

Factors Influencing Particulate Matter Inside and Outside Homes in a Rural County

B. Pavilonis, W. Sanderson, M. Humann, P. O'Shaughnessy, K. Kelly, G. Moore, J. Merchant

Department of Occupational and Environmental Health, The College of Public Health, The University of Iowa

Introduction

Epidemiological evidence suggests a strong association between exposure to high concentrations of particulate matter (PM) and morbidity and mortality. Vulnerable populations such as children, the elderly and asthmatics are at an increased risk of adverse health effects due to their physiology and health status. While numerous studies have been performed to quantitatively assess exposure to PM in urban areas, few studies have been done exclusively in rural communities. Compared to urban areas, the composition of PM in rural environments is markedly different. Ambient air in rural environments typically has higher concentrations of endotoxins and organic dusts, both of which are powerful respiratory irritants.

Study Objectives

1. Determine which home characteristics significantly influence indoor PM concentrations.
2. Evaluate how seasonality affects indoor and outdoor PM concentrations.
3. Assess the influence of living on an active farm in regards to PM exposure.

Methods

• Since 2007, indoor and outdoor PM₁₀ and PM_{2.5} data has been collected in an intensely agricultural county located in southeastern Iowa.

• Homes were selected from the Keokuk County Rural Health Study, a population based prospective cohort, and sampled continuously over a five day period.

• To date 175 homes have been sampled with an additional 75 scheduled to be surveyed before completion of the study in October 2011.



Results

Table 1: Pairwise t-test of indoor and outdoor PM concentrations by home

	PM ₁₀ (µg/m ³)		PM _{2.5} (µg/m ³)	
	Indoor	Outdoor	Indoor	Outdoor
Geometric Mean	21.1	19.6	12.9	8.4
Geometric SD	1.9	1.5	2.2	1.7
p-value	0.17		<0.01	

Table 2: Multivariable linear regression analysis of indoor PM data

Variable	PM ₁₀		PM _{2.5}	
	Parameter Estimate	p-value	Parameter Estimate	p-value
Spring-Summer months	1.24	0.03	1.40	<0.01
Cooking with gas	1.20	0.09	1.28	0.04
Heating home with gas	1.31	0.10	1.52	0.03
Smoking in home	1.51	0.03	1.58	0.03
Poor housekeeping	1.42	0.03	2.24	<0.01
Log Outdoor PM10 (µg/m ³)	0.35	<0.01	---	---
Log Outdoor PM2.5 (µg/m ³)	---	---	0.31	0.01

Table 3: Multivariable linear regression analysis of outdoor PM data

Variable	PM ₁₀		PM _{2.5}	
	Parameter Estimate	p-value	Parameter Estimate	p-value
Season				
Winter	---	---	---	---
Spring	1.05	0.67	-1.20	0.12
Summer	1.16	0.10	-1.25	0.03
Fall	-1.05	0.61	-1.57	<0.01
Living on an active farm	1.44	0.04	-1.10	0.75

Conclusions

- Indoor PM_{2.5} concentrations were significantly higher compared to outdoor concentrations. However, there was no statistical difference between indoor and outdoor PM₁₀ concentrations.
- Cooking and heating with gas, smoking in the home and poor housekeeping significantly increased indoor respirable particulate levels.
- Outdoor particulate levels were directly related to indoor levels.
- PM_{2.5} concentrations varied significantly across season.
- Participants living on a farm had significantly higher outdoor PM₁₀ exposure than non-farming families.

Future Research

1. Perform endotoxin analysis on indoor and outdoor PM₁₀ samples.
2. Develop a multivariate model to predict indoor and outdoor endotoxin concentrations based on home characteristics.
3. Evaluate the effect of other potential covariates such as distance to grain bins, living on a gravel road and metrological data on outdoor PM concentrations.



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