CLINICAL RESEARCH STUDY

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The Effect of a Statewide Smoking Ordinance on Acute Myocardial Infarction Rates

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ABSTRACT

BACKGROUND: Public smoking ordinances may reduce acute myocardial infarction events. Most studies assessed small communities with reported reductions as high as 40%. No reduction or smaller reductions were found in countrywide studies; less is known about the impact of statewide ordinances. We previously demonstrated identical 27% reductions in acute myocardial infarction hospitalizations in 2 Colorado communities after enactment of strict smoking ordinances. Subsequently, on July 1, 2006, a statewide ordinance went into effect. We sought to determine the impact of this legislation on acute myocardial infarction hospitalization rates.

METHODS: Hospital admissions for a primary acute myocardial infarction diagnosis were examined from 2000 to 2008. Poisson regression models were fit to the monthly events from January 1, 2000, to March 31, 2008. The final model included a quadratic trend over time, harmonic terms, and a post-ordinance effect. The model was adjusted temporally for population changes, using population estimates as an offset variable.

RESULTS: A total of 58,399 unique acute myocardial infarctions were recorded during the study period. No significant reduction in acute myocardial infarction rates was observed post-ordinance (relative risk, 1.059; 95% confidence interval, 0.993-1.131). However, a steep decline in acute myocardial infarction rates was noted from 2000 to 2005 just before enactment. There were 11 strict, local smoking ordinances in effect within Colorado before enactment of the statewide ordinance. After excluding these communities, the findings were similar (relative risk, 1.038; 95% confidence interval, 0.971-1.11).

CONCLUSIONS: Although local smoking ordinances in Colorado previously suggested a reduction in acute myocardial infarction hospitalizations, no significant impact of smoke-free legislation was demonstrated at the state level, even after accounting for preexisting ordinances.

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KEYWORDS: Acute myocardial infarction; Secondhand smoke; Smoking ordinance

Cigarette smoking is one of the most potent risk factors for acute myocardial infarction in the United States.[1] Secondhand smoke exposure results in a dose-dependent increase in acute myocardial infarction risk among both smokers and nonsmokers.[2] The biologic basis for secondhand smoke as a trigger for acute myocardial infarction has been documented extensively. The cascade of ischemic events may be mediated through platelet aggregation and plaque destabilization via augmentation of collagenases that degrade vulnerable intracoronary plaques.[3-5] This proposed mechanism of plaque destabilization suggests that secondhand smoke exposure may precipitously increase acute myocardial infarction risk, which could explain the abrupt reduction in acute myocardial infarction rates observed soon after smoking ordinance enactment in both Colorado and Arizona.[6,7]

These findings from geographically isolated communities have led to the assumption that wider adoption of public smoking restrictions would decrease acute myocardial infarction incidence in the broader population.

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Comprehensive public smoking ordinances now exist in population centers worldwide. Many studies have attempted to quantify the reduction in acute myocardial infarction risk associated with the elimination of secondhand smoke in public venues. However, there have been considerable discrepancies in the magnitude of the effect of smoke-free legislation. Initial studies examining smoking ordinances and acute myocardial infarction incidence found unexpectedly large reductions in acute myocardial infarction hospitalizations in the post-ordinance period, ranging from 11% to 40%.[6,8-11] Three meta-analyses summarize these data and suggest that in aggregate, smoke-free policy results in a 17% to 19% relative risk (RR) reduction in acute myocardial infarction incidence rates.[12-14]

Statewide and countrywide smoking regulations provide the opportunity to study larger populations compared with local ordinances. Several countrywide studies have been completed, including studies in the United States, Italy, Ireland, England, Netherlands, and Scotland.[15-21] These studies report a lesser impact (no effect to a 17% reduction), suggesting that inadequate sample size could have led to random variation within smaller populations. Two small communities in Colorado previously enacted smoke-free legislation, and a RR reduction of 27% in acute myocardial infarction hospitalizations was demonstrated.[6,11] In 2006, Colorado enacted a statewide smoking ordinance. We therefore assessed the impact of this statewide ordinance on acute myocardial infarction hospitalizations overall and after accounting for preexisting local ordinances.

CLINICAL SIGNIFICANCE

- A statewide smoking ordinance in Colorado did not decrease nonfatal acute myocardial infarction hospitalization rates significantly, even after accounting for previous local smoking ordinances.
- The utility of smoke-free policy for reducing the burden of ischemic cardiovascular disease remains uncertain despite known associations of secondhand smoke with acute myocardial infarction.

MATERIALS AND METHODS

Smoke-free Ordinance

On July 1, 2006, the Colorado Clean Indoor Air Act was enacted. The ordinance prohibited smoking in most indoor enclosed areas open to the public, including bars, restaurants, building common areas such as elevators and hallways, and in all areas of employment that were not specifically exempted. Smoking within 15 feet of the main entrance to a building also was prohibited. Outdoor patio areas and cigar bars were excluded, but signage warning the public of possible secondhand smoke was required. The ordinance included a fine of up to $200 for a first violation within a calendar year escalating to a fine up to $500 for the third and each subsequent violation within any given calendar year.[21]

Data Collection

Publically available data on acute myocardial infarction hospitalizations were obtained from the Colorado Hospital Association, an organization that gathers information from all acute care hospitals in the State. Deidentified individual hospitalization records for a primary diagnosis of acute myocardial infarction (International Classification of Diseases, Ninth Revision = 410.xx) were obtained for the study period of January 1, 2000 to March 31, 2008. Secondary diagnoses of acute myocardial infarction were excluded to enhance diagnostic accuracy as previously described.[6,11] The statewide sum of acute myocardial infarction admission for each calendar month in the study period was computed. Information about preexisting local ordinances was obtained from the American Non-smokers' Rights Foundation.[22] A strict local ordinance was defined as one prohibiting smoking in both bars and restaurants and was required to have been enacted at least 1 full month before the statewide ordinance was implemented. Yearly population estimates were obtained from the US Census Bureau to calculate population acute myocardial infarction rates per 100,000 individuals.[23] Linear interpolation of the yearly data was used to produce monthly population estimates.

Analysis

The study was exempted by the Colorado Multiple Institutional Review Board. Sociodemographic and clinical characteristics of the study population were tabulated, and differences between the pre- and post-ordinance cohort were compared using the Student t test and the chi-square test. A Poisson regression model was fit to the time series of statewide monthly acute myocardial infarction counts adjusted for monthly population estimates. Predictor variables included a harmonic to model the seasonal trend in primary acute myocardial infarction rates, a cubic model of time to adjust for secular trends, and an indicator variable for post-ordinance effect. We then evaluated the overall population-adjusted acute myocardial infarction rates from 2000 to 2008 and generated relative risk ratios. To determine whether model estimates were biased to the null effect by preexisting local smoking ordinances, analyses were performed subsequently excluding locations with a strict smoke-free ordinance. An unadjusted P value less than .05 was considered to indicate statistical significance. All analyses were performed in SAS version 8.0 (SAS Institute Inc, Cary, NC).