Indoor Air Quality in Franklin County, Kentucky Hospitality Venues, 2008

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Executive Summary

Indoor air quality was assessed in seven locations in Franklin County, Kentucky including five restaurants, one bar and one entertainment venue located outside the city limits of Frankfort. Fine particulates were measured from April 17 to April 25, 2008 using the TSI SidePak AM510 Personal Aerosol Monitor. The average $PM_{2.5}$ level from the seven locations was compared to the average $PM_{2.5}$ levels in the City of Frankfort and Louisville before and after implementation of their smoke-free laws, as well as the National Ambient Air Quality Standard (NAAQS; 35µg/m^3) for 24 hours.

Key findings of the study are:

- The level of indoor air pollution in hospitality venues measured in Franklin County (average $PM_{2.5}$ = 77 µg/m^3) was approximately 2.8 times higher than Frankfort's post-law and 8.5 times higher than Louisville after implementation of their comprehensive smoke-free laws (see Figure 1). Further, the level of indoor air pollution in Franklin County hospitality venues was 2.2 times higher than the National Ambient Air Quality Standard for outdoor air.

- The five restaurants, one bar and one entertainment venue had average $PM_{2.5}$ levels ranging from 10 to 183 µg/m^3 (see Figure 2). Air pollution in five of the seven venues exceeded the National Ambient Air Quality Standard for outdoor air.

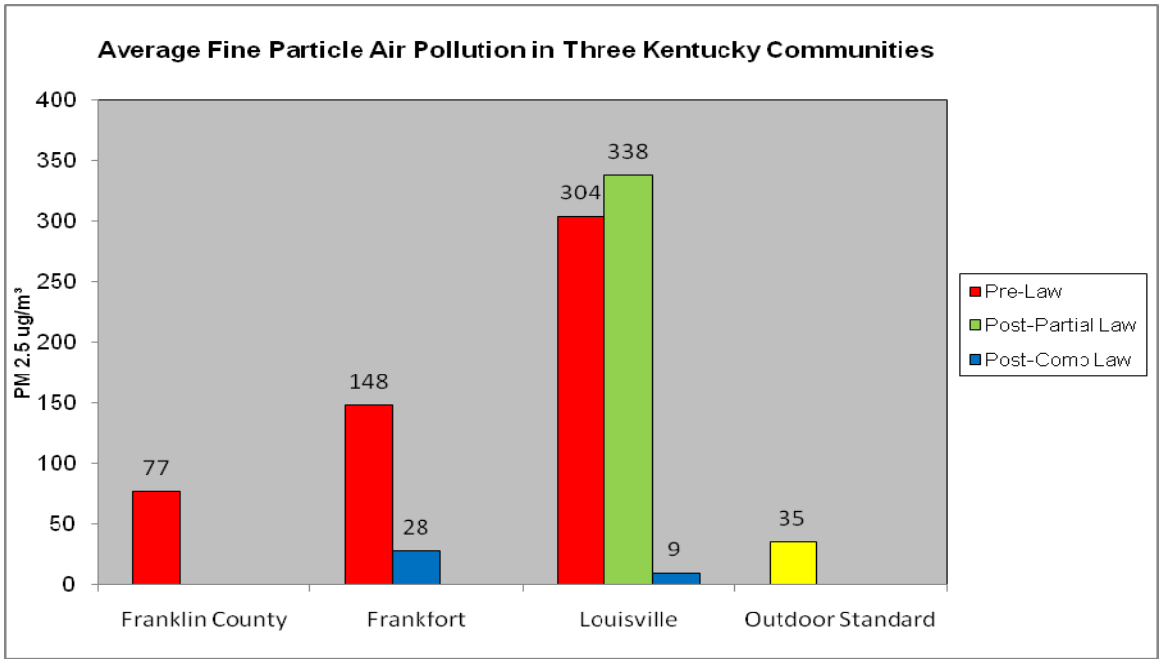

Figure 1. Average fine particle air pollution in four Kentucky communities, pre- and post-law

Note: *Post-Partial Law in Louisville reflects air quality following implementation of a law covering some venues and Post-Comp Law reflects the results of a comprehensive smoke-free law covering all venues.*

Introduction

Secondhand smoke (SHS) contains at least 250 chemicals that are known to be toxic.[1,2] There is no safe level of exposure to SHS.[2] SHS exposure is the third leading cause of preventable death in the United States.[3] 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.[1,2,3] SHS exposure is a cause of heart disease and lung cancer in nonsmoking adults.[1-4] An estimated 3,000 nonsmokers die from lung cancer[5] annually and over 46,000 nonsmokers die from heart disease[2] 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.[6]

Currently in the U.S., 16,505 local municipalities are covered by either local or state 100% smoke-free laws in workplaces and/or restaurants and/or bars.[7] It is estimated that approximately 70% of the U.S. population are protected by clean indoor air regulations that cover virtually all indoor worksites including bars and restaurants. There are 2,982 local ordinances or regulations that restrict smoking to some extent in workplaces across the United States and Washington D.C.[7] The extent of protection provided by these laws vary widely from community to community.

As of January 1, 2009, 21 Kentucky communities had enacted smoke-free laws or adopted smoke-free regulations. The most comprehensive ordinances/regulations, 100% smoke-free workplace *and* 100% smoke-free enclosed public place laws, have been enacted in 11 communities: Georgetown, Morehead, Ashland, Elizabethtown, Hardin County (unincorporated areas), Madison County (Board of Health regulation), Louisville, Danville, Woodford County (Board of Health regulation), Lexington-Fayette County, and Clark County (Board of Health regulation). The next most comprehensive ordinances, 100% smoke-free enclosed public place laws, have been implemented in three communities: Letcher County, Frankfort and Paducah. Seven communities have enacted partial smoke-free laws/regulations, protecting workers and patrons in some public venues: Daviess County, Henderson, Oldham County, Paintsville, Pikeville, Beattyville, and Hopkins County (Board of Health regulation).

In 2006, the Frankfort City Commission implemented a smoke-free public places ordinance in Frankfort, the county seat of Franklin County. As the citywide smoke-free ordinance is limited to Frankfort, the surrounding areas of Franklin County are not protected by a smoke-free law.

In Louisville, Kentucky, two different types of smoke free laws have been enacted and implemented since 2005. In November 2005, a smoke-free law covering most buildings open to the public but with significant exemptions was implemented in Louisville Metro. In July 2007, Louisville Metro strengthened their ordinance to cover all workplaces and all buildings open to the public.

The purpose of this study was to (a) assess air quality in seven Franklin County, Kentucky hospitality venues; and (b) compare the results to the City of Frankfort and Louisville's air quality before and after their smoke-free laws took effect.

Methods

TSI SidePak AM510 Personal Aerosol Monitor

Between April 17 and April 25, 2008, indoor air quality was assessed in seven indoor locations in Franklin County including five restaurants, one bar and one entertainment venue located outside the Frankfort city limits. 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 2.5µm in micrograms per cubic meter, or $PM_{2.5}$. 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. 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 $PM_{2.5}$ concentration within each venue. The Kentucky Center for Smoke-free Policy (KCSP) staff trained researchers from the University of Kentucky College of Nursing and the Franklin 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 smoker density (i.e., average number of burning cigarettes per 100 m^3) were reported for each venue and averaged for all venues.

Results

The five restaurants, one bar and one entertainment venue were visited Thursday through Friday for an average of 58 minutes (range 46-68 minutes). Visits occurred at various times of the day from 10:25 AM to 10:05 PM. The average size of the Franklin County venues was 1,237 m^3 (range 110-4360 m^3) and the average smoker density was 1.39 #bc/100 m^3. On average, 41 patrons were present per venue and 4.4 burning cigarettes per venue were observed. Descriptive statistics for each venue are summarized in Table 1.

Table 1. Air Quality Data for Seven Venues in Franklin County, Kentucky, April 2008

Venue	Date Sampled	Size (m^3)	Average # people	Average # burning cigs	Smoker density (#bc/100m^3)	Average $PM_{2.5}$ level
Restaurant A	4/17/2008	110	9	0.0	0.00	10
Restaurant B	4/18/2008	3163	70	1.2	0.04	32
Restaurant C	4/19/2008	159	34	1.0	0.63	63
Restaurant D	4/19/2008	395	31	1.2	0.30	78
Restaurant E	4/25/2008	233	18	17.5	7.51	115
Bar A	4/18/2008	242	26	2.6	1.07	55
Enter. A	4/17/2008	4360	102	7.1	0.16	183
Averages		1237	41	4.4	1.39	77

As depicted in Figure 1, the average level of indoor air pollution in the 7 Franklin County venues (77μg/m^3) was approximately 2.8 times higher than Frankfort's and 8.5 times higher than Louisville after implementing their comprehensive smoke-free laws. Further, the level of indoor air pollution in Franklin County hospitality venues was 2.2 times higher than the National Ambient Air Quality Standard (35 μg/m^3) for 24 hours.

It is important to note that after a partial smoke-free law was implemented in Louisville, the average $PM_{2.5}$ level rose slightly to 338 μg/m^3 (see Figure 1). Only 3 of the 10 venues were smoke-free as a result of the partial ordinance. After the comprehensive smoke-free law was implemented, the average $PM_{2.5}$ level dropped substantially to 9 μg/m^3, with all 10 venues being smoke-free.

Figure 2 shows the average level of indoor air pollution in each of the seven tested venues. The average $PM_{2.5}$ levels ranged from 10 μg/m^3 to 183 μg/m^3. Air pollution in five venues exceeded the National Ambient Air Quality Standard for outdoor air (NAAQS; 35 μg/m^3).

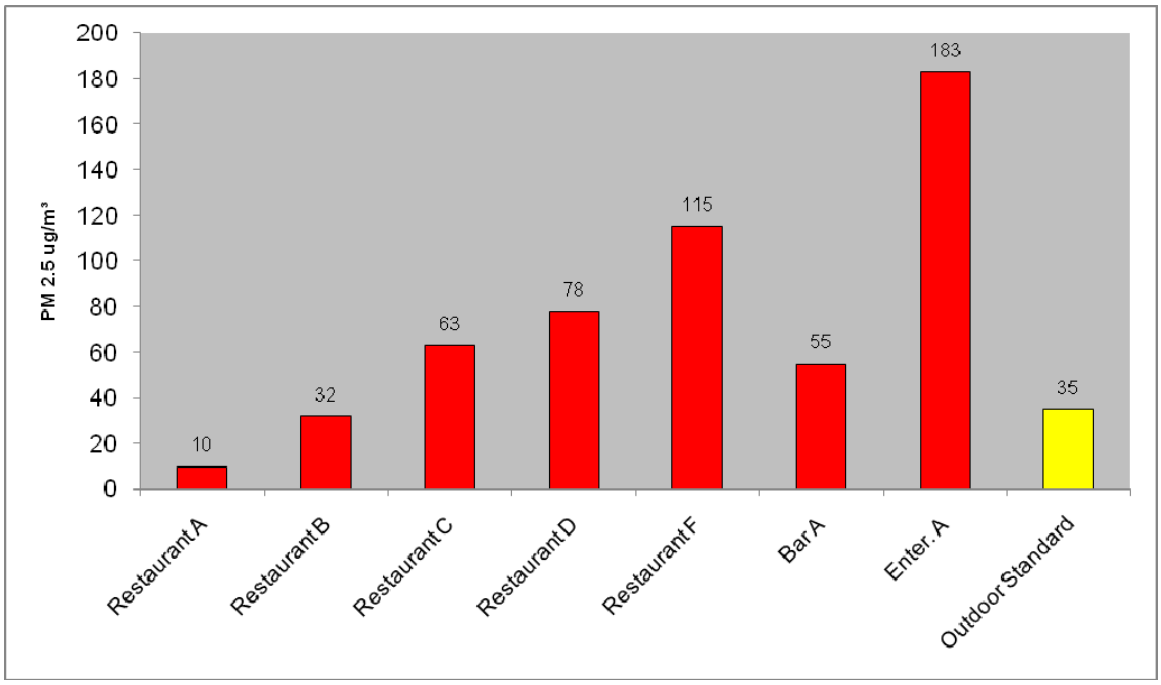

Figure 2. Average indoor fine particle concentration in seven Franklin County, Kentucky venues, 2008

Discussion

The average $PM_{2.5}$ level in seven Franklin County, Kentucky venues was 77 µg/m^3, which is 2.2 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.[8] To protect the public's health, the EPA set a new limit of 35 µg/m^3 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.[9] The average level of indoor air pollution was 199 µg/m^3 pre-law and dropped to 18 µg/m^3 post-law. Average levels of indoor air pollution dropped from 86 µg/m^3 to 20 µg/m^3 after Georgetown, Kentucky implemented a comprehensive smoke-free law on October 1, 2005.[10] 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.[11] 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.[12]

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.[13] 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.[14] 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.[15]

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." [2] SHS causes coronary heart disease, lung cancer, other cancers, and lung disease in nonsmoking adults.

Many 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.[6] 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."[2]

Conclusions

This study demonstrated that workers and patrons in Franklin County hospitality venues are exposed to harmful levels of SHS. On average, workers and patrons in Franklin County were exposed to indoor air pollution levels approximately 2.2 times the National Ambient Air Quality Standard, and the level of indoor air pollution in these venues was 2.8 times higher than Frankfort's and 8.5 times higher than Louisville's average $PM_{2.5}$ level after implementation of their comprehensive smoke-free laws. Partial smoke-free laws do not protect workers and patrons from harmful indoor air pollution. However, when smoking is completely prohibited as with Louisville's comprehensive smoke-free ordinance, air quality is significantly improved.

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