Employment Change for Bars and Restaurants Following a Statewide Clean Indoor Air Policy

Elizabeth G. Klein, PhD, MPH, Jean L. Forster, PhD, MPH, Natalie M. Collins, MPH, Darin J. Erickson, PhD, Traci L. Toomey, PhD, MPH

Background: Clean indoor air policies have been adopted to protect employees in all workplaces from exposure to environmental tobacco smoke. Despite numerous studies where no significant economic effects were associated with clean indoor air policies, concerns persist that such policies will have a severe, negative effect on alcohol-licensed businesses.

Purpose: This study examines the effect of a comprehensive, statewide clean indoor air law on bar and restaurant employment in Minnesota as a whole, as well as by region in the state.

Methods: Interrupted time-series analyses were conducted separately on bar and restaurant employment between 2004 and 2008 using data reported by businesses to the Minnesota Department of Employment and Economic Development. The statewide clean indoor air policy was implemented October 2007; analyses were conducted in 2009.

Results: After accounting for changes in employment in all other sectors for the state as a whole, there were no significant changes in statewide bar or restaurant employment associated with the state-level clean indoor air policy. Additionally, no significant changes were observed in regional bar or restaurant employment following enactment of the clean indoor air policy.

Conclusions: Enactment of a comprehensive clean indoor air policy in Minnesota did not result in significant changes in bar or restaurant employment in rural or urban regions of the state or the state as a whole. In Minnesota, neither bars nor restaurants were associated with significant changes in employment following the enactment of a comprehensive, statewide clean indoor air policy.

Introduction

Individuals can experience frequent exposure to environmental tobacco smoke (ETS) at work, especially those who work in bars or restaurants.1 Bar and restaurant workers (also called hospitality workers), have been identified as a higher-risk group for ETS exposure in the workplace.2 Clean indoor air policies or other restrictions on indoor smoking have been deemed the most effective method available to reduce or remove ETS exposure to protect the health of employees.3

Many studies have been conducted to assess the influence of clean indoor air policies on economic factors for worksites, with a particular focus on bars and restaurants. These worksites are of interest due to the correlation between smoking and drinking behaviors.4 Opponents of the policies argue that clean indoor air policies in bars and restaurants may reduce the number of customers in these establishments, thereby reducing these establishments’ revenue, employment opportunities, and likelihood of remaining in business. Employment and sales revenue figures reported to the state by businesses are regarded as high-quality, objective data appropriate for estimating for potential economic change in bars and restaurants.5

In the U.S., most research on the effect of clean indoor air policies on bars and restaurants has been conducted at the local level, as these local policies were generally the first to be implemented. Measures to describe such effects on bars and/or restaurants are those that objectively reflect the economic status of these businesses and can represent changes in patronage and/or income.6 Studies of local clean indoor air policies have consistently reported no significant economic effects on either bar or restaurant employment or sales revenue.6 As of July 2010,
30 states have implemented a 100% smokefree policy that applies to both bars and restaurants. In four states (California, New York, Massachusetts, and Florida) economic effects from their state’s clean indoor air policy were evaluated. None of the studies found significant, long-term effects on objective measures of economic change in bars and restaurants. Of these, only the studies in California and New York evaluated the effect of a statewide clean indoor air policy on both bars and restaurants, and none have examined regional differences. Opponents of clean indoor air policies have raised concerns that statewide policies may have a differential effect on border communities or rural regions that may be masked in statewide analyses.

One technique for the evaluation of economic changes associated with clean indoor air policy is an interrupted time-series analysis. Using this method, a city or state’s measure of economic health can be compared before and after policy enactment, controlling for time trends and season of the year. In the published literature, interrupted time-series analysis has been applied to the question of economic effects of local and state clean indoor air policies on restaurants and/or bars in California; Ottawa, Canada; and in Minneapolis and St. Paul MN, where no significant long-term economic effects were detected in any of these locations.

In October 2007, the Minnesota legislature implemented a statewide, comprehensive clean indoor air policy, following adoption of several local ordinances. Many businesses have claimed economic hardship from and sought modification of the local and statewide policies. In Minnesota, studies of local clean indoor air policies found no significant changes in hospitality employment; however, the effect of Minnesota’s statewide clean indoor air policy has not been fully evaluated using statistical techniques to account for economic changes over numerous years. Local bar and restaurant owners continue to claim the statewide clean indoor air policy has harmed their businesses, especially for those located in more rural regions of Minnesota.

The goal of this paper is to use time-series analytic methods to evaluate potential changes in bar and restaurant employment in Minnesota resulting from this comprehensive, statewide clean indoor air policy that banned smoking in both bars and restaurants. The independent investigation of bars and restaurants has not been covered in the current evaluations of clean indoor air policies in Minnesota or elsewhere. This paper also aims to assess whether there was geographic variation across Minnesota in terms of potential economic changes. Based on the extensive literature on the economic effects of clean indoor air policies, it is hypothesized that there is a null association between clean indoor air policy implementation and employment in bars or restaurants at the state or regional level in Minnesota.

Methods
To evaluate the economic effects on bars and restaurants resulting from the statewide clean indoor air policy in Minnesota, an interrupted time-series analysis was conducted. Bar and restaurant employment was used as a measure of economic effects, and the measures of employment were evaluated separately to investigate whether the clean indoor air policy influenced either business type differently. Further, regions within the state of Minnesota were also evaluated to determine whether the statewide policy effect varied by location. The University of Minnesota IRB granted approval for this project.

Data used in these analyses were collected by the Minnesota Department of Employment and Economic Development (DEED) (www.positivelyminnesota.com/index.aspx). Minnesota businesses are required by law to report a monthly total of employees to DEED. Businesses most likely to be licensed to sell alcohol were selected using the North American Industry Classification System (NAICS) industry codes for bars (NAICS code 7224) and full-service restaurants (NAICS code 7221). Bar and restaurant employment was assessed separately in order to assess the independent effect the clean indoor air policy had on each type of business setting.

Data for the present study were reported for minor civil divisions (MCDs) in the state of Minnesota. Every MCD in the state that reported any employment in either bars or full-service restaurants during the study period was included (MCDs: n=702 for restaurants, n=713 for bars).

The state of Minnesota was divided into seven generally established regions in order to evaluate geographic variability in effects of the statewide clean indoor air policy on employment. The regions were (1) Minneapolis; (2) St. Paul; (3) the seven-county metropolitan area excluding Minneapolis and St. Paul; (4) northwest Minnesota; (5) northeast Minnesota; (6) southwest Minnesota; and (7) southeast Minnesota. An interrupted time-series of monthly bar and restaurant employment was constructed for each region.

Statistical Analysis
Outcome and control variables. Employment data from DEED are reported as a total number of individuals employed, regardless of full-time or part-time status; the resulting total number of employees is referred to as “employment.” Over the period of study, data were missing for some MCDs at some time points; the procedure to address this issue was based on the number of establishments reported within any given MCD. If an MCD had fewer than three establishments, time points with missing data were assumed to be zero (MCDs: n=284 for restaurants, n=233 for bars). Specifically, any month where employment data are missing assumes that zero staff were reported for that time period in that MCD; a conservative assumption was used that employees may have been laid off during such a time period (hence zero staff reported). If an MCD had three or more establishments and any time points included missing data, that MCD was excluded from these analyses altogether (MCDs: n=4 for restaurants, n=2 for bars). The primary outcome variable was derived from the number
of employees aggregated across all MCDs within the region or the state for each month.

To account for any general economic changes during the study period, employment for the entire state in all industries (NAICS code 0) minus bar and restaurant employment was used as a covariate to serve as a proxy for general economic conditions. The total employment across all industries was aggregated across all MCDs within the region or the state for each month.

**Independent variable.** The statewide, comprehensive clean indoor air policy in Minnesota was implemented on October 1, 2007. An indicator variable was created by assigning a “0” to the months prior to policy implementation, and assigning a “1” to the months where the policy was in effect. The study period for these analyses was July 2004 to December 2008, for a total of 54 months.

**Interrupted time-series analyses.** The present analytic strategy was employed in a related evaluation of the local clean indoor air policies in Minneapolis–St. Paul, Minnesota, described elsewhere. To account for the underlying economic trends, seasonality, and other factors unrelated to the enactment of the clean indoor air policy, a Box–Jenkins interrupted time-series design was used. Essentially, an interrupted time-series design uses the state of Minnesota and each region as its own control with the clean indoor air policy enactment as the interruption (also called the intervention) to look at the effect on employment before and after the interruption took place. Analysis of an interrupted time-series was done using the autoregressive integrated moving average (ARIMA) model, as the model can account for all aspects of the autocorrelation structure of the series, and provide an assessment of a significant effect resulting from the intervention. The processes of the Box–Jenkins ARIMA \((p,d,q)/(P,D,Q)\) model is described for a general seasonal ARIMA model for outcome variable \(y_t\) as:

\[
y_t = \frac{(1 - \Theta_0 B^s - \cdots - \Theta_s B^{s\omega})(1 - \phi_1 B - \cdots - \phi_p B^p)(1 - \theta_1 B^q - \cdots - \theta_q B^q)(1 - \delta B^d)(1 - B)^d}{(1 - \Phi_1 B^s - \cdots - \Phi_s B^{s\omega})(1 - \Phi_p B^p)(1 - B)^P}(1 - B)^D \alpha_t + \eta_t
\]

where \(p\) is the order of the auto-regressive process, \(d\) is the degree of nonseasonal differencing, \(q\) is the order of the moving-average process, \(P\) is the order of the seasonal auto-regressive process, \(D\) is the degree of seasonal differencing, \(Q\) is the order of the seasonal moving-average process, \(s\) is the seasonal span, \(\Phi_1\) to \(\Phi_p\) are the seasonal auto-regressive parameters, \(\Phi_1\) to \(\Phi_p\) are regular auto-regressive parameters, \(\Theta_1\) to \(\Theta_s\) are the seasonal moving-average parameters, \(\theta_1\) to \(\theta_q\) are regular moving-average parameters, \(\eta_t\) is a random (white-noise) error component, \(\alpha\) is a constant, and \(B\) is the backshift operator such that \(B(z_t) = z_{t-1}\). The dependent and control variables were both log transformed; therefore the exponentiated parameter estimate shows the relative effects of the clean indoor air policy as a percentage change in employment.

A systematic process was employed for each individual ARIMA model using three procedures: model identification, parameter estimation, and diagnostic checking. For each individual time series, various models were fit and compared, including autoregressive, moving average, or autoregressive moving average models. The simplest model that best described the behavior of each time series was selected. Differencing was used to achieve stationarity, defined as when there was no systematic increase or decrease in the level of the series, confirmed by the augmented Dickey–Fuller test. The Ljung–Box Q-test for white noise was tested up to 24 months’ lag to confirm there was no pattern beyond a purely random process.

After an ARIMA model of the series was identified, transfer functions representing hypothesized effects of the intervention (clean indoor air policy enactment) were added to the ARIMA noise model. The transfer function represented the magnitude of a change in employment resulting from the intervention of clean indoor air policy. Specifically, the transfer functions can be described as: (1) a gradual permanent change; (2) an abrupt permanent change; or (3) an abrupt temporary change. Based on previous work, these transfer functions were chosen to represent the most likely shape of hypothesized changes in employment following the implementation of a clean indoor air policy. The best fitting model was chosen based on the smallest values for both the Akaike information criteria (AIC) and Schwarz–Bayesian criteria (SBC) as model fit statistics. Detailed model specifications are available by request.

Relevant parameter estimates from the ARIMA models included the parameter estimates omega \((\omega)\) and delta \((\delta)\), where the sign represented the direction of the change. For each of the patterns, the estimate \((\omega)\) represents an estimate of the initial change in the employment due to the effect of the clean indoor air policy. When exponentiated, this \(\omega\) value can be interpreted as a percentage change in bar and restaurant employment after policy enactment. The rate of effect \((\delta)\) represents the speed at which a gradual increase or decay of these initial changes occurred over time. Significance was determined by a \(p\)-value of 0.05 or lower. Both the statewide and regional analyses were performed using PROC ARIMA in SAS version 9.1.

**Results**

Simple, unadjusted plots of total monthly employment for regions within the state of Minnesota are shown for restaurants (Figure 1) and bars (Figure 2). Both figures are shown without a log transformation for ease of interpretation.

![Figure 1](www.ajpm-online.net)
To determine if the associations varied by geographic region, analyses were conducted for seven geographic regions within the state of Minnesota. Results for restaurant employment indicated that the statewide clean indoor air policy was associated with a nonsignificant, positive increase in employment for all regions (Table 2), except in northeast and southeast Minnesota, where there were nonsignificant decreases in employment of less than 1% \((p=0.80\) and \(p=0.54\), respectively). In Table 3, results for regional bar employment showed nonsignificant changes in employment that ranged from a 2.4% decrease in employment in northeast Minnesota \((p=0.12)\) to a 4.8% increase in employment in St. Paul \((p=0.07)\).

**Discussion**

Consistent with other evaluations of clean indoor air policies, the current study did not find a significant change in bar or restaurant employment following enactment of a comprehensive, statewide clean indoor air policy. Further, there were no significant differences in the effect of the statewide clean indoor air policy on bar or restaurant employment across geographic regions of the state of Minnesota.

Generally speaking, studies using time-series analyses with either employment or revenue as a measure of economic effect have found little or no effect from local- or state-level clean indoor air policies in the U.S. Using empirical evidence from community- and state-level analyses, researchers have consistently concluded that no meaningful, long-term effects have been detected from the enactment of clean indoor air policies in bars or restaurants.

Inspection of the unadjusted employment graphs for regions within the state of Minnesota were noteworthy. Generally speaking, the regional patterns of restaurant employment appear flat over the period of study, regardless of location in the state. Although these trends are not statistically evaluated, they are consistent with the findings from the interrupted time-series analyses within specific regions and the state. While the employment level in bars appears to show a decreasing trend over the period of study, this gradual decline seems to start prior to the statewide clean in-
door air policy. Although local clean indoor air policies were implemented in a few cities in Minnesota during the years before the statewide policy, studies of these local policies have not found significant changes in bar or restaurant employment associated with their respective local clean indoor air policies.15

Although numerous cities, states, and countries have been studied for economic effects from clean indoor air policies, questions have been raised as to whether regional attributes may result in different economic effects. In particular, one study reported that communities with harsher winter climates may be more likely to be negatively affected by clean indoor air policies, as outdoor areas may experience colder temperatures that are more inhospitable for smokers.26 The present study and another from Ottawa, Canada,16 did not detect strong economic effects using the same time-series methods in regions with severely cold winters. Both studies used objective outcome measures (tax revenue data from Ottawa) and multiple years of data; the most notable difference between the Ottawa study and the present study was that the Ottawa study combined analysis of bar/restaurant data instead of stratifying the analyses by bars and restaurants. The four regions outside Minneapolis–St. Paul and the metropolitan area are quite rural, and these results suggest that rural areas did not suffer disproportionately from this comprehensive, statewide clean indoor air policy.

There are four key strengths to highlight from the present analyses: (1) the use of an interrupted time-series was an appropriate tool to evaluate the implementation of public health policy while controlling for other pertinent economic factors; (2) few analyses of statewide, comprehensive clean indoor air policies have been conducted; therefore, these results help to inform the debate and discussion about the economic factors that may result from such a policy; (3) bar and restaurant employment was evaluated separately, thus allowing for detection of any differences by the type of hospitality establishment; and (4) regional analyses were conducted in order to investigate whether meaningful geographic differences in economic effects might exist and otherwise go undetected within a broader statewide analysis.

Despite these strengths, the present study has limitations. Although the use of more than 30 months in the analyses meets the minimum requirement for sufficient statistical power,27 additional months of data after the clean indoor air policy enactment would have provided enhanced power to detect a potential association between clean indoor air policy and hospitality employment. Although statistical power may be desirable, the estimates of effect size detected here do not suggest that much large change is happening with regard to bar or restaurant employment; therefore, additional power would only assist in increasing the precision of the CIs and would not be likely to change the interpretation of the findings. The use of employment data has been demonstrated as an objective and valuable measure of economic change in the hospitality industry.2 Yet individual business modifications, such as a reduction in the hours of operation or

---

Table 2. Abrupt permanent change in Minnesota restaurant employment following a statewide, comprehensive clean indoor air policy, by region

<table>
<thead>
<tr>
<th>Final model</th>
<th>Minneapolis</th>
<th>St. Paul</th>
<th>Rest of the twin cities metro area</th>
<th>Northwest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial effects (ω)</td>
<td>0.006 (−0.025, 0.036)ns</td>
<td>0.015 (−0.025, 0.055)ns</td>
<td>0.015 (−0.001, 0.032)ns</td>
<td>0.005 (−0.015, 0.025)ns</td>
</tr>
<tr>
<td>Rate of effects (δ)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>All industry employment</td>
<td>0.189 (−0.145, 0.522)ns</td>
<td>−0.181 (−0.641, 0.278)ns</td>
<td>−0.042 (−0.270, 0.187)ns</td>
<td>0.044 (−0.105, 0.193)ns</td>
</tr>
<tr>
<td>Q(24)*</td>
<td>χ²=31.5, p=0.14</td>
<td>χ²=19.9, p=0.71</td>
<td>χ²=29.2, p=0.21</td>
<td>χ²=25.8, p=0.36</td>
</tr>
<tr>
<td>ARIMA noise model</td>
<td>(0,1,0)(0,0,0)₁₂</td>
<td>(0,1,0)(0,0,0)₁₂</td>
<td>(0,1,0)(0,1,0)₁₂</td>
<td>(0,1,0)(0,1,0)₁₂</td>
</tr>
</tbody>
</table>

| Initial effects (ω) | —0.003 (−0.023, 0.018)ns | 0.007 (−0.021, 0.036)ns | —0.008 (−0.038, 0.022)ns | — |
| Rate of effects (δ) | — | — | — | — |
| All industry employment | 0.060 (−0.234, 0.126)ns | −0.180 (−0.470, 0.110)ns | −0.121 (−0.340, 0.098)ns | — |
| Q(24)* | χ²=24.3, p=0.44 | χ²=44.0, p=0.01 | χ²=28.5, p=0.24 | — |
| ARIMA noise model | (0,1,0)(0,1,0)₁₂ | (0,1,0)(0,1,0)₁₂ | (0,1,0)(0,0,0)₁₂ | — |

Note: Significant numbers (p<0.05) are shown in bold. ns = p>0.05

*Ljung–Box Q test for white noise

ARIMA, autoregressive integrated moving average
changes from full-time to part-time employment status, cannot be detected from a measurement of total employment. While no regional differences were detected in these analyses, individual-level business data would be required in order to provide more in-depth investigation of business- or neighborhood-level changes in employment.

Conclusion

Consistent with similar studies within the U.S. and internationally, the current study found no significant economic effects resulting from enactment of a statewide, comprehensive clean indoor air policy in Minnesota. Clean indoor air policies are an effective means to protect hospitality employees from exposure to ETS in the workplace. This study, along with others, suggests that it is possible to protect the health of employees without negative economic effects on businesses.

We thank the Minnesota Department of Employment and Economic Development for its cooperation in use of employment data. This research was funded by ClearWay Minnesota research program grant RC-2008-0017. The contents of this manuscript are solely the responsibility of the authors and do not necessarily reflect the official views of ClearWay Minnesota.

No financial disclosures were reported by the authors of this paper.

This paper was supported by ClearWay MinnesotaSM as part of a supplement entitled ClearWay MinnesotaSM. Advancing Tobacco Control Through Applied Research (Am J Prev Med 2010;39[6S1]).

Table 3. Abrupt permanent change in Minnesota bar employment following a statewide, comprehensive clean indoor air policy, by region

<table>
<thead>
<tr>
<th>Final model</th>
<th>Log of employment, estimate (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minneapolis</td>
</tr>
<tr>
<td>Initial effects ((\omega))</td>
<td>0.002 (–0.062, 0.066)ns</td>
</tr>
<tr>
<td>Rate of effects ((\delta))</td>
<td>–</td>
</tr>
<tr>
<td>All industry employment</td>
<td>0.262 (–0.434, 0.959)ns</td>
</tr>
<tr>
<td>ARIMA noise model</td>
<td>(\chi^2=29.5, \ p=0.20)</td>
</tr>
</tbody>
</table>

ARIMA, autoregressive integrated moving average

References

3. USDHHS. The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General. Atlanta GA: USDHHS, CDC, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2006.

Did you know?
According to the 2009 Journal Citation Reports®, published by Thomson Reuters, the 2009 impact factor for the American Journal of Preventive Medicine is 4.235.