The smoking gun: working to eliminate tobacco smoke exposure

PATRICK N. BREYSSE[a] AND ANA NAVAS-ACIEN[a]

[a]Department of Environmental Health Sciences, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland, USA

Address all correspondence to pbreysse@jhsph.edu

doi:10.1038/jes.2010.34

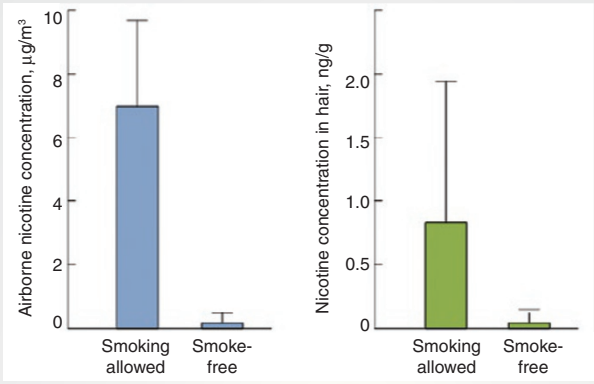
"The scientific evidence indicates that there is no risk-free level of exposure to secondhand smoke" (US DHHS, 2006).

BACKGROUND

The 1972 US Surgeon General's Report on smoking reported the first systematic examination of the impact of smoking on indoor environments (US DHEW, 1972). The report noted the lack of exposure data, concluding that the contribution to human disease of tobacco smoke components (e.g., particulate matter (PM) and oxides of nitrogen) was not well known.

By the early 1980s, evidence of the health consequences of secondhand smoke (SHS) exposure was mounting. The literature suffered, however, from limited data characterizing the extent of SHS exposure. The recent report of the Surgeon General on the health consequences of involuntary smoking (US DHHS, 2006) relied heavily on the growing body of literature describing exposure to PM, nicotine, nitrosamines, and other tobacco compounds associated with SHS exposure.

SHS exposure is most commonly assessed by measuring PM and nicotine in the air. Measuring PM for this purpose began in the early 1980s, and determining vapor-phase nicotine concentrations dates back to landmark studies in the late 1980s (Spengler et al., 1981; Repace, 1980; Mattson et al., 1989). Biomonitoring offers important insights into internal dose by integrating multiple exposure sources and can thus provide information about exposure in different environments (e.g., home, work, and transportation). Cotinine—the principal metabolite of nicotine—in biological samples (e.g., serum) is the biomarker that is used most often to assess short-term and ongoing SHS exposure.



Airborne and hair nicotine concentrations in nonsmoking employees, by smoking status of bars, recruited in Baltimore, MD, before enactment of smoke-free legislation (median and 75th percentile of the distribution).

The World Health Organization Framework Convention on Tobacco Control (FCTC) has set the stage for efforts to reduce smoking worldwide. Tobacco smoke exposure studies have made essential contributions to tobacco control efforts in the United States and worldwide.

In Baltimore, MD, smoking was allowed in bars and nightclubs before the enactment of comprehensive smoke-free legislation in February 2008. To objectively document secondhand smoke exposure levels in Baltimore bars, we measured nicotine concentrations in the air as well as in the hair of nonsmoking employees in 11 bars. As shown in the figure, bars that allowed smoking had median airborne and hair nicotine concentrations 45 and 16 times higher, respectively, than bars that did not permit smoking. These findings were widely disseminated via advocacy groups and local media and were presented to local and statewide government entities in support of the smoke-free legislation that was subsequently approved in the city of Baltimore and later in the state of Maryland (unpublished data).

IMPACT AND IMPLICATIONS FOR EXPOSURE SCIENCE

Measurements of airborne nicotine and PM in public places have contributed to the development and implementation of smoke-free legislation around the world by documenting the magnitude and extent of SHS exposure (Navas-Acien et al., 2004; Hyland et al., 2008; Jiang et al., 2010). While SHS concentrations range widely across locations and countries, elevated concentrations are consistently found in restaurants, bars, and casinos, raising major concerns about the health of the patrons and the employees in those environments. For example, SHS assessments have provided key evidence indicating that separate nonsmoking sections in public places are insufficient to protect nonsmokers from SHS exposure, and that such exposure is a significant occupational health problem for nonsmokers in workplaces that allow smoking. Overall, these and other studies have clearly documented that comprehensive smoke-free legislation is urgently needed to protect all people, including workers in the hospitality industry.

The World Health Organization Framework Convention on Tobacco Control (FCTC), developed in response to the globalization of the tobacco epidemic, entered into force in 2005. Article 8 requires signatories to adopt legislative measures to

protect the population from exposure to tobacco smoke in all indoor public places and workplaces. According to Article 8, protection from tobacco smoke is grounded in fundamental human rights and freedoms.

In response to the FCTC, many countries and subnational entities are enacting comprehensive smoke-free laws that ban smoking in indoor public places. For example, in the United States and Canada, many states and provinces have passed comprehensive smoke-free legislation. Despite these successes, the World Health Organization estimated in 2009 that only 5% of the world's population was covered by comprehensive smoke-free laws (WHO, 2009). In the United States, it was estimated that 41% of the population was covered by comprehensive laws as of April 2010 (Americans for Non-smokers' Rights, 2010).

The FCTC also indicated that smoke-free legislation should be monitored and evaluated for compliance. Although questionnaires and observation are useful tools for evaluating the implementation of smoke-free laws, airborne nicotine, PM, and other tobacco markers have the advantage of allowing precise, objective measures of SHS exposure at a reasonable cost.

Exposure measurement and biomonitoring have played a critical role in implementation and compliance with tobacco control efforts. First, they provide baseline measures in critical locations, including both public and private places, as well as overall levels of SHS exposure in the nonsmoking population. Detecting SHS is a powerful argument in support of comprehensive smoke-free initiatives because it has been firmly established that there are no safe levels of SHS exposure. Second, they provide unquestionable evidence that some approaches to eliminating SHS exposure, such as mechanic ventilation systems and separated areas for smokers and nonsmokers, are ineffective. Third, they allow for comparisons between places where smoking is allowed and those that are comprehensively smoke-free. Similarly, biomonitoring allows for comparison of SHS exposure for individuals working or living in places where smoking is allowed with that for similar individuals working or living in comprehensively smoke-free places. Studies have shown dramatically higher SHS exposures in locations where smoking is allowed as well as in individuals spending time in those environments.

The fourth role of exposure measurement and biomonitoring is for dissemination and advocacy campaigns to audiences such as the media, policy makers, medical and public health providers, and the public at large. In most countries where SHS exposure assessments have been conducted, this information has been presented to legislative bodies debating tobacco control legislation. Local evidence of tobacco smoke exposure provides a powerful tool for policy development. Finally, SHS exposure data are critical to evaluate the implementation of tobacco control programs. For instance, in the United States, serum cotinine levels declined 70% from the late 1980s to the early 2000s (Pirkle et al., 2006), providing evidence of the impact of tobacco control measures implemented during the 1990s. These evaluations also identify opportunities for improvement. For example, serum cotinine data clearly showed that additional tobacco control efforts are needed among young children and black populations in the United States (Pirkle et al., 2006).

Assessment of SHS exposure has afforded a key evidence base needed to establish the associated risks, to drive policy efforts worldwide aimed at banning smoking in public places, and to assess compliance with smoking bans.

ACKNOWLEDGEMENT

The authors are supported by research grants from the Flight Attendant Medical Research Institute.

REFERENCES

Americans for Nonsmokers' Rights. Percent of U.S. State Populations Covered by 100% Smokefree Air Laws (1 April 2010). http://www.no-smoke.org/pdf/percentstatepops.pdf.

Hyland A, Travers MJ, Dresler C, Higbee C, and Cummings KM. A 32-country comparison of tobacco smoke derived particle levels in indoor public places. *Tob Control* 2008: 17: 159–165.

Jiang RO, Cheng KI, Acevedo-Bolton V, Klepeis NE, Repace JL, Ott WR *et al.* Measurement of fine particles and smoking activity in a statewide survey of 36 California Indian casinos. *J Expo Sci Environ Epidemiol*; e-pub ahead of print 17 February 2010.

Mattson M.E., Boyd G., Byar D., Brown C., Callahan J.F., Corle D. *et al.* Passive smoking on commercial airline flights. *JAMA* 1989: 261: 867–872.

Navas-Acien A., Peruga A., Breysse P., Zavaleta A., Blanco-Marquizo A., Pitarque R. *et al.* Secondhand tobacco smoke in public places in Latin America, 2002–2003. *JAMA* 2004: 291: 2741–2745.

Pirkle J.L., Bernert J.T., Caudill S.P., Sosnoff C.S., and Pechacek T.F. Trends in the exposure of nonsmokers in the U.S. population to secondhand smoke: 1988–2002. *Environ Health Perspect* 2006: 114: 853–858.

Repace J.L., and Lowery A.H. Smoking rates among gamblers at Nevada casinos mirror US smoking rate. *Science* 1980: 208: 464–472.

Spengler J.D., Dockery D.W., Turner W.A., Wolfson J.M., and Ferris B.G. Long-term measurements of the respirable sulfates and particles inside and outside homes. *Atmos Environ* 1981: 15: 23–30.

US DHEW. Department of Health, Education, and Welfare. The Health Consequences of Smoking: A Report of the Surgeon General (1972). DHEW publication no. (HSM) 72-7516. http://profiles.nlm.nih.gov/NN/B/B/P/M.

US DHHS. Department of Health and Human Services. The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General (2006). http://www.surgeongeneral.gov/library/secondhandsmoke/index.html.

WHO. World Health Organization. WHO Report on the Global Tobacco Epidemic, 2009: Implementing Smoke-Free Environments. http://www.who.int/tobacco/mpower/2009/gtcr_download/en/index.html.

International Society of Exposure Science

Science for Better Environmental Health

This Exposure Science Digest is sponsored by the International Society of Exposure Science (www.isesweb.org) in celebration of its 20th anniversary.