Pilot Study on Secondhand Smoke Exposure in Homes

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Introduction

- With the increasing normative trend of smoke-free policies in worksites and public places such as bars and restaurants, the primary source of secondhand smoke for most people is the home
- In 2001-2002, the Census Bureau's Current Population Survey data found that 34% of U.S. homes did not have a smoke-free policy

Harmful Effects of Secondhand Smoke

- Acute, immediate cardiovascular effects
- Heart disease
- Lung cancer
- Increased risk of SIDS, respiratory infections, ear problems, asthma and slowed lung growth in children
- Developmental defects, pre-term delivery, and cancer among children and infants

Air Monitoring Methods

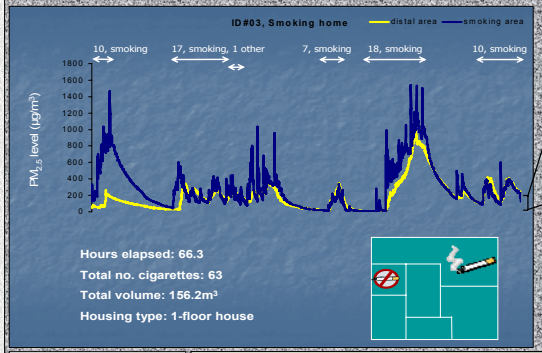
- Cigarettes and other smoked tobacco products emit particulate matter less than 2.5µm in diameter ($PM_{2.5}$) which are easily inhaled deeply into the lungs
- $PM_{2.5}$ is used as a marker for exposure to more than 4,000 compounds found in secondhand smoke
- The TSI SidePak AM510 Personal Aerosol Monitor was used to measure $PM_{2.5}$ in 10 smoking homes and 3 smoke-free homes
- Among smoking homes (n=10), one air monitor was set up in the primary smoking area of the home, and one air monitor was set up in a distal area
- Among smoke-free homes (n=3), one air monitor was placed in the kitchen and the other in a distal room

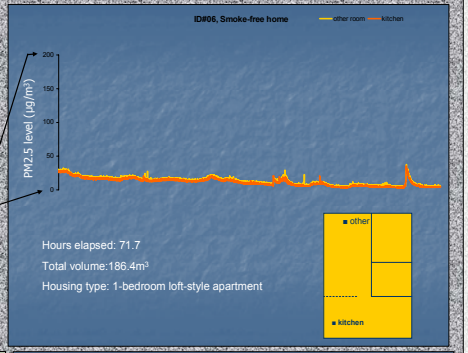
The EPA has set $PM_{2.5}$ standards for outdoor air

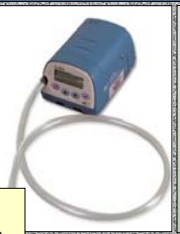
An average annual exposure level of 15µg/m³ and 24-hour exposure level 65µg/m³ were set in an effort to protect the public's health

Air Quality Index Levels of Health Concern	$PM_{2.5}$ (µg/m³)	Meaning
Good	≤15	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	16-40	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	41-65	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	66-150	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	151-250	Health alert: everyone may experience more serious health effects.
Hazardous	≥251	Health warnings of emergency conditions. The entire population is more likely to be affected.

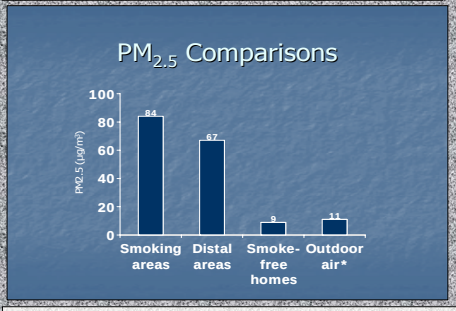
Examples of Real-Time Data Plots







- *The average PM2.5 level among smoking areas was almost 10 times higher than that in smoke-free homes*
- *The average PM2.5 level among the distal areas was almost 8 times higher than that in smoke-free homes*
- *The average PM2.5 level among smoking areas was only 24% greater than that in the distal areas, showing no protection in the distal areas*



ID	Smoking status	Hours	Total number of cigarettes smoked	Total living space volume (m3)	Average PM2.5 level in smoking area	Average PM2.5 level in distal area	Average PM2.5 level overall (smoke-free)
1	smoker	76.0	22	125.6	39.3	37.9	N/A
3	smoker	66.3	63	156.2	284.8	194.0	N/A
4	smoker	73.7	36	170.1	Invalid	110.5	N/A
5	smoker	65.9	63	85.0	117.5	59.6	N/A
7	smoker	71.1	92	236.5	73.9	58.8	N/A
10	smoker	70.4	83	225.2	26.8	17.1	N/A
12	smoker	71.5	26	164.8	22.6	13.9	N/A
13	smoker	77.9	18	250.4	35.8	24.8	N/A
8	smoker	71.1	22	30.9	92.0	95.8	N/A
9	smoker	71.5	13	49.0	59.5	62.1	N/A
2	non-smoker	70.9	N/A	83.2	N/A	N/A	6.4
6	non-smoker	71.7	N/A	186.4	N/A	N/A	12.4
11	non-smoker	77.5	N/A	253.1	N/A	N/A	6.9
average		71.9	43.8	155.1	83.6	67.4	8.6
MIN		65.9	13.0	30.9	22.6	13.9	6.4
MAX		77.9	92.0	253.1	284.8	194.0	12.4

*Average outdoor PM2.5 level for 2006 in Erie County as measured by the U.S. EPA Federal Reference Method, http://www.epa.gov/air/data accessed on August 28, 2006

**ID#8 and ID#9 were efficiency apartments without much physical barrier between the smoking and distal area monitors, which explains why the PM2.5 levels are similar between the two monitors

Log Data Collection

- Participants kept a log of smoking behavior, cooking behavior, use of heating or cooling appliances and window placement (open/closed)
- This log data was matched with the real-time air monitoring data to explain $PM_{2.5}$ levels

Duration

- The average time that the monitors ran in the home was 72 hours

Living Space Volume

- Room dimensions were measured to assess the volume of the living area
- Among smoking homes, the average smoking room volume was 32m³ and that of the distal areas was 31m³
- The average total household volume among smoking homes was 149m³ and among smoke-free homes it was 174m³

Cigarettes

- The average number of cigarettes smoked in the smoking areas of smoking households was 33 (range, 13 to 62) cigarettes
- The average number of cigarettes smoked throughout the home was 44 (range, 13 to 92) cigarettes

$PM_{2.5}$ Levels

- In smoking households, among smoking rooms, the average $PM_{2.5}$ concentration was 84µg/m³, approximately 24% greater than that for the distal rooms and almost 10 times greater than that for the smoke-free homes
- In smoking households, among the distal rooms, the average $PM_{2.5}$ concentration was 67µg/m³, almost 8 times greater than that for the smoke-free homes
- The smoke-free homes' average $PM_{2.5}$ concentration overall was 9µg/m³

Note: We applied a calibration factor of 0.32 to the Sidepak data, which is appropriate for secondhand smoke

Conclusions and Implications

- All smoking homes, regardless of living space volume or number of cigarettes smoked, had $PM_{2.5}$ levels which fall into an unhealthy range of the EPA recommendations for outdoor air
- Levels of $PM_{2.5}$ were elevated throughout the home, as shown by the distal area monitors, and the secondhand smoke was not restricted to just the active smoking area
- Anyone residing in homes where there is active smoking is exposed to unhealthy air which can lead to undesirable health consequences
- The ideal solution to protect everyone living in the home is for the smokers to quit and for the occupants to institute a smoke-free home policy
- **Regardless of the smoking status of household members, the institution of a smoke-free home policy can protect occupants from harmful secondhand smoke in their living space**

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