

## **Indoor Air Quality in Clark County's Hospitality Venues**

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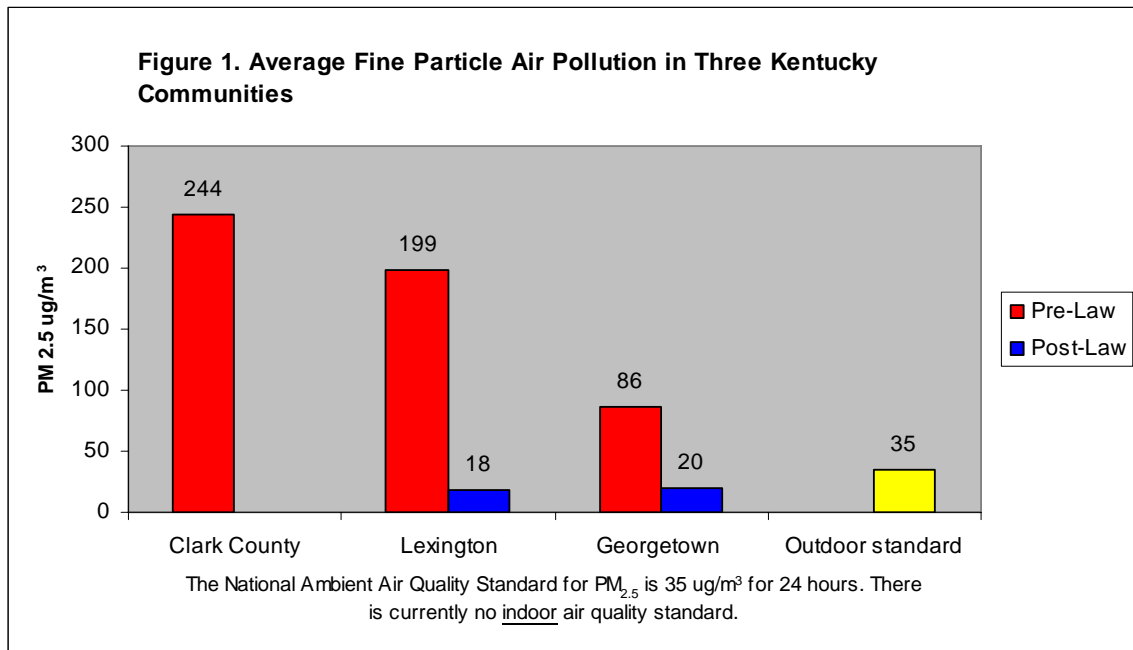
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## Executive Summary

Indoor air quality was assessed in 12 locations in Clark County, including eight restaurants, two bars and two entertainment venues. Locations were sampled from February 11, 2007 to March 2, 2007, using the TSI SidePak AM510 Personal Aerosol Monitor. The average PM<sub>2.5</sub> level from all 12 locations is compared to the average PM<sub>2.5</sub> levels in Lexington and Georgetown pre- and post-law, as well as the National Ambient Air Quality Standard (NAAQS; 35µg/m<sup>3</sup>) for 24 hours.

Key findings of the study are:

- The level of indoor air pollution in venues sampled in Clark County (average PM<sub>2.5</sub> = 244 µg/m<sup>3</sup>) was 13.6 times higher than Lexington's post-law and 12.2 times higher than Georgetown's post-law average PM<sub>2.5</sub> levels (see Figure 1). The data also suggest that average air pollution in the Clark County locations (244 µg/m<sup>3</sup>) was 7 times higher than the National Ambient Air Quality Standard for outdoor air.
- The eight restaurants, two bars, and two entertainment venues had average PM<sub>2.5</sub> levels ranging from 8 µg/m<sup>3</sup> to 1258 µg/m<sup>3</sup> (see Figure 2). Air pollution in nine of the 12 venues exceeded the National Ambient Air Quality Standard for outdoor air. Of the three venues which did not exceed the National Ambient Air Quality Standard, one venue was smoke-free and there was no observed smoking in a second venue. In the third venue, less than one burning cigarette on average was observed.



## Introduction

Secondhand smoke (SHS) contains at least 250 chemicals that are known to be toxic.<sup>1,2</sup> There is no safe level of exposure to SHS.<sup>2</sup> SHS exposure is the third leading cause of preventable death in the United States.<sup>3</sup> SHS is a mixture of the smoke from the burning end of tobacco products (sidestream smoke) and the smoke exhaled by smokers (mainstream smoke) and is known to cause cancer in humans.<sup>1,2,3</sup> SHS exposure is a cause of heart disease and lung cancer in nonsmoking adults.<sup>1-4</sup> An estimated 3,000 nonsmokers die from lung cancer<sup>5</sup> annually and over 46,000 nonsmokers die from heart disease<sup>2</sup> every year in the U.S. It is estimated that approximately 60% of people in the United States have biological evidence of SHS exposure.<sup>6</sup>

It is estimated that approximately 54.8% of the U.S. population are protected by clean indoor air regulations that cover virtually all indoor worksites including bars and restaurants.<sup>7</sup> There are over 2,500 local ordinances or regulations that restrict smoking to some extent in workplaces across the United States and Washington D.C.<sup>8</sup> The extent of protection provided by these laws vary widely from community to community.

To date in Kentucky, 13 communities have enacted and implemented smoke-free laws. The most comprehensive ordinances, 100% smoke-free workplace *and* 100% smoke-free enclosed public place laws, have been implemented in Georgetown, Morehead, Ashland, and Elizabethtown. The next most comprehensive ordinances, 100% smoke-free enclosed public place laws, have been implemented in Lexington, Letcher County, Frankfort, and Paducah. Five communities have implemented partial smoke-free laws, protecting workers and patrons in some public venues: Louisville, Daviess County, Paintsville, Henderson, and Oldham County. As of July 1, 2007, Louisville's law will implement a strengthened comprehensive law. One additional community has enacted a 100% smoke-free workplace and 100% smoke-free public place regulation via their Board of Health (Madison County).

The purpose of this study was to (a) assess air quality in 12 Clark County, Kentucky hospitality venues; and (b) compare the results to Lexington and Georgetown, Kentucky air quality data before and after their smoke-free laws took effect.

## Methods

Between February 11 and March 2, 2007, indoor air quality was assessed in 12 indoor locations including eight restaurants, two bars and two entertainment venues in Clark County. Sites were of various sizes; some sites were individually owned establishments and some were part of local or national chain entities.

A TSI SidePak AM510 Personal Aerosol Monitor (TSI, Inc., St. Paul, MN) was used to sample and record the levels of respirable suspended particles in the air. The SidePak uses a built-in sampling pump to draw air through the device and the particulate matter in the air scatters the light from a laser to assess the real-time concentration of particles smaller than  $2.5\mu\text{m}$  in micrograms per cubic meter, or  $\text{PM}_{2.5}$ . The SidePak was calibrated against a light scattering instrument, which had been previously calibrated and used in similar studies. In addition, the SidePak was zero-calibrated prior to each use by attaching a HEPA filter according to the manufacturer's specifications.

TSI SidePak AM510 Personal Aerosol Monitor



The equipment was set to a one-minute log interval, which averages the previous 60 one-second measurements. Sampling was discreet in order not to disturb the occupants' normal behavior. For each venue, the first and last minute of logged data were removed because they are averaged with outdoor and entryway air. The remaining data points were averaged to provide an average  $\text{PM}_{2.5}$  concentration within each venue. The Kentucky Center for Smoke-free Policy (KCSP) staff trained researchers from the Clark County Health Department, who did the sampling and sent the data to KCSP for analysis.

### Statistical Analyses

Descriptive statistics including the venue volume, number of patrons, number of burning cigarettes, and smoking density (i.e., average number of burning cigarettes per  $100\text{ m}^3$ ) were reported for each venue and averaged for all venues.

## Results

The eight restaurants, two bars and two entertainments were visited for an average of 54 minutes (range 42-83 minutes). Visits occurred at various times of the day from 9:01 AM to 10:46 PM. The average size of the Clark County venues was  $4,351\text{ m}^3$  (range 238-30,602  $\text{m}^3$ ) and the average smoker density was 0.13 #bc/100  $\text{m}^3$ . Descriptive statistics for each venue are summarized in Table 1.

As depicted in Figure 1, the average level of indoor air pollution in the 12 Clark County venues ( $244\text{ }\mu\text{g}/\text{m}^3$ ) was 13.6 times higher than Lexington's post-law and 12.2 times higher than Georgetown's post-law average  $\text{PM}_{2.5}$  levels (18 and 20  $\mu\text{g}/\text{m}^3$ , respectively).

Clark County's average level of indoor air pollution was 7 times higher than the National Ambient Air Quality Standard for 24 hours (35  $\mu\text{g}/\text{m}^3$ ).

**Table 1.** Indoor air quality data for 12 venues in Clark County, 2007

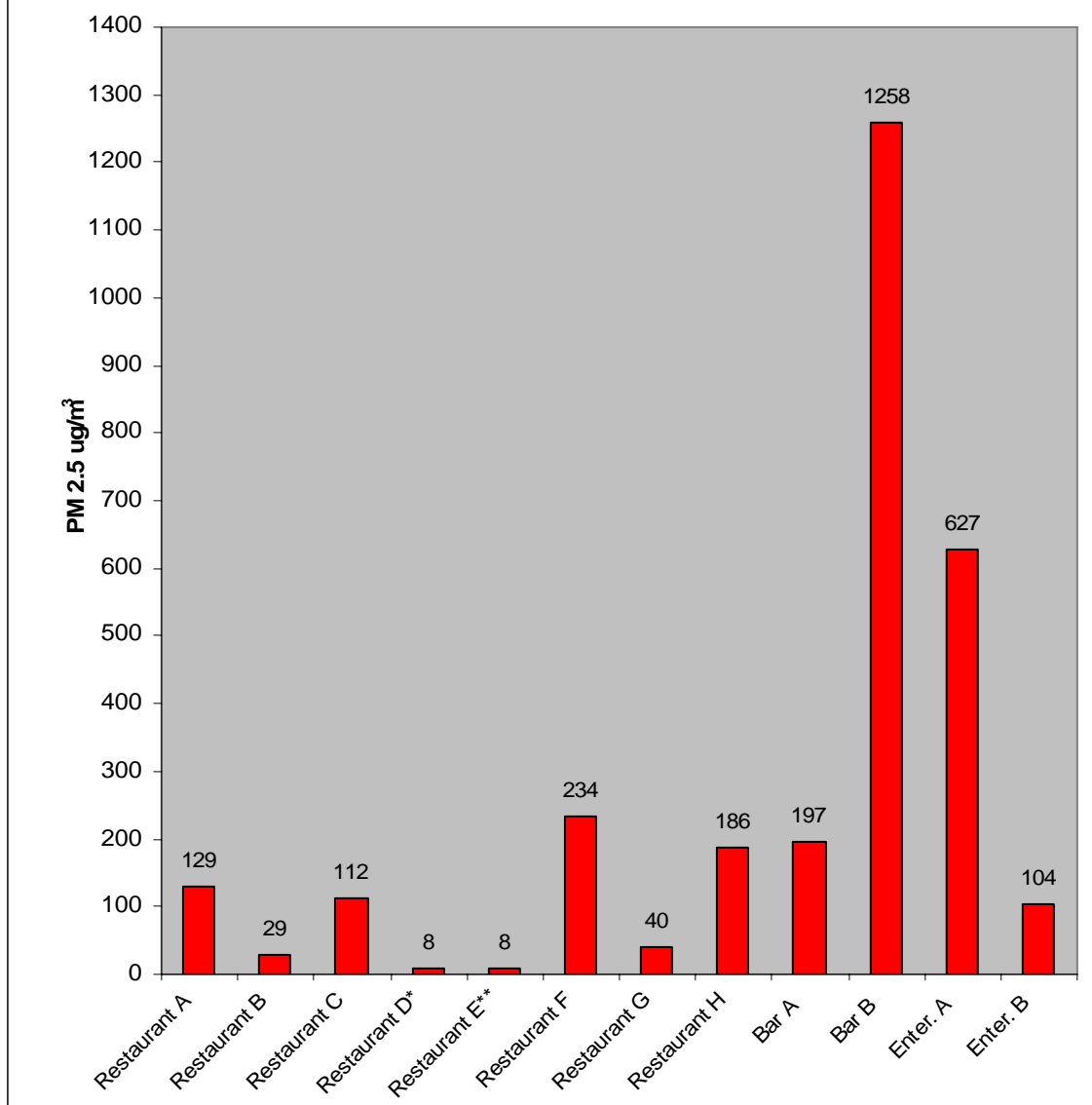
Venue	Date Sampled	Size ( $\text{m}^3$ )	Average # people	Average # burning cigs	Smoker density (#bc/100 $\text{m}^3$ )	Average PM <sub>2.5</sub> level ( $\mu\text{g}/\text{m}^3$ )
Restaurant A	2/11/2007	280	24	1.3	0.47	129
Restaurant B	2/11/2007	312	12	0.6	0.19	29
Restaurant C	2/11/2007	1014	131	1.6	0.16	112
Restaurant D*	2/11/2007	376	31	0.0	0.00	8
Restaurant E**	2/14/2007	238	24	0.0	0.00	8
Restaurant F	2/24/2007	7249	95	3.6	0.05	234
Restaurant G	3/2/2007	453	48	0.5	0.11	40
Restaurant H	3/2/2007	2039	90	2.2	0.10	186
Bar A	2/23/2007	1700	38	1.7	0.11	197
Bar B	2/23/2007	5095	77	10.2	0.20	1258
Enter. A	2/11/2007	30602	320	67.0	0.22	627
Enter. B	3/2/2007	2856	43	1.5	0.05	104

\* Restaurant displays no smoking signs.

\*\* Restaurant voluntarily smoke-free.

Figure 2 shows the average level of indoor fine particle air pollution in each of the 12 monitored venues. The average PM<sub>2.5</sub> levels ranged from 8  $\mu\text{g}/\text{m}^3$  to 1258  $\mu\text{g}/\text{m}^3$ . Air pollution in the nine venues exceeded the National Ambient Air Quality Standard for outdoor air (NAAQS; 35  $\mu\text{g}/\text{m}^3$  for 24 hours).

**Figure 2. Average Fine Particle Air Pollution in 12 Venues in Clark County, 2007**



\* Restaurant displays no smoking signs.

\*\* Restaurant voluntarily smoke-free.

**Discussion**

The average PM<sub>2.5</sub> level in the 12 venues in the Clark County was 244 µg/m<sup>3</sup>, 7 times higher than the National Ambient Air Quality Standard for outdoor air (35µg/m<sup>3</sup>). There were over 80 EPA cited epidemiologic studies in creating a particulate air pollution standard in 1997.<sup>9</sup> To protect the public’s health, the EPA will set a new limit of 35 µg/m<sup>3</sup> for PM<sub>2.5</sub> on December 17, 2006 as the average level of exposure over 24-hours.

Two Kentucky air quality studies have demonstrated significant improvements in air quality as a result of implementing a comprehensive smoke-free law. Hahn et al. showed a 91% decrease in indoor air pollution after Lexington, Kentucky implemented a comprehensive smoke-free law on April 27, 2004.<sup>10</sup> The average level of indoor air pollution was 199  $\mu\text{g}/\text{m}^3$  pre-law and dropped to 18  $\mu\text{g}/\text{m}^3$  post-law. Average levels of indoor air pollution dropped from 86  $\mu\text{g}/\text{m}^3$  to 20  $\mu\text{g}/\text{m}^3$  after Georgetown, Kentucky implemented a comprehensive smoke-free law on October 1, 2005. Similarly, other studies show significant improvements in air quality after implementing a smoke-free law. One California study showed an 82% average decline in air pollution after smoking was prohibited.<sup>11</sup> When indoor air quality was measured in 20 hospitality venues in western New York, average levels of respirable suspended particles (RSP) dropped by 84% after a smoke-free law took effect.<sup>12</sup>

Other studies have assessed the effects of SHS on human health. Hahn et al. found a 56% drop in hair nicotine levels in a sample of workers after Lexington implemented a smoke-free law, regardless of whether workers were smokers or nonsmokers.<sup>13</sup> Workers were also less likely to report colds and sinus infections after the law went into effect. Similarly, Farrelly et al. also showed a significant decrease in both salivary cotinine concentrations and sensory symptoms in hospitality workers after New York State implemented a smoke-free law in their worksites.<sup>14</sup> Smoke-free legislation in Scotland was associated with significant improvements in symptoms, spirometry measurements, and systemic inflammation of bar workers. The significant improvement of respiratory health was reported in only one month after smoke-free law.<sup>15</sup>

The body of literature showing SHS's negative effects is compelling. Surgeon General Carmona, vice admiral of the U.S. Public Health Service said, "The scientific evidence is now indisputable: secondhand smoke is not a mere annoyance. It is a serious health hazard that can lead to disease and premature death in children and nonsmoking adults." SHS has been shown to cause cancer and is associated with an increased risk for lung cancer and coronary heart disease in nonsmoking adults. Approximately 60% of people in the United States have biological evidence of SHS exposure.<sup>16</sup>

## **Conclusions**

This study demonstrated that workers and patrons in Clark County are exposed to harmful levels of SHS. On average, workers and patrons in Clark County were exposed to indoor air pollution levels 7 times higher than the National Ambient Air Quality Standard, and the level of indoor air pollution in Clark County venues was 13.6 times higher than Lexington's post-law and 12.2 times higher than Georgetown's post-law average  $\text{PM}_{2.5}$  levels

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