

## **Indoor Air Quality in Bingo Halls, Lexington, Kentucky, 2008**

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## Executive Summary

Indoor air quality was assessed in five bingo halls in Lexington, Kentucky. Fine particulates were measured from February 15 to February 22, 2008, using the TSI SidePak AM510 Personal Aerosol Monitor. The average PM<sub>2.5</sub> level from the five locations was compared to the average PM<sub>2.5</sub> levels in the Georgetown bingo hall and a sample of Lexington hospitality venues before and after implementation of their smoke-free laws, 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 measured in the five Lexington bingo halls (average PM<sub>2.5</sub> = 237 µg/m<sup>3</sup>) was approximately 5.5 times higher than the Georgetown bingo hall post-law and 13 times higher than Lexington's post-law average PM<sub>2.5</sub> level in a sample of hospitality venues (see Figure 1). Further, the level of indoor air pollution in Lexington bingo halls was 6.8 times higher than the National Ambient Air Quality Standard for outdoor air.
- The average PM<sub>2.5</sub> levels in the five Lexington bingo halls ranged from 102 to 439 µg/m<sup>3</sup> (see Figure 2). Air pollution in all five bingo halls exceeded the National Ambient Air Quality Standard for outdoor air.

## 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 due to secondhand smoke exposure. It is estimated that approximately 60% of people in the United States have biological evidence of SHS exposure.<sup>6</sup>

Currently in the U.S., 13,689 local municipalities are covered by either local or state 100% smoke-free laws in workplaces and/or restaurants and/or bars.<sup>7</sup> It is estimated that approximately 65.1% of the U.S. population are protected by clean indoor air regulations that cover virtually all indoor worksites including bars and restaurants. There are 2,883 local ordinances or regulations that restrict smoking to some extent in workplaces across the United States and Washington D.C.<sup>7</sup> The extent of protection provided by these laws vary widely from community to community.

Currently in Kentucky, 19 communities have enacted and 16 communities have implemented smoke-free laws or regulations. The most comprehensive ordinances/regulations, 100% smoke-free workplace *and* 100% smoke-free enclosed public place laws (including bingo halls), have been implemented in Georgetown, Morehead, Ashland, Elizabethtown, Hardin County (unincorporated areas), Madison County (Board of Health regulation) and Louisville. The next most comprehensive ordinances, 100% smoke-free enclosed public place laws, have been implemented in Lexington, Letcher County, Frankfort and Paducah. Danville recently enacted a 100% smoke-free workplace and enclosed public places law to be implemented in August 2008. Woodford County Board of Health recently adopted a 100% smoke-free workplace and enclosed public places regulation to be implemented in August 2008. Five communities have implemented partial smoke-free laws, protecting workers and patrons in some public venues: Daviess County, Henderson, Oldham County, Paintsville and Pikeville. Only Daviess County, the City of Henderson, Pikeville, and Paintsville's smoke-free ordinances contain specific language that exempts bingo parlors. Beattyville recently enacted a partial smoke-free workplace and enclosed public places law to be implemented in August 2008.

On April 27, 2004, Lexington-Fayette County implemented a smoke-free ordinance prohibiting smoking in all buildings open to the public including bingo parlors. According to the Lexington-Fayette County Health Department, the bingo halls have not been in compliance with the ordinance since the law took effect. A series of legal challenges over a three-year period debated whether Lexington's bingo halls and the high school booster clubs that operate bingo were eligible for the private clubs exemption of Lexington's law. The most recent ruling came on January 18, 2008, when Fayette Circuit Judge James Ishmael affirmed a 2005 District Court ruling that found that booster clubs qualify as private organizations under the Lexington-Fayette County smoke-free ordinance. Private organizations are exempt from the ordinance.

The purpose of this study was to (a) assess air quality in five Lexington bingo halls; and (b) compare the results to air quality in the Georgetown bingo hall and a sample of Lexington hospitality venues before and after the smoke-free laws took effect.

## Methods

Between February 15 and February 22, 2008, indoor air quality was assessed in five Lexington bingo halls, Kentucky. The Georgetown bingo hall was visited on September 16, 2005 before the smoke-free law took effect and January 28, 2006 during the post-law period.

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 summarized to provide an average  $\text{PM}_{2.5}$  concentration within each venue. The Kentucky Center for Smoke-free Policy (KCSP) staff trained student researchers from the University of Kentucky College of Nursing and College of Public Health, 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 smoker density (i.e., average number of burning cigarettes per  $100\text{ m}^3$ ) were reported for each venue and averaged for all venues.

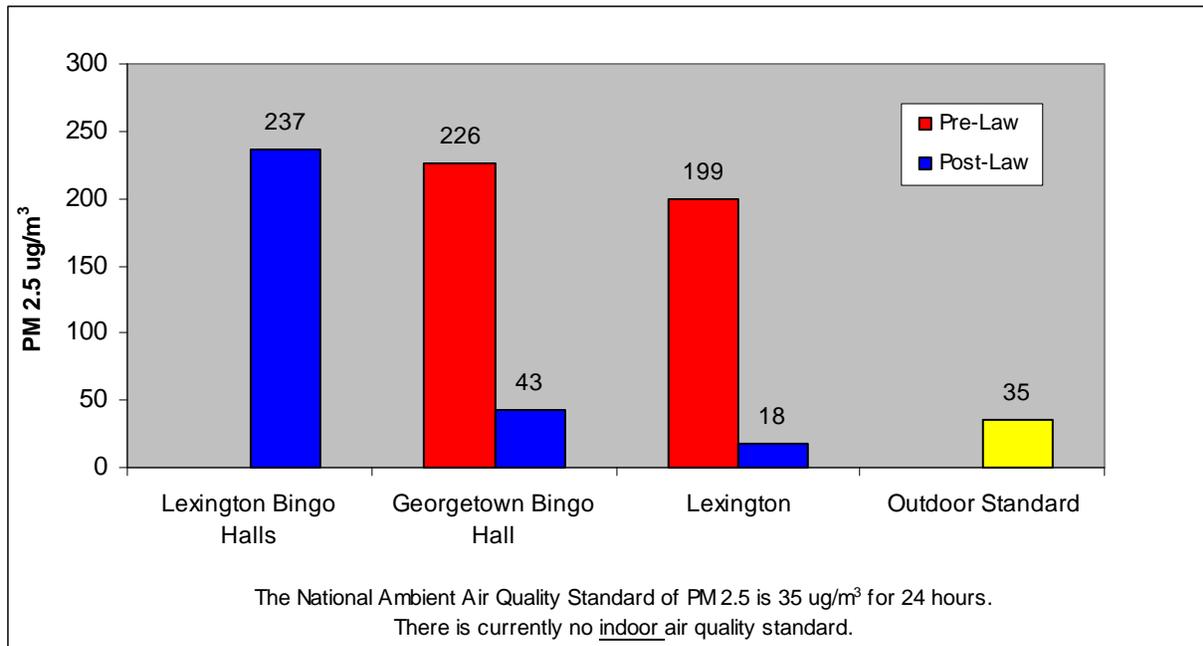
## Results

The five Lexington bingo halls were visited Friday through Friday for an average of 124 minutes (range 75-156 minutes). Visits occurred at various times of the day from 12:00 AM to 9:00 PM. The average size of the bingo halls was  $954\text{ m}^3$  (range  $150\text{-}1,908\text{ m}^3$ ) and the average smoker density was  $1.33\text{ \#bc}/100\text{ m}^3$ . On average, 71 patrons were present per venue and 6.8 burning cigarettes per venue were observed. Descriptive statistics for each venue are summarized in Table 1.

**Table 1. Air Quality Data for Five Bingo Halls in Lexington, Kentucky, February 2008**

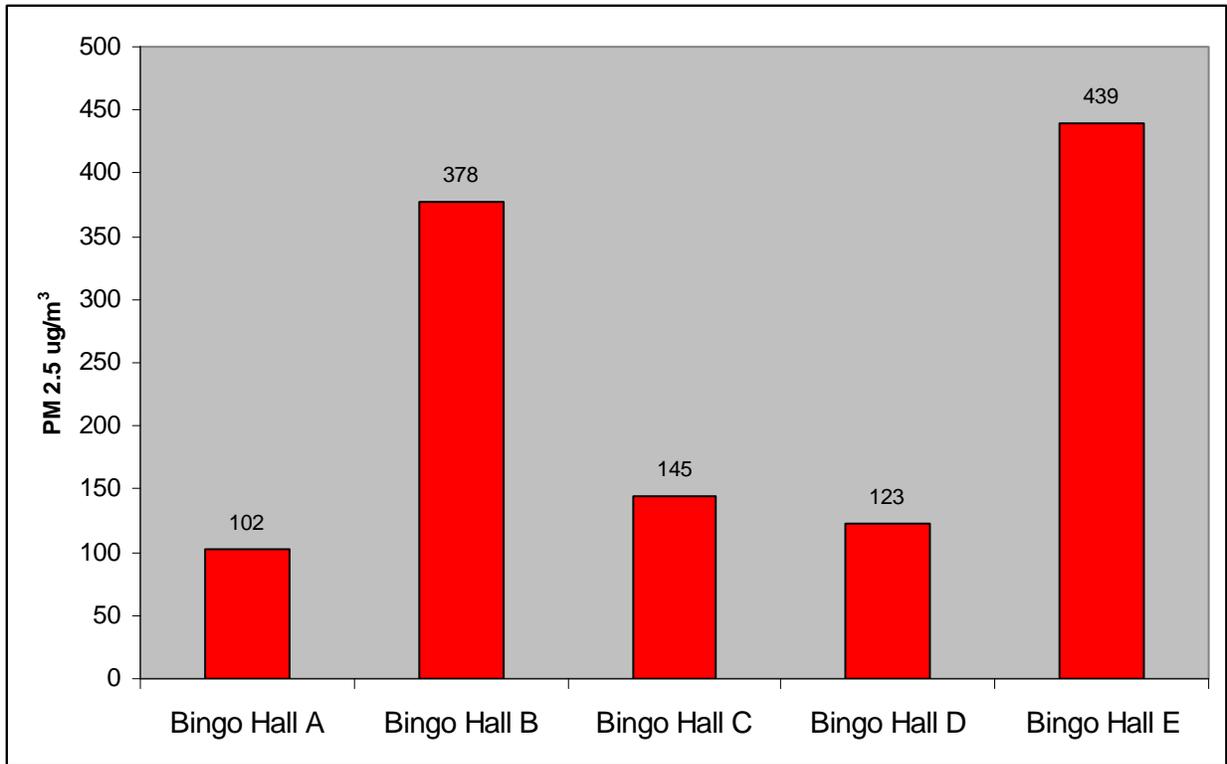
Venue	Date Sampled	Size (m <sup>3</sup> )	Average # people	Average # burning cigs	Smoker density (#bc/100m <sup>3</sup> )	Average PM <sub>2.5</sub> level
Bingo Hall A	2/15/2008	150	37	3.2	2.13	102
Bingo Hall B	2/16/2008	221	52	6.1	2.76	378
Bingo Hall C	2/16/2008	1908	156	11	0.58	145
Bingo Hall D	2/19/2008	1696	69	8.3	0.49	123
Bingo Hall E	2/22/2008	794	40	5.3	0.67	439
Averages		954	71	6.8	1.33	237

As depicted in Figure 1, the average level of indoor air pollution in the five Lexington bingo halls (average PM<sub>2.5</sub> = 237 µg/m<sup>3</sup>) was approximately 5.5 times higher than the Georgetown bingo hall post-law and 13 times higher than Lexington’s post-law average PM<sub>2.5</sub> level. Further, the level of indoor air pollution in Lexington bingo halls was 6.8 times higher than the National Ambient Air Quality Standard (35 µg/m<sup>3</sup>) for 24 hours.



**Figure 1. Average fine particle air pollution in Lexington and Georgetown bingo halls and Lexington hospitality venues, pre- and post-law**

Figure 2 shows the average level of indoor air pollution in each of the five tested bingo halls. The average PM<sub>2.5</sub> levels ranged from 102 µg/m<sup>3</sup> to 439 µg/m<sup>3</sup>. Air pollution in all five bingo halls exceeded the National Ambient Air Quality Standard for outdoor air (NAAQS; 35 µg/m<sup>3</sup>).



**Figure 2. Average indoor fine particle concentration in five Lexington bingo halls, 2008**

## Discussion

The average PM<sub>2.5</sub> level in the five bingo halls was 237 µg/m<sup>3</sup>, which is 6.8 times higher than the National Ambient Air Quality Standard for outdoor air set by the EPA. There were over 80 EPA cited epidemiologic studies in creating a particulate air pollution standard in 1997.<sup>8</sup> To protect the public's health, the EPA set a new limit of 35 µg/m<sup>3</sup> on December 17, 2006 as the average level of exposure over 24-hours in *outdoor environments*. There is no EPA standard for indoor air quality.

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>9</sup> The average level of indoor air pollution was 199 µg/m<sup>3</sup> pre-law and dropped to 18 µg/m<sup>3</sup> post-law. Average levels of indoor air pollution dropped from 86 µg/m<sup>3</sup> to 20 µg/m<sup>3</sup> after Georgetown, Kentucky implemented a comprehensive smoke-free law on October 1, 2005.<sup>10</sup> 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 particle (RSP) dropped by 84% after a smoke-free law took effect.<sup>12</sup> The level of respirable particulate matter in bowling alleys, pool halls, and bingo halls dropped by 77% in New York's gaming facilities after implementation of smoke-free law,<sup>13</sup> similar to the reduction in air pollution in the Georgetown bingo hall after the smoke-free law was enforced.<sup>10</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>14</sup> Workers were also less likely to report colds and sinus infections after the law went into effect. Similarly, Farrelly et al. 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>15</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>16</sup> Levels of the carcinogen NNAL and cotinine were reduced by 52% and 98%, respectively, in nonsmoking casino employees after a smoke-free law was implemented in Ontario, Canada.<sup>17</sup>

Smoke-free ordinances have been shown to have no impact on bingo hall profits. In 2002, Glantz and Wilson-Loots assessed receipts from charitable gaming venues in Massachusetts and concluded that smoke-free ordinances were not associated with any effect on profits from charitable games.<sup>18</sup> Indeed, the continuing presence of a smoky environment appears to discourage consumers from patronizing certain hospitality establishments, including bingo parlors. One study found that of both smoking and non-smoking consumers who avoid patronizing smoky places, bingo halls are most often avoided.<sup>19</sup> Furthermore, the percentage of gamblers who smoke in Nevada casinos was not significantly different from the smoking rate of the general population, refuting the argument that a greater percentage of casino gamblers are smokers.<sup>20</sup>

There is no longer any doubt in the medical or scientific communities that SHS is a significant public health problem. In 2006, U.S. Surgeon General Carmona, 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.”<sup>2</sup> SHS causes coronary heart disease, lung cancer, other cancers, and lung disease in nonsmoking adults.

Millions of Americans, both children and adults, are still exposed to secondhand smoke in their homes and workplaces. Approximately 60% of people in the United States have biological evidence of SHS exposure.<sup>6</sup> U.S. Surgeon General Carmona said, “Eliminating smoking in indoor spaces fully protects nonsmokers from exposure to secondhand smoke. Separating smokers from nonsmokers, cleaning the air, and ventilating buildings cannot eliminate exposure of nonsmokers to secondhand smoke.”<sup>2</sup>

## **Conclusions**

This study demonstrated that workers and patrons in bingo halls in Lexington are exposed to harmful levels of SHS. On average, workers and patrons in bingo halls were exposed to indoor air pollution levels approximately 6.8 times the National Ambient Air Quality Standard, and the level of indoor air pollution in these bingo halls was 13 times higher than Lexington’s post-law.

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