



National and state prevalence of smoke-free rules in homes with and without children and smokers: Two decades of progress[☆]



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ABSTRACT

Objective. The home is the primary source of secondhand smoke (SHS) exposure for children. We assessed national and state progress in smoke-free home (SFH) rule adoption in homes with and without children and adult smokers.

Methods. Data came from the 1992–1993 and 2010–2011 Tobacco Use Supplements to the Current Population Survey, a U.S. national probability household survey. Households were defined as having a SFH rule if all household respondents aged ≥ 18 indicated no one was allowed to smoke inside the home at any time. Households with children were those with occupants aged < 18 . Smokers were those who smoked ≥ 100 lifetime cigarettes and now smoked “everyday” or “some days”.

Results. From 1992–1993 to 2010–2011, SFH rule prevalence increased from 43.0% to 83.0% ($p < .05$). Among households with children, SFH rules increased overall (44.9% to 88.6%), in households without smokers (59.7% to 95.0%), and households with ≥ 1 smokers (9.7% to 61.0%) ($p < .05$). Among households without children, SFH rules increased overall (40.8% to 81.1%), in households without smokers (53.4% to 90.1%), and households with ≥ 1 smokers (6.3% to 40.9%) ($p < .05$). Prevalence increased in all states, irrespective of smoker or child occupancy ($p < .05$). In 2010–2011, among homes with smokers and children, SFH rule prevalence ranged from 36.5% (West Virginia) to 86.8% (California).

Conclusions. Considerable progress has been made adopting SFH rules, but many U.S. children continue to be exposed to SHS because their homes are not smoke-free. Further efforts to promote adoption of SFH rules are essential to protect all children from this health risk.

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Introduction

Exposure to secondhand smoke (SHS) from burning tobacco products causes heart disease, stroke, and lung cancer in nonsmoking adults and sudden infant death syndrome, acute respiratory infections, middle ear disease, reduced lung function, and more severe asthma in children (US Department of Health and Human Services, 2006). SHS exposure from cigarettes alone causes an estimated 41,000 deaths among

nonsmoking U.S. adults and \$5.6 billion annually in lost productivity from premature death each year (US Department of Health and Human Services, 2014). The Surgeon General of the U.S. public Health Service has concluded that there is no risk-free level of SHS and that only eliminating smoking in indoor spaces fully protects nonsmokers from the adverse health effects of SHS exposure in these environments (US Department of Health and Human Services, 2006; U.S. Department of Health and Human Services, 2010). Young children are particularly affected by SHS exposure because they are still developing physically, have higher breathing rates than adults, and have little control over their indoor environments (US Department of Health and Human Services, 2006).

In the U.S., considerable progress has been made in increasing the proportion of the population covered by state or local comprehensive smoke-free laws that prohibit smoking in indoor public places and worksites, including restaurants and bars (Centers for Disease Control and Prevention, 2014a; Municipalities with Local 100% Smokefree Laws, 2015; National Cancer Institute, 2015). As of January 2015, 26 states, D.C., and approximately 700 communities have enacted comprehensive smoke-free laws (Centers for Disease Control and Prevention,

Abbreviations: CI, confidence interval; D.C., District of Columbia; TUS-CPS, Tobacco Use Supplement to the Current Population Survey; SHS, secondhand smoke.

[☆] Implications and contributions: Secondhand smoke poses a health risk to nonsmokers and the home is the primary exposure source for children. This study shows considerable progress has been made adopting smoke-free home rules. However, many children, especially those in homes with smokers, are exposed to secondhand smoke because their homes are not smoke-free.

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2014a; Municipalities with Local 100% Smokefree Laws, 2015). The adoption of such laws has been shown to reduce SHS exposure and the incidence of certain adverse health events among nonsmoking hospitality workers and the public (US Department of Health and Human Services, 2006; Goodman et al., 2009; Haw and Gruer, 2007). Adoption of smoke-free policies in areas frequented by children, including schools and playgrounds, has also increased in recent years (Centers for Disease Control and Prevention, 2014a). However, millions of nonsmokers continue to be exposed to SHS in areas not covered by such policies (Homa et al., 2015; Centers for Disease Control and Prevention, 2010), including private settings such as homes (King et al., 2013a; Zhang et al., 2014). The home is the primary source of SHS exposure for children, and a major source for adults (US Department of Health and Human Services, 2006). Nearly all nonsmokers who live with someone who smokes in their home are exposed to SHS (Centers for Disease Control and Prevention, 2010).

The proportion of U.S. households with voluntary smoke-free home rules increased from 1992–1993 (43.1%) to 2010–2011 (83.0%); increases were observed among both households with no adult cigarette smokers (56.7% to 91.4%) and those with ≥ 1 adult smokers (9.6% to 46.1%) (King et al., 2014a). Corresponding declines in SHS exposure among all U.S. adults have occurred during the same period (National Cancer Institute, 2015; King et al., 2013a; Centers for Disease Control and Prevention, 2008). Research has found that parental smoking, low socioeconomic status, and low educational attainment are independently associated with children's exposure to SHS in the home (Orton et al., 2014). Moreover, youth that live in households with 100% smoke-free rules that are enforced are significantly less likely to report SHS exposure (Cartmell et al., 2011). However, no studies have assessed both the national and state-specific prevalence and trends in smoke-free rules according to whether a child and/or smokers live in the home. To address this research gap, this study assessed data from the 1992–1993 and 2010–2011 Tobacco Use Supplements to the Current Population Survey (TUS-CPS) to determine progress in national and state prevalence of voluntary smoke-free rules in homes with and without children and adult smokers.

Methods

Data source

Data came from the Current Population Survey, a national probability household survey administered to the civilian, noninstitutionalized population (U.S. Department of Commerce, 2006). Since 1992–1993, the Tobacco Use Supplement to the Current Population Survey has collected national and state data on tobacco use and tobacco-related attitudes and policies, including home smoking rules. While the TUS-CPS sample sizes have ranged from 293,543 in 1992–1993 to 229,456 in 2010–2011, 20% and 25%, respectively, have been by proxy response. For this analysis, we used the 1992–1993 ($n = 238,637$) and the 2010–2011 ($n = 171,365$) self-respondents aged ≥ 18 years, as only self-respondents are asked about home smoking rules.¹⁸ All persons aged 18 years and older (15 years and older for the 1992–2006 TUS-CPS) in households interviewed for the Current Population Survey are eligible for the Tobacco Use Supplement. If the household is eligible for the supplement, the interviewer attempts to interview each eligible individual in the household; however, proxy responses are accepted in certain situations (e.g. 4th call back, respondent will not return before closeout, the household is getting irritated). Eligible household members were interviewed by telephone or in their homes; on average, over the 1992–2011 survey period, approximately 69% (68% for self-respondents only) of supplement respondents have been interviewed by telephone and 31% (32% for self-respondents only) by personal interview.¹⁸ The sample included persons aged ≥ 15 until 2006, and those aged ≥ 18 since 2007; to ensure comparability, this analysis was restricted to those aged ≥ 18 years. Overall sample response rates were 72% in 1992–1993 and 62% in 2010–2011 (US Department of Commerce, Census Bureau, 2012).

Measures

Smoke-free home rules

Each household member aged ≥ 18 years who self-responded to the TUS-CPS was asked, "Which statement best describes the rules about smoking inside your home?" The response options were, "No one is allowed to smoke anywhere inside your home," "Smoking is allowed in some places or at some times inside your home," and "Smoking is permitted anywhere inside your home." Households were considered to have a smoke-free home rule if all adult respondents aged ≥ 18 years in the household reported no one was allowed to smoke anywhere inside the home at any time.

Children in the home

The Current Population Survey assessed the names and ages of all persons whose permanent residence is within the interviewed households. Households were considered to have children in the home if a respondent indicated that a person aged < 18 years' permanent residence was within the household.

Cigarette smoking status

Each household member who was administered the TUS-CPS was asked, "Have you smoked at least 100 cigarettes in your entire life?", and "Do you now smoke cigarettes every day, some days, or not at all?" Households were considered to have ≥ 1 smokers if at least one respondent had smoked ≥ 100 cigarettes in their lifetime and now smoked "everyday" or "some days."

Analysis

Data were analyzed using SAS-callable SUDAAN 9.2 (RTI, Research Triangle Park, NC), and adjusted for the probability of selection and nonresponse: "self-response" weights from the TUS-CPS dataset were applied. Households with discrepancies in responses (i.e., one respondent reported a smoke-free home rule, and another did not) were excluded (1992–1993 = 6.9% and 2010–2011 = 1.8%); a supplementary sensitivity analysis revealed that excluding these individuals from the analysis did not meaningfully change the magnitude of the observed point estimates or the extent of relative percent change, either nationally or across states. Point estimates were used to describe smoke-free home rule prevalence overall and by state. For all households, those with ≥ 1 smokers, and those without ≥ 1 smokers, estimates of smoke-free home rule prevalence were calculated according to whether or not the household had children < 18 . Overall estimates of smoke-free home rule prevalence according to whether an adult lived in the household were included for reference (King et al., 2014a). Chi-squared tests were used to assess differences between years and whether children < 18 resided in the home ($p < 0.05$), and relative percent change was used to ascertain variations in the magnitude of smoke-free home rule prevalence across states.

Results

All households

Among all U.S. households, the overall prevalence of smoke-free home rules increased from 43.0% to 83.0% during 1992–1993 to 2010–2011 ($p < 0.05$; relative percent change, 93.0%); increases in the overall prevalence of smoke-free rules were observed in every state and D.C. ($p < 0.05$; relative percent change range: 34.9% in Utah to 171.1% in Kentucky) (Table 1). By state, overall smoke-free rule prevalence ranged from 25.6% in Kentucky to 69.4% in Utah in 1992–1993, and from 69.0% in West Virginia to 93.6% in Utah in 2010–2011. Among households with children aged < 18 , smoke-free rule prevalence increased nationally from 44.9% to 88.6% during 1992–1993 to 2010–2011 ($p < 0.05$; relative percent change, 97.3%); increases were observed in every state and D.C. ($p < 0.05$; relative percent change range: 32.3% in Utah to 201.1% in Kentucky). By state, prevalence among households with children aged < 18 ranged from 24.9% in Kentucky to 73.1% in Utah in 1992–1993, and from 72.9% in West Virginia to 96.7% in Utah in 2010–2011. Among households without children, smoke-free rule prevalence increased nationally from 40.8% to 81.1% ($p < 0.05$; relative percent change, 98.8%); increases were observed in every state and D.C. ($p < 0.05$; relative percent change range: 44.3% in Utah to 153.4% in Kentucky and West Virginia). By state, prevalence

Table 1Percentage of households with a smoke-free home rule,^a by state and whether a child aged <18 years lives in the household—United States, 1992/1993 and 2010/2011.

State	All households			Households with children <18 ^b			Households without children <18 ^b		
	1992/1993	2010/2011 ^c	Relative change ^d	1992/1993	2010/2011 ^c	Relative change ^d	1992/1993	2010/2011 ^c	Relative change ^d
	%	%	%	%	%	%	%	%	%
Alabama	38.7	80.9	+109.0	40.8	83.0	+103.4	35.6	80.2	+125.3
Alaska	50.8	85.6	+68.5	55.5	93.2	+67.9	44.6 ^e	83.0 ^e	+86.1
Arizona	54.1	91.0	+68.2	58.7	93.9	+60.0	48.4 ^e	90.0	+86.0
Arkansas	33.1	73.1	+120.8	33.9	79.2	+133.6	32.0	71.1	+122.2
California	59.0	91.5	+55.1	62.3	96.3	+54.6	55.1 ^e	89.7 ^e	+62.8
Colorado	47.8	87.4	+82.8	51.8	92.6	+78.8	43.8	85.5 ^e	+95.2
Connecticut	44.7	84.6	+89.3	44.7	89.7	+100.7	44.7	82.8 ^e	+85.2
Delaware	40.0	80.4	+101.0	41.1	84.7	+106.1	38.7	78.9	+103.9
D.C.	41.3	80.7	+95.4	35.1	84.1	+139.6	44.6	80.2	+79.8
Florida	50.1	88.3	+76.2	53.3	94.2	+76.7	46.5 ^e	86.7 ^e	+86.5
Georgia	41.4	84.9	+105.1	41.5	90.8	+118.8	41.1	82.5 ^e	+100.7
Hawaii	51.2	85.1	+66.2	54.8	92.2	+68.2	46.3	82.6 ^e	+78.4
Idaho	50.0	88.6	+77.2	55.8	93.9	+68.3	43.0 ^e	86.5 ^e	+101.2
Illinois	38.5	79.2	+105.7	40.0	84.3	+110.8	37.0	77.3 ^e	+108.9
Indiana	33.9	73.9	+118.0	34.3	78.2	+128.0	33.4	72.2	+116.2
Iowa	35.9	78.4	+118.4	37.2	86.6	+132.8	34.6	76.1 ^e	+119.9
Kansas	39.6	81.1	+104.8	42.7	86.0	+101.4	36.2	79.7	+120.2
Kentucky	25.6	69.4	+171.1	24.9	75.0	+201.2	26.6	67.4	+153.4
Louisiana	37.0	82.5	+123.0	38.3	85.8	+124.0	34.9	81.3	+133.0
Maine	39.5	82.0	+107.6	42.0	88.9	+111.7	36.6	79.9 ^e	+118.3
Maryland	42.4	84.3	+98.8	45.8	90.1	+96.7	38.1 ^e	82.4 ^e	+116.3
Massachusetts	40.2	84.1	+109.2	42.1	92.7	+120.2	38.3	81.2 ^e	+112.0
Michigan	35.0	76.3	+118.0	34.7	82.1	+136.6	35.3	74.4 ^e	+110.8
Minnesota	39.6	84.2	+112.6	40.0	91.7	+129.3	39.3	82.1 ^e	+108.9
Mississippi	40.9	80.2	+96.1	41.0	83.0	+102.4	40.7	79.2	+94.6
Missouri	34.1	74.1	+117.3	34.9	81.0	+132.1	33.3	71.7 ^e	+115.3
Montana	42.8	82.8	+93.5	44.9	85.6	+90.6	40.6	82.1	+102.2
Nebraska	40.0	82.3	+105.8	42.6	88.2	+107.0	37.1	80.3 ^e	+116.4
Nevada	45.5	86.5	+90.1	48.8	91.7	+87.9	42.1	84.9 ^e	+101.7
New Hampshire	38.3	83.5	+118.0	40.0	90.2	+125.5	36.4	81.4 ^e	+123.6
New Jersey	45.5	86.1	+89.2	46.6	90.0	+93.1	44.1	84.8	+92.3
New Mexico	45.4	84.4	+85.9	47.7	91.5	+91.8	42.7	81.7 ^e	+91.3
New York	41.4	81.2	+96.1	42.2	87.4	+107.1	40.5	79.3 ^e	+95.8
North Carolina	34.1	79.4	+132.8	34.9	85.3	+144.4	33.1	77.3 ^e	+133.5
North Dakota	40.9	81.2	+98.5	38.7	85.6	+121.2	43.0	79.9	+85.8
Ohio	35.0	73.7	+110.6	36.3	80.7	+122.3	33.5	71.3 ^e	+112.8
Oklahoma	39.1	76.4	+95.4	42.2	81.9	+94.1	34.9	74.8	+114.3
Oregon	49.8	90.8	+82.3	54.1	94.4	+74.5	45.0	89.7	+99.3
Pennsylvania	39.6	78.5	+98.2	41.3	85.5	+107.0	37.8	76.5 ^e	+102.4
Rhode Island	38.9	79.4	+104.1	40.3	84.2	+108.9	37.3	77.6 ^e	+108.0
South Carolina	39.9	78.0	+95.5	41.6	82.2	+97.6	37.2	76.8	+106.5
South Dakota	36.7	80.8	+120.2	40.3	86.6	+114.9	33.1	78.7 ^e	+137.8
Tennessee	33.9	75.0	+121.2	33.0	85.2	+158.2	35.1	71.5 ^e	+103.7
Texas	46.3	85.1	+83.8	49.8	91.3	+83.3	42.1 ^e	82.4 ^e	+95.7
Utah	69.4	93.6	+34.9	73.1	96.7	+32.3	63.7	91.9 ^e	+44.3
Vermont	39.0	85.0	+117.9	41.2	89.6	+117.5	36.8	83.6	+127.2
Virginia	39.0	85.6	+119.5	41.0	87.6	+113.7	36.4	84.8	+133.0
Washington	54.3	90.7	+67.0	59.9	94.3	+57.4	48.5 ^e	89.6 ^e	+84.7
West Virginia	27.9	69.0	+147.3	28.6	72.9	+154.9	26.8	67.9	+153.4
Wisconsin	36.5	83.1	+127.7	36.8	90.5	+145.9	36.1	80.9 ^e	+124.1
Wyoming	38.5	78.8	+104.7	42.2	86.6	+102.8	34.1	76.2 ^e	+123.5
United States	43.0	83.0	+93.0	44.9	88.6	+97.3	40.8 ^e	81.1 ^e	+98.8

Abbreviations: CI = confidence interval; D.C. = District of Columbia.

^a Households were considered to have a smoke-free rule if all adult respondents aged ≥18 in the household reported that no one was allowed to smoke anywhere inside the home at any time.^b Households were considered to have ≥1 child if at least one occupant aged <18 lived in the household.^c A significant difference ($p < 0.05$) was observed between 1992/1993 and 2010/2011 for all states and the overall US.^d Relative percent change between 1992/1993 and 2010/2011.^e Statistically different ($p < .05$) from “Households with Children <18” for the same survey wave (1992/1993 or 2010/2011).

among households without children ranged from 26.6% in Kentucky to 63.7% in Utah in 1992–1993, and from 67.4% in Kentucky to 91.9% in Utah in 2010–2011.

Households with no adult smokers

Among U.S. households with no adult smokers, the overall prevalence of smoke-free home rules increased from 56.7% to 91.4% during 1992–1993 to 2010–2011 ($p < 0.05$; relative percent change, 61.2%); increases in smoke-free rule prevalence among households with no adult

smokers were also observed in every state and D.C. ($p < 0.05$; relative percent change range: 17.5% in Utah to 115.6% in Kentucky) (Table 2). By state, smoke-free rule prevalence among households with no adult smokers ranged from 39.2% in Kentucky to 82.8% in Utah in 1992–1993, and from 82.9% in West Virginia to 97.3% in Utah in 2010–2011. Among households with children aged <18 and no adult smokers, smoke-free rule prevalence increased nationally from 59.7% to 95.0% during 1992–1993 to 2010–2011 ($p < 0.05$; relative percent change, 59.1%); increases were observed in every state and D.C. ($p < 0.05$; relative percent change range: 16.2% in Utah to 124.1% in

Table 2
Percentage of households with no adult smokers with a smoke-free home rule,^a by state and whether a child aged <18 years lives in the household^f—United States, 1992/1993 and 2010/2011.

State	All households with no adult smokers			Households with children <18 ^b			Households without children <18 ^b		
	1992/1993	2010/2011 ^c	Relative change ^d	1992/1993	2010/2011 ^c	Relative change ^d	1992/1993	2010/2011 ^c	Relative change ^d
	%	%	%	%	%	%	%	%	%
Alabama	54.1	91.3	+68.8	57.0	93.7	+64.4	50.1	90.5	+80.6
Alaska	68.0	94.7	+39.3	73.1	98.1	+34.2	61.0 ^e	93.6	+53.4
Arizona	68.2	96.4	+41.3	72.7	98.3	+35.2	62.8	95.7	+52.4
Arkansas	46.7	85.5	+83.1	49.8	87.4	+75.5	43.4	84.9	+95.6
California	71.6	94.9	+32.5	74.1	97.5	+31.6	68.6 ^e	93.9 ^e	+36.9
Colorado	62.9	93.3	+48.3	67.6	95.3	+41.0	58.3	92.6	+58.8
Connecticut	58.4	92.5	+58.4	57.9	95.7	+65.3	59.2	91.3 ^e	+54.2
Delaware	52.2	90.2	+72.8	52.4	92.6	+76.7	51.8	89.3	+72.4
D.C.	52.8	89.3	+69.1	49.2	93.1	+89.2	54.4	88.7	+63.1
Florida	64.8	94.5	+45.8	67.4	98.0	+45.4	61.7 ^e	93.6 ^e	+51.7
Georgia	55.1	91.5	+66.1	55.6	95.1	+71.0	54.4	90.0 ^e	+65.4
Hawaii	64.6	89.9	+39.2	68.4	95.5	+39.6	59.5	88.1 ^e	+48.1
Idaho	66.1	95.1	+43.9	73.5	99.0	+34.7	57.6 ^e	93.5 ^e	+62.3
Illinois	51.3	89.0	+73.5	54.8	92.8	+69.3	47.9	87.6 ^e	+82.9
Indiana	47.6	86.3	+81.3	50.3	87.9	+74.8	44.9	85.7	+90.9
Iowa	48.0	89.4	+86.3	53.5	94.9	+77.4	43.4	87.8 ^e	+102.3
Kansas	54.9	91.8	+67.2	60.8	95.8	+57.6	48.8 ^e	90.6	+85.7
Kentucky	39.2	84.5	+115.6	39.8	89.2	+124.1	38.4	83.1 ^e	+116.4
Louisiana	47.8	92.0	+92.5	51.1	93.7	+83.4	43.4	91.5	+110.8
Maine	57.5	90.6	+57.6	60.6	95.4	+57.4	54.1	89.2 ^e	+64.9
Maryland	56.7	90.6	+59.8	60.7	95.7	+57.7	51.8	88.9 ^e	+71.6
Massachusetts	51.2	91.8	+79.3	54.9	95.7	+74.3	47.7 ^e	90.5 ^e	+89.7
Michigan	49.1	87.2	+77.6	49.6	91.0	+83.5	48.5	86.0	+77.3
Minnesota	53.8	92.8	+72.5	57.2	97.3	+70.1	51.0	91.5 ^e	+79.4
Mississippi	53.9	88.8	+64.7	55.3	89.4	+61.7	52.1	88.5	+69.9
Missouri	46.0	87.1	+89.3	48.3	92.9	+92.3	43.8	85.2 ^e	+94.5
Montana	56.8	91.5	+61.1	62.0	95.1	+53.4	52.1 ^e	90.7	+74.1
Nebraska	52.2	90.8	+73.9	55.7	96.1	+72.5	48.5	89.1 ^e	+83.7
Nevada	62.5	94.3	+50.9	67.5	97.4	+44.3	57.6 ^e	93.3 ^e	+62.0
New Hampshire	51.5	92.5	+79.6	54.2	96.4	+77.9	48.7	91.1 ^e	+87.1
New Jersey	58.3	92.7	+59.0	59.9	94.8	+58.3	56.4	91.9	+62.9
New Mexico	58.8	90.9	+54.6	61.5	98.3	+59.8	55.8	88.1 ^e	+57.9
New York	53.7	89.8	+67.2	55.3	94.5	+70.9	52.1	88.3 ^e	+69.5
North Carolina	46.2	90.2	+95.2	47.9	94.9	+98.1	44.4	88.5 ^e	+99.3
North Dakota	53.0	90.6	+70.9	52.8	91.3	+72.9	53.2	90.4	+69.9
Ohio	47.9	86.4	+80.4	51.9	91.9	+77.1	44.0 ^e	84.7 ^e	+92.5
Oklahoma	55.2	90.3	+63.6	59.5	92.0	+54.6	49.5	89.8	+81.4
Oregon	64.5	95.9	+48.7	67.9	96.7	+42.4	60.6	95.6	+57.8
Pennsylvania	52.7	88.3	+67.6	56.0	94.0	+67.9	49.4 ^e	86.8 ^e	+75.7
Rhode Island	52.6	90.1	+71.3	54.1	94.1	+73.9	50.9	88.6	+74.1
South Carolina	54.3	88.7	+63.4	56.9	93.0	+63.4	50.6	87.5	+72.9
South Dakota	50.0	89.8	+79.6	56.2	93.8	+66.9	44.5 ^e	88.5	+98.9
Tennessee	48.8	87.7	+79.7	49.2	94.6	+92.3	48.4	85.4 ^e	+76.4
Texas	60.3	92.5	+53.4	65.0	95.6	+47.1	54.9 ^e	91.1 ^e	+65.9
Utah	82.8	97.3	+17.5	84.7	98.4	+16.2	79.8	96.7	+21.2
Vermont	54.6	92.1	+68.7	59.3	96.7	+63.1	50.1	90.9 ^e	+81.4
Virginia	53.8	93.2	+73.2	55.9	95.9	+71.6	50.9	92.2	+81.1
Washington	69.5	95.2	+37.0	74.4	97.4	+30.9	64.2	94.4	+47.0
West Virginia	41.8	82.9	+98.3	44.8	89.9	+100.7	38.3	81.1	+111.7
Wisconsin	50.4	91.4	+81.3	53.5	96.2	+79.8	47.6	90.0 ^e	+89.1
Wyoming	52.8	90.3	+71.0	58.6	94.0	+60.4	47.3	89.0	+88.2
United States	56.7	91.4	+61.2	59.7	95.0	+59.1	53.4 ^e	90.1 ^e	+68.7

Abbreviations: CI = confidence interval; D.C. = District of Columbia.

^a Households were considered to have a smoke-free rule if all adult respondents aged ≥18 in the household reported that no one was allowed to smoke anywhere inside the home at any time. Households were considered to have ≥1 adult smokers if at least one adult occupant aged ≥18 reported that they had smoked ≥100 cigarettes in their lifetime and smoked “everyday” or “some days” at the time of the survey.

^b Households were considered to have ≥1 child if at least one occupant aged <18 lived in the household.

^c A significant difference ($p < 0.05$) was observed between 1992/1993 and 2010/2011 for all states and the overall US.

^d Relative percent change between 1992/1993 and 2010/2011.

^e Statistically different ($p < .05$) from “Households with Children <18” for the same survey wave (1992/1993 or 2010/2011).

Kentucky). By state, prevalence among households with children aged <18 and no adult smokers ranged from 39.8% in Kentucky to 84.7% in Utah in 1992–1993, and from 89.2% in Kentucky to 98.4% in Utah in 2010–2011. Among households without children or adult smokers, smoke-free rule prevalence increased nationally from 53.4% to 90.1% ($p < 0.05$; relative percent change, 68.7%); increases were observed in every state and D.C. (relative percent change range: 21.2% in Utah to 116.4% in Kentucky). By state, prevalence among households without

children or adult smokers ranged from 38.3% in West Virginia to 79.8% in Utah in 1992–1993, and from 81.1% in West Virginia to 96.7% in Utah in 2010–2011.

Households with ≥1 adult smokers

Among U.S. households with ≥1 adult smokers, the overall prevalence of smoke-free home rules increased from 9.6% to 46.1% during

1992–1993 to 2010–2011 ($p < 0.05$; relative percent change, 380.2%); increases in the prevalence of smoke-free rules among households with ≥ 1 adult smokers were also observed in all states and D.C. during this period (relative percent change range: 227.3% in Utah to 909.6% in South Dakota) (Table 3). By state, smoke-free rule prevalence among households with ≥ 1 adult smokers ranged from 3.6% in Kentucky to 20.9% in Utah in 1992–1993, and from 27.2% in Kentucky to 70.2% in Washington in 2010–2011. Among households with children

aged < 18 and ≥ 1 adult smokers, smoke-free rule prevalence increased nationally from 9.7% to 61.0% during 1992–1993 to 2010–2011 ($p < 0.05$; relative percent change: 528.9%); increases were observed in every state and D.C. ($p < 0.05$; relative percent change range: 203.9% in Arizona to 878.9% in Tennessee). By state, prevalence among households with children aged < 18 and ≥ 1 adult smokers ranged from 4.5% in Kentucky to 26.7% in Utah in 1992–1993, and from 36.5% in West Virginia to 86.8% in California in 2010–2011. Among households

Table 3

Percentage of households with adult smokers with a smoke-free home rule,^a by state and whether a child aged < 18 years lives in the household[†]—United States, 1992/1993 and 2010/2011.

State	All households with adult smokers			Households with children $< 18^{\dagger}$			Households without children $< 18^{\dagger}$		
	1992/1993	2010/2011 ^c	Relative change ^d	1992/1993	2010/2011 ^c	Relative change ^d	1992/1993	2010/2011 ^c	Relative change ^d
	%	%	%	%	%	%	%	%	%
Alabama	6.7	38.4	+473.1	9.7	45.5	+369.1	^e	35.5	–
Alaska	14.1	56.5	+300.7	16.3	79.3	+386.5	11.4	47.7 ^f	+318.4
Arizona	17.2	64.8	+276.7	23.3	70.8	+203.9	9.6 ^f	62.9	+555.2
Arkansas	5.3	35.9	+577.4	6.9	54.2	+685.5	^e	30.0 ^f	–
California	19.0	67.9	+257.4	24.0	86.8	+261.7	13.1 ^f	62.0 ^f	+373.3
Colorado	10.2	55.6	+445.1	13.9	77.6	+458.3	6.1	48.5 ^f	+695.1
Connecticut	11.7	47.5	+306.0	14.6	60.8	+316.4	^e	42.8 ^f	–
Delaware	9.9	39.1	+294.9	12.5	53.8	+330.4	^e	33.6 ^f	–
D.C.	5.5	31.7	+476.4	^e	42.8	–	^e	29.6	–
Florida	13.2	57.1	+332.6	17.7	73.4	+314.7	8.0 ^f	53.1 ^f	+563.8
Georgia	7.9	51.9	+557.0	8.4	70.2	+735.7	^e	44.0 ^f	–
Hawaii	12.7	57.3	+351.2	18.0	77.2	+328.9	^e	48.0 ^f	–
Idaho	11.5	61.6	+435.7	16.4	68.7	+318.9	5.0 ^f	59.3	+1,086.0
Illinois	7.2	38.1	+429.2	8.9	50.6	+468.5	5.0	33.4 ^f	+568.0
Indiana	7.8	31.4	+302.6	9.8	48.8	+398.0	^e	23.5 ^f	–
Iowa	5.6	41.4	+639.3	6.3	58.4	+827.0	4.5	36.6 ^f	+713.3
Kansas	4.9	43.1	+779.6	6.7	57.2	+753.7	^e	37.9 ^f	–
Kentucky	3.6	29.3	+713.9	4.5	43.3	+862.2	^e	23.7 ^f	–
Louisiana	11.6	45.6	+293.1	11.6	64.3	+454.3	11.6	35.9 ^f	+209.5
Maine	8.1	50.5	+523.5	10.3	69.3	+572.8	5.6	43.8 ^f	+682.1
Maryland	6.3	48.9	+676.2	9.3	57.7	+520.4	^e	46.0	–
Massachusetts	10.0	42.2	+322.0	12.2	71.0	+482.0	7.0	35.2 ^f	+402.9
Michigan	6.1	36.0	+490.2	8.0	53.0	+562.5	3.6 ^f	29.6 ^f	+722.2
Minnesota	7.8	48.9	+526.9	8.7	70.6	+711.5	6.7	42.1 ^f	+528.4
Mississippi	9.1	47.4	+420.9	10.5	60.3	+474.3	^e	41.9	–
Missouri	7.6	36.0	+373.7	9.1	52.1	+472.5	^e	29.2 ^f	–
Montana	7.4	49.7	+571.6	8.8	60.1	+583.0	5.5	46.1	+738.2
Nebraska	8.6	49.2	+472.1	12.6	63.6	+404.8	^e	43.1 ^f	–
Nevada	10.3	55.1	+435.0	12.4	65.7	+429.8	7.9	52.3	+562.0
New Hampshire	7.3	44.4	+508.2	9.1	59.3	+551.6	^e	40.1 ^f	–
New Jersey	10.1	47.5	+370.3	13.2	55.9	+323.5	5.4 ^f	45.1	+735.2
New Mexico	11.4	54.7	+379.8	13.5	58.7	+334.8	^e	53.3	–
New York	8.1	36.5	+350.6	10.3	53.5	+419.4	5.4 ^f	30.5 ^f	+464.8
North Carolina	8.6	36.7	+326.7	10.4	47.8	+359.6	5.9 ^f	32.7	+454.2
North Dakota	8.3	47.7	+474.7	8.2	69.4	+746.3	8.6	39.6 ^f	+360.5
Ohio	6.0	34.3	+471.7	7.7	53.3	+592.2	3.3 ^f	25.9 ^f	+684.8
Oklahoma	6.0	40.5	+575.0	8.4	60.1	+615.5	^e	33.3 ^f	–
Oregon	13.1	65.6	+400.8	18.6	82.4	+343.0	7.3	60.6	+730.1
Pennsylvania	7.9	39.9	+405.1	10.1	57.7	+471.3	5.1 ^f	33.8 ^f	+562.7
Rhode Island	6.6	37.5	+468.2	9.1	45.4	+398.9	^e	34.7	–
South Carolina	7.4	33.1	+347.3	10.1	41.8	+313.9	^e	30.2	–
South Dakota	5.2	52.5	+909.6	7.7	70.6	+816.9	^e	43.3 ^f	–
Tennessee	4.6	35.8	+678.3	5.7	55.8	+878.9	2.7	29.1 ^f	+977.8
Texas	10.6	51.7	+387.7	13.2	68.4	+418.2	7.0 ^f	45.9 ^f	+555.7
Utah	20.9	68.4	+227.3	26.7	82.2	+207.9	^e	62.6	–
Vermont	8.3	56.1	+575.9	7.8	68.4	+776.9	8.8	50.9	+478.4
Virginia	7.4	46.1	+523.0	9.6	45.9	+378.1	4.4	46.2	+950.0
Washington	16.9	70.2	+315.4	22.7	79.4	+249.8	11.1 ^f	67.4	+507.2
West Virginia	4.0	27.2	+580.0	5.5	36.5	+563.6	^e	23.5	–
Wisconsin	5.9	49.4	+737.3	7.9	67.9	+759.5	3.0	43.6 ^f	+1,353.3
Wyoming	6.2	41.1	+562.9	9.9	63.2	+538.4	^e	33.6 ^f	–
United States	9.6	46.1	+380.2	9.7	61.0	+528.9	6.3 ^f	40.9 ^f	+549.2

Abbreviations: CI = confidence interval; D.C. = District of Columbia.

^bHouseholds were considered to have ≥ 1 child if at least one occupant aged < 18 lived in the household.

^a Households were considered to have a smoke-free rule if all adult respondents aged ≥ 18 in the household reported that no one was allowed to smoke anywhere inside the home at any time. Households were considered to have ≥ 1 adult smokers if at least one adult occupant aged ≥ 18 reported that they had smoked ≥ 100 cigarettes in their lifetime and smoked “everyday” or “some days” at the time of the survey.

^c With the exception of estimates not presented, a significant difference ($p < 0.05$) was observed between 1992/1993 and 2010/2011 for all states and overall US.

^d Relative percent change between 1992/1993 and 2010/2011.

^e Estimate not presented because relative standard error $\geq 40\%$.

^f Statistically different ($p < .05$) from “Households with Children < 18 ” for the same survey wave (1992/1993 or 2010/2011).

without children, but with ≥ 1 adult smokers, smoke-free rule prevalence increased nationally from 6.3% to 40.9% ($p < 0.05$; relative percent change: 549.2%); increases were observed in every state and D.C. ($p < 0.05$; relative percent change range: 209.5% in Louisiana to 1,353% in Wisconsin). By state, prevalence among households without children, but with ≥ 1 adult smokers, ranged from 2.7% in Tennessee to 13.1% in California in 1992–1993, and from 23.5% in West Virginia to 67.4% in Washington in 2010–2011.

Discussion

These findings reveal that considerable progress has been made adopting smoke-free home rules, but many U.S. children remain unprotected by such rules, and thus, may continue to be exposed to SHS in their homes. In particular, 2 in 5 respondents living in households occupied by both smokers and children did not have a smoke-free home rule during 2010–2011. Because 100% smoke-free indoor environments are the only effective way to fully eliminate SHS exposure (US Department of Health and Human Services, 2006; US Department of Health and Human Services, 2014), continued efforts are warranted to educate the public about the dangers of SHS and to promote the adoption of smoke-free home environments, particularly among subpopulations at greatest risk for exposure, including households with smokers and children, those who live in multiunit housing, veterans' households, and states with higher smoking prevalence (US Department of Health and Human Services, 2006; US Department of Health and Human Services, 2014; Zhang et al., 2014).

The increased prevalence of smoke-free home rules observed nationally and across all states might be attributable to multiple factors, including the spread of state and local comprehensive smoke-free laws prohibiting smoking in public places and worksites, declines in smoking prevalence among adults and youth, and population level interventions and activities that can reduce children's exposure to SHS in the home (US Department of Health and Human Services, 2006; US Department of Health and Human Services, 2014; Centers for Disease Control and Prevention, 2014a). Comprehensive smoke-free laws have been shown to stimulate the adoption of voluntary smoke-free home rules, decrease population smoking rates, and increase support for smoke-free environments among nonsmokers and smokers (US Department of Health and Human Services, 2006; Cheng et al., 2015). However, although considerable progress has been made in implementing comprehensive smoke-free laws at the state and local level over the past two decades (Centers for Disease Control and Prevention, 2014a; Municipalities with Local 100% Smokefree Laws, 2015; National Cancer Institute, 2015), approximately half (50.7%) of U.S. residents were not covered by such laws as of January 2015 (American Nonsmokers' Rights Foundation, 2015a). Moreover, during 2010–2011, the most recent year in which population level estimates of cotinine (a biomarker of SHS exposure that was measured in the blood) were available, approximately 58 million U.S. residents aged ≥ 3 years were exposed to SHS, including 15 million children; disparities in exposure were also apparent across subpopulations, with exposure being particularly high among children aged 3–11 years, non-Hispanic black persons (including 7 in 10 non-Hispanic black children), those who live in poverty, and those living in rental housing (Homa et al., 2015).

Substantial increases were observed in the prevalence of smoke-free rules in households with at least one smoker, even in states with high cigarette smoking prevalence. This finding might reflect changes in public awareness of the dangers of SHS, as well as shifts in attitudes about the social acceptability of smoking around nonsmokers, especially children (US Department of Health and Human Services, 2006; US Department of Health and Human Services, 2014). The implementation of smoke-free home rules in households with smokers and children is especially important given that more than 98% of children living with someone who smokes inside the home were exposed to SHS according to serum cotinine determinations during 2007–2008 (Centers for

Disease Control and Prevention, 2010). The present findings indicate that during 2010–2011, 2 in 5 respondents who lived in households occupied by both smokers and children did not have a smoke-free home rule. This situation is compounded by the fact that existing research has documented disparities in the adoption of smoke-free home rules among households with children and cigarette smokers; during 2006–2007, among households with children and smokers, only 32.8% of non-Hispanic black households had smoke-free home rules, compared with 48.0% of non-Hispanic white households and 72.2% of Mexican American households (Mills et al., 2011). Additionally, variations in smoke-free home rules have been observed between veterans and non-veterans, adjusting for sociodemographic factors and children in the household (Zhang et al., 2014). These findings underscore the importance of continued efforts to reduce SHS exposure in all settings to protect nonsmokers, particularly children. Based on evidence that SHS exposure is reduced among children whose parents have been informed about the harms of SHS, the American Academy of Pediatrics and the U.S. Public Health Service recommend that clinicians ask parents and other caregivers about their smoking, advise them about the harms of SHS, and offer encouragement and help in quitting (Fiore et al., 2008; Committee on Environmental Health et al., 2009).

The home is the primary source of SHS exposure for children (US Department of Health and Human Services, 2006). Those who live in multiunit housing are particularly likely to experience SHS exposure in the home, where SHS can infiltrate smoke-free living units from units and shared areas where smoking occurs (King et al., 2010). Approximately 80 million Americans reside in multiunit housing, including over 18.2 million children (King et al., 2013b), and population-based surveys suggest that more than one-third of multiunit housing residents with smoke-free home rules have experienced unwanted SHS incursions in their home that originated from elsewhere in or around their buildings (Snyder et al., 2015). The potential for SHS exposure in government-subsidized housing is particularly concerning because many of these units are occupied by persons who are especially sensitive to the effects of SHS, including children, the elderly, and the disabled (King et al., 2014b). Prohibiting smoking in all U.S. subsidized housing, including public housing (Mason et al., 2015), has the potential to generate annual societal cost savings of approximately \$500 million (King et al., 2014b). The U.S. Department of Housing and Urban Development has taken steps to encourage public housing authorities and operators of multifamily housing rental assistance programs such as Section 8 to implement smoke-free policies (U.S. Department of Housing and Urban Development, 2012; U.S. Department of Housing and Urban Development, 2010). As of January 2015, several hundred public housing authorities had instituted such policies, including all 20 in Maine (American Nonsmokers' Rights Foundation, 2015b). Additionally, a growing number of communities, including 15 in California, have enacted laws prohibiting smoking in multiunit housing buildings, including both private market-rate and government subsidized housing (American Nonsmokers' Rights Foundation, 2015b). Efforts to implement smoke-free policies in both subsidized and market-rate multiunit housing could further protect nonsmokers from SHS exposure in their homes.

Continued efforts to reduce SHS exposure in all settings are critical to ensure that all nonsmokers are protected from this hazard. Several federal government initiatives are currently addressing SHS exposure, including in private settings such as the home. For example, in 2011, as part of the Community Transformation Grant initiative funded by the Centers for Disease Control and Prevention (CDC), multiple communities implemented interventions to address the issue of SHS in multiunit housing (Centers for Disease Control and Prevention, 2014b). CDC also continues to educate the public about the harms of SHS exposure and to reinforce the benefits of smoke-free environments through its national media campaign, "Tips from Former Smokers" (Centers for Disease Control and Prevention, 2015). The Environmental Protection Agency has played an especially significant role in promoting smoke-

free homes over the past two decades through collaboration with the public health community, health care practitioners, state and local tobacco control programs, and other organizations at the local, state, and national levels (US Department of Health and Human Services, 2006; United States Environmental Protection Agency, 2015). Moreover, the Department of Housing and Urban Development has issued several notices encouraging public housing authorities and operators of multifamily housing rental assistance programs to implement smoke-free policies (U.S. Department of Housing and Urban Development, 2012; U.S. Department of Housing and Urban Development, 2010). Furthermore, since 2011, the National Cancer Institute has funded the State and Community Tobacco Control Research Initiative, which includes grantees that are conducting research evaluating smoke-free home interventions (National Cancer Institute, State, 2014). It's also important to note that in addition to the aforementioned federal initiatives, numerous complementary efforts to address smoke-free housing have also been developed, implemented, and sustained by state and community governments, non-government organizations, and public health advocacy organizations.

The findings in this report are subject to at least seven limitations. First, smoke-free home rules were self-reported, which could introduce bias. However, parental reporting of smoke-free home rules strongly correlates with child cotinine levels, a biomarker of SHS exposure, suggesting that self-reports of smoke-free home rules are accurate (Spencer et al., 2005). Second, because the 2010–2011 TUS-CPS was only administered to respondents aged ≥ 18 years, respondents aged 15–17 years who completed the 1992–1993 TUS-CPS were excluded. However, a secondary analysis including these persons did not significantly impact the findings. Third, members of households with discrepant reports of smoke-free home rules were excluded; however, the percentage of excluded respondents was small and declined over time. Fourth, neither the 1992–1993 nor the 2010–2011 TUS-CPS questionnaire included items on housing type; thus, it was not possible to assess the extent of smoke-free rule prevalence among multiunit housing residents, who are particularly susceptible to involuntary SHS incursions in the home (King et al., 2010; King et al., 2013b; Snyder et al., 2015). Fifth, limited sample size for several states prevented the ability to present statistically stable estimates of smoke-free home rules using a lower age cut-point for children living in the home (e.g. ≤ 5 years). Sixth, the analysis excluded proxy respondents, as only self-respondents were asked about home smoking rules. Moreover, some demographic patterns of proxy and self-respondents differed between the two assessment periods, and the proportion of proxy respondents was lower in 1992–1993 (20%) than in 2010–2011 (25%). Given that previous research suggests that proxy responses result, on average, in lower smoking estimates than do self-responses (Soulaikova et al., 2009), the exclusion of proxy responses might have introduced some bias into the estimation of smoke-free home rules. Finally, response rates for TUS-CPS have declined over time (72% during 1992–1993 to 62% during 2010–2011). Lower response rates can increase bias; however, the data were adjusted for nonresponse, and the estimates were comparable to other self-reported surveys of national and state-specific smoke-free home prevalence (Homa et al., 2015; King et al., 2013a).

In conclusion, the findings from this study reveal that considerable progress has been made adopting smoke-free home rules over a two-decade period. However, many U.S. children, particularly those who reside in homes with smokers, continue to be exposed to SHS because their homes are not smoke-free. Efforts to educate the public about the adverse health effects of SHS exposure, as well as to promote voluntary smoke-free home rules and smoke-free multiunit housing policies, are critical to protect nonsmokers from this known and preventable health hazard.

Transparency document

The Transparency document associated with this article can be found, in the online version.

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