Published in final edited form as:
Ann Behav Med. 2010 May ; 39(2): 198–203. doi:10.1007/s12160-010-9174-8.

Secondhand Smoke Policy and the Risk of Depression

Frank C. Bandiera, M.P.H.,
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

Alberto J. Caban-Martinez, M.P.H.,
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

Kristopher L. Arheart, Ed.D.,
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

Evelyn P. Davila, M.P.H.,
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

Lora E. Fleming, M.D., Ph.D.,
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

Noella A. Dietz, Ph.D.,
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

John E. Lewis, Ph.D.,
Department of Psychiatry and Behavioral Sciences, Miller School of Medicine, University of Miami, Miami, FL, USA

David Fabry, Ph.D., and
Department of Otolaryngology, Miller School of Medicine, University of Miami, Miami, FL, USA

David J. Lee, Ph.D.
Department of Epidemiology and Public Health, Miller School of Medicine, University of Miami, P.O. Box 016069 (D-4-11), Miami, FL 33101, USA

David J. Lee: dlee@med.miami.edu

Abstract

Background—Banning smoking in work and public settings leads to immediate reductions in disease burden. However, no previous studies have looked specifically at the impact smoking bans may have on depression.

Methods—The 2006 Behavioral Risk Factor Surveillance System (BRFSS) uses a cross-sectional design representative of the non-institutionalized civilian US population. Never smoker survey participants ≥18 years of age were selected from the BRFSS (*n*=41,904) with their self-report of depressive symptoms in the last 2 weeks, as assessed by the Patient Health Questionnaire. Models with adjustment for survey design, sociodemographics, alcohol consumption, and work and home smoking policies were considered.

Correspondence to: David J. Lee, dlee@med.miami.edu.

Results—Following covariate adjustment, the risk of major depression was significantly higher for those living where smoking was allowed anywhere in the home versus those living in homes with complete smoking bans and in those who indicated that smoking was permitted in their work areas versus those reporting complete workplace smoking bans.

Conclusions—Findings from the present analysis support policies that ban smoking in all workplace settings. Interventions designed to eliminate smoking in the home are also needed.

Keywords

Secondhand smoke; Depression; Tobacco policy; Mental health policy

Introduction

Secondhand smoke (SHS) exposure causes premature death and disease in persons who do not smoke [1]. Pooled data from 1988 to 2002 indicate that approximately 43% of the United States (US) population was exposed to SHS [2]. Depression is a common and often chronic disorder, affecting over 32 million US adults in their lifetime and over 13 million US adults in the last 12 months [3]. Depression has been associated with an increased risk for premature mortality [4,5], morbidity [6], and decreased worker productivity [7]. In fact, depression is the third leading cause of disability-adjusted life years in developed countries [8].

It is well established that smokers are at a greater risk for depression [9–13], although the exact direction of this relationship is not clear. Smokers may smoke to "self-medicate" in response to their depression [12], and/or smoking may precede the onset of their depression [13]. Alternatively, a shared genetic predisposition may explain this relationship [9]. A paucity of research has examined potential relationships between SHS exposure and depression. Some cross-sectional evidence suggests that SHS exposure may be associated with depression among never smokers [14,15]; however, no research has evaluated the relationship between SHS policies at work and SHS rules at home with the risk for depression.

Methods

Description of Surveys

The Behavioral Risk Factor Surveillance System (BRFSS) (http://www.cdc.gov/BRFSS/), a telephone-based survey, is conducted every year by the Centers for Disease Control and Prevention. The survey is designed to be representative of all demographic groups in the non-institutionalized US population. Complete data from never smokers 18 years or older were obtained from the 2006 BRFSS. This study was approved by the University of Miami Institutional Review Board. These optional modules were asked by Alabama, Arkansas, Georgia, Indiana, Iowa, Louisiana, Missouri, Nevada, New Hampshire, North Dakota, Oklahoma, Virgin Islands, Virginia, West Virginia, Wisconsin, and Wyoming (http://apps.nccd.cdc.gov/BRFSSModules/ModByCat.asp?Yr=2006).

Measures

SHS Policy—In the BRFSS, participants were asked: "Which statement best describes the rules about smoking inside your home?" For smoking policies at work, participants were asked: "Which of the following best describes your place of work's official smoking policy for indoor public or common areas, such as lobbies, rest rooms, and lunch rooms?" and "Which of the following best describes your place of work's official smoking policy for work areas?" Persons who were not employed were not asked the work questions (for item responses, see Table 1).

Current Depression—The Patient Health Questionnaire (PHQ-8) [16] was used to measure depression. A summed score of 10 or greater from a range of 0–24 was used to classify "major depression." This cut-off score has 100% sensitivity and 95% specificity for diagnosing major depression [16]. The continuous score was also used, representing the cumulative number of "depressive symptoms."

Covariates

Age, race/ethnicity, gender, education, general health, and alcohol consumption were measured by participant self-report. Age was measured in years; participants were classified as: non-Hispanic White, non-Hispanic Black, Hispanic, or non-Hispanic other; male or female; and did not graduate high school, graduated high school, attended college or technical school, or graduated from college or technical school. Alcohol consumption was classified using a continuous measure of average number of drinks per day in the past year. General health was coded as excellent (1), very good (2), good (3), fair (4), or poor (5) and was treated as an ordinal variable.

Sample Selection

Participants were asked if they had smoked 100 or more cigarettes in their lifetime. Those responding "yes" were asked if they currently smoked cigarettes. Self-identified current smokers and former smokers were excluded from the analysis. Analyses were performed with "never smokers" (defined as those who reported not smoking 100 or more cigarettes in their lifetime [n=41,904]).

Statistical Analysis

Multivariable logistic regressions were performed with adjustments for survey design and potential confounders using SAS version 9.2. The model estimated the effects of SHS home and work policies on the dichotomous measure of depression using the SAS command PROC SURVEY LOGISTIC, controlling for sociodemographic and clinical characteristics as described above. STATA version 10.0 was also used to analyze a continuous measure of depression with the same predictor and covariates as in the logistic regression, also with adjustment for survey design. Zero-inflated Poisson regression was utilized because the depressive symptoms measure was positively skewed with an excess of zeros.

Results

Demographic and Health Characteristics and Participant-Reported Home and Workplace Secondhand Smoke Policies

The average age of the sample was 44 years, nearly 57% were female, 75% were non-Hispanic White, and nearly 62% reported at least some college education (Table 1). Approximately eight in 10 participants reported that smoking was not permitted in their homes and at their place of work. The mean depression score was 2.96.

Covariates and Depression

In our multivariable models, age was inversely related with both major depression and depressive symptoms (Table 2). In addition, the average number of drinks per day was positively associated with both major depression and depressive symptoms. Poor general health was positively associated with major depression and depressive symptoms. Males were significantly less likely to have major depression and depressive symptoms than females. Overall, we found few significant differences in major depression and depressive symptoms among the different race/ethnic subpopulations. Education was significantly and inversely related with both major depression and depressive symptoms.

Secondhand Smoke Rules/Policy at Home/Work and Major Depression

The strongest associations between SHS home rules, workplace policies, and risk for depression were observed when comparing never smokers living and working in environments with no smoking restrictions versus never smokers in environments with complete smoking restrictions (Table 2). In the models adjusted for age, race/ethnicity, gender, education, general health, and alcohol consumption, the risk of major depression for those living where smoking was allowed anywhere in the home or allowed in work areas versus those reporting complete home and workplace smoking restrictions was increased (odds ratio [OR]=2.15 [95% confidence interval=1.24–3.71] and OR=2.40 [95% confidence interval=1.17–4.95], respectively); although elevated, there was no statistically significant association between smoking policies in public work areas and major depression (OR=2.12 [95% confidence interval=0.87–5.17]).

Similarly, those living where smoking was allowed anywhere in the home or in work areas had more depressive symptoms compared with those reporting complete smoking bans (β=0.38, p<0.001 and β=0.25, p=0.02, respectively); there was no significant association between public work area smoking policies and depressive symptoms (β= 0.23, p=0.14). There were also no significant interactions between gender and policies at work/home (all ps>0.20).

Discussion

Forty-three percent of the US population is potentially exposed to SHS [2], and over 35 million US adults may suffer at least one lifetime episode of major depression [3]. To the authors' knowledge, this is the first study to assess the relationship between smoking policies at work and at home with an increased risk for depression among a representative national sample of never smokers in the US. Our findings can be interpreted in the context of the Behavioral Ecological Model [17]. According to this model, efforts to prevent exposure to SHS should be done at different levels, i.e., from macrosystemic (culture) to microsystemic (individual). Individual interventions can be briefly but effectively performed by clinicians to increase cessation rates and reduce SHS exposure in the home [18,19]. At the macrosystemic or cultural level, banning smoking in all public places would dramatically reduce population-level exposure to SHS. By intervening at different levels, an antismoking culture is created, and thus, there would be less cigarette smokers and less exposure to SHS [20,21]. Although not specifically focused on depression, other studies have shown that banning smoking in workplaces and public settings leads to immediate reductions in overall hospital admissions and disease-specific symptoms in workers and the public at large [22]. Therefore, banning smoking in all places may lead to a decrease in the rates of depression. On the other hand, if the temporal association is that depression leads to increased smoking and increased SHS exposure, banning smoking would still be beneficial because depressed persons would be less likely to smoke and not be exposed to SHS.

Strengths and Limitations

An advantage of the present analysis is that it uses a nationally representative sample of the US population. Furthermore, depression was measured using the PHQ, a well-validated measure [16,23]. However, the individual history of depression was not assessed. Because of the absence of biochemical confirmation, we must also assume that actual SHS exposure varies in a dose–response fashion with the presence and extent of reported home and workplace smoking policies.

Multiple and systematic replications of previous studies [14,15] provide additional argument for a causal association. Furthermore, experiments or controlled studies that examine large-scale policies may not be practically or ethically undertaken. Thus, results from this study, as

well from previous studies [14,15], may be the best basis for inference, as well as providing further support for comprehensive public policies which seek to further lower SHS exposure in the population.

In conclusion, this study suggests that the lack of both smoking policies at work and at home that limit or ban indoor smoking is associated with depression. Continued progress toward protecting all workers from SHS exposure is consistent with the present study findings. Interventions designed to eliminate smoking in the home are also needed. Modest financial incentives to prevent smoking at home already exist, most directly through owner and renter insurance rates which are typically higher for smokers [24]. However, public health campaigns and similar interventions that promote greater awareness of the negative consequences associated with smoking and SHS are also warranted to encourage individuals to stop smoking at home.

Acknowledgments

This study was completed while Frank C. Bandiera was a doctoral student in epidemiology at the University of Miami. Mr. Bandiera is a recipient of an individual predoctoral grant from the National Institute of Mental Health to study the association between asthma and mental health outcomes and to receive advanced training in statistical methods, genetic epidemiology, and behavioral medicine (1F31MH084567). This work was funded in part by grants from the Flight Attendant Medical Research Institute (FAMRI; Dr. Lee, principal investigator) and from the National Institute of Occupational Safety and Health (NIOSH; R01 OH03915; Dr. Fleming, principal investigator).

Abbreviations

BRFSS	Behavioral Risk Factor Surveillance System
SHS	Secondhand smoke
DALYS	Disability-adjusted life years
CDC	Centers for Disease Control and Prevention
OR	Odds ratio

References

1. Hill L, Mueller MR, Roussos S, et al. Opportunities for the use of decision aids in primary care. Fam Med 2009;41:350–355. [PubMed: 19418284]
2. Pirkle JL, Bernert JT, Caudill SP, Sosnoff CS, Pechacek TF. Trends in the exposure of nonsmokers in the U.S. population to secondhand smoke: 1988–2002. Environ Health Perspect 2006;114:853–858. [PubMed: 16759984]
3. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: Results from the National Comorbidity Survey Replication (NCS-R). JAMA 2003;289:3095–3105. [PubMed: 12813115]
4. Everson SA, Roberts RE, Goldberg DE, Kaplan GA. Depressive symptoms and increased risk of stroke mortality over a 29-year period. Arch Intern Med 1998;158:1133–1138. [PubMed: 9605786]
5. Zheng D, Macera CA, Croft JB, Giles WH, Davis D, Scott WK. Major depression and all-cause mortality among white adults in the United States. Ann Epidemiol 1997;7:213–218. [PubMed: 9141645]
6. Merikangas KR, Ames M, Cui L, et al. The impact of comorbidity of mental and physical conditions on role disability in the US adult household population. Arch Gen Psychiatry 2007;64:1180–1188. [PubMed: 17909130]
7. Kessler R, White LA, Birnbaum H, et al. Comparative and interactive effects of depression relative to other health problems on work performance in the workforce of a large employer. J Occup Environ Med 2008;50:809–816. [PubMed: 18617837]

8. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: Systematic analysis of population health data. Lancet 2006;367:1747–1757. [PubMed: 16731270]
9. Dierker LC, Avenevoli S, Stolar M, Merikangas KR. Smoking and depression: An examination of mechanisms of comorbidity. Am J Psychiatry 2002;159:947–953. [PubMed: 12042182]
10. Glassman AH, Helzer JE, Covey LS, et al. Smoking, smoking cessation, and major depression. JAMA 1990;264:1546–1549. [PubMed: 2395194]
11. Kendler KS, Neale MC, MacLean CJ, Heath AC, Eaves LJ, Kessler RC. Smoking and major depression. A causal analysis. Arch Gen Psychiatry 1993;50:36–43. [PubMed: 8422220]
12. Khantzian EJ. The self-medication hypothesis of substance use disorders: A reconsideration and recent applications. Harv Rev Psychiatry 1997;4:231–244. [PubMed: 9385000]
13. Klungsoyr O, Nygard JF, Sorensen T, Sandanger I. Cigarette smoking and incidence of first depressive episode: An 11-year, population-based follow-up study. Am J Epidemiol 2006;163:421–432. [PubMed: 16394201]
14. Bandiera FC, Arheart KL, Caban-Martinez AJ, et al. Secondhand smoke exposure and depressive symptoms. Psychosom Med 2010;72:68–72. [PubMed: 19949159]
15. Nakata A, Takahashi M, Ikeda T, Hojou M, Nigam JA, Swanson NG. Active and passive smoking and depression among Japanese workers. Prev Med 2008;46:451–456. [PubMed: 18314186]
16. Kroenke K, Strine TW, Spitzer RL, Williams JB, Berry JT, Mokdad AH. The PHQ-8 as a measure of current depression in the general population. J Affect Disord 2009;114:163–173. [PubMed: 18752852]
17. Hovell MF, Hughes SC. The behavioral ecology of secondhand smoke exposure: A pathway to complete tobacco control. Nicotine Tob Res 2009;11:1254–1264. [PubMed: 19776346]
18. Gehrman CA, Hovell MF. Protecting children from environmental tobacco smoke (ETS) exposure: A critical review. Nicotine Tob Res 2003;5:289–301. [PubMed: 12791524]
19. Stead LF, Bergson G, Lancaster T. Physician advice for smoking cessation. Cochrane Database Syst Rev 2008;(2):CD000165. [PubMed: 18425860]
20. Gilpin EA, Lee L, Pierce JP. Changes in population attitudes about where smoking should not be allowed: California versus the rest of the USA. Tob Control 2004;13:38–44. [PubMed: 14985593]
21. Levy DT, Romano E, Mumford EA. Recent trends in home and work smoking bans. Tob Control 2004;13:258–263. [PubMed: 15333881]
22. Institute of Medicine. Secondhand smoke exposure and cardiovascular effects: Making sense of the evidence. Washington: National Academies Press; 2009.
23. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: Validity of a brief depression severity measure. J Gen Intern Med 2001;16:606–613. [PubMed: 11556941]
24. Hofstetter CR, Hovell MF, Jung KR, Raman R, Irvin V, Ni R. The first puff: Forces in smoking initiation among Californians of Korean descent. Nicotine Tob Res 2007;9:1277–1286. [PubMed: 18058346]

Table 1

Demographic characteristics, health characteristics, and reported home and work-place SHS policies of eligible sample: 2006 BRFSS

	Number[a]	Percentage	SE of percentage	Mean	SE of mean
Age	41,490			43.99	0.15
Gender					
Male	13,391	43.07	0.44		
Female	28,513	56.92	0.44		
Race/ethnicity					
Non-Hispanic White	32,648	75.13	0.41		
Non-Hispanic Black	5,351	13.82	0.32		
Non-Hispanic other	1,123	3.98	0.22		
Non-Hispanic multiracial	668	1.56	0.12		
Hispanic	1,686	5.49	0.24		
Education					
<High school	3,536	7.74	0.22		
=High school	12,468	28.76	0.38		
Attended college	10,708	25.91	0.37		
Graduated college	15,100	37.57	0.39		
Drinks per day	41,259			0.22	0.00
General health	41,782			2.29	0.00
Home rules					
No official policy	3,976	8.33	0.20		
Allowed in some places	1,757	4.71	0.19		
Allowed anywhere	422	1.08	0.08		
Not allowed anywhere	35,749	85.86	0.28		
Work policy in public areas[b]					
No official policy	831	4.33	0.27		
Allowed in some places	2,157	12.94	0.44		
Allowed anywhere	256	1.40	0.13		
Not allowed anywhere	16,897	81.31	0.51		
Work policy in work areas[b]					

	Number[a]	Percentage	SE of percentage	Mean	SE of mean
No official policy	733	4.17	0.28		
Allowed in some places	1,332	7.75	0.32		
Allowed anywhere	172	0.81	0.08		
Not allowed anywhere	17,940	87.25	0.42		
Depressive symptoms	41,904			2.96	0.03

[a] Sample size varies due to item nonresponse

[b] Asked only if employed

Table 2

Association between SHS rules at home, policy in public areas, and depression and depressive symptoms in never smokers: 2006 BRFSS

Variable	Depression/depressive symptoms														
	Rules at home (n=40,327)					Policy in public workplace areas (n =19,571)[a]					Policy in work areas (n=19, 597)[b]				
	Logistic regression		Zero-inflated Poisson regression			Logistic regression		Zero-inflated Poisson regression			Logistic regression		Zero-inflated Poisson regression		
	OR	95% CI	β	SE	p value	OR	95% CI	β	SE	p value	OR	95% CI	β	SE	p value
Age (years)	0.98	0.97–0.98	−0.01	0.00	<0.001	0.97	0.96–0.98	−0.01	0.00	<0.001	0.97	0.96–0.98	−0.01	0.00	<0.001
Alcohol consumption	1.00	1.00–1.00	0.00	0.00	<0.01	1.00	1.00–1.00	0.00	0.00	<0.01	1.00	1.00–1.00	0.00	0.00	<0.01
General health	2.37	2.12–2.65	0.28	0.01	<0.001	1.86	1.48–2.34	0.23	0.01	<0.001	1.86	1.47–2.34	0.23	0.02	<0.001
Gender															
Male	0.72	0.58–0.90	−0.11	0.02	<0.001	0.72	0.48–1.10	−0.08	0.04	0.04	0.72	0.47–1.11	−0.08	0.04	0.04
Female	1.00		Reference			1.00		Reference			1.00		Reference		
Race/ethnicity															
Non-Hispanic White	1.18	0.65–2.15	0.06	0.07	0.37	0.74	0.28–1.95	−0.01	0.13	0.90	0.73	0.27–2.01	−0.02	0.13	0.88
Non-Hispanic Black	1.56	0.82–2.97	0.16	0.08	0.04	1.23	0.41–3.64	0.11	0.14	0.42	1.20	0.39–3.64	0.10	0.14	0.46
Non-Hispanic other	1.62	0.82–3.21	0.17	0.09	0.07	1.17	0.39–3.46	0.14	0.16	0.36	1.19	0.39–3.64	0.14	0.16	0.38
Non-Hispanic multiracial	1.21	0.61–2.38	0.21	0.09	0.02	0.65	0.20–2.04	−0.01	0.16	0.97	0.66	0.20–2.14	0.00	0.16	0.98
Hispanic	1.00		Reference			1.00		Reference			1.00		Reference		
Education															
Did not graduate high school	2.49	1.80–3.44	0.29	0.04	<0.001	2.30	1.10–4.78	0.27	0.08	0.001	2.20	1.11–4.35	0.26	0.07	0.001
Graduated high school	1.76	1.37–2.24	0.16	0.02	<0.001	2.26	1.42–3.60	0.20	0.04	<0.001	2.20	1.38–3.48	0.20	0.04	<0.001
Attended college	1.77	1.42–2.20	0.16	0.02	<0.001	2.28	1.65–3.16	0.23	0.04	<0.001	2.64	1.61–3.17	0.23	0.04	<0.001
Graduated from college	1.00		Reference			1.00		Reference			1.00		Reference		
Rules/policy															
No official policy	1.25	1.02–1.53	0.08	0.02	<0.01	1.38	0.77–2.44	0.07	0.08	0.37	1.82	0.98–3.38	0.13	0.10	0.22
Allowed in some places	1.40	1.08–1.83	0.11	0.03	<0.01	1.03	0.63–1.85	0.03	0.05	0.54	1.20	0.73–1.99	0.07	0.06	0.23
Allowed anywhere	2.15	1.24–3.71	0.38	0.09	<0.001	2.12	0.87–5.17	0.23	0.15	0.14	2.40	1.17–4.95	0.25	0.11	0.02
Not allowed anywhere	1.00		Reference			1.00		Reference			1.00		Reference		

[a] Based on the question: “Which of the following best describes your place of work’s official smoking policy for indoor public or common areas, such as lobbies, rest rooms, and lunch rooms?”

[b] Based on the question: “Which of the following best describes your place of work’s official smoking policy for work areas?”