HHS Public Access

Author manuscript

Tob Control. Author manuscript; available in PMC 2019 May 13.

Published in final edited form as:

Tob Control. 2015 July ; 24(4): 376–381. doi:10.1136/tobaccocontrol-2013-051526.

Association between current asthma and secondhand smoke exposure in vehicles among adults living in four US states

Kimberly H Nguyen[1], **Brian A King**[1], and **Shanta R Dube**[1,2]

[1]Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[2]Division of Epidemiology and Biostatistics, School of Public Health, Georgia State University, Georgia, USA

Abstract

Objective—Many states have implemented laws prohibiting tobacco smoking in indoor public places. However, private settings remain a major source of secondhand smoke (SHS) exposure for many people. We assessed the association between current asthma and SHS exposure in vehicles among adult never-smokers in Indiana, Kentucky, Louisiana and Mississippi.

Methods—Data came from the 2011 Behavioral Risk Factor Surveillance System, a state-based telephone survey of US adults aged ≥18 years. Analyses were restricted to states (n=4) that administered an optional SHS module. Prevalence of self-reported asthma and past 7-day SHS exposure in vehicles was calculated by demographics, voluntary smoke-free vehicle rules and SHS exposure in homes, public places and workplaces. Logistic regression was used to assess the adjusted association between asthma and SHS exposure in vehicles.

Results—Among 17 863 never-smoking adults, 7.4% reported having current asthma, whereas 12.3% reported past 7-day SHS exposure in vehicles. Among adults with asthma, SHS exposure in vehicles was lower among those with voluntary smoke-free rules compared with those without voluntary smoke-free rules (9.5% vs 56.7%, p<0.0001). Following adjustment, adults exposed to SHS in a vehicle had a higher odds of having current asthma compared with unexposed adults (OR=2.01, 95% CI 1.18 to 3.40).

Conclusions—Never-smoking adults recently exposed to SHS in a vehicle had higher odds of having current asthma compared with unexposed adults. Efforts are warranted to warn about the dangers of SHS and to encourage voluntary smoke-free rules in vehicles, especially among adults with asthma.

Correspondence to: Kimberly Nguyen, Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 4770 Buford Highway, MS F-79, Atlanta, GA 30341, USA; Uxp1@cdc.gov.

Contributors KHN designed the study, conducted the analyses and interpreted the data, drafted the manuscript and approved the final version of the manuscript. BAK and SRD provided contributions to the design of the study, assisted with interpretation of the data, revised the manuscript and approved the final version of the manuscript.

Publisher's Disclaimer: Disclaimer The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Competing interests None.

Ethics approval This study consisted of secondary analyses of de-identified data, and was therefore exempt from ethics approval.

INTRODUCTION

Secondhand smoke (SHS) is a mixture of gases and particles from burning tobacco products and the smoke exhaled by the smoker. SHS contains more than 7000 chemicals, including hundreds that are toxic and approximately 70 that can cause cancer in humans.[1] The US Surgeon General concluded that there is no risk-free level of SHS exposure.[1] Max and colleagues reported that in the USA in 2006, SHS was responsible for an estimated 42 000 deaths among adults and nearly 900 among infants.[2] In addition, deaths attributed to SHS resulted in approximately $6.6 billion of lost productivity, or $158 000 per death. Furthermore, SHS can trigger asthma episodes and increase the severity of attacks among adults with asthma.[3]

Asthma, a chronic inflammatory disorder, causes the airways of the lungs to swell and narrow, leading to wheezing, shortness of breath, chest tightness and coughing.[3] Among several factors that can trigger an asthma attack, SHS can exacerbate asthma when gases and particles from SHS enter the lungs, causing the walls of the airways in the lungs to swell and the airways to narrow.[3] This results in less air moving in and out of the lungs and mucus from the lungs clogging the airways.[3] Many studies have found that among never-smoking adults with asthma, SHS exposure can lead to increased severity of asthma attacks, worse health status and higher odds of emergency department visits, urgent physician visits and hospitalisations.[4–6] Those with the highest levels of SHS exposure also had the most severe asthma, and those who reported reduced SHS exposure had reduced asthma severity, improved health status and decreased emergency department visits and hospitalisations.

The US Surgeon General has concluded that eliminating smoking in indoor spaces is the only way to fully protect never-smokers from SHS exposure.[1] In the USA, considerable progress has been made to increase the number of statewide comprehensive smoke-free laws that prohibit tobacco smoking in all indoor areas of public places and work sites, including restaurants and bars. As of April 2013, 26 US states and the District of Columbia (DC) have enacted comprehensive smoke-free laws.[7] With the implementation of voluntary smoke-free laws in public settings, such as work sites, bars and restaurants, the prevalence of SHS exposure among never-smokers has declined significantly from 52.5% during 1999–2000 to 40.1% during 2007–2008 across all sex, age, race/ethnicity and income groups except non-Hispanic whites.[8]

Despite the increasing number of US states and localities that have implemented comprehensive voluntary smoke-free laws, private settings, such as vehicles, remain a major source of SHS exposure for many individuals.[9–10] Studies have found that the mean levels of polycyclic aromatic hydrocarbons (PAHs), a by-product of burning tobacco products, are markedly higher in vehicles (1325.1 ng/m^3) than in other private settings, such as homes (16–350 ng/m^3).[11,12] Previous studies have examined SHS exposure in vehicles[10]; however, to our knowledge, no study has assessed the association between SHS exposure in vehicles and adult asthma. To fill this research gap, we assessed the association between current adult asthma and SHS exposure in vehicles among never-smoking adults in four US states (ie, Indiana, Kentucky, Louisiana and Mississippi) by using data from the Behavioral Risk Factor Surveillance System (BRFSS).

METHODS

Data source and sample

The BRFSS is a telephone survey conducted by the Centers for Disease Control and Prevention (CDC) and state health departments that is administered in all 50 states, DC and US territories.[13] The BRFSS completes more than 400 000 adult interviews each year, making it the largest continuously conducted multimode (ie, mail, landline phone, cell phone) health survey system in the world. The survey collects information about modifiable risk factors for chronic diseases and other leading causes of death among the non-institutionalised US population aged 18 years or older annually. Estimates from the BRFSS have been found to be reliable and valid.[14]

During 2011, a BRFSS module, which included questions about SHS, was proposed by the CDC's Office on Smoking and Health (OSH). The module was administered and used among landline-only participants by four states (ie, Indiana, Kentucky, Louisiana and Mississippi). Historically, these four states are among those with the highest prevalence of cigarette smoking.[15] Response rates for BRFSS are calculated by using standards set by the American Association of Public Opinion Research,[16] which defines a response rate as the number of respondents who completed the survey divided by all eligible and likely eligible persons. The median response rate for all states and Washington, DC, in 2011 was 49.7% and ranged from 33.8% to 64.1%.[17] The response rate for states included in this analysis was 47.6% (Indiana), 61.4% (Kentucky), 52.9% (Louisiana) and 51.0% (Mississippi).

Measures

Asthma—Current asthma was determined by the following questions from the Core BRFSS: "Have you ever been told you had asthma?" and "Do you currently have asthma?" Respondents who replied 'yes' to both questions were categorised as having current asthma. Self-reported asthma has previously been validated against clinical diagnosis,[18] and there is general agreement among researchers that such questions have strong face and construct validity.[19]

SHS exposure—Exposure to SHS in vehicles was assessed by the following questions from the SHS module: "During the past 7 days, on how many days did you ride in a vehicle where someone other than you was smoking tobacco?" Respondents who reported 1–7 days were classified as exposed to SHS in a vehicle within the past 7 days. An analysis performed by using the original categorical variables for SHS exposure in vehicles provided unstable estimates because of low sample sizes in each category; thus, SHS exposure was collapsed into a binary variable.

To control for SHS exposure in other settings, respondents were asked about their SHS exposure in homes and in public areas. Respondents were asked, "Not counting decks, porches, or garages, during the past 7 days, on how many days did someone other than you smoke tobacco inside your home while you were at home?" Respondents who reported 1–7 days were classified as exposed to SHS in their homes within the past 7 days. In addition, a variable for SHS exposure in workplaces and public settings was created. Respondents were

asked, “During the past 7 days, on how many days did you breathe the smoke from someone else who was smoking in an indoor public place?” and “During the past 7 days, on how many days did you breathe the smoke at your workplace from someone other than you who was smoking tobacco?” Respondents who reported 1–7 days for either of these questions were classified as exposed to SHS in other places within the past 7 days.

Smoke-free vehicle rules—Voluntary smoke-free rules in vehicles were determined by the following questions in the module: “Not counting motorcycles, in the vehicles that you or family members who live with you own or lease, is smoking always allowed in all vehicles, sometimes allowed in at least one vehicle, or never allowed in any vehicle?” Respondents who responded ‘never allowed in any vehicle’ were classified as having a household voluntary smoke-free vehicle rule.

Respondent characteristics—To control for the relationship between asthma and active smoking, the present analysis was limited to never-smoking adults. Never-smoking adults were defined as respondents who answered ‘no’ to the question, “Have you smoked at least 100 cigarettes in your entire life?”

Demographic characteristics included the following: sex (male or female), age group (18–24, 25–44, 45–64 or ≥65 years), annual household income (<$25 000, $25 000–$49 999, $50 000–$74 999 or $75 000+), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic and non-Hispanic other) and current health insurance status (yes or no). Respondents were considered to have health insurance if they answered ‘yes’ to the question, “Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?”

Statistical analysis—Data from states that administered the optional SHS module (Indiana, Kentucky, Louisiana and Mississippi) were combined to increase sample size and power for the study. There were 17 863 never-smokers from these four states in the combined data set.

Weighted analyses were conducted by using SAS-callable SUDAAN V.9.2 (RTI International, Research Triangle Park, North Carolina, USA) to account for the complex sampling design and to increase the representativeness of the sample.[10] χ^2 tests were conducted to determine whether prevalence of SHS exposure differed significantly among adults with and without voluntary smoke-free vehicle rules (α=0.05). Binary logistic regression models were fitted to determine the association between SHS exposure in vehicles and current asthma among never-smoking adults, adjusting for sex, age, race/ethnicity, annual household income, insurance status, voluntary smoke-free vehicles rules and SHS exposure in homes, public places and workplaces. Power analyses were conducted to determine the ability of our study to detect a significant association if one exists. We had 87% power to detect a significant association between SHS exposure in a vehicle and current asthma (α=0.05).

RESULTS

The sample included 17 863 never-smoking adults in Indiana, Kentucky, Louisiana and Mississippi, of which 7.4% reported that they currently had asthma (table 1). The mean age of all respondents was 44 years (SD=±0.28). Males made up 42.3% of the sample. By race/ethnicity, 74.5% were non-Hispanic white, 21.2% non-Hispanic black, 2.8% Hispanic and 1.5% Non-Hispanic other. Eighty-five per cent of respondents reported having health insurance, and annual household income levels were distributed as follows: <$25 000, 30.9%; $25 000–$49 999, 24.2%; $50 000–$74 999, 16.0%; ≥$75 000, 29.0%. Eighty-two per cent of respondents stated that they had voluntary smoke-free rules in vehicles, and 12.3% reported that they were exposed to SHS in vehicles in the past 7 days. In addition, 41.0% reported being exposed to SHS at work or in an indoor public place, and 8.7% reported being exposed to SHS in homes during the past 7 days, including 4.1% of those with a voluntary policy and 60.4% of those without a voluntary policy.

Prevalence of SHS exposure in vehicles was significantly lower among adults with voluntary smoke-free vehicle rules than among those without such rules. For example, only 5.6% of never-smoking adults who have smoke-free vehicle rules were exposed to SHS in vehicles compared with 43.5% of never-smoking adults who did not have smoke-free vehicle rules ($p<0.0001$) (table 2). Furthermore, among adults with asthma, exposure to SHS in a vehicle was significantly lower among those with a voluntary smoke-free vehicle rule (9.5%) compared with those without these rules (56.7%) ($p<0.0001$). Irrespective of sex, age, race/ethnicity, annual household income or insurance status, adults with voluntary smoke-free vehicle rules had lower prevalence of SHS in vehicles than adults without these rules ($p<0.0001$).

Among adults with current asthma, 78.8% reported having a voluntary smoke-free vehicle rule, and 19.5% were exposed to SHS in vehicles during the past 7 days (table 3). Never-smoking adults who reported that they were exposed to SHS in vehicles during the past 7 days had higher odds of having current asthma (OR=2.01, 95% CI 1.18 to 3.40) after adjustment for sex, age, race/ethnicity, annual household income, insurance status, voluntary smoke-free vehicles rules and exposure to SHS in the home, workplace and indoor public places.

DISCUSSION

During 2011, we found that approximately 1 of 5 never-smoking adults with asthma from four states (ie, Indiana, Kentucky, Louisiana and Mississippi) were exposed to SHS in vehicles. In addition, adults who reported exposure to SHS in vehicles were twice as likely to report having current asthma after controlling for potential confounders. Adults with asthma who had voluntary smoke-free vehicle rules also reported significantly lower exposure to SHS in vehicles than adults without these rules. These results underscore the need for efforts to educate adults about the dangers of SHS exposures, especially those with asthma, and to encourage the adoption of voluntary smoke-free rules in private settings such as vehicles. Furthermore, avoidance of SHS exposure is a recommended strategy for asthma management among adults with asthma.[20]

The prevalence of SHS exposure in vehicles was significantly lower among adults with voluntary smoke-free rules than among those without such rules. Across all sociodemographic characteristics, those with voluntary smoke-free vehicle rules had significantly lower SHS exposure than those without voluntary smoke-free rules ($p<0.0001$). This finding is consistent with environmental studies showing that voluntary smoke-free vehicles have substantially lower levels of SHS constituents than those in which smoking is permitted.[21] Accordingly, more efforts are warranted to educate adults about steps to avoid SHS as a strategy for asthma control and to promote the adoption of voluntary smoke-free vehicle rules.

In addition to the adoption of voluntary smoke-free rules at the individual level, progress has also been made in recent years to address the extent of exposure to SHS in this environment at the societal level. For example, Arkansas, California, Louisiana, Maine, Oregon, Utah and the US territory of Puerto Rico have instituted laws that prohibit smoking in vehicles occupied by youth younger than a specified age.[22] However, it is important to note that, given the greater population-level protection afforded by smoke-free laws in work sites and public places, voluntary smoke-free vehicle laws are best suited for consideration following the implementation of comprehensive smoke-free laws in all public places and work sites, including restaurants and bars.

The present study was conducted among never-smoking adults because including current smokers in the analysis would artificially inflate the odds of asthma because of the mechanisms of active smoking on reduced lung function.[23] There are several limitations to consider in this study. First, this study examined the effect of SHS exposure on current asthma, not lifetime asthma, which may have happened years ago and then resolved. Given SHS exposure was based on past 7 days, assessment of current asthma is a more appropriate outcome than lifetime asthma and is less likely to result in inflated ORs. Second, the measure used to define current asthma in this study may lack sensitivity. A more sensitive measure may have been an item that assessed actual incidence of symptoms, such as having an asthma attack during the past 7 days. Because evidence from the US Surgeon General Report does not suggest that SHS exposure increases asthma prevalence, but rather increases severity of symptoms, our outcome measure could have lacked sensitivity of the characteristic of asthma for which there is evidence of SHS effects. Thus, the effect size of 2.10 may be an underestimate of the impact of SHS exposure on exacerbating asthma symptoms. Third, cell phone respondents were excluded and only four states (Indiana, Kentucky, Louisiana and Mississippi) were selected for the inclusion of the SHS module, which limits the generalisability of our findings. Fourth, SHS exposure and voluntary smoke-free rules were determined by self-report, which could result in exposure misclassification. However, studies suggest that this misclassification could underestimate actual SHS exposure, and our observed ORs may be biased towards the null.[24] Finally, the BRFSS is a cross-sectional study, so it is not possible to make statements about causality or direction of effect regarding SHS and current asthma.

CONCLUSIONS

Our findings suggest that never-smoking adults who have voluntary smoke-free rules in vehicles were significantly less likely to be exposed to SHS in vehicles than adults without voluntary smoke-free rules. In addition, those with smoke-free vehicle rules were also significantly less likely to have current asthma. To reduce asthma exacerbations and other harmful health effects, efforts are needed to continue to educate adults about the dangers of SHS and to encourage the adoption of voluntary smoke-free rules in private settings such as vehicles.

Although we did not assess children in this study, they would also benefit greatly from smoke-free vehicle policies. Several states and jurisdictions have passed smoke-free laws in vehicles with children.[25] Studies have found that smoke-free laws were significantly associated with lower odds of asthmatic symptoms (OR 0.67 (95% CI 0.48 to 0.93)) among non-smoking youth.[26] Such laws protecting children should also raise awareness about adult exposure and possibly provide partial protection for adults.

The Global Advisors Smokefree Policy (GASP) states that smoke-free rules in vehicles can reduce SHS exposure among children and non-smoking adults.[21] However, our study shows that 21% of never-smoking adults with asthma do not have voluntary smoke-free rules in vehicles, and 20% were exposed to SHS in vehicles during the past 7 days. Adults with voluntary smoke-free rules had significantly lower prevalence of SHS exposure in vehicles than adults without voluntary smoke-free rules, which underscores the importance of encouraging adults to implement voluntary smoke-free rules in vehicles to reduce their exposure to SHS, especially because SHS avoidance is an asthma control strategy.[16]

Acknowledgements

We are grateful to the BRFSS state coordinators for leading the data collection process and to the BRFSS staff at the Centers for Disease Control and Prevention for ensuring the data sets are of high quality.

REFERENCES

1. Department of Health and Human Services. The health consequences of exposure to tobacco smoke: a report of the surgeon general. Atlanta, GA 2006.
2. Max W, Sung HY, Shi Y. Deaths from secondhand smoke exposure in the United States: economic implications. Am J Public Health 2012;102:2173–80. [PubMed: 22994180]
3. Dougherty RH, Fahy JV. Acute exacerbations of asthma: epidemiology, biology and the exacerbation-prone phenotype. Clin Exp Allergy 2009;39: 193–202. [PubMed: 19187331]
4. Comhair SA, Gaston BM, Ricci KS, et al. Detrimental effects of environmental tobacco smoke in relation to asthma severity. PLoS One 2011;6:e18574. [PubMed: 21572527]
5. Eisner MD, Klein J, Hammond SK, et al. Directly measured second hand smoke exposure and asthma health outcomes. Thorax 2005;60:814–21. [PubMed: 16192366]
6. Dahms TE, Bolin JF, Slavin RG. Passive smoking. Effects on bronchial asthma. Chest 1981;80:530–4. [PubMed: 7297141]
7. CDC STATE System: Centers for Disease Control and Prevention. State Activities Tracking and Evaluation (STATE) System (STATE). http://apps.nccd.cdc.gov/statesystem/Default/Default.aspx (accessed on 10 Aug 2013).

8. Centers for Disease Control and Prevention (CDC). Vital Signs: neversmokers' exposure to secondhand smoke—United States, 1999–2008. MMWR Morb Mortal Wkly Rep 2010;59(35): 1141–6. [PubMed: 20829748]
9. Jie Y, Ismail NH, Jie X, et al. Do indoor environments influence asthma and asthma-related symptoms among adults in homes?: a review of the literature. J Formos Med Assoc 2011;110:555–63. [PubMed: 21930065]
10. King BA, Dube SR, Homa DM. Smoke-free rules and secondhand smoke exposure in homes and vehicles among US adults, 2009–2010. Prev Chronic Dis 2013; 10:E79. [PubMed: 23680508]
11. Northcross AL, Trinh M, Kim J, et al. Particulate mass and polycyclic aromatic hydrocarbons exposure from secondhand smoke in the back seat of a vehicle. Tob Control 2014;23:14–20. [PubMed: 23172398]
12. Naumova YY, Eisenreich SJ, Turpin BJ, et al. Polycyclic aromatic hydrocarbons in the indoor and outdoor air of three cities in the U.S. Environ Sci Technol 2002;36:2552–9. [PubMed: 12099449]
13. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. http://www.cdc.gov/brfss/ (accessed on 12 Aug 2013).
14. Fahimi M, Link M, Schwartz DA, et al. Tracking chronic disease and risk behavior prevalence as survey participation declines: statistics from the Behavioral Risk Factor Surveillance System and other national surveys. Prev Chronic Dis 2008;5:A80. [PubMed: 18558030]
15. Centers for Disease Control and Prevention. Tobacco Control State Highlights 2012. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2013.
16. American Association for Public Opinion Research. http://www.aapor.org/Standard_Definitions2.htm (accessed on 4 Aug 2013).
17. Behavioral Risk Factor Surveillance System. Data Quality. http://www.cdc.gov/brfss/pdf/2011_Summary_Data_Quality_Report.pdf (accessed on 29 Oct 2013).
18. Nelson DE, Powell-Griner E, Town M, et al. A comparison of national estimates from the National Health Interview Survey and the Behavioral Risk Factor Surveillance System. Am J Public Health 2003;93:1335–41. [PubMed: 12893624]
19. McDowell I, Newell C. Measuring health: a guide to rating scales and questionnaires. New York: Oxford University Press, 1996:31–3.
20. Guidelines for the Diagnosis and Management of Asthma (EPR-3). National Heart, Lung, and Blood Institute. 2013 http://www.nhlbi.nih.gov/guidelines/asthma/ (accessed on 29 Aug 2013).
21. Jones MR, Navas-Acien A, Yuan J, et al. Secondhand tobacco smoke concentrations in motor vehicles: a pilot study. Tob Control 2009;18:399–404. [PubMed: 19706642]
22. Global Advisors on Smokefree Policy (GASP). Smoke-free Vehicles When Children are Present. http://www.njgasp.org/f_SF%20cars,kids,%20info,%20arguments.pdf (accessed on 20 Aug 2013).
23. Thomson NC, Chaudhuri R, Heaney LG, et al. Clinical outcomes and inflammatory biomarkers in current smokers and exsmokers with severe asthma. J Allergy Clin Immunol 2013;131:1008–16. [PubMed: 23419540]
24. Max W, Sung HY, Shi Y. Who is exposed to secondhand smoke? Self-reported and serum cotinine measured exposure in the U.S., 1999–2006. Int J Environ Res Public Health 2009;6:1633–48. [PubMed: 19543411]
25. Smoke-free Vehicles When Children are Present. Global Advisors Smokefree Policy (GASP). 2013 http://www.njgasp.org/pc-studies.htm (accessed on 2 Nov 2013).
26. Dove M, Dockery D, Connolly G. Smoke-free air laws and Asthma prevalence, symptoms, and severity among nonsmoking youth. Pediatrics 2011;127:102–9. [PubMed: 21149426]

What this paper adds

- Adults with current asthma may be exposed to secondhand smoke (SHS) in vehicles, which may exacerbate their symptoms.
- This study used data from the Behavioral Risk Factor Surveillance System (BRFSS) to assess the association between SHS in vehicles and current asthma among adults in four states (Indiana, Kentucky, Louisiana and Mississippi).
- The data indicate that adults who are exposed to SHS in vehicles were approximately twice as likely to have current asthma compared with adults who were unexposed to SHS in vehicles.
- There is a need to encourage adults with current asthma to implement voluntary smoke-free rules in vehicles to reduce their exposure to SHS.
- to implement voluntary smoke-free rules in vehicles to reduce their exposure to SHS, especially because SHS avoidance is an asthma control strategy.

Table 1

Characteristics of never-smoking adults aged 18 years or older in Indiana, Kentucky, Louisiana and Mississippi, BRFSS 2011

	Number	Percentage (95% CI)
Total	17 863	
Sex		
Male	4608	42.3 (40.8 to 43.8)
Female	13 255	57.7 (56.3 to 59.2)
Age (years)		
18–24	592	18.4 (16.9 to 20.0)
25–44	3418	33.9 (32.6 to 35.3)
45–64	7160	31.1 (30.0 to 32.3)
>65	6519	16.5 (15.9 to 17.2)
Race/ethnicity		
white, Non-Hispanic	12 997	74.5 (73.3 to 75.7)
black, Non-Hispanic	3866	21.2 (20.1 to 22.4)
Hispanic	353	2.8 (2.3 to 3.4)
other, Non-Hispanic	171	1.5 (1.1 to 2.0)
Annual household income		
<$25 000	4938	30.9 (29.5 to 32.4)
$25 000-S49 999	3556	24.2 (22.9 to 25.5)
$50 000-S74 999	2018	16.0 (14.8 to 17.1)
>$75 000	3365	29.0 (27.6 to 30.4)
Health insurance status		
Yes	15 894	84.9 (83.8 to 86.0)
No	1915	15.1 (14.0 to 16.3)
Adult current asthma		
Yes	1378	7.4 (6.7 to 8.2)
No	16 392	92.6 (91.8 to 93.4)
Voluntary smoke-free rules in vehicle *		
Yes	13 918	82.1 (80.8 to 83.4)
No	2201	17.9 (16.6 to 19.2)
Ride in a vehicle where someone was smoking (past 7 days) †		
Yes	1347	12.3 (11.2 to 13.5)
No	15157	87.7 (86.5 to 88.8)
Breathe smoke in home (past 7 days) ‡		
Yes	979	8.7 (7.8 to 9.7)
No	15 532	91.3 (90.3 to 92.2)
Breathe smoke at work or in an indoor public place (past 7 days) §		
Yes	3206	41.0(39.1 to 42.9)
No	5241	59.0 (57.1 to 60.9)

Percentages are weighted.

*Defined as a response of 'never allowed in any vehicle' to the question, "Not counting motorcycles, in the vehicles that you or your family members who live with you own or lease, is smoking....?"

†Defined as a response of 1–7 days to the question, "During the past 7 days, on how many days did you ride in a vehicle where someone other than you was smoking tobacco?"

‡Defined as a response of 1–7 days to the question, "Not counting decks, porches, or garages, during the past 7 days, on how many days did someone other than you smoke tobacco inside your home while you were at home?"

§Defined as a response of 1–7 days to the question, "How many days did you breathe the smoke at your workplace from someone other than you who was smoking tobacco?", and "Not counting the number of times while you were at work, during the past 7 days, on how many days did you breathe the smoke from someone else who was smoking in an indoor public place?"

BRFSS, Behavioral Risk Factor Surveillance System.

Tob Control. Author manuscript; available in PMC 2019 May 13.

Table 2

Prevalence of secondhand smoke exposure in vehicles among never-smoking adults aged 18 years or older, by voluntary smoke-free vehicle rule status, Indiana, Kentucky, Louisiana and Mississippi, BRFSS 2011

	Voluntary smoke-free vehicle rules[†,‡]		
	Overall percentage exposed to SHS in vehicles	**Yes Percentage exposed to SHS in vehicles**	**No Percentage exposed to SHS in vehicles**
Total	12.3 (11.2 to 13.5)	5.6 (4.6 to 6.5)	43.5 (39.4 to 47.6)[*]
Sex			
Male	14.0 (12.0 to 16.0)	7.1 (5.4 to 8.8)	43.7 (36.9 to 50.4)[*]
Female	11.1 (9.8 to 12.4)	4.5 (3.4 to 5.5)	43.4 (38.4 to 48.3)[*]
Age (years)			
18–24	23.5(19.1 to 28.0)	11.7 (7.4 to 16.0)	49.6 (40.0 to 59.1)[*]
25–44	12.5 (10.5 to 14.5)	6.5 (4.8 to 8.2)	43.8(36.3 to 51.3)[*]
45–64	9.6(8.4 to 10.9)	3.7 (2.9 to 4.5)	41.4 (35.9 to 46.8)[*]
>65	5.2 (4.3 to 6.2)	2.0 (1.4 to 2.6)	30.0 (24.3 to 35.7)[*]
Race/ethnicity			
white, Non-Hispanic	11.3 (10.0 to 12.6)	4.7 (3.6 to 5.7)	43.2 (38.3 to 48.1)[*]
black, Non-Hispanic	15.2 (12.8 to 17.6)	8.5 (6.3 to 10.7)	43.3 (35.2 to 51.3)[*]
Hispanic	17.3(6.7 to 28.0)	6.0 (0.0 to 12.9)	64.1 (39.3 to 88.9)[*]
other, Non-Hispanic	17.0 (2.8 to 31.2)	10.2 (0.0 to 26.9)	42.0 (5.7 to 78.3)[*]
Household income			
<$25 000	18.6 (15.9 to 21.3)	9.0 (6.4 to 11.5)	50.2 (43.2 to 57.2)[*]
$25 000-$49 999	11.2 (9.0 to 13.4)	4.1 (2.7 to 5.6)	38.6 (30.3 to 47.0)[*]
$50 000-$74 999	8.0(5.8 to 10.2)	3.3 (1.7 to 5.0)	35.3 (24.6 to 46.4)[*]
>$75 000	5.8 (4.1 to 7.5)	3.1 (1.7 to 4.5)	33.2 (22.5 to 43.8)[*]
Health insurance status			
Yes	10.8(9.7 to 12.0)	4.7 (3.8 to 5.6)	42.2 (37.7 to 46.6)[*]
No	19.9(16.2 to 23.5)	9.8 (6.6 to 13.1)	47.2 (37.5 to 57.0)[*]
Adult current asthma			

	Voluntary smoke-free vehicle rules[†,‡]		
	Overall percentage exposed to SHS in vehicles	**Yes Percentage exposed to SHS in vehicles**	**No Percentage exposed to SHS in vehicles**
Yes	19.5(14.5 to 25.4)	9.5 (5.0 to 14.0)	56.7 (43.5 to 70.0) [*]
No	11.7(10.5 to 12.9)	5.2 (4.3 to 6.2)	42.1 (37.8 to 46.4) [*]

Percentages are weighted.

[*] χ^2 $p < 0.0001$. Those without voluntary smoke-free rules were significantly different from those with voluntary smoke-free rules.

[†] Defined as a response of 'never allowed in any vehicle' to the question, "Not counting motorcycles, in the vehicles that you or your family members who live with you own or lease, is smoking....?"

[‡] Defined as a response of 1–7 days to the question, "During the past 7 days, on how many days did you ride in a vehicle where someone other than you was smoking?" BRFSS, Behavioral Risk Factor Surveillance System; SHS, secondhand smoke.

Tob Control. Author manuscript; available in PMC 2019 May 13.

Table 3

Unadjusted odds and adjusted odds of current asthma among never-smoking adults aged 18 years or older, Indiana, Kentucky, Louisiana and Mississippi, BRFSS, 2011

	Current asthma		Unadjusted		Adjusted	
	Number	Percentage (95% CI)	OR	95% CI	aOR	95% CI
Sex						
Male	225	28.5 (23.7 to 33.8)	1.00		1.0	
Female	1153	71.5 (66.2 to 76.3)	1.91	1.47 to 2.47	1.93	1.32 to 2.82
Age (years)						
18–24	52	18.9 (13.8 to 25.3)	1.15	0.77 to 1.72	0.80	0.32 to 1.98
25–44	239	31.8 (27.0 to 37.0)	1.04	0.81 to 1.33	1.19	0.71 to 2.00
45–64	633	34.4 (30.2 to 38.8)	1.24	1.02 to 1.50	1.13	0.69 to 1.84
>65	445	14.9(12.8 to 17.4)	1.0		1.0	
Race/ethnicity						
white, Non-Hispanic	923	74.0 (68.9 to 78.5)	1.00		1.00	
black, Non-Hispanic	349	23.0(18.9 to 27.8)	1.11	0.85 to 1.44	0.93	0.58 to 1.49
Hispanic	19	2.4 (0.9 to 6.3)	0.86	0.30 to 2.46	1.02	0.18 to 5.63
other, Non-Hispanic	15	0.7 (0.3 to 1.4)	0.43	0.19 to 0.96	0.44	0.10 to 1.97
Household income						
<$25 000	500	42.5 (37.0 to 48.2)	1.68	1.23 to 2.29	1.61	0.98 to 2.67
$25 000-$49 999	247	19.6 (15.8 to 24.1)	0.94	0.67 to 1.33	0.67	0.42 to 1.05
$50 000-$74 999	134	13.0 (9.6 to 17.4)	0.95	0.63 to 1.44	0.83	0.50 to 1.37
>$75 000	177	24.9 (20.1 to 30.4)	1.00		1.00	
Health insurance status						
Yes	1203	85.7 (81.6 to 89.0)	1.07	0.78 to 1.47	1.37	0.83 to 2.26
No	161	14.3 (11.0 to 18.4)	1.00		1.00	
Voluntary smoke-free rules in vehicle [*]						
Yes	1040	78.8 (73.5 to 83.3)	0.79	0.58 to 1.08	1.13	0.64 to 2.00
No	190	21.2 (16.8 to 26.5)	1.0		1.00	
Ride in a vehicle where someone was smoking (past 7 days) [†]						
Yes	145	19.5 (15.0 to 24.9)	1.82	1.31 to 2.55	2.01	1.18 to 3.40

	Current asthma		Unadjusted		Adjusted	
	Number	**Percentage (95% CI)**	**OR**	**95% CI**	**aOR**	**95% CI**
No	1122	80.5 (75.1 to 85.0)	1.0		1.0	
Breathe smoke in home (past 7 days)[≠]						
Yes	94	12.3 (8.6 to 17.3)	1.52	1.00 to 2.32	1.01	0.51 to 2.01
No	1167	87.7 (82.7 to 91.4)	1.0		1.0	
Breathe smoke at work or in an indoor public place (past 7 days)[§]						
Yes	285	50.6 (43.1 to 56.9)	1.53	1.12 to 2.09	1.33	0.64 to 2.00
No	299	49.4 (41.9 to 56.9)	1.0		1.0	

Percentages are weighted.

[*]Defined as a response of ‘never allowed in any vehicle’ to the question, “Not counting motorcycles, in the vehicles that you or your family members who live with you own or lease, is smoking....?”

[†]Defined as a response of 1–7 days to the question, “During the past 7 days, on how many days did you ride in a vehicle where someone other than you was smoking tobacco?”

[≠]Defined as a response of 1–7 days to the question, “Not counting decks, porches, or garages, during the past 7 days, on how many days did someone other than you smoke tobacco inside your home while you were at home?”

[§]Defined as a response of 1–7 days to the question, “How many days did you breathe the smoke at your workplace from someone other than you who was smoking tobacco?” and “Not counting the number of times while you were at work, during the past 7 days, on how many days did you breathe the smoke from someone else who was smoking in an indoor public place?”

BRFSS, Behavioral Risk Factor Surveillance System.