Editorial

Smoking Bans Prevent Heart Attacks

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In this issue of *Circulation*, Bartecchi and colleagues[1] describe a reduction in hospitalizations for acute myocardial infarction in Pueblo, Colo, after the implementation of a city-wide smoking ordinance. The ordinance, which was strictly enforced, prohibited smoking in all workplaces, including bars and restaurants, and in all buildings open to the public. The findings in Pueblo confirm a similar assessment of the consequences of a public smoking ban in Helena, Mont, which was the first such assessment reported.[2] In the Montana study, the law was in force for 6 months before a challenge led to a court order suspending it. Admissions for acute myocardial infarction declined by 40% during the 6 months of the ban and then rose after it was lifted.

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Replication is critical in inferring causality.[3] The drop in hospitalizations for acute myocardial infarction after the ban in Pueblo provides clear confirmation of the results in Helena. The new report[1] has several strengths. The number of hospitalizations (855) is large, so the impact of the ban can be precisely estimated; the statistical analysis indicates that the findings are highly unlikely to have arisen by chance. The design incorporated 2 comparison populations: residents of Pueblo County outside of the city of Pueblo and residents of El Paso County, which includes Colorado Springs. By including these comparison populations, Bartecchi et al[1] were able to account for temporal trends of a decline in hospitalizations for acute myocardial infarction that might have mistakenly been attributed to the ordinance. Their final regression model estimated a decline of approximately 30% in the hospitalization rate after the ordinance; there was no decline in El Paso County. This beneficial effect is of sufficient magnitude to be readily visible in their Figure 3, which plots the raw data.[1]

How might a smoking ban sharply reduce the rate of hospitalizations for acute myocardial infarction? The implementation of an enforced smoking ordinance would be followed by an immediate reduction in exposure to secondhand smoke and also by a drop in the cigarette consumption of active smokers.[4] Each of these consequences would be expected to the reduce risk for acute myocardial infarction.

Active and passive smoking are well-documented causes of morbidity and mortality from coronary heart disease, and smoking cessation leads to relatively rapid reversal of some of the excess risk associated with active smoking.[3,5,6] Within a year after successful cessation, the smoking-associated risk for coronary heart disease events drops by about 50%. Little research has been carried out to determine the decline of risk for coronary heart disease events after a reduction in exposure to secondhand smoke. However, adverse effects of secondhand smoke exposure on the clotting profile and endothelial cell function might quickly reverse.[6]

There is extensive evidence showing that workplace bans reduce employees' exposure to secondhand smoke.[6] The beneficial consequences of bans for indoor air quality have been documented by tracking air levels of nicotine, which comes solely from tobacco combustion, and cotinine, a principal nicotine metabolite and highly specific biomarker in saliva, urine, or blood. Enforced bans lower the nicotine concentration to below the limit of detection, and cotinine levels also drop. For example, Mulcahy et al[7] recently reported on the smoking ban in Ireland and the impact it had on salivary cotinine concentrations in hotel employees and on nicotine levels in bars. In the hotel employees, the median cotinine concentration dropped from 1.6 ng/mL to 0.5 ng/mL; the median concentration of nicotine in the bars declined from 35.5 $\mu g/m^3$ to 6.0 $\mu g/m^3$. Smoking bans lead to parallel reductions in exposure to the myriad other components of tobacco smoke.[6]

Workplace smoking bans also reduce cigarette consumption by active smokers by both reducing the number of cigarettes smoked and promoting cessation.[4,8] In a meta-analysis of 26 studies, Fichtenberg and Glantz[4] estimated that totally smoke-free workplaces were associated with reductions in smoking prevalence of about 4% and in cigarettes consumed daily of about 3.1 cigarettes per day for active smokers. The length of time for the benefits of workplace smoking bans to take effect after implementation has not been described.

Because of a lack of information on pre- and postordinance patterns of active and passive smoking and the contributions of various places, such as workplaces, public places, and homes to secondhand smoke exposures of nonsmokers, the 30% drop in hospitalization rate in Pueblo postordinance cannot readily be apportioned among active and nonsmokers. In comparisons of exposure to nonexposure to secondhand smoke at home or at work, being exposed increases the risk for coronary heart disease events by about 20% to 30%. Active smoking approximately doubles the risk of coronary heart disease compared with the risk in never-smokers. Given the high proportion of passive smokers, even the reduction in the workplace contribution to exposure may have resulted in a detectable decline in the hospitalization rate for acute myocardial infarction. Similarly, an immediate reduction in the risk for acute myocardial infarction through reduced active smoking may have plausibly contributed to the

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

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(*Circulation.* **2006;114:1450-1451.**)

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***Circulation* is available at http://www.circulationaha.org**
DOI: 10.1161/CIRCULATIONAHA.106.649103

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observed decline as well. Neither the Helena[2] nor the Pueblo[1] study addressed the specific contributions of reduced active and passive smoking to the decline in hospitalization rate after implementation of a smoking ordinance.

The report by Bartecchi et al[1] adds to a substantial body of experimental and observational evidence on risks for cardiovascular disease associated with passive smoking. The topic of passive smoking and heart disease was not addressed in Surgeon General Koop's landmark 1986 report on involuntary smoking.[9] The first epidemiological studies on this topic were published in the mid-1980s, and many epidemiological and experimental studies on secondhand smoke and cardiovascular disease have been published subsequently. In contrast with the 1986 report, several chapters of Surgeon General Carmona's 2006 report[6] on involuntary smoking address cardiovascular disease, and the report offers the conclusion that exposure to secondhand smoke causes coronary heart disease. The report reviews findings of both cohort and case-control studies, as well as experimental evidence, showing that secondhand smoke exposure adversely affects platelet and endothelial cell functioning and produces coronary atherosclerosis. A similar set of pathogenetic processes has been postulated as an underlying association of air pollution with cardiovascular disease.[10]

The 2006 report of the Surgeon General[6] and the 2005 report of the California Environmental Protection Agency[11] on secondhand smoke provide a strong scientific foundation for policies that protect nonsmokers from inhaling secondhand smoke. Among its overall conclusions, the Surgeon General's report comments on the causation of morbidity and premature mortality in children and adults exposed to secondhand smoke and the impossibility of providing full protection without eliminating smoking indoors. Greater ventilation, ie, increasing the exchange of indoor with outdoor air, filtration, and separation of smokers from nonsmokers, will not suffice.

The move toward protecting nonsmokers from involuntarily inhaling secondhand smoke dates to the early 1970s. Surgeon General Steinfeld recognized the possibility of adverse health consequences of secondhand smoke in his 1972 report.[12] The Civil Aeronautics Board required no-smoking sections on commercial airline flights beginning in 1973, and in the 1970s some states and municipalities passed laws to limit smoking. The move toward smoke-free environments accelerated with the 1986 Surgeon General's report and other authoritative reports with conclusions that secondhand smoke exposure causes disease and other adverse health effects. As of July 1, 2006, there were 474 municipalities and 11 states in the United States with smoke-free ordinances in place and 8 smoke-free countries.[13] After the publication of the new Surgeon General's report in June 2006, the strength of its findings motivated many communities and several states to pass smoke-free ordinances.

The findings in Helena and Pueblo indicate that the widening coverage of the population of the United States (and of populations in other countries) by smoke-free ordinances will lower coronary heart disease morbidity and mortality. The Framework Convention for Tobacco Control, a global public health treaty, has protection against exposure to secondhand smoke as a major provision. Smoke-free ordinances should be included in any population-level program for prevention of cardiovascular disease, and the broad community of health professionals involved in cardiovascular disease should vigorously support and promote such initiatives.[14] Undoubtedly, there will be more reports tracking the consequences of smoke-free ordinances for disease risk; fortunately, there is an ever-increasing number of locations with ordinances in force in which to make these observations.

Acknowledgments

Dr. Samet has received grant support from GlaxoSmithKline, the American Legacy Foundation, Flight Attend Medical Research Institute (FAMRI), and Atlantic Philanthropies. He is the recipient of the Dr William Cahan Distinguished Professor Award from the Flight Attendant Medical Research Institute.

Disclosures

None.

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Circulation. 2006;114:1450-1451
doi: 10.1161/CIRCULATIONAHA.106.649103
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

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