree of these three types of cellular injury can be determined by measuring specific biochemicals in the blood.

These biochemicals are known as biomarkers, and even acute changes in biomarker levels present an increased risk for individuals currently diagnosed with heart disease.

PM exposure has also been associated with increased levels of these biomarkers **(CLICK),** and it has been proposed that *chronic* PM exposure can promote cardiovascular events like heart-attacks and strokes through long-term elevation of these biomarkers.

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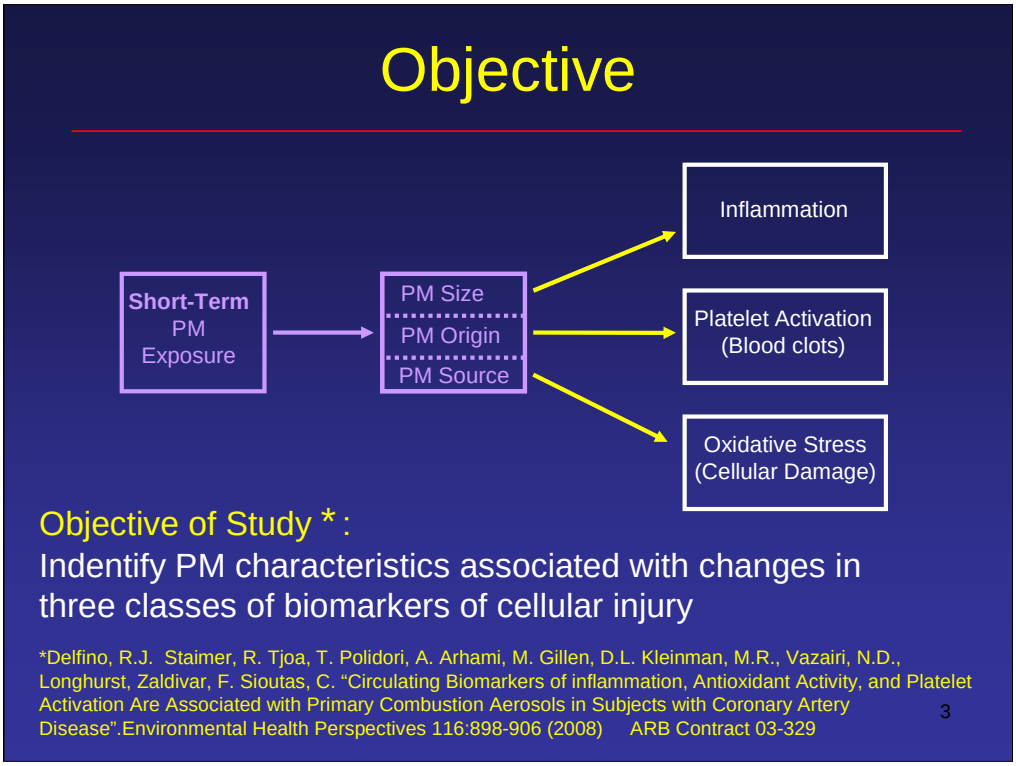

Today's health update focuses on the *acute* effects of short-term PM exposure to determine the temporal relationship between changes in PM exposure and biomarker levels.

While this relationship has been observed in several studies, it is unknown what specific properties of PM can be linked to changes in biomarker levels.

In today's study, Dr. Ralph Delfino and his colleagues at the University of California at Irvine, focuses on PM characteristics such as source, size, and origin.

They investigated the relationships between changes in these PM characteristics and biomarker levels in a panel of elderly subjects with preexisting cardiovascular disease.

This work was partially funded by the ARB, the National Institute of Environmental Health Sciences and the South Coast Air Quality Management District.

Methods

- 29 elderly adults in Southern California with coronary artery disease
- Blood analyzed for three classes of biomarkers
- PM characterization
  - PM mass for different size fractions
    - Quasi-ultrafine (≤0.25μm)
    - "Fine" (0.25-2.5μm)
    - Coarse (10-2.5μm)
  - Particle number
  - PM source: primary vs. secondary
  - PM origin: indoor vs. outdoor

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This study followed 29 elderly adults living in retirement homes in Southern California.

They ranged in age from 71 to 96 years old, and the average age was 85.

All subjects had a confirmed diagnosis of coronary artery disease, were non-smokers, and were ambulatory enough to complete simple tasks.

Blood samples were obtained weekly over 2-six week periods, one during the summer, and the other during the fall.

These samples were analyzed for biomarkers of inflammation, platelet activation, and oxidative stress.

In addition, during the same periods, PM samples were collected both inside and outside the retirement homes where the subjects resided, and were characterized by size, particle number, source, and origin.

Results

Changes in biomarker levels most consistently associated with:

- Ultrafine PM (≤0.25μm)
- Primary combustion PM (elemental and organic carbon)
- Particle number
- PM2.5 components originating outdoors

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Statistical comparisons between changes in biomarker levels and PM characteristics revealed consistently higher associations with certain identifiable characteristics.

These included quasi-ultrafine PM, defined by the study's authors as PM less than 0.25 microns in diameter.

Other associations were with fine PM from primary combustion sources, particle number, and components of fine PM originating outdoors.

Conclusion

- Traffic-related pollutants can lead to changes in biomarker levels
  - –Ultrafine PM, primary organic and elemental carbon
- Exposure to these components of PM may lead to acute adverse health outcomes in elderly people with cardiovascular disease

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Based upon these results, the authors concluded that changes in biomarker levels are strongly associated with acute exposures of PM that have characteristics similar to traffic-related pollutants; in particular, ultrafine PM and those from outdoor primary combustion.

Thus, exposure to these types of PM may lead to adverse health effects in people with a history of cardiovascular disease.

This concludes my presentation, and we will be happy to answer any questions.