



## Short Communication

## Smoke-free homes among single-parent families: Differences associated with parental race/ethnicity and smoking behaviors

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## ABSTRACT

We assessed differences in the rates of smoke-free homes among single-parent households with regard to parental race/ethnicity and smoking status. We identified two cohorts representative of the U.S. single-parent households with underage children (children under the age of 18) based on the Tobacco Use Supplement to the Current Population Survey: 2010–11 ( $n = 6474$ ) and 2014–15 ( $n = 6114$ ). The interviews were conducted by phone and in-person. Statistical analysis was performed in 2017. The overall rate of smoke-free homes was 82% in 2010–11 and 86% in 2014–15. The rate of a smoke-free home was highest for Non-Hispanic (NH) Asian (94%) and Hispanic (92%) parents and lowest for NH Multiracial (77% in 2010–11 and 82% in 2014–15) in both survey periods. However, 2014–15 model-based comparisons relative to NH Whites indicated only one significant difference: the rate was lower for NH Blacks (OR = 0.46, 99% CI = 0.32:0.66). The smoke-free homes were least prevalent among daily smokers, followed by occasional smokers, followed by former smokers, and most prevalent among never smokers in each survey period. The 2010–11 and 2014–15 rates were 45% and 54% for daily, 64% and 72% for occasional, 89% and 91% for former, and 93% and 94% for never smokers. The gap in the rates of smoke-free homes for diverse parental racial/ethnic groups observed in 2010–11 decreased by 2014–15. While smoke-free homes became more prevalent in 2014–15, the rates remain drastically different among families with different parental smoking behaviors. Exposure to secondhand smoke at home remains common among single-parent households where the parent smokes.

## 1. Introduction

Exposure to secondhand smoke (SHS) during infancy and childhood can lead to reduced lung function (Tager 2008), respiratory infections (Öberg et al. 2011), invasive meningococcal disease (Murray et al. 2012), and other health problems (King et al. 2016). Because the exposure to SHS for children occurs primarily in homes, a smoke-free home environment is vital for eliminating and reducing the exposure to SHS (U.S. Department of Health and Human Services 2014).

In the U.S., the prevalence of smoke-free homes among households with underage children (younger than 18 years old) had increased from 45% in 1992–93 to 89% in 2010–11 (King et al. 2016). However, exposure to SHS at home is not uniform among diverse populations (Homa et al. 2015; King et al. 2016; U.S. Department of Health and Human Services 2014). For example, smoke-free homes are less prevalent in non-Hispanic (NH) Black households than they are in NH White, Hispanic, and NH Asian households (Binns et al., 2009; Hawkins and Berkman 2011; King et al. 2013; Mills et al. 2011; Zhang et al. 2011). Specifically, in 2006–07, among households with adult smokers,

the smoke-free homes were 50% as likely among NH Blacks than among NH Whites (Hawkins and Berkman 2011) and the increase in the rate of smoke-free homes for NH Blacks was 25% less than those for NH Whites from 1992–93 to 2006–07 (Mills et al. 2011). In addition, smoke-free homes are less prevalent among households with adult smokers than among households with no adult smokers (Binns et al., 2009; Hawkins and Berkman 2011; Zhang et al. 2011). In the U.S., among the single-parent households where the parent never smoked, the rate of smoke-free homes was 67% in 1995–96 and 89% in 2006–07; while among the households where the parent was a current smoker, the rate of smoke-free homes was only 13% in 1995–96 and 40% in 2006–07 (Zhang et al. 2011).

The smoking rules at home also differ between single-parent and two-parent households. In 1995–96, the rate of smoke-free homes was 46% among the single-parent households and 63% among the two-parent households (Zhang et al. 2011). In 2006–07, the rate of smoke-free homes was 75% among the single-parent households and 88% among the two-parent households (Zhang et al. 2011). Thus, children in single-parent households were more likely to be exposed to SHS than

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children in two-parent households. Among the single-parent households, the lower rate of smoke-free homes corresponded to NH Black and NH White parents relative to Hispanic parents, parents who did not complete the high school relative to those who completed the high school, and parents who were current or former smokers relative to never smokers (Zhang et al. 2011). The rates of smoke-free homes were similar among female- and male-parent households, as well as households with diverse parental age groups (Zhang et al. 2011). Single-parent households became more prevalent in the past decades in the U.S.: the rate was 9% in 1996 and 27% in 2016 (U.S. Department of Commerce, Census Bureau 2016a). However, the most recent studies addressing smoking rules at home used 2006–07 data. Thus, there is a lack of research addressing recent prevalence of smoke-free homes.

We examined whether the rates of smoke-free homes differ among seven parental racial/ethnic groups and evaluated disparities in the rates of smoke-free homes associated with parental smoking behaviors. In addition, we estimated the 2010–11 and 2014–15 rates of smoke-free homes for U.S. single-parent households with diverse characteristics.

## 2. Methods

### 2.1. Data

We used data from the Tobacco Use Supplement (TUS) to the Current Population Survey, administered by the U.S. Census Bureau for the National Cancer Institute (U.S. Department of Commerce, Census Bureau 2016b). These data are de-identified and available for public use. We identified two cohorts of single-parent households and analyzed the cohorts separately. The 2010–11 cohort consisted of 6474 households and the 2014–15 cohort consisted of 6114 households. Single-parent households were identified using the following criteria: 1) there is only one adult (18+ years old) in the household, 2) there is at least one underage child (i.e., under 18 years old) in the household, and 3) the parent self-responded to the survey, i.e., reports from proxy-respondents were not included in the study. We note that the parents are not necessarily the biological parents of the co-resident children. The Appendix below presents parental sociodemographic characteristics and parental smoking status for each cohort. The interviews were conducted by phone (59% in 2010–11 and 57% in 2014–15) or personal interviews (41% in 2010–11 and 43% in 2014–15). About 17% of the single-parent households resided in the Northeastern U.S. region; 22% in the Midwestern region; 41% in the Southern region; and 20% in the Western region; about 85% in a metropolitan area; and 15% in a non-metropolitan area.

### 2.2. Measures

The primary (binary) measure “smoke-free home” is differentiated between smoke-free and not smoke-free homes. The measure was based on parental responses to the survey question: “Which statement best describes the rules about smoking inside your home?” The parent could choose one of the following response options: option 1) no one is allowed to smoke anywhere, option 2) smoking is allowed in some places or at some times, and option 3) smoking is allowed anywhere. Response option 1 corresponds to “a smoke-free home”, while options 2 and 3 correspond to “not a smoke-free home”. The secondary measures were the parental race/ethnicity (Hispanic and several NH groups including White, Black, Asian, American Indian/Alaska Native, Hawaiian/Pacific Islander, and Multiracial) and smoking status (daily smoker, occasional smoker, former smoker, and never smoker). These and additional considered characteristics are depicted in the Appendix. U.S. regions and metropolitan status are defined accordingly to the U.S. Census Bureau (U.S. Department of Commerce, Census Bureau 2017).

### 2.3. Statistical analyses

First, we analyzed two-way contingency tables between the parental race/ethnicity and smoke-free home measure using the Rao-Scott chi-square tests (Rao and Scott 1984). Similarly, we analyzed two-way contingency tables between parental smoking status and smoke-free home measure. If an overall association was significant (at the 5% level), we performed multiple comparisons among diverse parental racial/ethnic groups (reference group was NH White) and diverse parental smoking behaviors (reference group was “never smoker”). We used Bonferroni adjustments for multiplicity. Specifically, when each of the five racial/ethnic groups were compared to NH Whites, the adjusted  $p$ -value was 5 times the original  $p$ -values and when former, daily, and occasional smokers were compared to never smokers, the adjusted  $p$ -value was 3 times the original  $p$ -value. The adjusted  $p$ -values are presented in Results section. We also used the Bonferroni method for calculating simultaneous 95% confidence intervals.

Next, for each cohort we fitted a logistic regression model to evaluate the relationship between the logit of probability of a smoke-free home and parental race/ethnicity and smoking status while controlling for other important covariates (parental age, sex, marital status, education level, employment status, metropolitan status, U.S. region of residency, and survey mode). The 2010–11 model fit statistics were: Likelihood Ratio  $\chi^2 = 2,192,373$ ,  $df = 22$ ,  $p < 0.001$ . The 2014–15 model fit statistics were Likelihood Ratio  $\chi^2 = 1,756,557$ ,  $df = 22$ ,  $p < 0.001$ . Significant factors are depicted in Table 2. Parental age, sex, and marital status were not significantly associated with the odds of a smoke-free home in each model. In addition, the metropolitan status was not significant in the 2014–15 model. Because the sample size for cross-groups for NH Hawaiian/Pacific Islanders was insufficient, this group was not included in tests and models.

In all analyses, we incorporated the main and 160 replicate weights, and used Balanced Repeated Replications for variance estimation (Wolter 2007). This approach allowed adjusting for the complex design of the Survey (U.S. Department of Commerce, Census Bureau 2016b). All analyses were performed using SAS®9.4 software (SAS Institute Inc, 2013).

## 3. Results

### 3.1. Disparities in the rates of smoke-free homes associated with parental race/ethnicity

Table 1 depicts prevalence of smoke-free homes for diverse parental populations and significance of comparisons relative to NH Whites and never smokers. The overall rates of a smoke-free home differed significantly among the parental racial/ethnic groups in both 2010–11 and 2014–15 (both  $p$ 's  $< 0.001$ ). In 2010–11 and 2014–15, smoke-free homes were consistently more prevalent among Hispanic parents than among NH White parents. In addition, smoke-free homes were more prevalent among NH Asian parents than among NH White parents in 2010–11, but the difference became nonsignificant in 2014–15.

Table 2 presents the model-based results. Race/ethnicity was a significant predictor in both models. In 2010–11, the smoke-free homes were significantly more prevalent among Hispanic and less prevalent among NH Black parents than among NH White parents. The difference was not significant for NH Asian parents. In 2014–15, the rate of a smoke-free home was significantly lower for NH Black parents than for NH White parents; other differences were not significant.

### 3.2. Disparities in the rates of smoke-free homes associated with parental smoking status

The overall rates of a smoke-free home differed among parents who were never smokers, former smokers, occasional, or daily smokers; the differences were significant in both 2010–11 and 2014–15 (both

**Table 1**  
Prevalence of smoke-free homes; 2010–11 and 2014–15 tobacco use supplement to the current population survey data, U.S., statistical analysis performed in 2017.

Parental characteristic	2010–11		2014–15	
	Percent	Adjusted <i>p</i> -value	Percent	Adjusted <i>p</i> -value
Race/ethnicity	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
NH White	80.3	Reference	85.8	Reference
NH Black	78.8	NS	83.5	NS
NH American Indian/ Alaska Native	80.2	NS	84.1	NS
NH Asian	95.2	0.005	93.4	NS
NH multiracial	76.9	NS	81.9	NS
NH Hawaiian/Pacific Islander	77.4	NP	88.8	NP
Hispanic	91.9	< 0.001	91.7	< 0.001
Smoking status	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
Never smoker	92.9	Reference	94.0	Reference
Former smoker	88.6	< 0.001	91.4	NS
Occasional smoker	64.4	< 0.001	71.7	< 0.001
Daily smoker	45.2	< 0.001	54.2	< 0.001

Note. NS stands for “not significant”, NP stands for “not performed.”

*p*'s < 0.001). Table 1 illustrates that smoke-free homes were significantly more prevalent among never smokers than among former and current smokers (occasional and daily) in 2010–11 and remained significant for current smokers in 2014–15; the adjusted *p*-value was 0.052 for the comparison between former smokers and never smokers and thus, it was not significant at the 5% level.

These results were consistent with the model-based results. Table 2 illustrates that parental smoking status was a significant predictor in

**Table 2**  
Model-based comparisons of the rates of smoke-free homes; 2010–11 and 2014–15 tobacco use supplement to the current population survey data, U.S., statistical analysis performed in 2017.

Parental characteristic	2010–11		2014–15	
	Odds ratio of a smoke-free home	Simultaneous confidence intervals	Odds ratio of a smoke-free home	Simultaneous confidence intervals
Race/ethnicity (reference level: NH White)	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
NH Black/African American	0.58***	(0.41: 0.80)	0.46***	(0.32: 0.66)
NH American Indian/Alaska Native	0.94	(0.41: 2.17)	0.86	(0.29: 2.55)
NH Asian	1.73	(0.33: 9.03)	1.46	(0.24: 8.90)
NH Multiracial	0.84	(0.36: 1.94)	0.63	(0.26: 1.57)
Hispanic	1.88***	(1.24: 2.85)	1.06	(0.65: 1.74)
Smoking Status (reference level: never smoker)	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
Former smoker	0.53***	(0.37: 0.77)	0.57**	(0.37: 0.87)
Occasional smoker	0.12***	(0.08: 0.18)	0.16***	(0.10: 0.25)
Daily smoker	0.07***	(0.05: 0.09)	0.07***	(0.05: 0.09)
Education (reference level: below high school)	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
High school/equivalent	1.43**	(1.07: 1.92)	1.16	(0.80: 1.67)
College/equivalent	2.06***	(1.49: 2.86)	1.74***	(1.21: 2.50)
Graduate degree	4.33***	(2.09: 9.00)	1.99	(0.95: 4.18)
Employment status	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
Employed versus unemployed/not in labor force	1.54***	(1.28: 1.86)	1.72***	(1.37: 2.15)
US Region (reference level: West)	Overall <i>p</i> < 0.001		Overall <i>p</i> < 0.001	
Northeast	0.42***	(0.28: 0.64)	0.43***	(0.26: 0.69)
Midwest	0.34***	(0.24: 0.50)	0.33***	(0.21: 0.51)
South	0.50***	(0.34: 0.74)	0.51***	(0.36: 0.74)
Metropolitan status	Overall <i>p</i> = 0.022		Not significant	
Metropolitan versus non-metropolitan	1.34*	(1.04: 1.71)	1.16	(0.90: 1.50)
Survey mode	Overall <i>p</i> = 0.001		Overall <i>p</i> < 0.001	
Phone interview versus personal interview	1.36**	(1.13: 1.65)	1.85***	(1.52: 2.25)

Note.  
\* Adjusted *p* < 0.05.  
\*\* Adjusted *p* < 0.01.  
\*\*\* Adjusted *p* < 0.001.

both models. Moreover, smoke-free homes were significantly more prevalent among never smokers than among former, occasional, and daily smokers consistently in both periods, 2010–11 and 2014–15. In addition, the patterns in the estimates illustrate the following trend: the odds of a smoke-free home are the lowest among daily smokers, followed by occasional smokers, and then by former smokers. The odds are the highest among the never smokers.

3.3. Additional findings: disparities in the rates of smoke-free homes associated with other characteristics

In addition to parental race/ethnicity and smoking status, the prevalence of smoke-free homes differed depending on a parent's education level, employment status, U.S. region of residency, and survey mode. These results were consistent in both periods, 2010–11 and 2014–15. Specifically, the odds of a smoke-free home increased with the education level, were higher among employed than unemployed/not in labor force parents, and among those who resided in the Western U.S. region than those who resided in the Northeastern, Midwestern, or Southern U.S. regions. In addition, the odds were higher for parents interviewed by phone than by personal interviews, potentially suggesting that phone interviews are associated with a higher response bias.

4. Discussion

The overall prevalence of smoke-free homes among single-parent households has increased from 82% in 2010–11 to 86% in 2014–15 in the U.S. While we did not assess the significance of the change, the 4% increase suggests a positive trend in the prevalence of smoke-free homes in the nation. The prevalence of smoke-free homes ranged from 77% for NH Multiracial parents to 95% for NH Asian parents in

2010–11 and from 82% for NH Multiracial to 93% for NH Asian parents in 2014–15. The model-based comparisons that adjusted for the other factors indicated that relative to NH White parents, the rates were significantly lower for NH Black parents in 2010–11 and 2014–15 and significantly higher for Hispanic parents in 2010–11. These findings were observed after adjusting for smoking behaviors and several socioeconomic characteristics (such as education, employment), suggesting that the racial/ethnic disparities in the home smoking rules among single-parent families are not only due to racial/ethnic differences in the socioeconomic status but also due to additional factors. Culture plays a critical role in parenting. In some cultures, e.g., Asian and Hispanic cultures, the children are perceived as “the jewels of the family” (Gilliard et al. 2007). Because of this perception, these children’s health and smoke-free home environment are among the key priorities for the entire family (Drake et al. 2011; McGlade et al. 2004). In Black/African American tradition, “it takes a village to raise a child” (Palmer and Gasman 2008), i.e., sharing childcare arrangements with extended family and community is common (Brody et al. 1999). Because of this, children may actually spend more time outside than inside the home. Thus, smoking bans at home are perceived as less important for the child’s health in these families than in families where the child spends more time at home.

Consistent patterns in the prevalence of smoke-free homes were observed with respect to smoking behaviors of single parents: the rate ranged from 45% for daily smokers to 93% for never smokers in 2010–11 and from 54% for daily smokers to 94% for never smokers in 2014–15. Even after adjusting for other covariates, the smoke-free homes were most prevalent among never smokers, followed by former smokers, then by occasional smokers and finally, daily smokers; all comparisons relative to never smokers were significant. These findings are consistent with earlier studies, illustrating that exposure to secondhand smoke at home is associated with parental smoking behaviors and smoke-free homes are less prevalent among higher nicotine dependent smokers (Binns et al., 2009; Hawkins and Berkman 2011; Zhang et al. 2011). While the trends observed in this study are logical, the results suggest that underage children living with a single parent who smoked are likely to be exposed to secondhand smoke at home. Even among families where the parent smoked occasionally, only about a third of families lived in a smoke-free environment. The finding that smoking bans at home are more common among parents who never smoked than among parents who are former smokers could be due to differences in social interactions, e.g., former smokers could be more open toward allowing their friends and relatives to smoke inside relative to never smokers.

The study has several limitations. First, the TUS reports might be subject to response bias and the magnitude of the bias might depend on the survey mode (Soulakova et al. 2015a; Soulakova et al. 2009; Soulakova et al. 2012; Soulakova et al. 2015b). Similar to prior research (Soulakova et al. 2009), we observed that higher rates of smoke-free homes (perceived as a positive event) were associated with phone interviews rather than personal interviews. An additional limitation is

that due to a small sample size for NH Hawaiian/Pacific Islander parents, this group was not included in statistical comparison. Nonetheless, the observed rate of smoke-free homes for this group was in the range of the rates for the other racial/ethnic groups.

Future research can be targeted on evaluating smoking rules at home and longitudinal trends in the rates of smoke-free homes among two-parent households foster families, households with young children, and households that experience financial burden. This knowledge will help identify pediatric populations that are the most disadvantaged in terms of exposure to secondhand smoke, allowing for the creation of tailored strategies for reducing the exposure.

**5. Conclusion**

Smoke-free homes became more prevalent in recent years: the overall increase in prevalence was about 4% from 2010–11 to 2014–15. The overall gap in the prevalence of a smoke-free home for diverse racial/ethnic groups narrowed in 2014–15. While some differences relative to NH Whites were detected, the 2014–15 prevalence of a smoke-free home was above 80% for all parental racial/ethnic groups. However, the prevalence of a smoke-free home differed significantly across parental smoking behaviors and the difference was substantial. The 2014–15 rates of a smoke-free home were 54% for daily smokers, 72% for occasional smokers, 91% for former smokers, and 94% for never smokers. Thus, in 2014–15 among underage children living with a single parent who smoked daily, only 54% of children lived in a smoke-free home environment, while 46% of children were exposed to secondhand smoke at home. Exposure to secondhand smoke at home remains common among single-parent households where the parent smokes.

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**Conflict of interests**

Yujiao Mai has no conflict of interest. Selena Leonardo has no conflict of interest. Julia Soulakova has no conflict of interest.

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**Appendix A. Characteristics of single parents living with underage children; 2010–11 and 2014–15 tobacco use supplement of the current population survey data, U.S., statistical analysis performed in 2017**

Characteristics	2010–11		2014–15	
	Count	Percent	Count	Percent
Age				
18–24	522	11.1	383	10.4
25–44	4304	65.1	4179	66.3
45–64	1555	22.6	1443	21.9
65 +	93	1.2	109	1.4
Sex				



Male	989	16.1	1003	16.5
Female	5485	83.9	5111	83.5
Race/ethnicity				
NH White	3474	47.6	3252	46.0
NH Black	1610	30.0	1524	28.3
NH American Indian/Alaska Native	117	1.1	111	1.1
NH Asian	111	1.9	112	2.3
NH Hawaiian/Pacific Islander	22	0.2	19	0.2
NH Multiracial	132	1.6	115	2.0
Hispanic	1008	17.6	981	20.1
Marital status				
Ever-married (married-spouse absent, widowed, divorced or separated)	3973	58.0	3672	55.8
Never married	2501	42.0	2442	44.2
Education level				
Below high school	849	14.5	716	12.6
High school/equivalent	1890	29.8	1767	29.6
College/equivalent	3337	50.0	3180	50.7
Graduate degree	402	5.7	451	7.1
Employment status				
Employed (at work or absent)	4470	67.6	4447	71.6
Unemployed/not in labor force	2004	32.4	1667	28.4
Smoking status				
Never smoker	3929	63.0	3824	66.0
Former smoker	924	13.6	929	13.6
Occasional smoker	359	5.0	326	5.1
Daily smoker	1262	18.4	1035	15.3
U.S. Region				
Northeast	1238	17.3	933	17.3
Midwest	1581	22.7	1291	20.9
South	2245	40.1	2496	42.2
West	1410	19.9	1394	19.6
Metropolitan status				
Metropolitan	5088	83.9	4878	86.0
Non-Metropolitan	1386	16.1	1236	14.0
Survey mode				
Phone Interview	3906	58.7	3481	56.6
Personal Interview	2568	41.3	2633	43.4
Sample Size (population count)	6474 (8,627,716)		6114 (9,208,467)	

Note. Percentages are based on the population (weighted) counts.

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