Exposure to Environmental Tobacco Smoke

Identifying and Protecting Those At Risk

The dangers of exposure to environmental tobacco smoke (ETS) are now well established. Reports from the US Environmental Protection Agency[1] and the California Environmental Protection Agency[2] and meta-analyses published last year[3,4] have shown convincingly that exposure to ETS causes lung cancer, heart disease, and other serious illnesses.

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The California Environmental Protection Agency report estimated that each year in the United States, ETS exposure causes 3000 deaths due to lung cancer, 35 000 to 62 000 deaths due to ischemic heart disease, and 1900 to 2700 deaths due to sudden infant death syndrome. Exposure to ETS is also responsible for 9700 to 18 600 cases of low-birth-weight infants annually, 8000 to 26 000 new cases of asthma in children, exacerbation of asthma in 400 000 to 1 million children, and 150 000 to 300 000 cases of bronchitis or pneumonia in children aged 18 months and younger (of which 7500 to 15 000 require hospitalization).[2]

Who Is At Risk?

Virtually everyone in the United States is at some risk of harm from exposure to secondhand smoke. The reasons are that nearly everyone is exposed to tobacco smoke,[5] and there is no evidence of a threshold level of exposure below which exposure is safe.[1] Nevertheless, it is useful to address the question: who is at greatest risk from passive smoking?

Most people spend about 90% of their time in 2 "microenvironments": home and work.[6] Thus, populations at greater risk of harm from ETS are those who live with smokers and those who work where smoking is allowed. Data from the Third National Health and Nutrition Examination Survey (NHANES III) showed that the number of smokers in the household and the hours exposed to ETS at work were significantly associated with levels of serum cotinine (a metabolite of nicotine).[5]

Some people are more susceptible to harm from a given level of exposure to ETS because of their age or health status. Infants and children exposed to ETS are more likely to develop pneumonia, bronchitis, asthma, and middle ear disease.[1,2,7] One reason infants and children may be more susceptible to harm from ETS is that their lungs and other respiratory tissue are still developing. The infant lung has immature immunologic function, very small airways that are vulnerable to obstruction, and fewer alveoli in relation to the number of airways.[8] Children are also more prone to illness from ETS because they have a higher respiratory rate than adults and because some ETS-associated conditions (eg, middle ear disease) occur primarily at young ages.

Persons with certain chronic conditions are more likely than healthy people to suffer when exposed to ETS. Passive smoking exacerbates symptoms of asthma in adults.[2] In addition, persons with allergies, chronic obstructive pulmonary disease, chronic heart disease, and peripheral vascular disease may be more susceptible to the ill effects of ETS and its constituents (eg, carbon monoxide).[9-11]

For a given microenvironment, the harm from passive smoking depends on time spent in that environment and the concentration of ETS in that air space. The concentration of ETS, in turn, is affected by the size of the space, the number of people smoking there, and the ventilation rate. Those factors create a substantial risk of harm from ETS in certain occupational settings.

Workers At Great Risk

Before smoking on commercial aircraft was banned in the United States, flight attendants were at high risk of illness from secondhand smoke. Many passengers smoked, the air space was small, and the air filtration and outside air flow rates were inadequate in removing ETS.[12] Moreover, separation of smokers and nonsmokers in the aircraft cabin did not protect passengers in nonsmoking areas or flight attendants assigned to work in those areas from exposure to ETS.[13] Flight attendants who work for foreign airlines that still allow smoking on their flights continue to be exposed to dangerous levels of ETS.

Casino workers represent another occupational group at high risk of disease from ETS. Very few casinos restrict smoking on their premises, and smokers are likely to be overrepresented among patrons of these establishments. Moreover, the risk-taking ambience and the free flow of alcohol at casinos probably encourage a high level of smoking among gamblers. A health hazard evaluation of a large casino in Atlantic City, NJ, conducted by the National Institute for Occupational Safety and Health, showed that employees working in the gaming areas of the casino were exposed to ETS at levels greater than those observed among participants in the NHANES III who had reported exposure to ETS at both home and work.[14,15] Employees working at nonsmoking tables had similar serum and urine cotinine levels as employees working at tables where smoking was permitted.

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Howard et al[16] studied 74 nonsmokers, 38 of whom were exposed to ETS at work and 36 of whom were not (none of the 74 had exposure to ETS at home). Those exposed to ETS at work (the majority [31/38] of whom were casino workers [written communication from Dr Chris A. Pritsos to James Repace, June 8, 1998]) had higher serum cotinine levels and increased levels of oxidative DNA mutagens when compared with those not exposed at work.[16] Kado et al[17] measured mutagenic activity in air sampled from a casino and a bingo parlor using a *Salmonella* microsuspension assay and found that mutagenic activity correlated with airborne nicotine and total suspended particulate matter.

Restaurant and bar workers comprise yet another group who are affected disproportionately by ETS. In a meta-analysis, Siegel[18] found that levels of ETS are 1.6 to 2.0 times higher in restaurants and 3.9 to 6.1 times higher in bars than in office workplaces of other businesses. Levels of ETS in restaurants and bars were 1.5 times higher and 4.4 to 4.5 times higher, respectively, than in residences with at least 1 smoker. Based on published studies of lung cancer risk among food service employees that controlled for active smoking, Siegel[18] concluded that "there may be a 50% increase in lung cancer risk among food-service workers that is in part attributable to tobacco smoke exposure in the workplace." The Massachusetts Department of Public Health also found a 50% excess risk of lung cancer among food service workers, most likely related to their exposure to secondhand smoke.[19]

Based on measurements from published studies, Siegel[18] calculated the ratio of mean nicotine concentration in several usually smoky worksites to the concentration in typical offices. Bingo parlors were the smokiest (ratio = 13.0), followed by bars (4.8), billiard halls (4.7), betting establishments (3.7), bowling alleys (2.6), and restaurants (1.6).[20]

In this issue of *JAMA,* Eisner et al[21] provide another line of evidence concerning the hazards of passive smoking for workers in these establishments. They studied the respiratory health of a cohort of bartenders before and after passage of state legislation in California prohibiting smoking in bars and taverns. The study cohort was composed of 53 bartenders from a random sample of 25 bars and taverns in San Francisco. At baseline (in the month preceding imposition of the smoking ban), all of the bartenders reported ETS exposure at work and most reported heavy exposure. Self-reported ETS exposure at work declined from a median of 28 hours per week at baseline to 2 hours per week at follow-up (1-2 months after the smoking ban was in place). A marked decline in the prevalence of respiratory symptoms (wheezing, dyspnea, cough, and phlegm production) and sensory irritation symptoms (eye, nose, or throat irritation) occurred, and improvement in pulmonary function (FVC [forced vital capacity] and FEV_1 [forced expiratory volume in 1 second]) was observed after controlling for personal smoking and upper respiratory tract infections. As Eisner and colleagues note, their study provides evidence that workplace smoking prohibitions have immediate beneficial effects on adult respiratory health, not to mention their likely effect in reducing the long-term risk of lung cancer and cardiovascular disease.

Eliminating Exposure

Because of the risks of passive smoking, nonsmokers' exposure to secondhand smoke needs to be eliminated. That goal can be accomplished through 2 different approaches: prohibiting smoking indoors or limiting smoking to rooms that have been specially designed to prevent smoke from escaping to other areas of the building.[22] The former approach is the preferred option, as it ensures maximum protection of nonsmokers, is easier and less expensive to implement, and avoids exposing smokers to the added risk of concentrated ETS in designated smoking areas.[23]

Strategies to protect nonsmokers can be divided into 4 categories: education, regulation, legislation, and litigation. Education about the dangers of passive smoking is important for 2 reasons. First, it lays the groundwork for good compliance with legislation and regulation. Public support for smoking restrictions and bans in the United States has grown through the years,[24] helping to ensure smooth implementation of those policies. In France, by contrast, public smoking restrictions were imposed by "top-down" action of the federal government, without meaningful grass-roots pressure[25]; as a result, compliance has been less than ideal. A second reason education is important is that some areas—such as private homes—are difficult to control through legislation, so education is the main intervention strategy that is available.[26]

Education alone is usually not effective in protecting nonsmokers. Even though most Americans believe that passive smoking is harmful to health and most nonsmokers are annoyed by exposure to ETS, many smokers light their cigarettes inside public places without asking if others mind, and few nonsmokers ask smokers to put out their cigarettes when they light them indoors.[27] Because children cannot protect themselves and because nonsmoking adults are prone to suffer in silence when exposed to ETS, public policies are needed to protect them.

Regulation by the Occupational Safety and Health Administration (OSHA) could protect workers throughout the United States from exposure to ETS. In 1994, OSHA proposed sweeping rules that would ban smoking in worksites except in separately ventilated areas.[28] Unfortunately, final rules have not been promulgated, and there is no indication that they will be anytime soon. President Clinton signed an executive order in August 1997 banning smoking in federal buildings,[29] and governors in at least 7 states (Colorado, Idaho, Michigan, Ohio, South Dakota, Washington, and Wyoming) have done the same for state government worksites.[30] Two states, Washington and Maryland, have promulgated strong clean indoor air regulations.[30]

Legislation at the federal level bans smoking on commercial aircraft for flights that are 6 hours or less in duration.[31] Federal legislation also requires that organizations and agencies have smoke-free indoor facilities if they receive federal funding for children's services.[32] At the state level, as of December 31, 1997, 21 states banned smoking in day care centers or restricted it to designated areas with separate ventilation, but only 10 states had such a policy for government worksites, only 1 state (California) had such a policy for private worksites, and only 3 states (California, Utah, and Vermont) had such a policy for restaurants.[33] Clean indoor air legislation has also been passed by many local jurisdictions.[34]

Despite the abundant research that has established the harmfulness of passive smoking,[1-4] and despite the education, regulation, and legislation that have grown out of the nonsmokers' rights movement in the United States, a large number of Americans continue to be exposed involuntarily to ETS at worksites and other public places.[5,35] As a result, litigation is now being used increasingly to protect nonsmokers from exposure to ETS. Much of this litigation is aimed at protecting workers at highest risk of harm from ETS.

A class action lawsuit filed against the tobacco industry on behalf of flight attendants harmed by secondhand smoke was settled for $350 million.[36] Similar class action lawsuits have been filed in Nevada and New Jersey on behalf of casino workers harmed by ETS.[37] Many companies have been sued for not offering their employees smoke-free work space, workers' compensation claims have been filed based on workplace exposure to ETS, and parental smoking is being considered in child custody cases.[38,39] Some of these cases have been brought under the public accommodation provisions of the Americans With Disabilities Act.[40]

In June 1993, the US Supreme Court ruled that the Nevada state prison may have subjected a convicted murderer to cruel and unusual punishment (in violation of the 8th Amendment to the US Constitution) by forcing him to live with a smoking cellmate.[41] Millions of Americans outside prison are exposed involuntarily to secondhand smoke every day, and many of them will suffer the cruel fate of lung cancer, heart disease, or some other malady caused by that exposure. As a society, we need to intensify our efforts to convince parents, employers, building managers, legislators, and other decision makers to ban smoking in the indoor space under their control. In the absence of such action, slow and costly litigation will become the main strategy for addressing this problem. And passive smoking will continue to cause a great deal of premature death, disability, and suffering in the interim.

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1. US Environmental Protection Agency. *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders.* Washington, DC: Environmental Protection Agency, Office of Air and Radiation; 1992. Environmental Protection Agency publication EPA/600/6-90/006F.
2. California Environmental Protection Agency. *Health Effects of Exposure to Environmental Tobacco Smoke.* Sacramento: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment; 1997.
3. Hackshaw AK, Law MR, Wald NJ. The accumulated evidence on lung cancer and environmental tobacco smoke. *BMJ.* 1997;315:980-988.
4. Law MR, Morris JK, Wald NJ. Environmental tobacco smoke exposure and ischaemic heart disease: an evaluation of the evidence. *BMJ.* 1997;315:973-980.
5. Pirkle JL, Fiegal KM, Bernert JT, Brody DJ, Etzel RA, Maurer KR. Exposure of the US population to environmental tobacco smoke: the Third National Health and Nutrition Examination Survey, 1988 to 1991. *JAMA.* 1996;275:1233-1240.
6. Szalai A. *The Use of Time: Daily Activities of Urban and Suburban Populations in Twelve Countries.* The Hague, Netherlands: Mouton Publishers; 1972.
7. Mannino DM, Siegel M, Husten C, Rose D, Etzel R. Environmental tobacco smoke exposure and health effects in children: results from the 1991 National Health Interview Survey. *Tob Control.* 1996;5:13-18.
8. National Research Council. *Environmental Tobacco Smoke: Measuring Exposures and Assessing Health Effects.* Washington, DC: National Academy Press; 1986:209-211.
9. Aronow WS. Effects of passive smoking on angina pectoris. *N Engl J Med.* 1978;299:21-24.
10. Aronow WS, Ferlinz J, Glauser F. Effect of carbon monoxide on exercise performance in chronic obstructive pulmonary disease. *Am J Med.* 1977;63:904-908.
11. Aronow WS, Stemmer EA, Isbell MW. Effect of carbon monoxide exposure on intermittent claudication. *Circulation.* 1974;49:415-417.
12. National Research Council. *The Airliner Cabin Environment: Air Quality and Safety.* Washington, DC: National Academy Press; 1986.
13. Mattson ME, Boyd G, Byar D, et al. Passive smoking on commercial airline flights. *JAMA.* 1989;261:867-872.
14. Trout D, Decker J. *NIOSH Health Hazard Evaluation Report, HETA 95-0375-2590, Bally's Park Place Casino Hotel, Atlantic City, New Jersey.* Cincinnati, Ohio: NIOSH Publications Office; July 1996.
15. Trout D, Decker J, Mueller C, Bernert JT, Pirkle J. Exposure of casino employees to environmental tobacco smoke. *J Occup Environ Med.* 1998;40:270-276.
16. Howard DJ, Ota RB, Briggs LA, Hampton M, Pritsos CA. Environmental tobacco smoke in the workplace induces oxidative stress in employees, including increased production of 8-hydroxy-2-deoxyguanosine. *Cancer Epidemiol Biomarkers Prev.* 1998;7:141-146.
17. Kado NY, McCurdy SA, Tesluk SJ, et al. Measuring personal exposure to airborne mutagens and nicotine in environmental tobacco smoke. *Mutat Res.* 1991;261:75-82.
18. Siegel M. Involuntary smoking in the restaurant workplace: a review of employee exposure and health effects. *JAMA.* 1993;270:490-493.
19. Brooks DR, Davis LK. *Employment as a Waiter or Waitress and Risk of Lung Cancer.* Boston: Massachusetts Department of Public Health, Bureau of Health Statistics, Research and Evaluation, Occupational Health Surveillance Program; 1995.
20. Siegel M. *Smoking and Bars: A Guide for Policy Makers.* Boston, Mass: Boston University School of Public Health; January 1998.
21. Eisner MD, Smith AK, Blanc PD. Bartenders' respiratory health after establishment of smoke-free bars and taverns. *JAMA* 1998;280:1909-1914.
22. US Environmental Protection Agency. *Secondhand Smoke: What You Can Do About Secondhand Smoke as Parents, Decisionmakers, and Building Occupants.* Washington, DC: Environmental Protection Agency; July 1993. Environmental Protection Agency publication EPA-402-F-93-004.
23. Siegel M, Husten C, Merritt RK, Giovino GA, Eriksen MP. Effects of separately ventilated smoking lounges on the health of smokers: is this an appropriate public health policy? *Tob Control.* 1995;4:22-29.
24. US Department of Health and Human Services. *Reducing the Health Consequences of Smoking: 25 Years of Progress: A Report of the Surgeon General.* Rockville, Md: US Public Health Service, Centers for Disease Control, Office on Smoking and Health, 1989: chapter 4. US Dept of Health and Human Services publication CDC 89-8411.
25. Vogel D, Kagan RA, Kessler T. Political culture and tobacco control: an international comparison. *Tob Control.* 1993;2:317-326.
26. Ashley MJ, Ferrence R. Reducing children's exposure to environmental tobacco smoke in homes: issues and strategies. *Tob Control.* 1998;7:61-65.
27. Davis RM, Boyd GM, Schoenborn CA. "Common courtesy" and the elimination of passive smoking: results of the 1987 National Health Interview Survey [published correction appears in *JAMA.* 1990;263:3025]. *JAMA.* 1990;263:2208-2210.
28. Occupational Safety and Health Administration. Notice of proposed rulemaking: notice of informal public hearing. 59 *Federal Register* 15968 (April 5, 1994) (codified at 29 CFR §1910, 1915, 1926, 1928).
29. Associated Press. Clinton bans smoking in US buildings, not outside. *Washington Post.* August 10, 1997:A9.
30. Centers for Disease Control and Prevention. *State Tobacco Control Highlights—1996.* Atlanta, Ga: Centers for Disease Control and Prevention, Office on Smoking and Health, 1996. Centers for Disease Control and Prevention publication 099-4895.
31. 49 USC 41706.
32. 20 USC 6081-6084.
33. Centers for Disease Control and Prevention. State and national tobacco control highlights. Available at: http://www.cdc.gov/tobacco/statehi/statehi.htm. Accessed November 10, 1998.
34. Rigotti NA, Pashos CL. No-smoking laws in the United States: an analysis of state and city actions to limit smoking in public places and worksites. *JAMA.* 1991;266:3162-3167.
35. Gerlach KK, Shopland DR, Hartman AM, Gibson JT, Pechacek TF. Workplace smoking policies in the United States: results from a national survey of more than 100 000 workers. *Tob Control.* 1997;6:199-206.
36. Navarro M. Cigarette makers reach settlement in nonsmoker suit. *New York Times.* October 11, 1997:A1.
37. Smothers R. Workers challenge casinos' role as a haven for smokers. *New York Times.* May 25, 1998:B1.
38. Sweda EL. *Summary of Legal Cases Regarding Smoking in the Workplace and Other Places.* Boston, Mass: Tobacco Control Resource Center; July 1997.
39. Sweda EL, Gottlieb MA, Porfiri RC. Protecting children from exposure to environmental tobacco smoke. *Tob Control.* 1998;7:1-2.
40. Parmet WE, Daynard RA, Gottlieb MA. The physician's role in helping smoke-sensitive patients to use the Americans With Disabilities Act to secure smoke-free workplaces and public spaces. *JAMA.* 1996;276:909-913.
41. *Helling v McKinney,* 113 S Ct 2475 (1993).

Individualizing Aspirin Therapy for Prevention of Cardiovascular Events

In this issue of THE JOURNAL, He and colleagues[1] present the results of a meta-analysis on the risk of hemorrhagic stroke in patients treated with aspirin at the regimens currently prescribed for the prevention of carotid, coronary, or peripheral artery thrombotic occlusion. This review of a subset of 16 randomized controlled trials of aspirin for the prevention of cerebrovascular accidents, involving more than 55 000 patients, confirms that aspirin, even at the average dosage of 273 mg/d (range, 75-1500 mg/d), increases the risk of cerebral bleeding.

See also p 1930.

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