RESEARCH COMMUNICATION

Secondhand Smoke Concentrations in Hospitality Venues in the Pacific Basin: Findings from American Samoa, Commonwealth of the Northern Mariana Islands, and Guam

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Abstract

Introduction: Secondhand smoke (SHS) from burning tobacco products causes disease and premature death among nonsmokers. Although the number of laws prohibiting smoking in indoor public places continues to increase, millions of nonsmokers in the United States (US) and its territories remain exposed to SHS. This study assessed indoor air pollution from SHS in hospitality venues in three US Pacific Basin territories. Methods: Air monitors were used to assess $PM_{2.5}$, an environmental marker for SHS, in 19 smoke-permitted and 18 smoke-free bars and restaurants in American Samoa, Commonwealth of the Northern Mariana Islands (CNMI), and Guam. Observational logs were used to record smoking and other sources of air pollution. Differences in average $PM_{2.5}$ concentrations were determined using bivariate statistics. Results: The average $PM_{2.5}$ level in venues where smoking was always permitted [arithmetic mean (AM)=299.98 μg/m^3; geometric mean (GM)=200.39 μg/m3] was significantly higher (p<0.001) than smoke-free venues [AM=8.33 μg/m3; GM=6.14 μg/m^3]. In venues where smoking was allowed only during certain times, the average level outside these times [AM=42.10 μg/m^3; GM=41.87 μg/m^3] was also significantly higher (p<0.001) than smoke-free venues. Conclusions: Employees and patrons of smoke-permitted bars and restaurants are exposed to dangerous levels of air pollution from SHS, even during periods when active smoking is not occurring. Prohibiting smoking in all public indoor areas, irrespective of the venue type or time of day, is the only way to fully protect nonsmokers from SHS exposure in these environments.

Keywords: Tobacco smoking - secondhand smoke - air pollution - health policy - public smoking bans

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Introduction

Exposure to secondhand smoke (SHS) from burning tobacco products causes lung cancer and heart disease in nonsmoking adults and sudden infant death syndrome, acute respiratory infections, middle ear disease, exacerbated asthma, respiratory symptoms, and decreased lung function in children (USDHHS, 2006). Even brief exposure to SHS can cause cardiovascular disease and lead to acute cardiac events (USDHHS, 2010). In the United States (U.S.), 25 states and one territory have enacted comprehensive policies that prohibit tobacco smoking in all indoor public areas, including worksites and hospitality venues such as restaurants and bars (CDC, 2010a; ANR, 2011). The implementation of such policies significantly reduces SHS exposure (USDHHS, 2006) and can have an immediate and sustained impact on smoking related outcomes, including decreased incidence of heart attacks in the general population (Lightwood & Glantz, 2009). However, the millions of nonsmokers who reside in areas not covered by comprehensive smoke-free policies remain susceptible to SHS exposure. The need for such policies is particularly vital in U.S. Pacific Basin territories, where tobacco control resources are limited (Allen & Clark, 2007) and most recent estimates of adult smoking prevalence (territory range: 24.0%-41.0%) (ASG & WHO, 2007; Rasanathan & Tukuitonga, 2007; CDC, 2010b) are markedly higher than in the mainland U.S. (state range: 9.8%-25.6%) (CDC, 2010c).

The U.S. Pacific Basin territories of American Samoa, CNMI, and Guam currently have partial smoke-free policies that prohibit smoking in some, but not all, indoor public areas (ANR, 2011). In 2005, the Legislature of Guam enacted the Natasha Protection Act (Public Law 20-80), which prohibits smoking in all stand-alone restaurants, but exempts bars and certain worksites. In CNMI, the Smoke-Free Air Act of 2008 (Public Law 16-46) prohibits smoking in all worksites and stand-alone restaurants, but exempts all stand-alone bars and certain attached bar areas of restaurants once the kitchen ceases meal service. Most recently, the Legislature of American Samoa enacted the American Samoa Smoke Free Environment Act (Public Law 31), which prohibits smoking in all restaurants and bars effective January 2011,

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but exempts certain private worksites.

Fine particulate matter with a diameter of less than 2.5 microns ($PM_{2.5}$) has previously been used to assess indoor concentrations of SHS in hospitality venues in multiple countries (Hyland et al., 2008; Connolly et al., 2009). Particles of this size are emitted in significant quantities during tobacco combustion and can easily be inhaled deep into the lungs (Travers et al., 2004). To protect public health, the U.S. Environmental Protection Agency (EPA) currently recommends that average annual and 24-hour outdoor $PM_{2.5}$ exposure should not exceed 15 μg/m3 and 35 μg/m^3, respectively (USEPA, 2006).

The objective of this study was to determine the extent and magnitude of $PM_{2.5}$ concentrations within a sample of smoke-free and smoke-permitted bars and restaurants in American Samoa, CNMI, and Guam. Since locally salient research documenting the health impact of SHS in the Pacific Basin has been limited (Allen & Clark, 2007), the findings of this study could help inform the strengthening and retention of comprehensive public indoor smoke-free policies in these three territories and throughout the Pacific region.

Materials and Methods

Site Selection

Data were collected between December 6th and 19th, 2010, in a sample of 37 hospitality venues throughout American Samoa, CNMI, and Guam. A convenience sample approach was employed to select a range of venues based upon smoking policy, type, and size. The sample consisted of stand-alone restaurants, stand-alone bars, and restaurants with attached bars. Only venues that were open to the public, covered by a ceiling, and at least 75% enclosed by side walls were included in the sample.

Procedures

All venues were assessed during peak business hours (11:00 AM to 1:00 AM) on varying days of the week. All data were collected by trained local volunteers under the direct supervision of research personnel. Upon entering each venue, the volunteers placed concealed air monitoring equipment in a central location near the height at which a person breathes air. The concentration of fine particulate air pollution was then continuously assessed for a minimum of 30 minutes inside each venue. In addition, volunteers recorded the number of persons and burning cigarettes in each venue at 15 minute intervals. They also determined and recorded the dimensions of each venue.

Equipment

TSI SidePak AM510 Personal Aerosol Monitors® (TSI, Inc., St. Paul, Minnesota) were used to assess indoor levels of respirable suspended particulate (RSP) in real-time. This device is a scientifically validated instrument that has previously been used to quantify levels of SHS in public areas, including bars and restaurants (Repace, 2004; Travers et al., 2004; Connolly et al., 2009). The device functions via an interior sampling pump which draws continuously streaming aerosol into a sensing chamber where it is illuminated by a laser light. Particulate in the aerosol stream scatters this light, which is then quantified by a photometer and converted to the mass concentration of the aerosol. The specific class of RSP assessed was $PM_{2.5}$, or fine particulate matter with a diameter less than 2.5 μm. Prior to each use, the device was zero calibrated in accordance with the manufacturer's specifications and set to a flow rate of 1.7 liters per minute and a log interval of 1-minute.

Measures

The primary outcome of interest was the average concentration of $PM_{2.5}$ in smoke-permitted and smoke-free venues within each venue and territory. "Smoke-Permitted" was defined as the allowance of smoking in an indoor area of the venue during some or all business hours, whereas "smoke-free" was defined as the prohibition of smoking in all indoor areas of the venue, regardless of the time of day.

Within each venue, the presence of "active smoking" was also determined, which was defined as any instance in which at least one individual was observed smoking a lit cigarette in any indoor area during the monitoring period. Additional measures included the volume of the venue (m^3) as calculated from the recorded room dimensions, average number of persons present, and average number of burning cigarettes. Active smoker density was also determined for each venue by dividing the mean number of burning cigarettes by the venue volume.

Data Analysis

Data were downloaded using TrakPro v. 3.41 (TSI, Inc., St. Paul, MN) and analyzed using PASW Statistics v. 18.0 (SPSS, Inc., Chicago, IL). In accordance with previous assessments of PM2.5 associated SHS, data were multiplied by a standard calibration factor of 0.32 (Travers et al., 2004; Connolly et al., 2009). This calibration factor was determined in a controlled experiment in which the TSI SidePak® was collocated with gravimetrically standardized instruments used in past SHS exposure studies (Repace, 2004).

Both arithmetic and geometric mean $PM_{2.5}$ concentrations (μg/m^3) were calculated for each venue and territory following categorization by three types of policy status: (i) smoke-permitted and active smoking observed, (ii) smoke-permitted and no active smoking observed, and (iii) smoke-free and no active smoking observed. Due to the nonparametric nature of the data, a Mann-Whitney U-Test was used to determine statistically significant differences between categories. A Wilcoxon Signed Rank Test was also used to determine differences within a single venue assessed during two separate periods. To evaluate the extent to which air quality levels were associated with active smoking, a Spearman Rank Correlation Coefficient (rs) was used to determine the correlation between average $PM_{2.5}$ concentrations and active smoker density.

Results

Air quality was assessed in 19 smoke-permitted venues and 18 smoke-free venues throughout American Samoa (smoke-permitted, n=3; smoke-free, n=9), CNMI (smoke-

Table 1. Summary Characteristics and Average PM2.5 Concentrations in Smoke-Permitted and Smoke-Free Hospitality Venues: American Samoa, Guam, and Commonwealth of the Northern Mariana Islands

ID	Territory[a]	Venue Type	Venue Volume (m^3)	Average Persons in Venue	Average Burning Cigarettes	Active Smoker Density[b]	Average Venue $PM_{2.5}$ [$\mu g/m^3$]	Average(GM[a]) Territory $PM_{2.5}$ [μgm^3]
Smoke-Free								
No Active Smoking Observed								
1	AS	Restaurant	189	9	0.00	0.00	15.22	
2	AS	Restaurant	360	9	0.00	0.00	12.57	
3	AS	Restaurant	630	59	0.00	0.00	10.10	
4	AS	Bar	162	9	0.00	0.00	7.22	
5	AS	Restaurant/Bar	120	16	0.00	0.00	6.49	
6	AS	Restaurant/Bar	84	10	0.00	0.00	5.72	
7	AS	Restaurant	405	17	0.00	0.00	5.43	
8	AS	Restaurant	800	10	0.00	0.00	4.11	
9	AS	Restaurant	504	12	0.00	0.00	2.95	7.09 (6.09)
10	CNMI	Restaurant	315	6	0.00	0.00	15.06	
11	CNMI	Restaurant	960	25	0.00	0.00	10.17	
12	CNMI	Restaurant/Bar	368	9	0.00	0.00	5.16	
13	CNMI	Restaurant/Bar	210	11	0.00	0.00	3.78	
14	CNMI	Restaurant/Bar	6000	26	0.00	0.00	1.56	6.51 (4.66)
15	GU	Restaurant	315	37	0.00	0.00	24.79	
16	GU	Restaurant	1932	115	0.00	0.00	12.84	
17	GU	Restaurant	900	14	0.00	0.00	3.75	
18	GU	Restaurant	350	33	0.00	0.00	2.39	12.76 (8.63)
Overall Average (GM[a])			811 (435)	24 (17)	0.00[c]	0.00[c]	8.33 (6.14)	
Smoke-Permitted								
No Active Smoking Observed[d]								
19[e]	CNMI	Restaurant/Bar	462	14	0.00	0.00	45.73	
20	CNMI	Restaurant/Bar	195	25	0.00	0.00	41.78	
21	CNMI	Restaurant/Bar	700	36	0.00	0.00	38.16	42.10 (41.87*)
Overall Average (GM[a])			452 (398)	25 (24)	0.00[c]	0.00[c]	42.1 (41.87*)	
Active Smoking Observed[d]								
22	AS	Bar	96	7	1.67	1.74	224.11	
23	AS	Restaurant/Bar	210	8	1.75	0.83	65.26	
24	AS	Restaurant/Bar	1656	9	1.00	0.06	34.38	99.18 (64.71*)
25	CNMI	Bar	700	83	5.00	0.71	734.05	
26	CNMI	Bar	196	12	1.33	0.68	478.05	
27	CNMI	Bar	910	24	1.33	0.15	251.27	
28	CNMI	Bar	263	19	2.00	0.76	192.46	
29	CNMI	Bar	2025	56	4.00	0.20	119.01	
19[e]	CNMI	Restaurant/Bar	462	9	0.67	0.15	92.28	304.7 (230.3*)
30	GU	Bar	400	20	3.33	0.83	863.51	
31	GU	Bar	240	26	4.67	1.95	495.89	
32	GU	Bar	312	20	2.33	0.75	408.87	
33	GU	Bar	891	20	1.00	0.11	366.17	
34	GU	Bar	600	9	2.00	0.33	324.54	
35	GU	Bar	4495	38	2.67	0.06	323.91	
36	GU	Bar	1680	34	2.33	0.14	302.10	
37	GU	Bar	252	13	1.00	0.40	26.19	382.04 (290.80*)
Overall Average (GM[a])			905 (543)	24 (19)	2.24 (1.91)	0.58 (0.35)	300.0 (200.4*)	

[a]AS, American Samoa; CNMI, Commonwealth of the Northern Mariana Islands; GM, Geometric Mean; GU, Guam; [b]Average number of burning cigarettes per 100 cubic meters; [c]Geometric mean not calculated; [d]Venues were assessed when smoking was prohibited (before 10 PM); [e]Venue was assessed when smoking was permitted (after 10 PM) and prohibited (before 10 PM); *p<0.001, Mann-Whitney U-Test, compared to "smoke-free and no active smoking observed"

permitted, n=8; smoke-free, n=5), and Guam (smoke-permitted, n=8; smoke-free, n=4). Among the 19 smoke-permitted venues, 2 were assessed during a time of the day in which smoking was not allowed and 1 was assessed both before and during the time period when smoking was allowed. The average monitoring duration was 37 minutes in smoke-permitted venues (range=30-58 minutes) and 45 minutes in smoke-free venues (range=30-63 minutes).

The Table shows select characteristics of the sample by venue and territory. No active smoking was observed in either the 18 smoke-free venues or 3 smoke-permitted venues assessed when no smoking was allowed. In contrast, active smoking was observed in all 17 smoke-permitted venues in which smoking was always allowed. The average venue volume was 811 m^3 (geometric mean (GM)=435 m^3; range=84-6000 m^3) in smoke-free venues, 452 m^3 (GM=398 m^3; range=195-700 m^3) in smoke-permitted venues with no smoking observed, and 905 m^3

(GM=543 m^3; range=96-4495 m^3) in smoke-permitted venues with smoking observed. The average number of persons present was 24 (GM=17 persons; range=6-115) in smoke-free venues, 25 (GM=24 persons; range=14-36) in smoke-permitted venues with no smoking observed, and 24 in smoke-permitted venues with smoking observed (GM=19 persons; range=7-83).

Among all three territories combined, the average $PM_{2.5}$ concentration in the 18 smoke-free venues was 8.33 $\mu g/m^3$ (geometric mean (GM)=6.14 $\mu g/m^3$). Following stratification by territory, the average concentration in smoke-free venues was greatest in Guam (12.76 $\mu g/m^3$; GM=8.63 $\mu g/m^3$), followed by American Samoa (7.09 $\mu g/m^3$; GM=6.09 $\mu g/m^3$), and CNMI (6.51 $\mu g/m^3$; GM=4.66 $\mu g/m^3$).

The average $PM_{2.5}$ concentration in the 3 smoke-permitted venues assessed when no smoking was allowed was 42.1 $\mu g/m^3$ (GM=41.87 $\mu g/m^3$), which was significantly higher ($p<0.001$) than the smoke-free venues (8.33 $\mu g/m^3$; GM=6.14 $\mu g/m^3$). In addition, there was a significant ($p<0.001$) two-fold increase in average $PM_{2.5}$ observed in the smoke-permitted venue (ID 19) assessed both before (45.73 $\mu g/m^3$; GM=45.73 $\mu g/m^3$) and during (92.28 $\mu g/m^3$; GM=91.03 $\mu g/m^3$) the period smoking was allowed.

The overall average $PM_{2.5}$ concentration in smoke-permitted venues in which smoking was observed was 299.98 $\mu g/m^3$ (GM=200.39) and significantly higher ($p<0.001$) than average concentrations in smoke-free venues (8.33 $\mu g/m^3$; GM=6.14 $\mu g/m^3$). The average concentration in these smoke-permitted venues was greatest in Guam (382.04 $\mu g/m^3$; GM=290.80 $\mu g/m^3$), followed by CNMI (304.74 $\mu g/m^3$; GM=230.32$\mu g/m^3$), and American Samoa (99.18 $\mu g/m^3$; GM=64.71 $\mu g/m^3$), all of which were significantly higher ($p<0.001$) than average concentrations within each territory's respective smoke-free venues.

In the 17 smoke-permitted venues in which active smoking was observed, the average number of burning cigarettes was 2.24 (GM=1.91; range=0.67-5.00), which corresponds to an active smoker density of 0.58 cigarettes per 100 cubic meters (GM= 0.35; range= 0.06-1.95). In contrast, no burning cigarettes were observed in the smoke-free venues, resulting in an active smoker density of 0.00. Among all of the assessed venues, average $PM_{2.5}$ concentrations were significantly correlated ($p<0.001$) with active smoker density, both overall (rs=0.82) and stratified by territory (American Samoa, rs=0.76, p=0.004; CNMI, rs=0.86, $p<0.001$; Guam, rs=0.87, $p<0.001$).

Discussion

This study demonstrates that employees and patrons of smoke-permitted bars and restaurants are exposed to indoor air pollution from secondhand tobacco smoke, even during periods when active smoking is not occurring. Since separating smokers from nonsmokers, cleaning the air, and ventilating buildings cannot effectively eliminate SHS (USDHHS, 2006), prohibiting smoking in all public indoor areas, irrespective of the venue type or time of day, represents the only way to fully protect nonsmokers from SHS exposure in these environments.

In the present study, the average $PM_{2.5}$ levels in venues where smoking was always or sometimes permitted were significantly higher than levels in 100% smoke-free venues. Since the duration of air monitoring in each venue was approximately one hour or less, these $PM_{2.5}$ levels are not directly comparable to the current 24-hour average exposure standards established by the U.S. Environmental Protection Agency (USEPA, 2006). However, assuming the observed levels were analogous to daily levels, the geometric mean $PM_{2.5}$ level in venues where smoking was always (200.39 $\mu g/m^3$) or sometimes (41.87 $\mu g/m^3$) permitted exceeded the average 24-hour EPA standard of 35 $\mu g/m^3$. In contrast, the geometric mean $PM_{2.5}$ level in smoke-free venues (6.14 $\mu g/m^3$) was acceptable according to the EPA standard.

Strengthening current smoke-free policies in American Samoa, CNMI, and Guam to prohibit smoking in all indoor public areas, including all worksites, restaurants, and bars, should improve the health and well-being of employees and patrons. Research suggests that the implementation of smoke-free policies can lead to reduced respiratory symptoms (Eisner et al., 1998; Farrelly et al., 2005) and tobacco consumption (Fichtenberg & Glantz, 2002) among bar and restaurant workers, as well as the reduced incidence of heart attack among the general public (IOM, 2009). Moreover, the implementation of such policies should not have an adverse impact on business. Economic studies report either neutral or positive effects of comprehensive smoke-free policies on bar and restaurants sales and employment (Scollo et al., 2003).

To our knowledge, this study is the first to quantify SHS exposure in hospitality venues throughout American Samoa, CNMI, and Guam. Strengths of this study include the use of a scientifically validated monitoring instrument capable of real-time data acquisition, as well as the inclusion of venues with varying levels of size, patronage, and smoking restrictions. However, some study limitations should be noted. First, PM2.5 is not specific to tobacco smoke and can be produced directly from other sources such as cooking and ambient particles. Nonetheless, these exogenous factors would presumably be present in both smoke-free and smoke-permitted venues. Moreover, a significant correlation was observed between smoking density and $PM_{2.5}$ in the assessed venues, thus indicating that observed differences in average $PM_{2.5}$ are most likely attributable to SHS. Second, $PM_{2.5}$ was assessed in a convenience sample of bars and restaurants due to the lack of a comprehensive list of venues throughout each territory. Although this may limit the generalizeability of the findings, the observed $PM_{2.5}$ levels are consistent with previous assessments of smoke-free and smoke-permitted venues throughout multiple countries (Hyland et al., 2008; Connolly et al., 2009). Finally, it was not possible to statistically adjust for ventilation or tobacco smoke infiltration from outdoor areas. However, previous research suggests that the impact of ventilation does not account for marked differences in $PM_{2.5}$ levels between smoke-permitted and smoke-free venues (Repace, 2004).

Despite these limitations, the findings of this study provide compelling evidence that a 100% smoke-free policy is an effective method to reduce SHS exposure in public indoor environments throughout American Samoa, CNMI, and Guam. In addition to characterizing $PM_{2.5}$ concentrations in additional venue types throughout these territories, future studies should more intensely examine the extent of air quality in public indoor environments before and after the implementation of comprehensive smoke-free policies.

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References

Allen M, and Clarke D (2007) Reducing tobacco-related harm in the Pacific. *Pacific Health Dialog*, **14**, 115-7.

American Samoa Government and World Health Organization. American Samoa NCD Risk Factors STEP Report. Available at: http://www.who.int/chp/steps/Printed_STEPS_Report_American_Samoa.pdf. Accessed February 15, 2011.

Americans Nonsmokers' Rights Foundation (2011). U.S. 100% Smokefree Laws in Workplaces and Restaurants and Bars. Available at: http://www.no-smoke.org/pdf/WRBLawsMap.pdf. Accessed January 24, 2011.

Centers for Disease Control and Prevention (2010a) State Tobacco Activities Tracking and Evaluation (STATE) System. Available at: http://www.cdc.gov/tobacco/statesystem. Accessed January 24, 2011.

Centers for Disease Control and Prevention (2010b). State-specific prevalence of cigarette and smokeless tobacco use among adults – United States, 2009. *Morbid Mort Week Rep*, **59**, 1400-6.

Centers for Disease Control and Prevention (2010c). Vital signs: current cigarette smoking among adults aged ≥ 18 years – United States, 2009. *Morbid Mort Week Rep*, **59**, 1135-40.

Connolly GN, Carpenter CM, Travers MJ, et al (2009). How smoke-free laws improve air quality: a global study of Irish pubs. *Nicotine & Tobacco Research*, **11**, 600-5.

Eisner MD, Smith AK, Blanc PD (1998). Bartenders' Respiratory Health After Establishment of Smoke-Free Bars and Taverns. *JAMA*, **280**, 1909-14..

Farrelly MC, Nonnemaker JM, Chou R, et al (2005). Changes in hospitality workers' exposure to secondhand smoke following the implementation of New York's smoke-free law. *Tobacco Control*, **14**, 236-41.

Fitchtenberg CM and Glantz, SA (2002). Effect of smoke-free workplaces on smoking behavior: systematic review. *BMJ*, **325**, 188.

Hyland A, Travers MJ, Dresler C, Higbee C, Cummings KM (2008). A 32-country comparison of tobacco smoke derived particle levels in indoor public places. *Tobacco Control*, **17**, 159-65.

Institute of Medicine of the National Academies (2009). Secondhand Smoke Exposure and Cardiovascular Effects: Making Sense of the Evidence. Washington DC; Institute of Medicine.

Lightwood JM and Glantz SA (2009). Declines in acute myocardial infarction after smoke-free laws and individual risk attributable to secondhand smoke. *Circulation*, **120**, 1373-9.

Rasanathan K and Tukuitonga CF (2007). Tobacco smoking prevalence in Pacific Island countries and territories: a review. *NZ Med J*, **120**, U2742.

Repace J (2004). Respirable particles and carcinogens in the air of Delaware hospitality venues before and after a smoking ban. *J Occupational Environmental Med*, **46**, 887-905.

Scollo M, Lal A, Hyland A, Glantz S (2003). Review of the quality of studies on the economic effects of smoke-free policies on the hospitality industry. *Tobacco Control*, **12**, 13-20.

Travers MJ, Cummings MJ, Hyland A, et al (2004). Indoor air quality in hospitality venues before and after implementation of a clean indoor air law—Western New York. *Morbid Mort Week Rep*, **53**, 1038-41.

U.S. Department of Health & Human Services (2006). The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General. Atlanta, GA: USDHHS, CDC and Prevention, CCHP, NCCDPHP, OSH.

U.S. Department of Health and Human Services (2010). How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General. Atlanta, GA: UDHHS, CDC, NCCDPHP, OSH.

U.S. Environmental Protection Agency (2006). Area Designations for 2006 24-Hour Fine Particle (PM2.5) Standards. Available at: http://www.epa.gov/pmdesignations/2006standards/index.htm Accessed February 01, 2011.

Wakefield M, Trotter L, Cameron M, et al (2003). Association between exposure to workplace secondhand smoke and reported respiratory and sensory symptoms: cross-sectional study. *J Occupational Environmental Med*, **45**, 622-7.

Widome R, Samet JM, Hiatt RA, et al (2010). Science, prudence, and politics: the case of smoke-free indoor spaces. *Annals of Epidemiology*, **20**, 428-35.