

Recent California Studies on Indoor and Personal Exposure to PM



ARB Board Meeting

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California Environmental Protection Agency
 Air Resources Board

Thank you, Ms. Witherspoon, and good morning, members of the Board.

Today, I will summarize a few of the key findings from two new California studies of personal and indoor PM exposure. This picture shows the type of personal exposure monitor that the study subjects wore or kept nearby at all times.

Personal, Indoor, and Outdoor PM Exposure Studies

- ARB and U.S. EPA funding
- 15 COPD patients and 17 healthy subjects
- Los Angeles: coastal and inland homes in winter and summer
- Measurements:
 - Pollutants: PM10, PM2.5, chemical components
 - Ventilation and other housing characteristics
 - Time-activity diaries

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The ARB and U.S. EPA co-funded two studies of indoor and personal exposure to PM in California. These were among a dozen U.S. studies conducted to help understand the relationships among indoor, outdoor, and personal exposure. The California studies focused on the contribution of indoor and outdoor sources to personal exposures.

The first study recruited 15 patients with chronic obstructive pulmonary disease, or COPD, which is a sensitive subpopulation of special interest. The second study recruited 17 healthy subjects.

All subjects lived in the Los Angeles area, and the sample included both coastal and inland locations, and households of ethnic diversity. Investigators measured PM10, PM2.5, and chemical components of PM2.5, both inside and outside the homes and in the personal breathing zone. Other measurements included building ventilation rates, and other housing characteristics such as the type of heating and cooking appliances and local traffic. The subjects kept daily time-activity diaries, noting any events that involved combustion or other PM sources.

Results

- **COPD: Personal PM2.5 > than indoor; indoor = outdoor PM2.5 levels**
- **COPD: Indoor PM2.5 -- Winter > Summer, Inland > Coastal**
- **Healthy: Higher individual variability in PM2.5 levels**
- **Healthy: Personal PM2.5 more strongly associated with indoor PM2.5**

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The results for the COPD subjects show that, on average, personal PM2.5 concentrations across the week were greater than indoor concentrations. Indoor concentrations were about equal to outdoor concentrations. No significant indoor sources or factors were associated with personal exposures, except for others smoking nearby. This was due to the minimal time that the COPD subjects spent on indoor activities such as cooking and cleaning.

Overall, indoor PM2.5 concentrations were higher in winter than in summer, and higher in inland communities compared to coastal areas. This reflects the lower ventilation rates in the winter season, and the higher outdoor PM2.5 levels in inland areas.

In the study of healthy subjects, the results suggest that personal and indoor PM2.5 had more individual-specific variability across the week, compared to the COPD patients. This was due to the healthy subjects being more active indoors. Cleaning and cooking activities were significantly associated with increased personal PM2.5 exposures, while window opening was associated with lower personal exposures.

Finally, personal PM2.5 was more strongly correlated with indoor PM2.5 than outdoor PM2.5. This reflects the influence of personal activities and proximity to indoor PM sources on personal exposures.

Indoor PM2.5 Toxicity

- **Study Design:**
 - Indoor and outdoor PM2.5, 14 paired samples, 9 Boston homes
- **Results:**
 - Lung cell inflammatory mediator higher with indoor vs. outdoor PM2.5
- **Conclusion:**
 - Indoor PM toxicity may be higher than outdoor PM toxicity, may be due to indoor PM sources

I would also like to mention a recent study from Harvard University that compared the toxicity of indoor and outdoor PM2.5 in lung cell cultures. The investigators collected 14 paired samples of indoor and outdoor PM2.5.

Nine Boston homes were sampled for one week in the spring, summer, or fall, or winter.

The results showed that the concentrations of an inflammatory mediator in the lung cells were much higher when the cells were treated with indoor PM2.5, compared to outdoor PM2.5.

The investigators concluded that indoor PM toxicity may be higher than outdoor PM toxicity, and that this may be due to indoor PM sources.

Implications

- **Indoor PM sources have a substantial effect on personal exposures**
- **Substantial individual variability during the day and week, due to air exchange rates and indoor activities and sources, must be considered for accurate exposure and risk assessment**
- **Further research on indoor PM toxicity and exposure are needed**

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In conclusion, the results of these studies have important implications for PM exposure assessment and interpretation of health studies. They show that the individual's proximity to indoor PM sources has a substantial effect on personal exposures. In addition, personal PM exposure has substantial individual variability during the day and week, due to short-term changes in air exchange rates and indoor activities and PM sources. This variability must be considered for accurate exposure and risk assessment. Finally, results from these studies indicated that further research on indoor PM toxicity and exposure are needed.

Thank you for your kind attention.