Published in final edited form as:

Am J Prev Med. 2011 December ; 41(6): 566–572. doi:10.1016/j.amepre.2011.08.014.

Association Between Smokefree Laws and Voluntary Smokefree-Home Rules

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Abstract

Background—More states and localities are passing restrictions on smoking in public places and workplaces.

Purpose—To determine what, if any, association exists between enactment of strong laws making public places or workplaces smokefree on adoption of voluntary smokefree-home policies, particularly whether such laws are associated with increased smoking at home.

Methods—Logistic regressions were used to quantify the OR of a person living with a 100% smokefree-home rule as a function of individual characteristics, household composition, and whether or not the residential region is covered by clean indoor air laws. The data came from successive waves of the Tobacco Use Supplement to Current Population Survey (TUS-CPS) for the years 1992–2007, and the American Nonsmokers' Rights Foundation database of state and local government clean indoor air laws. Analysis was conducted in 2010 and 2011.

Results—Living in a county fully covered by a 100% clean indoor air law in workplaces or restaurants or bars is associated with an increased likelihood of having a voluntary 100% smokefree-home rule both for people living with smokers (OR=7.76; 95% CI=5.27, 11.43) and not living with smokers (OR=4.12; 95% CI=3.28, 5.16).

Conclusions—Strong clean indoor air laws are associated with large increases in voluntary smokefree-home policies both in the homes with and without smokers. These results support the hypothesis of norm spreading of clean indoor air laws.

Introduction

Secondhand smoke (SHS) exposure among nonsmokers has declined substantially over time as clean indoor air laws have been adopted.¹ Nevertheless, in 2007–2008, 88 million nonsmokers aged ≥ 3 years in the U.S. were still exposed to SHS.² One objective of *Healthy People 2020*³ is increasing the number of smokefree homes because the home is the major source of SHS exposure for children² and some nonsmoking adults. Smokefree homes

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No financial disclosures were reported by the authors of this paper.

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protect people from the health risks of SHS,^{4–6} encourage smokers to quit and stay smokefree⁷, and reduce the likelihood children will start smoking.⁸

It has been argued smokefree workplace and public place laws will induce smokers to smoke more in their homes, or in other private venues, to satisfy their addiction to nicotine and compensate for smoking restrictions elsewhere (behavioral compensation).⁹ Alternatively, these laws might encourage people to implement smoking restrictions in their homes (norm spreading). Previous studies in Ireland, Scotland, and Australia concluded that after comprehensive smoking restrictions in public places the proportion of homes with voluntary smoking restrictions increased.^{10–12} This study of the U.S. uses the individual-level data from the Tobacco Use Supplements to Current Population Survey (TUS-CPS), a large nationally representative sample, linked with the American Nonsmokers' Rights Foundation Local Ordinance Database to investigate the influence of smokefree workplace and public place laws on the presence of smokefree rules in U.S. homes.

Methods

Data

The TUS-CPS for 1992/1993, 1995/1996, 1998/1999, 2001/2002, 2003, and 2006/2007 were used to obtain individual characteristics (gender, race, education, family income, marital status, employment status) and smoking status as well as the status of smoking restrictions at home (smoking is allowed in every area, some areas or some times, or no areas at all). The TUS-CPS is a household survey that provides directly observed information on several household members as well as surrogate responses for others, including smoking behavior of the respondent, the number of household members, and whether there are children in the household. Data were used only for direct respondents and weighted with the self-response supplement weights.¹³

The TUS-CPS provides the county identifiers for the 40% of respondents in its sample; most of the missing identifiers are from counties with populations less than 100,000 in order to maintain respondent confidentiality. Therefore, this analysis includes only people living in counties with population larger than 100,000. These counties account for approximately 73% of the U.S. population.¹⁴ County-level law information was linked to the TUS-CPS based on the county of the respondent's residence to identify the level of statutory or regulatory protection in each respondent's county.

Data on smokefree workplace and public place laws were obtained from the American Nonsmokers' Rights Foundation Local Ordinance database. This database provides state, county, and city-level laws and ordinances from 1990 to 2010 on smoking restrictions in workplace, restaurant, and bar venues. A county was categorized as having a "full coverage" if there was a 100%-smokefree law for workplaces *OR* restaurants *OR* bars that covered the entire county population due to state, county or municipal laws. A county was categorized as having a "partial coverage" if there was a 100%-smokefree law for workplaces *OR* restaurants *OR* bar venues that covered only part of county population. A county was categorized as "no coverage" if there was not a 100%-smokefree law at the state, county, or municipal level in any venues.

State anti-smoking sentiment

Public attitude toward cigarette smoking, which varies by state, may serve as a common determinant for both clean indoor air laws and smokefree-home rules. People living in places with strong attitudes for or against cigarette smoking may be less or more likely to support the smokefree bill and voluntarily adopt smokefree-home rules in the first place. An analysis was completed controlling for state antismoking sentiment to account for possible

confounding between this variable and smokefree laws and smokefree-home rules using a modified version of the anti-smoking sentiment defined by DeCicca et al.¹⁵ DeCicca, et al.'s original measure used factor analysis of answers to attitude questions from TUS-CPS 1992–2007 to create a measure they termed “state anti-smoking sentiment” based on agreement with more smoking bans in public areas, such as restaurants, hospitals, indoor work areas, bars and cocktail lounges, indoor sporting events, indoor shopping malls, whether or not agreeing on the promotion and advertisements on tobacco products, such as giving away free samples and tobacco advertising, as well as the smokefree policies at homes. (This measure is similar to indices developed by Gilpin et al¹⁶ and Alamar and Glantz¹⁷ using TUS-CPS data to investigate the changes in attitudes toward smoking restrictions in public places over time in California and the U.S.). This modified measure (D Kenkel, Cornell University, personal communication, 2010), excludes the information on smokefree-home policies.

Data Analysis and Regression Model

Data analysis

The sample was divided into two groups: adults (aged 18+ years) living in the homes with smokers and adults living without smokers. The crude proportion of being covered by a 100% smokefree-home rule by TUS-CPS survey year was calculated for both groups (Figure 1).

The average (or proportion) for each covariate (such as 100% law coverage, SES and demographics, and household characteristics) was calculated among adults (18+) living in the homes with and without smokefree policy. Univariate associations of each variable with 100% smokefree-home rule were tested with chi-square for categorical variables and ANOVA for continuous variables (Table 2).

Regression model

The main model specification stratified the sample into two groups: people living in homes with at least one smoker (smoker households) and people living in the homes without any smokers (nonsmoker households), and used logistic regression to estimate the odds of living in a smokefree home for these two groups separately. This approach captures the potential differences in the associations between smokefree laws and smokefree-home rules for these two groups.

A second model specification was used to estimate whether the examined associations between individual characteristics, household characteristics as well as law coverage and smokefree home-rule coverage are *statistically* different between people living in smoker households and in nonsmoker households. This model combined people living in both household types in one logistic regression that included interaction terms for the variable of whether or not living in a smoker household with all independent variables. The coefficients on these interaction terms provide information about whether or not the associations between the presence of smokefree laws and smokefree-home rules are different between people living in smoker households and those living in the nonsmoker households.

In both models, the outcome variable is a dichotomous variable: 1 if a person is covered by a 100%-smokefree restriction in the home and 0 otherwise. The main independent variables are individual characteristics (age, age squared to capture the nonlinear association of age with home rule, gender, race, marital status, employment status, education, and individual smoking status), household characteristics (the presence of children in the household, the presence of nonsmoking adults in the household, and family income), law coverage (full coverage, partial coverage), time trend to capture any unobserved trends that might make

home rules more likely over time, apart from smoking restriction laws, and seasonal effect (winter for November through February, or otherwise) to allow for the possibility that people might be more reluctant to enforce a 100% smokefree-home rule during winter (Table 1).

In the logistic regression analyses, observations were weighted by self-response weights, and SEs were clustered in the state level using the STATA 11 SE command: Logistic depvar indepvar [pw = *personalweights*], vce (cluster *statefips*)¹⁸, where *personalweights* is the variable name for personal weights, and *statefips* is the variable name for state identifiers. Analysis was conducted in 2010 and 2011.

Results

Descriptive Statistics

Clean indoor air laws and smokefree-home rules—The proportion of adults living in the homes with a 100%–smokefree home rule increased over time in households with smokers and nonsmokers (Figure 1). In 2006/2007, 44% of adults living in the smoker households were covered by a 100% smokefree-home rule compared to 88% living in the nonsmoker households.

From 1992 to 2007, on average 52% of adults lived in the homes with 100%–smokefree rules. A higher proportion of people living in homes with a 100% smokefree-home rule were fully covered by at least one 100%–smokefree law than those who lived in homes without a 100% smokefree-home rule. A higher proportion of people living without such a rule were not covered by any 100%–smokefree laws than those who lived with a 100% smokefree-home rule ($p < 0.01$ for all) (Table 2). Compared to people not having a 100% smokefree-home rule, people living in a home with such a rule tend to be older, male, married, more schooling years, non-African-American, not employed, and nonsmokers ($p < 0.01$ for all). People living in 100%–smokefree homes had a higher family income, and more were living with children and nonsmoking adults than those who do not have a smokefree-home rule (Table 2).

Multivariate Analysis

Main model specification: stratified sample—Living in a country with smokefree workplace and public place air laws is associated with having 100% home rules for both people living in smoker households (OR = 7.76; 95% CI=5.27, 11.43) and in nonsmoker households (OR = 4.12; 95% CI=3.28, 5.16) after controlling for year effects, seasonal effects, SES and demographics, and household composition (Table 3). There is a dose–response relationship: full coverage laws are associated with higher odds of having a smokefree-home rule than partial coverage laws (OR of 7.76 vs 1.85 for people living in smoker households and 4.12 vs 1.64 for people living in nonsmoker households).

Household composition is associated with smokefree-home rule adoption for people living in both smoker and nonsmoker households. The presence of children (OR = 1.50; 95% CI=1.29, 1.75 for people living in smoker households; OR = 1.38; 95% CI=1.18, 1.60 for living in nonsmoker households) and nonsmoking adults (OR = 1.74; 95% CI=1.52, 2.00 for people living in smoker households) is associated with higher odds of having a smokefree-home rule.

People living in the smoker households are less likely to report having a 100% smokefree-home rule in the winter (OR= 0.86; 95% CI=0.77, 0.96) than other seasons. Smokers (OR = 0.73; 95% CI=0.64, 0.84) are less likely to report a smokefree home. Older people (OR = 0.92; 95% CI=0.90, 0.94) are less likely to report having a smokefree-home rule than the

younger ones. Male (OR = 1.50; 95% CI=1.40, 1.62) and married (OR = 1.42; 95% CI=1.30, 1.55) respondents are more likely to report having a smokefree-home rule than women and nonmarried adults. Compared to high school education, college (OR = 1.41; 95% CI=1.30, 1.53) and more than college (OR = 1.55; 95% CI=1.35, 1.77) education increase the likelihood of having a smokefree-home rule.

The relationship between SES and demographics and smokefree-home rule adoption is similar for people living in nonsmoker households, except there are no effects of winter season and male gender; people of other races are more likely to report having a smokefree-home rule than Caucasians.

The alternative model specification: combined sample with interaction terms

—The odds of having a smokefree-home rule when there is a smokefree law is higher among people living in the smoker households than in nonsmoker households (OR = 1.16; 95% CI=1.06, 1.27 for partial coverage; OR = 1.90; 95% CI=1.57, 2.29 for full coverage) (Appendix A, available online at www.ajpmonline.org). The presence of children in the household did not interact with whether there were smokers in the household when determining the odds of having a smokefree household in the presence of smokefree laws ($p = 0.14$). Married (OR = 1.16; 95% CI=1.04, 1.31), male (OR = 1.44; 95% CI=1.31, 1.58), and college graduates (OR = 1.22; 95% CI=1.09, 1.37) who live in the smoker households are more responsive in terms of the increased smokefree home-rule coverage than those living in the nonsmoker households. Winter, year, family income, employed, and race are not differentially associated with smokefree home-rule adoption by people living in various types of households.

Controlling for Antismoking Sentiment

The results for the analysis that includes the antismoking sentiment index are similar to the main analysis, except that the relationship between living in a county with a partial law and a home smoking rule is no longer significant (Appendix B, available online at www.ajpmonline.org).

Discussion

These results demonstrate that the prevalence of smokefree-home rules is increasing in both households with and without smokers and that the presence of smokefree laws is associated with adopting smokefree-home rules, with a higher likelihood in households with smokers than households with only nonsmokers. Contrary to theoretic predictions,⁹ smokefree laws were not associated with increased smoking at home.

These results are consistent with existing studies from outside the U.S. A study of Scotland¹¹ found that smokefree-home rules increased after workplace smoking legislation, but its results were limited to households with children (who were the survey subjects for that study). A study of Australia,¹⁹ found that workplace restrictions were associated with higher prevalence of a rule that visitors not smoke in the home. A study of Ireland did not find a relationship between public place smokefree laws and smokefree-home rules, but also found no evidence for increased smoking at home (compensating behavior).¹⁰ The present results are consistent with a U.S. study that found smokefree laws were associated with lower exposure to passive smoking in children (measured by cotinine levels).⁶

The antismoking sentiment measure serves as an indicator for the general attitudes as well as social unacceptability toward cigarette smoking and voter preference for regulation of smoking in the state level.^{16, 17, 20} Even after controlling for antismoking sentiment, there is still find evidence for the norm spreading effect of smokefree workplace and public place

laws and evidence against “behavioral compensation.” Anti-smoking sentiment is highly correlated with the passage of the clean indoor air laws, therefore, the decreased association between smokefree laws and smokefree-home rules (OR = 7.76 without sentiment and OR = 4.08 with sentiment for full coverage and smoker households; OR = 4.12 without sentiment and OR = 2.44 with sentiment for full coverage and nonsmoker households) after controlling for antismoking sentiment may due to model over-adjustment ($p < 0.01$ without sentiment and $p = 0.89$ with sentiment for partial coverage and smoker households; $p < 0.01$ without sentiment and $p = 0.99$ with sentiment for partial coverage and nonsmoker households). The fact that there is a positive association between the presence of the laws and smokefree-home rules even after controlling for anti-smoking sentiment is consistent with the hypothesis that the existence of the law has a positive independent effect on smokefree-home rules.

Limitations

The data include several different units of observation: state, county, home (as explanatory variables) and individual (both as dependent variable and explanatory variables), which can produce dependence among the observations. This analysis used robust SEs clustered at the state level to deal with this potential problem, which is likely the most important source of dependence.

The validity of self-reported smoking status is a potential issue; compared to biochemically measured smoking status self-report understates current smoking, but the degree of under-report is constant over time.²¹ In addition, research on parental self-report of home safety rules shows that they are accurately reported.^{22–24}

In order to ensure there is an exogenous cut-off for whether or not being identified with a county identifier in TUS-CPS, additional sensitivity analyses were conducted that used data from only counties with populations greater than 200,000 and 300,000. The results were consistent with our main results. The results can be generalized to large counties in the U.S. with population over 100,000.

Because TUS-CPS use self-reported smoking behavior and smokefree policy and does not provide smoking information for every household member in a household, the variable of whether or not living in a household with smokers (or nonsmokers) may be misclassified in a situation where the only smoker (or nonsmoker) in the household was not interviewed, and this household may be misclassified into a household without smoker (or nonsmoker). As a sensitivity check, an analysis was conducted including people living in the households where all household members are interviewed about their smoking status and re-estimated the regression models. The results were consistent with the main results.

Because state anti-smoking sentiment is highly correlated with the presence of smokefree laws the values of the coefficients associating smokefree-home policies with smokefree laws with and without including state anti-smoking sentiment in the model likely brackets the independent association of smokefree laws on smokefree-home policies.

Conclusion

Although the aim of clean indoor air laws is to reduce the SHS exposure in public venues, our results provide evidence that these laws have the important additional effect of stimulating smokefree homes, with a larger association in homes occupied by smokers. There is not evidence that smokefree laws increase exposure to SHS by encouraging more homes to permit smoking in the home. These findings also support the hypothesis of “norm spreading” effect of clean indoor air laws and represent evidence against “behavioral

compensating.” Since the home remains a major source of SHS exposure for children, this work shows that an additional justification for enacting smokefree workplace and public place legislation is the secondary effect of stimulating voluntary smokefree-home rules, particularly in homes occupied by smokers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This work was supported by National Cancer Institute Grants CA-113710 and CA-61021. The funding agency played no role in the selection of the question for analysis, conduct of the research or preparation of the manuscript.

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Figure 1.
The proportion of adults (aged ≥ 18 years) covered by 100% smokefree-home rules for households with and without smokers

Table 1

Dependent and independent variable definitions

	Variable	Definition
Dependent variable	Whether or not a person is living in a home with a 100%-smokefree rule.	If a person is living in the home with 100%-smokefree rule (1); otherwise (0).
Independent variables		
Individual characteristics	Age	Respondent's age (years)
	Age squared	Age squared/100
	Gender	
	Race	Male (1); Female (0) White
		African-American Others (ref)
	Marital status	Married (1); otherwise (0)
	Employment status	Employed (1); otherwise (0)
	Education	Years of education
	Smoking status	Have smoked 100 cigarettes in lifetime and a current smoker (1); otherwise (0)
Household characteristics	Family income	Deflated family income (1982 dollars)
	Whether or not living with children	Live with children (1); otherwise (0)
	Whether or not living with any nonsmoking adults	Live with nonsmoking adults (1); otherwise (0)
Time indicator	Year variable	1992–2007
Seasonal effect	The survey month is in winter season or not	Survey month is in November – February (1); otherwise (0)
Law coverage	Full 100%-smokefree coverage	At least one venue (workplace, restaurant, or bar) is covered by a 100%-smokefree law and the law covers the entire county population.
	Partial 100%-smokefree coverage	At least one venue (workplace, restaurant, or bar) is covered by 100%-smokefree laws and the law does not cover the entire county population.
	No laws at all (ref)	There is no 100%-smokefree law at state or county or city level.

Table 2

Demographics, SES, household composition, and 100% smokefree-home rules

	Living in a home <i>with</i> 100% smokefree-home rules	Living in the home <i>without</i> 100% Smokefree-home rules	<i>p</i>
100% law coverage*			<0.01
Full	60.9%	53.3%	
Partial	12.8%	13.6%	
No	26.1%	33.0%	
SES and demographics			
Age (years)	49.7	47.1	<0.01
Male	52.4%	47.8%	<0.01
Marital Status	62.2%	47.4%	<0.01
Years of Education	13.6	13.0	<0.01
Race			<0.01
White	87.5%	83.5%	
Black	7.0%	11.9%	
Others	5.4%	4.4%	
Employed	62.7%	63.4%	<0.01
Smoker	25.6%	67.4%	<0.01
Household characteristics			
Real family income (\$)	30,092	23,897	<0.01
With Children	35.3%	30.8%	<0.01
With Nonsmokers	78.8%	40.0%	<0.01
Number of observations	62,847	58,849	
%	52%	48%	

* The ratios are adjusted for year variables, and they are based on a standardized year of 2007.

Table 3

Odds of living in a smokefree home

	Smoker household (≥ 1 smoker in the household)		Nonsmoker household (no smokers in the household)	
	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>
100% law coverage				
Partial (ref: no laws)	1.85 (1.60, 2.13)	<0.01	1.64 (1.41, 1.91)	<0.01
Full	7.76 (5.27, 11.43)	<0.01	4.12 (3.28, 5.16)	<0.01
Household characteristics				
Living with children	1.50 (1.29, 1.75)	<0.01	1.38 (1.18, 1.60)	<0.01
Living with nonsmokers	1.74 (1.52, 2.00)	<0.01	N/A	
Seasonal effect				
Winter (ref: otherwise)	0.86 (0.77, 0.96)	0.01	0.94 (0.83, 1.08)	0.40
SES and demographics				
Smoker	0.73 (0.64, 0.84)	<0.01	N/A	
Age	0.92 (0.90, 0.94)	<0.01	0.98 (0.97, 0.99)	<0.01
Age squared	1.08 (1.05, 1.10)	<0.01	1.01 (1.00, 1.03)	0.01
Married (ref: not married)	1.42 (1.30, 1.55)	<0.01	1.22 (1.11, 1.34)	<0.01
Male (ref: female)	1.50 (1.40, 1.62)	<0.01	1.04 (0.96, 1.12)	0.33
High school below (ref: high school graduates)	1.30 (1.13, 1.49)	<0.01	1.02 (0.87, 1.19)	0.79
College graduates	1.41 (1.30, 1.53)	<0.01	1.15 (1.04, 1.26)	<0.01
College above	1.55 (1.35, 1.77)	<0.01	1.33 (1.17, 1.52)	<0.01
Family income (unit: 1,000)	1.01 (1.00, 1.01)	<0.01	1.00 (1.00, 1.01)	0.04
Employed (ref: not employed)	1.12 (0.99, 1.28)	0.08	0.96 (0.86, 1.07)	0.48
Black (ref: white)	0.81 (0.66, 1.00)	0.05	0.89 (0.72, 1.11)	0.31
Other Races	1.21 (0.86, 1.69)	0.27	1.29 (1.08, 1.53)	0.01
Observations	60,541		61,155	

Control for continuous year variable. Robust SEs in parentheses. SEs are clustered in state level. Note: Observations are weighted by self-responder weights.