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Evaluation of the Massachusetts Smoke-free Workplace Law

A Preliminary Report

Division of Public Health Practice
Harvard School of Public Health
Tobacco Research Program

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Table of Contents

I. BACKGROUND

- Regulatory History
- Environmental Effect
- Economic Effect
- Study Objectives

II. METHODS

- Air Quality
- Implementation
- Economic Indicators

III. RESULTS

- Air Quality
- Observed Compliance
- Economic Evaluation

IV. DISCUSSION

V. CONCLUSION

VI. REFERENCES

VII. APPENDICES

- Comparison of Massachusetts and Individual Town Demographics
- Description of Air Monitoring Activity and Establishments
- Description of Air Monitoring Results

BACKGROUND

Regulatory History

The hazardous effects of secondhand smoke exposure (EPA, 1992; DHHS, 2001; Eisner, 1998; Siegel, 1993; Glantz & Parmley, 1991) are of particular concern in hospitality establishments because workers traditionally have the highest rates of exposure and the lowest levels of protection (Siegel & Skeer, 2003; Skeer & Siegel, 2003). Comprehensive smoke-free laws have proven to be the most efficient and effective approach to eliminating exposure to secondhand smoke in hospitality venues (CDC, 2000; Sargent, 2004; Skeer, 2005).

While localities have traditionally taken responsibility for protecting the health of workers and patrons, state-level clean indoor air policies have recently gained momentum. Since the enactment of California's state-wide smoking ban in 1998, seven states have implemented laws that completely prohibit smoking in all workplaces, including restaurants and bars (Delaware, 2002; New York, 2003; Maine, 2004; Connecticut, 2004; Massachusetts, 2004; Rhode Island, 2005). On July 5, 2004, the Massachusetts Smoke-Free Workplace Law went into effect, making Massachusetts the sixth state to ban smoking completely in all workplaces, including restaurants and bars. This comprehensive Massachusetts law aims to protect workers from the negative health effects from exposure to secondhand smoke. Workplace owners and managers are responsible for enforcement of the law and face fines up to \$300 for violations of non-compliance (MA Law Executive Summary, 2004).

Environmental Effect

Published studies have assessed the effect of state-wide smoking bans on indoor air quality (Stillman, 1990; Repace, 2004; Travers, 2004). Repace (2004) measured respirable suspended particle (RSP) air pollution and particulate polycyclic aromatic hydrocarbons (PAH) in six bars, one casino, and one pool hall in Delaware before and after the state-wide law went into effect. Travers and colleagues (2004) assessed the change in air quality in 20 hospitality establishments before and after the implementation of the New York State Clean Indoor Air Act. This research reported dramatic reductions in RSP levels (Repace, 2004; Travers et al. 2004) and carcinogenic PAH levels (Repace, 2004) after the smoking laws took effect.

Monitoring the change in RSPs in hospitality establishments is a useful tool to assess the effectiveness of smoking policies as secondhand smoke is a major source of RSPs (Repace, 1980; Invernizzi 2002; Invernizzi 2004). RSPs, specifically a class known as PM_{2.5} (i.e. particulate matter less than 2.5 microns in diameter), are very small particles suspended in the air which pose greater health risks (Repace, 2004; EPA, 2004; EPA, 2004) because they can easily be inhaled deep into the lungs. RSP level is a useful marker for approximately 4000 compounds over 50 of which are carcinogenic that people are exposed to in SHS (Repace, 2004). Because of their negative health effects, the Environmental Protection Agency has instituted an outdoor standard for RSPs less than 2.5 microns (PM_{2.5}), consisting of an average annual PM_{2.5} exposure level of 15 µg/m³ and a daily exposure level of 65 µg/m³ (EPA, 2004).

Economic Effect

Numerous studies have examined the economic effects of community and regional smoke-free policies in the US and internationally, indicating the absence of any negative effects and suggesting possible positive effects (Glantz 1999). Research has shown, for example, that local smoke-free policies in Massachusetts did not impact charitable gaming (e.g. bingo) (Glantz, 2003) and restaurant business (Bartosch & Pope, 2002). Most previous studies have focused on effects at the local and community level, whereas few statewide evaluations have been conducted (Glantz 1994; Glantz 1997; Mandel 2005).

The tobacco industry has consistently opposed smoke free legislation either directly, through front organizations, or by partnering with or recruiting trade associations within the hospitality industry (Samuels, 1991; Traynor, 1993; Glantz, 1999; Dearlove 2002). They argue that smoke-free ordinances would have negative economic effects, for example that sales of food and liquor will decline because smokers will eat out less leading to lower restaurant revenues and widespread job losses in the leisure and hospitality industry (Gambie 1991; KPMG Peat Marwick 1998; ANR, 2003). In Massachusetts, the tobacco industry and the Massachusetts Restaurant Association, a nonprofit trade association, made a concerted effort to defeat state and local laws that would restrict smoking in public places, particularly in beverage and food service establishments (Ritch, 2001).

Studies supported either directly or indirectly by the tobacco industry have claimed to demonstrate negative economic effects (Scollo, 2003). Specific criteria used to evaluate the quality of economic studies include: use of objective data such as tax collections and

employment statistics; inclusion of all data points after the law was implemented and several years before; use of regression or other statistical methods to control for secular trends, random fluctuation, and overall economic trends (Siegel, 1992). Past research cited by the tobacco industry which has suggested that smoke-free legislation has had negative effects on restaurants sales are based on invalid and weak evaluation approaches and therefore provide misleading and inappropriate findings (Siegel, 1992).

STUDY OBJECTIVES

This report describes an evaluation of the Massachusetts Smoke-Free Workplace Law. The main objectives were to: (1) assess the change in indoor air quality that occurred in a sample of hospitality venues pre and post the law; (2) determine compliance with the law after implementation; and (3) evaluate economic changes pre and post the law, including patronage, sales revenue, and employment rates.

METHODS

Air Quality

Sample. Hospitality venues were selected from five towns in Massachusetts that had either a very weak or no smoking policy in effect prior to the implementation of the state-wide ban (i.e. Lynn, Malden, Quincy, Waltham, and Worcester). The list of establishments was compiled by individuals from local tobacco control programs in each of the five communities. Appendix 1 presents the demographics of Massachusetts compared to the sample of five towns. The ultimate list comprised a convenience sample of 29 bars and restaurants. Post-ban, two establishments that were included in the pre-law measurements were closed indefinitely leaving 27 establishments that were visited both pre- and post-law, representing the final comparable sample.

Instrumentation. In each establishment, respirable suspended particles (RSP) were measured using a TSI SidePak AM510 Personal Aerosol Monitor (TSI, Inc., St. Paul, MN). The aerosol monitor was fitted with a 2.5 μm impactor in order to measure the concentration of particulate matter with a mass median aerodynamic diameter of 2.5 μm , or $\text{PM}_{2.5}$. The impactor is designed to remove half of the particles at 2.5 μm and larger particles with increasing efficiency. In order to ensure proper functioning of the impactor, it was cleaned prior to each use and a flow meter was used to ensure the SidePak's internal pump was operating at 1.7 L/min. The SidePak was used with the calibration factor set to 0.32. This calibration factor was determined by running the SidePak side-by-side in an experiment with another accurately calibrated laser photometer. This comparison aerosol monitor had been previously calibrated and used in similar studies.(Repace, 2004) In addition, the SidePak was zero-calibrated prior to each use by attaching a filter according to the manufacturer's specifications. The device contains a data logger that outputs mass concentration and time to a computer. The SidePak was set to a 1-minute log interval, meaning that every 60 seconds the device records the average of the previous 60 one-second measurements. A two-foot length of TygonTM tubing was attached to the inlet on the SidePak, and the device was concealed in a shoulder bag with a small amount of the tube protruding to sample the air.

Data Collection. Data collection occurred in two stages: pre-law and post-law. For both stages, each hospitality establishment was visited one time. Data collection occurred on Friday through Wednesday, between 6:45 PM and 1:15 AM, for an average of 35.3 minutes. Pre-law measurements were taken between June 23 and June 29, 2004, and post-law, between October 27 and December 1, 2004. Appendix II describes the

details of the hospitality establishments and the monitoring activity. Data collectors placed the air monitor in a computer bag, and entered each establishment sitting at a central location. The monitor was placed on a table, on the bar, or on a bar stool so that the air sampled was within normal breathing zones. Sampling was discreet in order not to disturb the occupants' normal behavior.

Outcome Measures. The main outcome measure to assess the indoor air quality in the hospitality establishments was the change in respirable suspended particles (RSP) less than 2.5 microns in diameter ($PM_{2.5}$) from pre-law to post-law. Observations were made at three different times in each establishment to determine the number of people present and the number of burning cigarettes. The first observation was made immediately upon entering an establishment, and the second and third observations were made in subsequent 15-minute intervals. The volume of each venue was measured using the Zircon DM S50 Sonic Measure (Zircon Corporation, Campbell, California). This tapeless measurement device measures up to 50 feet (15 m) using ultrasonic technology.

Data Analysis. For each establishment, the first and last minute of RSPs recorded were discarded because they were averaged with the air from outside and from entryways. The remaining data points were averaged to create a mean $PM_{2.5}$ measure within each establishment. TrakPro Version 3.41 (TSI, Inc., St. Paul, MN) was used to upload data from the SidePak for analysis and to create graphs. For each establishment, the numbers of people present and burning cigarettes were averaged for data analyses. The smoker density was calculated by dividing the average number of burning cigarettes by the room volume of the establishment.

Implementation

Observed compliance. To assess compliance with the smoking ban after implementation, the number of burning cigarettes in each establishment was observed and recorded during post-ban data collection periods. These observations were validated with the air monitor, as the monitor would reveal a spike in PM_{2.5} if smoking had indeed occurred outside the observation parameters.

Economic Indicators

Data Sources. Economic indicators used in the present study are based on state revenue and expenditures data, employment information, as well as other indicators of business activity in the relevant industries. Monthly meals tax, alcohol excise tax, and total sales and use tax collections were obtained from the Massachusetts Department of Revenue (DOR). Sales and use taxes refer to a 5% tax that the Massachusetts DOR applies to sales, rental, or use of personal tangible property. Monthly employment figures for the leisure and hospitality industries were obtained from the Current Employment Statistics (CES) Survey published by U.S. Bureau of Labor Statistics. Monthly net Keno sales figures were provided by the Massachusetts State Lottery Commission.

Outcome Measures

Patronage. Observations were made in each establishment to determine the number of people present and the number of burning cigarettes. The first observation was made immediately upon entering an establishment; the second and third observations were made in subsequent 15-minute intervals. Differences between the average numbers of patrons present pre- and post the law were tested using a paired t-test comparison.

Meals Sales and Alcoholic Beverages Sales. Monthly meals tax collections and alcoholic beverages excise tax collections and total sales and use tax collections were compared for a four year period prior to implementation of the law (January 2000- June 2004) with data for all months available (July, 2004 – January, 2005) after implementation.

Employment. The numbers of workers employed in the leisure and hospitality industry, specifically in food services and drinking places and in accommodations (e.g, hotels, motels, bed and breakfasts inns) were compared for the same periods prior to and following implementation of the law.

Gaming. Net Keno sales were compared for the same periods prior to and following implementation of the law.

Data Analysis. Unadjusted meals sales tax collections were multiplied by the ratio of total sales and use tax collections in 2004 to total sales and use collections for the respective years, in order to account for inflation and the state of the underlying economy. Meals tax collections in the months July – December, 2004 were compared with adjusted meals tax collections in the corresponding months of 1999-2003 using analysis of variance.

Meals tax collections analysis of variance Monthly meals tax collections, alcoholic beverages excise tax collections, and net Keno sales were each examined using linear regression analysis. Time (month), and an indicator for seasonality (December – February, March – May, June – August, and September – November) and the total sales and use tax collections in the corresponding months were included in the models as independent variables. An additional indicator variable was included in the analysis of

Keno sales to control for effects of the change in the time interval between games that occurred in March, 2003. A change in average monthly sales was determined by the variable representing the presence or absence of the ban, and a change in trend was determined by the interaction term between time and the presence or absence of the law.

Employment variables were compared using similar linear regression analysis models as those for meals, alcoholic beverages, and net keno sales. Dependent variables in these models were the numbers of employees in the respective industries (food services and drinking places, and accommodations. Independent variables were the number of employees in the respective industries among all states without smoke-free workplace laws through January 2005, and the total number of employees in the service provider domain in Massachusetts, in addition to time (month) and seasonality to control for economic trends.

RESULTS

Air Quality

A total of 27 establishments were revisited after the law went into effect. On average, levels of respirable suspended particles (RSPs) less than 2.5 microns in diameter (PM_{2.5}) decreased 93% in these venues after the Massachusetts Smoke-free Workplace Law went into effect (Figure 1). Additionally, the smoker density changed from 0.89 burning cigarettes per 100m³ to 0.00 after the implementation of the law. Prior to the state-wide smoking ban, burning cigarettes were observed in 27 of the 29 establishments visited (93%) (Appendix 3).

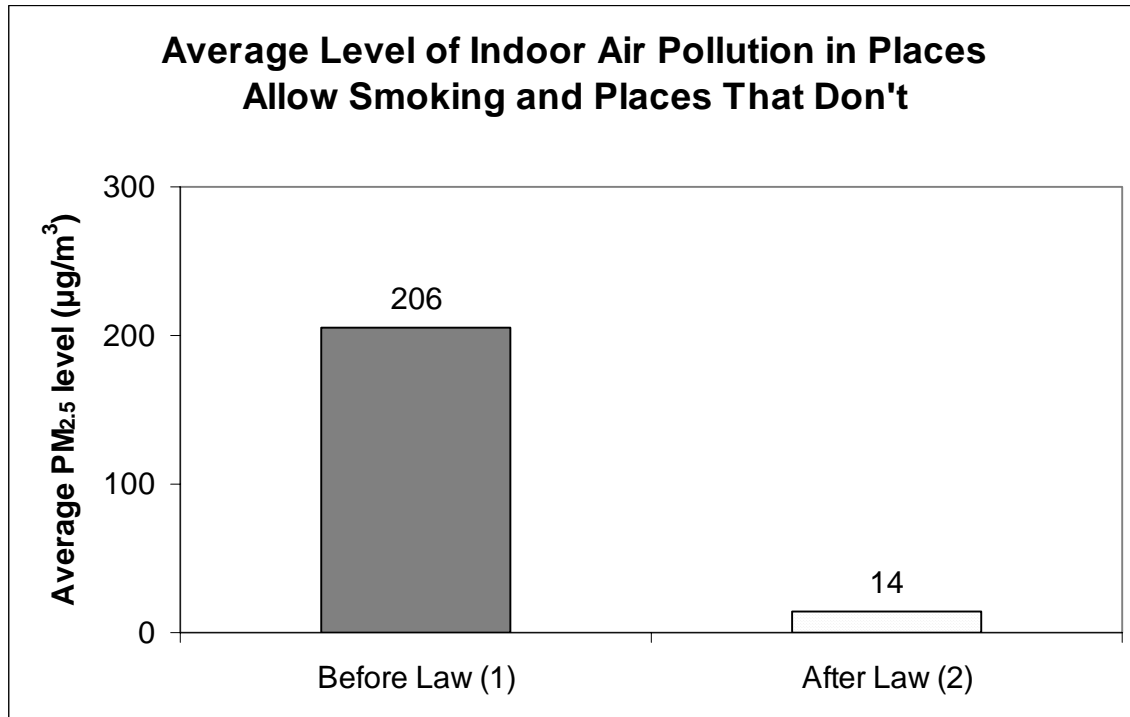


Figure 1. Fine Particle Air Pollution in All Massachusetts Venues, June 23, 2004 to December 1, 2004

(1) 29 venues sampled before Massachusetts smoke-free law went into effect

(2) same 27 venues sampled after Massachusetts smoke-free law went into effect (2 venues were closed)

Observed Compliance

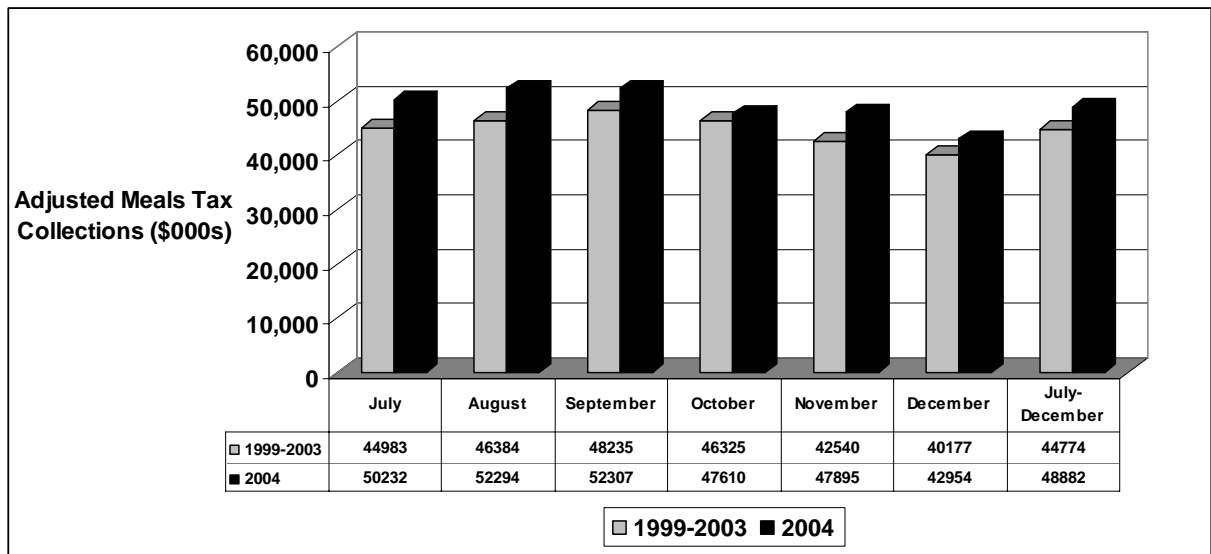
After implementation of the law, one burning cigarette was observed in 3.7 % (n=1) of the establishments. This establishment was observed to have one smoker with a burning cigarette, who was subsequently asked by a peer to put his cigarette out.

Economic Evaluation

Patronage in the restaurants and bars visited during this study was slightly higher following implementation of the law (37.9 persons per venue) than prior to the law (34.9), although this increase was not statistically significant (p = 0.609).

Inflation-adjusted meals sales tax collections were slightly higher, but not statistically significant on a month to month basis for at least the first six months following

implementation of the law compared with the corresponding months over the prior five years ($p=0.278$). Regression analysis revealed that monthly meals tax collections were unchanged ($p=0.827$) with implementation of the law. Similarly, no statistically significant change was observed in the alcoholic beverages excise tax collections ($p=0.855$).



Meals tax collections are adjusted for inflation by multiplying Massachusetts Department of Revenue monthly figures by the ratio of sales and use tax collections in 2004 to sales and use tax collections in the respective years, 1999-2003.

Figure 2. Massachusetts Meals Tax Collections (\$000s)

The numbers of Massachusetts workers since the year 2000 in the food services and drinking places and accommodation industries are shown in Tables 1 and 2.

Table 1. Food Services and Drinking Places (Thousands of Workers)					
Year	Winter	Spring	Summer	Fall	Total
2000	189.4	195.1	210.6	202.1	199.3
2001	192.4	198.4	214.3	203.6	202.2
2002	195.6	203.2	219.8	210.3	207.2
2003	198.2	203.7	220.8	212.3	208.8
2004	200.8	207.4	223.8	215.0	211.7
2005	201.0				

No statistically significant change was observed in the numbers of workers employed in food services and drinking places ($p=0.866$).

Table 2. Accommodation (Thousands of Workers)					
Year	Winter	Spring	Summer	Fall	Total
2000	31.6	33.5	40.0	36.5	35.4
2001	32.1	34.9	40.3	35.0	35.6
2002	29.9	32.0	38.7	35.0	33.9
2003	30.2	32.1	37.6	33.7	33.4
2004	30.3	31.2	37.5	35.6	33.6
2005	32.2				

Improvement was observed in the slightly downward trend of the numbers of workers employed in accommodation ($p<0.001$).

Regression analysis of the Current Employment Survey data showed no statistically significant changes in the numbers of workers employed in food services and drinking places ($p=0.866$). A statistically significant interaction between time and the presence or absence of the ban was observed with respect to the numbers of workers employed in accommodation ($p<0.001$). This result showed that a slightly negative trend in the numbers of workers in this industry that was present prior to implementation of the law was improved and potentially reversed following implementation of the law.

Net Keno sales (Table 3) have increased approximately \$121,000 per year since at least the year 2000 ($p < 0.001$). No statistically significant change in trend occurred with after implementation of the law ($p = 0.752$). Dollars waged per month prior to and following implementation of the law were unchanged ($p = 0.060$).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2000	52.6	45.7	47.2	58.9	45.0	43.1	53.4	43.8	54.0	44.9	45.1	56.2	49.2
2001	45.0	48.3	60.3	48.7	46.4	56.5	45.4	46.1	58.1	47.8	47.0	61.3	50.9
2002	49.0	52.2	66.9	51.3	51.1	62.8	49.5	62.7	50.5	53.3	66.9	53.6	55.8
2003	52.8	52.9	72.6	58.8	73.0	58.2	56.0	71.9	59.9	58.0	73.4	57.1	62.0
2004	71.8	61.9	63.8	62.5	75.5	60.0	70.0	54.9	54.2	69.0	55.9	57.1	63.1
2005	67.5												

No statistically significant change was observed in net monthly Keno sales ($p = 0.752$).

DISCUSSION

This evaluation demonstrates that the state-wide Massachusetts law has effectively improved indoor air quality in a sample of Massachusetts venues and has not negatively impacted leisure and hospitality revenue and employment in Massachusetts. Indoor air monitoring results indicate that, on average, levels of RSPs decreased 93% ($206 \mu\text{g}/\text{m}^3$ to $14 \mu\text{g}/\text{m}^3$) in a sample of 27 venues after the law took effect. These findings are consistent with other studies that have examined changes in air quality to evaluate the impact of smoking legislation (Repace, 2004; Travers et al, 2004).

Patronage in study establishments did not change between pre and post-law measurements. Analyses of economic data prior to and following implementation of the law demonstrated that the Massachusetts state-wide law did not negatively affect state-wide meals and alcoholic beverage excise tax collections. Furthermore, the number of

employees in food services and drinking places and accommodation establishments, and keno sales were not affected by the law.

Compliance data suggests that workplace owners are observing the Massachusetts law indicating successful implementation. Within five months of the law's implementation, 96.3% of the establishments were compliant with the smoking ban. These findings are supported by recent estimates from the Massachusetts Department of Public Health, which approximates a compliance rate of 90% (personal communication, Eileen Sullivan, March 23, 2005).

This evaluation provides evidence that state-wide smoke-free workplace laws are essential to protect workers and patrons from secondhand smoke exposure and supports other studies that show how smoking bans can rapidly and effectively improve indoor air quality in hospitality venues and reduce exposure to workers and patrons of these establishments (Travers et al. 2004). These study findings indicate that the Massachusetts law did not result in significant declines in Massachusetts leisure and hospitality industries. In fact, the analyses show increases in certain economic indicators.

Strengths/Limitations

Limitations of this study should be noted. First, a convenience sample was used to select the hospitality establishments included in this study. However, establishments that constituted a range of sizes, genres (from local pubs to trendy restaurants), and locations were selected in an effort to collect data from a representative sample of hospitality establishments. Second, secondhand smoke is not the only source of indoor levels of PM_{2.5}. Other sources such as ambient particle concentrations and cooking also

contribute to the indoor particle levels. However, smoking is the main contributor to indoor air pollution; once the state-wide smoking ban went into effect, $PM_{2.5}$ levels decreased approximately 90% indicating that cigarette smoke heavily contributed to the RSP levels prior to the implementation of the ban.

Despite important limitations, many factors contributed to the validity of the evaluation. First, a sensitive air monitor was used to sample air in an unobtrusive manner so employees were less likely to change their behavior by asking patrons not to smoke during post-ban measurements. Study establishments were visited at a variety of times to increase the generalizability. In addition, for pre and post-law measurements, establishments were visited on the same day of the week, at the same time of night, and for approximately the same amount of time, making the measurements more comparable, and potentially reducing the effects of possible confounding variables.

Economic findings in this report are subject to at least one important limitation. Before the state-wide law was implemented, many Massachusetts towns and cities had previously enacted complete and partial local smoking regulations (approximately 30% and 40% respectively). This study did not account for economic differences between towns and cities with various levels of local regulations prior to the implementation of the state-wide law. Nevertheless, data and methods used in the economic analyses did meet important criteria for validity. The data were objective, collected routinely by independent government agencies, and covered the periods of several years before and after the implementation of the law. Regression techniques were used to control for secular trends, seasonality, as well as economic trends, using total sales and use tax collections in analyses of revenues and total workforce in analyses of employment.

CONCLUSIONS

While state-wide smoking regulations are still relatively new in tobacco control, these study findings underscore the importance of comprehensive smoke-free policies. Even without much preparatory time from the signing to the implementation of the Massachusetts law, workplace owners are complying with the law. Local-level laws designating separate smoke-free sections and ventilation and filtration systems are more difficult and expensive to implement and enforce. With seven complete state-wide workplace-smoking bans successfully in place, and more states considering these laws, it is now time for legislation at the state-level to be more pervasive, ultimately providing workers with the health protection that they deserve.

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REFERENCES

American Lung Association of Maine. Maine Tobacco Laws and Facts. Available online at: http://mainelung.org/learn_with_us/advocacy/laws_brochure.htm#Public%20Places. Accessed March 30, 2005.

American Lung Association of Connecticut. Connecticut Smoking Ban In Effect. Available at: <http://www.alact.org/smokeban.html>. Accessed March 30, 2005.

Americans for Nonsmokers's Rights. Economic impact studies circulated by the tobacco industry. Berkeley, California: ANR 2003.

Breath. The California Smoke-Free Bars, Workplaces and Communities Programs. Available online at: http://www.breath-ala.org/html/work_status.html. Accessed March 30, 2005.

Centers for Disease Control and Prevention (CDC). Reducing tobacco use: a report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, CDC; 2000.

Dearlove JV, Bialous SA, Glantz. Tobacco industry manipulation of the hospitality industry to maintain smoking in public places. *Tobacco Control* 2002; 11:94-104.

Delaware Clean Indoor Air Law. Available online at: <http://www.alade.org/whatwedo/advocacy.htm>. Accessed March 30, 2005.

Eisner MD, Smith AK, Blanc PD. Bartenders' respiratory health after establishment of smoke-free bars and taverns. *JAMA*. 1998;280:1909-1914.

Gambie P. Economic impacts of a smoking ban in Bellflower, California. Los Angeles, California: California Business and Restaurant Alliance, 1991.

Glantz & Parmley (1991). Passive smoking and heart disease. *Epidemiology, physiology, and biochemistry*. *Circulation*, 83, 1-12.

Glantz S. Back to basics: Getting smoke-free workplaces back on track (editorial). *Tobacco Control* 1997; 6: 164-166.

Glantz SA. Smoke-free restaurant ordinances do not affect restaurant business. *Period. Journal of Public Health Management and Practice* 1999; 5: vi-ix.

Glantz SA, Wilson-Loots R. *Tob Control*. 2003 Dec;12(4):411-3. No association of smoke-free ordinances with profits from bingo and charitable games in Massachusetts.

Invernizzi G, Ruprecht A, Mazza R, Majno E, Rossetti E, Paredi P, Boffi R. [Real-time measurement of indoor particulate matter originating from environmental tobacco smoke: a pilot study] *Epidemiol Prev.* 2002 Jan-Feb;26(1):30-4.

Invernizzi G, Ruprecht A, Mazza R, Rossetti E, Sasco A, Nardini S, Boffi R. Particulate matter from tobacco versus diesel car exhaust: an educational perspective. *Tobacco Control.* 2004;13:219-221.

KPMG Peat Marwick for the American Beverage Institute. Effects of 1998 California smoking ban on bars, taverns, and night clubs, 1998.

Mandel LL, Alamar BC, Glantz SA. Smoke-free law did not affect revenue from gaming in Delaware. *Tobacco Control* 2005; 14:10-2.

Massachusetts Smoke-Free Workplace Law. Accessed on: January 13, 2005. Available on-line at: <http://www.mass.gov/legis/laws/seslaw04/sl040137.htm>. Accessed March 30, 2005.

Massachusetts Smoke-Free Workplace Law: Executive Summary. Available on-line at: http://www.mass.gov/dph/mtcp/resources/smoke_free_workplace_law_summary.doc. Accessed March 30, 2005.

Monthly Revenue Reports. Massachusetts Department of Revenue, 2005. (Accessed January 7, 2005, at <http://www.dor.state.ma.us/stats/RevRpt/index.htm>.)

New York State Department of Health. Clean Indoor Air Act. Available online at: http://www.health.state.ny.us/nysdoh/clean_indoor_air_act/index.htm

Repace JL, Lowrey AH. Indoor air pollution, tobacco smoke, and public health. *Science.* 1980;208:464-474.

Repace J. Respirable particles and carcinogens in the air of Delaware hospitality venues before and after a smoking ban. *JOEM.* 2004;46:887-905.

Rhode Island Department of Health. Smokefree Public Place and Workplace Law. Available online at: <http://www.health.state.ri.us/disease/tobacco/workplacelaw.php>. Accessed March 30, 2005.

Ritch WA, Begay ME. Strange bedfellows: The history of collaboration between the Massachusetts Restaurant Association and the tobacco industry. *American Journal of Public Health* 2001; 91:598-603.

Samuels B, Glantz S. The politics of local tobacco control. *JAMA* 1991; 266: 2110-2117.

Sargent RP, Shepard RM, Glantz SA. Reduced incidence of admissions for myocardial infarction associated with public smoking ban: before and after study. *BMJ*. 2004;328:977-980.

Scollo M, Lal A, Hyland A, Glantz. Review of the quality of studies on the economic effects of smoke-free policies on the hospitality industry. *Tobacco Control* 2003; 12: 13-20.

Siegel M. Economic impact of 100% smoke-free restaurant ordinances. In: *Smoking and Restaurants: A Guide for Policy Makers*. Berkeley: UC Berkeley/UCSF Preventive Medicine Residency Program: American Heart Association, California Affiliate, Alameda County Health Care Services Agency, Tobacco Control Program, 1992.

Siegel M. Involuntary smoking in the restaurant workplace: a review of employee exposure and health effects. *JAMA*. 1993;270:490-493.

Siegel M, and Skeer M. Exposure to secondhand smoke and excess lung cancer mortality risk among workers in the 5 B's bars, bowling alleys, billiard halls, betting establishments and bingo parlours. *Tobacco Control*, 2003; 12:333-338.

Skeer M, and Siegel M. The descriptive epidemiology of local restaurant smoking regulations in Massachusetts: An analysis of the protection of restaurant customers and workers. *Tobacco Control*, 2003; 12:221-226.

Skeer M, Cheng DM, Rigotti NA, Siegel M. Secondhand Smoke Exposure in the Workplace. *American Journal of Preventive Medicine*, 2005 (in press).

Stillman FA, Becker DM, Swank RT, Hantula D, Moses H, Glantz S, Waranch R. Ending smoking at the Johns Hopkins Medical Institutions: an evaluation of smoking prevalence and indoor air pollution. *JAMA* 1990;264:1565-1569.

Travers MJ, Cummings MJ, Hyland A, Repace J, Babb S, Pechacek T, Caraballo R. Indoor air quality in hospitality venues before and after implementation of a clean indoor air law – Western New York, 2003. *MMWR*. 2004;53:1038-1041.

Traynor M, Glantz S. New tobacco industry strategy to prevent local tobacco control. *JAMA* 1993; 270.

U.S. Environmental Protection Agency. *Respiratory health effects of passive smoking: Lung cancer and other disorders*. Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development, Office of Air and Radiation, 1992.

U.S. Department of Health and Human Services. *Ninth report on carcinogens*. Washington, DC: Public Health Service, National Toxicology Program, 2001.

U.S. Environmental Protection Agency. Particulate Matter (PM) in New England. (2004) Available online at: <http://www.epa.gov/boston/airquality/partic.html>. Accessed March 30, 2005.

U.S. Environmental Protection Agency. Health and Environmental Impacts of PM. (2004) Available at: <http://www.epa.gov/air/urbanair/pm/hlth1.html>. Accessed March 30, 2005.

Appendix I

Comparison of Massachusetts and Individual Town Demographics							
		Massachusetts Towns					
		Massachusetts (N = 6,349,097)	Lynn (N = 89,050)	Malden (N = 56,340)	Quincy (N = 88,025)	Waltham (N = 59,226)	Worcester (N = 172,648)
Sex	Female (%)	51.8	51.6	51.9	52.4	50.7	52.0
	Male (%)	48.2	48.4	48.1	47.6	49.3	48.0
Median age		36.5	34.2	35.7	37.6	34.2	33.4
Age Group	<18 (%)	23.6	27.0	19.9	17.5	15.5	23.6
	18-64 (%)	62.9	60.2	66.2	66.2	71.4	62.3
	>64 (%)	13.5	12.8	13.9	16.3	13.1	14.1
Race	White (%)	84.5	67.9	72.1	79.6	83.0	77.1
	Black or African American (%)	5.4	10.6	8.2	2.2	4.4	6.9
	Asian (%)	3.8	6.4	14.0	15.4	7.3	4.9
	Reporting Other Race (%)	6.3	15.1	5.7	2.77	5.3	11.1
Income	Median household income	\$50,502	\$37,364	\$45,654	\$47,121	\$54,010	\$35,623
	Per capita income	\$25,952	\$17,495	\$22,004	\$26,001	\$26,364	\$18,614
Education	% High school graduates (age 25+)	84.8	74.2	83.4	85.2	85.4	76.7
	% Bachelor's degree or higher (age 25+)	33.2	16.4	26.2	31.8	38.4	23.3

Appendix II

Description of Air Monitoring Activity and Establishments	
Number of establishments	
Preban	29
Postban	27
Location	Number of Establishments (N=27)
Lynn	5 (18.5%)
Malden	5 (18.5%)
Quincy	6 (22.2%)
Waltham	6 (22.2%)
Worcester	5 (18.5%)
Type of Establishment	
Free-standing bar	10 (37.0%)
Restaurant with bar	17 (63.0%)
Monitoring Activity Details	Dates
Preban	June 23 - June 29, 2004
Ban Implementation	July 5, 2004
Postban	October 28 - December 1, 2004
Days	Friday-Wednesday
Times	6:45 PM-12:15AM
Average length of stay	35.3 minutes
* Post ban two bars were closed indefinitely.	

Appendix III

Description of Air Monitoring Results – Establishments, Smoker Density, Pm2.5 Levels						
Venue Number (Bar, Restaurant, Bar/Restaurant Combination	Size (m³)	Active Smoker denisty		Average PM 2.5 level (µg/m³)		% reduction in PM 2.5
		Before July 5, 2004	After July 5, 2004	Before July 5, 2004	After July 5, 2004	
1	389	0.60	0.00	436	39	91.1
2	97	2.74	0.00	235	30	87.2
3	1393	0.45	0.00	727	12	98.4
4	274	0.61	0.00	671	12	98.2
5	381	1.05	0.00	260	29	88.9
6	656	0.97	0.00	406	20	98.1
7	2187	0.44	0.00	471	18	96.2
8	147	2.95	0.00	169	9	94.7
9	311	1.07	0.00	166	17	89.8
10	189	1.94	0.00	268	4	98.5
11	648	0.77	0.00	258	8	97.0
12	378	0.88	0.00	43	6	86.1
13	1516	0.00	0.00	33	42	0
14	330	0.61	0.00	120	7	94.2
15	338	0.00	0.00	7	3	57.2
16	204	0.16	0.00	23	9	60.9
17	907	0.15	0.00	68	13	80.9
18	270	0.99	0.00	111	8	92.8
19	275	1.69	0.00	141	20	85.8
20	216	0.15	0.00	79	6	92.4
21	259	1.16	0.00	155	2	98.7
22	346	0.48	0.00	45	2	95.6
23	254	0.66	0.00	117	13	88.9
24	273	1.34	0.00	629	12	98.1
25	447	1.05	0.00	23	23	0
26	176	1.51	0.00	40	12	70.0
27	986	0.20	0.00	34	4	88.2
28	567	0.35	N/A	113	N/A	
29	284	0.71	N/A	116	N/A	
Average		0.89		206	14	0.93

* Used to compare indoor air pollution levels between places that are required to be smoke-free and places that are not.
 ** Average number of burning cigarettes per 100m3