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Home Exposure to Secondhand Smoke among People Living in Multiunit Housing and Single Family Housing: a Study of California Adults, 2003–2012

Catrina Chambers, Hai-Yen Sung, and Wendy Max

ABSTRACT *Public health education efforts continue to encourage people to adopt voluntary smoking bans at home; nonetheless, the home remains a place where many people are exposed to secondhand smoke (SHS). Little is known about how SHS exposure in the home differs between adults residing in multiunit housing (MUH) and those residing in single family housing (SFH). This study (1) compared the socio-demographic characteristics, chronic disease conditions, and smoking status of adults living in MUH with those living in SFH, (2) assessed the correlates of living in MUH for adults, and (3) evaluated the association of residency in MUH and SFH with the odds of being exposed to SHS at home using population-based survey data of California adults. Smoking prevalence was significantly higher among MUH residents than SFH residents. The adjusted odds of exposure to SHS at home were 32 % higher for MUH smokers than SFH smokers but were not significantly different for non-smokers. This study presents evidence that there are significant socio-demographic differences between MUH residents and SFH residents and that MUH smokers have higher rates of exposure to SHS at home than SFH smokers after adjusting for other covariates. To reduce home exposure to SHS among MUH residents, it is important to adopt tobacco control policies that are aimed at reducing SHS exposure in and around MUH and at reducing cigarette smoking among current smokers in MUH.*

KEYWORDS *Smoking status, Secondhand smoke exposure at home, Multiunit housing, Single family housing*

INTRODUCTION

Secondhand smoke (SHS) exposure increases the risks of lung cancer, heart diseases, respiratory diseases, and premature death among non-smokers.[1] State and local smoke-free laws which prohibit smoking in indoor workplaces, restaurants and bars, and other public places have contributed to a significant reduction in SHS exposure in the USA.[2–5] Public health education efforts continue to encourage people to adopt voluntary smoking bans at home; nonetheless, the home remains to be a place where many people are exposed to SHS.[1,6] In 2009–2010, 19 % of US adults aged 18 years or older lived in household slacking smoke-free rules, and 11 million non-smoking adults were exposed to SHS in their homes.[7] Additionally, 4.8 million US children younger than 12 years old were exposed to SHS in the home in 2007.[8]

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Although it is not possible to legislate smoking bans in most home settings, multiunit housing (MUH) is an exception, and a growing number of local laws or ordinances have been enacted across the country to prohibit smoking in MUH residential units and in indoor and outdoor common areas such as balconies and patios.[9,10] Approximately 79 million Americans lived in MUH in 2009, accounting for a quarter of all US residents.[11] Studies which focus on tobacco exposure among MUH residents have found that 26.9 % of MUH residents do not have smoke-free home rules[12] and that 44–53 % of MUH residents with smoke-free home rules have experienced drifting SHS from other units or common areas of their building.[11,13] However, none of these studies examined SHS exposure in the home, and they did not compare SHS exposure between MUH residents and residents living in other home settings. Little is known about how SHS exposure in the home differs between adults residing in MUH and those residing in single family housing (SFH).

California has the second lowest proportion of non-smoking adults exposed to SHS at home among the 50 states in the nation,[7] and well-documented evidence has shown that large disparities in exposure exist across demographic subgroups, ranging from 3.5 % for Latina females to 21–22 % for American Indians and African Americans.[14] However, there is a lack of knowledge regarding SHS exposure in the home for MUH residents and how it differs from that of SFH residents in California. This knowledge is important for tobacco control policy because 32 % of Californians live in MUH, constituting one seventh of the total MUH population in the country.[11] Furthermore, although several US studies have examined selected demographic characteristics of MUH residents,[11,12] they neither compared the demographic characteristics between MUH residents and residents living in other housing types nor assessed whether there are statistically significant differences in these characteristics.

This study compares the socio-demographic characteristics, chronic disease conditions, and smoking status of adults living in MUH with those living in SFH, assesses the correlates of living in MUH for adults, and evaluates the association of MUH residency versus SFH residency with the odds of being exposed to SHS at home using population-based survey data of California adults. This is the first study which determines the predictors for MUH residency within the USA and examines the association between housing type and SHS exposure in the home with multivariable models.

METHODS

Data Source. The California Health Interview Survey (CHIS) is a survey of health-related information for California households which has been conducted on a biennial basis since 2001. Starting in 2011, the CHIS switched to a continuous data collection format across a 2-year cycle. The CHIS is a random-digit-dialed telephone survey of California's civilian non-institutionalized population that employs a two-stage geographically stratified sampling design. In the first stage, telephone numbers are randomly sampled within counties, and in the second stage, one adult is selected from all adult members of a sampled household. Beginning in 2007, the CHIS also includes a sample of cell phone–only households. We pooled data from the 2003, 2005, 2007, 2009, and 2011/2012 CHIS public use files for adults aged 18 years and older (N=213,525) for our analyses.*Housing Types*. CHIS respondents were asked to identify their housing type. The response categories were: a house (a single family detached house), a duplex (a single family attached house), a building with

three or more units, and a mobile home. We used the first category to classify adults living in SFH and combined the categories of duplex and building with three or more units to classify adults living in MUH. Respondents reporting they lived in mobile homes were excluded from this study because our preliminary analysis indicated that only 4 % of California adults reported living in mobile home housing and they differ from adults living in MUH and SFH in terms of socio-demographic characteristics, health conditions, and exposure to SHS at home.*Household Exposure to Secondhand Smoke*. Adults were asked "Is smoking ever allowed inside your home?" Those who answered "yes" were further asked "On average, about how many days per week is there smoking inside your home?" Those who indicated that smoking was allowed inside the home and that someone smoked inside the home at least 1 day per week were classified as being exposed to SHS at home. Those who answered "no" to the first question or zero days to the second question were classified as not being exposed to SHS at home.*Covariates*. Socio-demographic characteristics, smoking status, and chronic disease conditions reported in the CHIS data were included as covariates in this study. Socio-demographic characteristics included gender, age (18–24, 25–44, 45–64, and ≥65 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, and non-Hispanic Other), education (<high school diploma, high school diploma or general equivalency diploma, some college, and college degree and above), poverty level, health insurance status, and household size (1, 2, 3, or ≥4 people). The poverty level variable was constructed based on the federal poverty level (FPL) guidelines and self-reported household annual income into four categories: poor (≤99 % FPL), low income (100–199 % FPL), middle income (200–299 % FPL), and high income (≥300 % FPL). Individuals were classified by smoking status into current smokers and non-smokers. Current smokers were defined as those who smoked 100 cigarettes in their lifetime and now smoke cigarettes daily or some days. Non-smokers include former smokers (those who smoked 100 cigarettes in their life but do not smoke now) or never smokers (those who never smoked 100 cigarettes in their life). We included three chronic disease conditions known to be associated with SHS exposure: asthma, high blood pressure, and heart disease. An affirmative response to the CHIS questions "Has a doctor ever told you that you have asthma?", "Has a doctor ever told you that you have high blood pressure?", and "Has a doctor ever told you that you have heart disease?" was used to classify adults as having the specified health conditions.*Statistical Analysis*. Chi-square tests for two-way contingency tables were used to evaluate whether there is a significant relationship between housing type and each covariate. Multivariable logistic regression models were used to analyze factors associated with the likelihood of living in MUH. We conducted multivariable logistic regression analyses separately for current smokers and non-smokers to estimate the likelihood of exposure to SHS at home as a function of housing type and other covariates. The multivariable logistic regression analysis for current smokers excluded individuals who lived alone (n=7720) because they may not have additional sources of SHS other than their own smoking inside the home. For all multivariable logistic regressions, adjusted odds ratios (AORs) and 95 % confidence intervals (CIs) were computed to assess the strength of association. All analyses were conducted with SAS version 9.3 and were weighted using the sample weights to adjust for non-responses and the probability of unequal sample selection in the CHIS. We used SAS procedures that take into account the effects of the complex multistage survey design used by the CHIS. All estimates were considered statistically significant if the p value from a two-tailed test was <0.05.

RESULTS

Residents of Multiunit Housing and Single Family Housing

Table 1 shows the characteristics of California adults dwelling in MUH and SFH in 2003–2012. Twenty-eight percent of the California adults in our sample lived in MUH, and 72 % lived in SFH. This extrapolates to 7.3 million California adults living in MUH based on the sample weight in the 2011/2012 CHIS data. The distribution patterns of subcategories for each covariate differ significantly between the MUH adults and SFH adults for all covariates except for asthma. Among MUH residents, nearly half of them were between the ages of 25–44 years or reported poor or low income. Sixty-three percent were minorities including non-Hispanic Black (8.7 %), Hispanic (37.0 %), and non-Hispanic Asian (14.6 %); 21.4 % did not have a high school diploma; 23.4 % did not have health insurance; and 21.5 % lived in a household alone. In contrast, for SFH residents, 35.4 % of adults were between the ages of 25–44 years, 27.0 % had poor or low income, 49.6 % were minorities, 14.8 % did not have a high school diploma, 14.2 % were without health insurance, and 8.1 % lived alone. The percentage of MUH residents diagnosed with high blood pressure or heart disease was significantly lower than the percentages reported by SFH residents. Adults living in MUH were more likely to be current smokers than those living in SFH (17.5 vs 13.2 %).

Table 2 shows the estimated proportions of California adults living in MUH by socio-demographic characteristics, chronic disease diagnoses, and smoking status. The groups with the highest proportion living in MUH were those living alone (50.7 %), followed by the poor group (45.2 %), non-Hispanic Blacks (31.3 %), and those without health insurance (38.9 %). The multivariable regression results show that adults who were younger than age 65, minorities, those with lower levels of income, those without health insurance, and current smokers were significantly more likely to live in MUH than those aged 65 years or older, non-Hispanic Whites, those with the highest income, those with health insurance, and non-smokers. Compared to adults with a college degree and those living alone, adults with a GED/high school diploma or some college and those reporting a larger household size were less likely to live in MUH. Residents of MUH and SFH were equally likely to report a chronic disease diagnosis.

Exposure to SHS at Home

Among MUH adult residents regardless of smoking status, 7.7 % were exposed to SHS in the home compared to 4.8 % of adults living in SFH (data not shown). Table 3 shows the estimated proportions of non-smokers who are exposed to SHS at home by housing type, socio-demographic characteristics, and chronic disease status. Although the SHS exposure at home among all non-smokers was 2.7 %, the exposure rates varied across different subgroups, ranging from 1.7 % for those with a college degree to 6.7 % for non-Hispanic Blacks. By housing type, SHS exposure at home was 3.2 % for non-smokers living in MUH compared to 2.5 % for non-smokers living in SFH, but this difference was not statistically significant after controlling for other covariates.

Table 3 also shows that compared to non-Hispanic Whites, non-Hispanic Blacks were significantly more likely to be exposed to SHS at home while Hispanics were significantly less likely to be exposed, after adjusting for other covariates. Exposure to SHS at home was significantly higher among males compared to females, young

TABLE 1 Socio-demographic characteristics, chronic disease conditions, and smoking status of adults living in multiunit housing (MUH) and single family housing (SFH) in California, 2003–2012 (*N*=213,525)

		MUH adults		SFH adults		*p* value
		N	%	*N*	%	
Characteristics		55,148	27.9	158,377	72.1	
Age	18–24	4,810	15.5	9,302	13.5	<0.001
	25–44	19,372	49.5	38,890	35.4	
	45–64	17,610	23.6	66,622	35.7	
	≥65	13,356	11.4	43,563	15.4	
Gender	Female	33,707	51.7	92,319	50.9	0.037
	Male	21,441	48.3	66,058	49.1	
Race/ethnicity	Non-Hispanic White	27,858	37.1	105,949	50.4	<0.001
	Non-Hispanic Black	4,437	8.7	5,975	4.8	
	Hispanic	13,806	37.0	27,636	29.9	
	Non-Hispanic Asian	7,125	14.6	13,505	12.4	
	Non-Hispanic Other	1,922	2.6	5,312	2.5	
Education	Less HS diploma	8,705	21.4	13,749	14.8	<0.001
	GED/HS diploma	12,495	23.3	34,922	25.9	
	Some college	10,543	17.4	31,222	17.7	
	College degree	23,405	37.9	78,484	41.7	
Poverty level	≤99 % (poor)	11,542	23.7	12,518	11.1	<0.001
	100–199 % (low income)	12,720	23.1	21,514	15.9	
	200–299 % (middle income)	7,737	13.9	20,839	13.5	
	≥300 % (high income)	23,149	39.2	103,506	59.5	
Household size (no. of people)	1	22,247	21.5	31,992	8.1	<0.001
	2	14,457	27.7	56,287	26.4	
	3	7,482	17.9	25,321	19.5	
	≥4	10,962	32.9	44,777	46.0	
Smoking status	Current smokers	9,195	17.5	18,287	13.2	<0.001
	Non-smokers	45,953	82.5	140,090	86.8	
Health insurance	Insured	46,177	76.6	143,720	85.8	<0.001
	Uninsured	8,971	23.4	14,657	14.2	
Asthma	Yes	7,780	12.7	21,299	13.2	0.102
	No	47,368	87.3	137,078	86.8	
High blood pressure	Yes	17,545	22.8	52,518	26.3	<0.001
	No	37,603	77.2	105,859	73.7	
Heart disease	Yes	5,052	5.4	14,732	6.3	<0.001
	No	50,096	94.6	143,645	93.7	
Year	2003	11,462	21.7	28,500	18.1	<0.001
	2005	10,600	19.8	30,382	19.8	
	2007	12,340	18.9	36,029	20.6	
	2009	10,516	19.4	33,747	20.9	
	2011	10,230	20.3	29,719	20.6	

adults aged 18–24 years or those aged 45–64 years compared to those aged 65 years or older, the less educated compared to those with a college degree, lower income groups compared to the high income group, the uninsured compared to the insured, those living in households of two or three people compared to those living alone, and those with high blood pressure compared to those without high blood pressure.

TABLE 2 Proportion of adults who live in multiunit housing (MUH) by characteristics and the estimated adjusted odds ratio from a multivariable logistic regression model for the likelihood of living in MUH, California, 2003–2012 (*N*=213,525)

Characteristics		Proportion of MUH residents (%)	AOR (95 % CI)
Age	18–24	30.7	3.36 (3.11–3.64)**
	25–34	35.1	4.06 (3.82–4.31)**
	45–64	20.3	1.48 (1.40–1.55)**
	≥65 (*reference*)	22.2	
Gender	Female	28.2	1.00 (0.97–1.04)
	Male (*reference*)	27.5	
Race/ethnicity	Non-Hispanic White (*reference*)	22.1	
	Non-Hispanic Black	41.3	2.07 (1.92–2.24)**
	Hispanic	32.3	1.41 (1.33–1.48)**
	Non-Hispanic Asians	31.3	1.72 (1.62–1.82)**
	Non-Hispanic Other	28.1	1.17 (1.05–1.30)*
Education	Less HS diploma	35.9	1.02 (0.95–1.09)
	GED/HS diploma	25.8	0.78 (0.74–0.81)**
	Some college	27.5	0.90 (0.85–0.95)**
	College degree (*reference*)	26.0	
Poverty level	≤99 % (poor)	45.2	3.84 (3.60–4.09)**
	100–199 % (low income)	36.0	2.63 (2.49–2.78)**
	200–299 % (middle income)	28.5	1.81 (1.70–1.92)**
	≥300 % (high income) (*reference*)	20.3	
Household size (# of people)	1 (*reference*)	50.7	
	2	28.8	0.36 (0.34–0.38)**
	3	26.1	0.20 (0.19–0.21)**
	≥4	21.7	0.10 (0.09–0.11)**
Smoking status	Current smokers	33.7	1.14 (1.08–1.20)*
	Non-smokers (*reference*)	26.9	
Health insurance	Insured (*reference*)	25.6	
	Uninsured	38.9	1.21 (1.14–1.29)**
Asthma	Yes	27.1	0.95 (0.90–1.01)
	No (*reference*)	28.0	
High blood pressure	Yes	25,1	0.97 (0.93–1.02)
	No (*reference*)	29.8	
Heart disease	Yes	24.9	1.04 (0.96–1.13)
	No (*reference*)	28.0	
Year	2003 (*reference*)	31.6	
	2005	27.8	0.86 (0.82–0.90)**
	2007	26.1	0.81 (0.77–0.86)**
	2009	26.4	0.78 (0.74–0.82)**
	2011	27.6	0.81 (0.78–0.85)**

Note: % refers to the weighted percentage. Non-Hispanic Other includes any non-Hispanic single race not listed in the table or any two or more races

*Statistically significant at $p<0.01$; **statistically significant at $p<0.001$

AOR adjusted odds ratio, *HS* high school, *GED* general equivalency diploma, *CI* confidence interval

Table 4 is similar to Table 3 but focuses on current smokers who live with two or more people in the household. Exposure to SHS at home among current smokers (19.0 %) was much higher than that of non-smokers, with a wide range across

TABLE 3 Proportion of non-smokers who are exposed to secondhand smoke (SHS) at home by housing type and other characteristics, and the estimated adjusted odds ratio from a multivariate logistic regression model for the likelihood of being exposed to SHS at home among non-smokers: California non-smoking adults, 2003–2012 (*N*=186,043)

		Non-smoker sample	Non-smokers exposed to SHS at home		
		N	*N*	%	
Covariates		186,043	4,119	2.7	AOR (95% CI)
Housing Type	MUH	45,953	1,199	3.2	1.03 (0.91–1.17)
	SFH (*reference*)	140,090	2,920	2.5	
Age	18–24	11,810	659	5.5	2.62 (2.18–3.14)**
	25–44	49,238	818	2.1	1.17 (0.95–1.42)
	45–64	72,061	1,573	2.4	1.23 (1.06–1.44)*
	≥65 (*reference*)	52,934	1,069	2.4	
Gender	Female	111,987	2,153	2.5	0.81 (0.73–0.90)**
	Male (*reference*)	74,056	1,966	3.0	
Race/ethnicity	Non-Hispanic White (*reference*)	116,691	2,398	2.6	
	Non-Hispanic Black	8,531	455	6.7	1.88 (1.57–2.24)**
	Hispanic	36,574	672	2.1	0.41 (0.34–0.50)**
	Non-Hispanic Asians	18,700	389	2.7	0.88 (0.72–1.07)
	Non-Hispanic Other	5,547	205	3.9	1.13 (0.78–1.63)
Education	Less HS diploma	18,709	530	3.1	1.85 (1.49–2.30)**
	GED/HS diploma	38,911	1,282	3.9	1.86 (1.62–2.15)**
	Some college	35,071	930	3.4	1.62 (1.37–1.93)**
	College degree (*reference*)	93,352	1,377	1.7	
Poverty level	≤99 % (poor)	19,595	668	4.3	1.99 (1.62–2.46)**
	100–199 % (low income)	28,462	886	3.4	1.59 (1.36–1.86)**
	200–299 % (middle income)	24,361	640	3.3	1.50 (1.29–1.75)**
	≥300 % (high income) (*reference*)	113,625	1,925	2.0	
Household size (no. of people)	1 (*reference*)	46,519	828	2.2	
	2	62,630	1,565	2.9	1.50 (1.23–1.83)**
	3	28,217	723	3.1	1.40 (1.15–1.72)**
	≥ 4	48,677	1,003	2.6	1.10 (0.90–1.34)
Health insurance	Insured (*reference*)	167,650	3,413	2.3	
	Uninsured	18,393	706	4.7	1.84 (1.56–2.18)**
Asthma	Yes	24,853	588	2.9	0.96 (0.80–1.14)
	No (*reference*)	161,190	3,531	2.7	
High blood pressure	Yes	61,834	1,540	2.9	1.24 (1.09–1.41)*
	No (*reference*)	124,209	2,579	2.6	
Heart disease	Yes	17,716	458	3.1	1.19 (0.98–1.44)
	No (*reference*)	168,327	3,661	2.7	
Year	2003 (*reference*)	33,797	1,106	4.0	
	2005	35,270	856	2.9	0.75 (0.66–0.85)**
	2007	42,299	874	2.4	0.59 (0.52–0.68)**

TABLE 3 (Continued)

		Non-smoker sample	Non-smokers exposed to SHS at home		
		N	*N*	%	
Covariates		186,043	4,119	2.7	AOR (95% CI)
	2009	39,233	700	2.3	0.55 (0.44–0.67)**
	2011	35,444	583	2.1	0.53 (0.45–0.63)**

Note: *N* refers to the unweighted sample size. % refers to the weighted percentage. Non-Hispanic other includes any non-Hispanic single race not listed in the table or any two or more races

*Statistically significant at $p<0.01$; **statistically significant at $p<0.001$

AOR adjusted odds ratio, *HS* high school, *GED* general equivalency diploma, *SHS* secondhand smoke, *CI* confidence interval

different subgroups from 9.4 % for non-Hispanic Asians to 39.1 % for non-Hispanic Blacks. By housing type, 22.6 % of current smokers living in MUH were exposed to SHS at home compared to 17.5 % for those living in SFH. The adjusted odds of exposure to SHS at home were 32 % higher for MUH smokers than SFH smokers but were not significant for non-smokers. The multivariate logistic regression analysis also shows that compared to non-Hispanic White smokers, non-Hispanic Black smokers were significantly more likely to be exposed to SHS at home while Hispanic and non-Hispanic Asian smokers were significantly less likely to be exposed. SHS exposure at home was significantly more likely among lower education groups compared to college graduates, lower income groups compared to the high income group, those who were uninsured compared to those with health insurance, and those with asthma or high blood pressure compared to those without these diagnosis. In contract to the corresponding findings for non-smokers, the odds of being exposed to SHS at home among smokers was significantly higher among females than males but was significantly lower among the younger groups than those aged 65 years or older and those living in a household of three or more people than those living with two people.

CONCLUSIONS

The findings from this study indicate that racial/ethnic minorities and adults who are young, poor, uninsured, and living in small household sizes are more likely to live in MUH compared to non-Hispanic Whites and adults who are older than age 65 years, the wealthiest, or insured. Moreover, the findings also reveal that current smokers are significantly more likely to dwell in MUH than non-smokers and that exposure to SHS at home was significantly higher among current smokers residing in MUH than current smokers residing in SFH, although it was not significantly different between non-smokers residing in MUH and non-smokers residing in SFH.

Non-Hispanic racial/ethnic minorities, younger adults, and the poor were found in our study to be more likely to reside in MUH. These are among the vulnerable groups identified in the literature as being more likely to be current tobacco users,[15] more likely to be exposed to SHS at home,[16] and more likely to lack home smoking bans.[17] Unless more effective tobacco control efforts target vulnerable subgroups

TABLE 4 Proportion of current smokers who are exposed to secondhand smoke (SHS) at home by housing type and other characteristics, and the estimated adjusted odds ratio from a multivariate logistic regression model for the likelihood of being exposed to SHS at home among current smokers: California smoking adults who live with at least one household member, 2003–2012 (*N* = 19,762)

		Smoker sample	Smokers exposed to SHS at home		
		N	*N*	%	
Covariates		19,762	4,600	19.0	AOR (95 % CI)
Housing type	MUH	5,438	1,353	22.6	1.32 (1.17–1.49)***
	SFH (*reference*)	14,324	3,247	17.5	
Age	18–24	2,113	331	16.3	0.53 (0.41–0.69)***
	25–44	7,648	1,235	13.9	0.43 (0.35–0.53)***
	45–64	8,199	2,353	25.6	0.79 (0.66–0.94)**
	≥65 (*reference*)	1.802	681	34.3	
Gender	Female	9,680	2,654	23.7	1.28 (1.15–1.42)***
	Male (*reference*)	10,082	1,946	16.1	
Race/ethnicity	Non-Hispanic White (*reference*)	11,432	3,040	23.5	
	Non-Hispanic Black	1,250	489	39.1	1.80 (1.46–2.21)***
	Hispanic	4,197	502	10.0	0.40 (0.34–0.48)***
	Non-Hispanic Asians	1,621	175	9.4	0.43 (0.33–0.56)***
	Non-Hispanic Other	1,262	394	25.4	1.13 (0.93–1.36)
Education	Less HS diploma	2,979	637	17.2	1.43 (1.19–1.72)***
	GED/HS diploma	6,474	1,618	21.5	1.51 (1.31–1.74)***
	Some college	4,695	1,190	20.6	1.31 (1.12–1.52)***
	College degree (*reference*)	5,614	1,155	15.7	
Poverty level	≤99 % (poor)	3,203	764	19.8	1.38 (1.16–1.64)***
	100–199 % (low income)	4,103	1,018	19.6	1.33 (1.13–1.56)***
	200–299 % (middle income)	3,057	755	19.2	1.19 (1.01–1.40)*
	≥300 % (high income) (*reference*)	9,399	2,063	18.3	
Household size (# of people)	2 (*reference*)	8,114	2,646	29.7	
	3	4,586	1,007	19.9	0.70 (0.61–0.80)***
	≥4	7,062	947	12.2	0.45 (0.39–0.51)***
Health insurance	Insured (*reference*)	15,675	3,666	19.0	
	Uninsured	4,087	934	19.1	1.29 (1.13–1.48)***
Asthma	Yes	3,045	801	23.8	1.19 (1.01–1.40)*
	No (*reference*)	16,717	3,799	18.1	
High blood pressure	Yes	5,282	1,612	25.8	1.28 (1.12–1.46)**
	No (*reference*)	14,480	2,988	17.0	
Heart disease	Yes	1,234	394	29.2	1.11 (0.87–1.42)
	No (*reference*)	18,528	4,206	18.5	
Year	2003 (*reference*)	4,571	1208	24.0	
	2005	4,230	1101	21.1	0.83 (0.73–0.95)**
	2007	4,178	993	20.1	0.75 (0.63–0.88)***
	2009	3,553	733	15.8	0.56 (0.45–0.68)***
	2011	3,230	565	13.0	0.43 (0.35–0.51)***

Note: *N* refers to the unweighted sample size. % refers to the weighted percentage. Non-Hispanic Other includes any non-Hispanic single race not listed in the table or any two or more races

*Statistically significant at $p<0.05$; **statistically significant at $p<0.01$; ***statistically significant at $p<0.001$

AOR adjusted odds ratio, *HS* high school, *GED* general equivalency diploma, *SHS* secondhand smoke, *CI* confidence interval

and MUH residents, these populations will remain at a disproportionately higher risk of tobacco exposure.

Smoke-free MUH legislation and policies may offer an important opportunity to reduce in-home SHS exposure and smoking prevalence in the same way clean indoor air legislation and policies which prohibit smoking in workplaces and public places have contributed to denormalizing smoking in public places and have influenced adoption of voluntary smoke-free home rules in the USA.[18] Also, because current smokers are more likely to live in MUH than non-smokers, smoke-free MUH policies have great potential to reach current smokers and, consequently, may motivate them to reduce cigarette consumption or quit smoking in the same way that smoke-free worksite policies have motivated employees to reduce their cigarette consumption and stop smoking.[5,19,20] Therefore, implementing MUH smoking-free policies has great potential to reduce the disparities in tobacco exposure among the vulnerable populations who live in MUH, especially among female smokers, older smokers, and smokers living in smaller households since they were shown in this study to be more likely to be exposed to SHS at home than male smokers, younger smokers, and smokers living in larger household. However, further research is needed to document this impact.

Several limitations of this study are acknowledged. First, the CHIS self-reported measures for smoking status and SHS exposure at home may be subject to recall bias. Second, the CHIS did not include the source of in-home SHS exposure (e.g., who smokes in the home); thus, it is not feasible to determine whether smokers who reported that someone smoked inside their homes were exposed to others' cigarette smoke or to their own smoke. Future research is needed to identify the source of exposure to SHS at home among smokers living in MUH. Third, although our study shows that non-smoking adults diagnosed with high blood pressure and smokers diagnosed with high blood pressure and asthma had greater odds of being exposed to SHS at home than those not diagnosed, it is beyond the scope of this study to examine the causality of this association. Fourth, this study was not able to assess exposure to SHS from outside the living unit, i.e., drifting smoke. This is known to be an important source of exposure for those living in MUH and needs to be examined. Finally, this study excluded adults living in mobile homes. Future analysis is needed to compare exposure to SHS at home between mobile home residents and residents of other housing types.

In summary, this study presents evidence that there are significant socio-demographic differences between MUH residents and SFH residents and that MUH smokers have higher rates of exposure to SHS at home than SFH smokers after adjusting for other covariates. Dwellers of MUH may benefit from the implementation of smoke-free MUH polices. To reduce home exposure to SHS among MUH residents, it is important to adopt tobacco control initiatives and policies that are aimed at reducing SHS exposure in and around MUH and at reducing cigarette smoking among current smokers in MUH.

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REFERENCES

1. US Department of Health and Human Services. *The health consequences of involuntary exposure to tobacco smoke: a report of the surgeon general. Atlanta, GA: U.S. Department of health and human services, centers for disease control and prevention. Coordinating center for health promotion, national center for chronic disease prevention and health promotion, office on smoking and health*, 2006:1988–2002.
2. Pickett MS, Schober SE, Brody DJ, Curtin LR, Giovino GA. Smoke-free laws and secondhand smoke exposure in US non-smoking adults, 1999–2002. *Tob Control*. 2006; 15(4): 302–307.
3. Centers for Disease Control and Prevention (CDC). Reduced Secondhand Smoke Exposure After Implementation of a Comprehensive Statewide Smoking Ban — New York, June 26, 2003–June 30, 2004. *MMWR Morb Mortal Wkly Rep*. 2007;56(28):705–708.
4. Centers for Disease Control and Prevention (CDC). State Smoke-Free Laws for Worksites, Restaurants, and Bars — United States, 2000–2010. *MMWR Morb Mortal Wkly Rep*. 2011;60(15):472–475.
5. US Department of Health and Human Services. The health consequences of smoking—50 years of progress: a report of the surgeon general. Atlanta, GA: US 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. 2014. http://ash.org/wp-content/uploads/2014/01/full-report.pdf.
6. Centers for Disease Control and Prevention (CDC). Vital signs: nonsmokers' exposure to secondhand smoke—United States, 1999-2008. *MMWR Morb Mortal Wkly Rep*. 2010;59(35):1141.
7. 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.
8. Kabir Z, Connolly GN, Alpert HR. Secondhand smoke exposure and neurobehavioral disorders among children in the United States. *Pediatrics*. 2011; 128(2): 263–270.
9. Americans Nonsmokers' Rights Foundation (ANR). U.S. Local Laws and Policies Restricting or Prohibiting Smoking in Private Units of Multiunit Housing. 2013. http://www.no-smoke.org/pdf/smokefreemuh.pdf.
10. American Lung Association in California: Center for Tobacco Policy & Organizing (CTPO). Local California Smokefree Housing Policies: detailed analysis. 2013. http://center4tobaccopolicy.org/wp-content/uploads/2013/12/Local-California-Smokefree-Housing-Policies-Detailed-Analysis-December-2013.pdf.
11. King BA, Babb SD, Tynan MA, Gerzoff RB. National and state estimates of secondhand smoke infiltration among U.S. multiunit housing residents. *Nicotine Tobacco Res Off J Soc Res Nicotine Tobacco*. 2013; 15(7): 1316–1321.
12. King BA, Cummings KM, Mahoney MC, Juster HR, Hyland AJ. Multiunit housing residents' experiences and attitudes toward smoke-free policies. *Nicotine Tobacco Res Off J Soc Res Nicotine Tobacco*. 2010; 12(6): 598–605.
13. Hennrikus D, Pentel PR, Sandell SD. Preferences and practices among renters regarding smoking restrictions in apartment buildings. *Tob Control*. 2003; 12(2): 189–194.
14. California Department of Public Health (CDPH). Reduce Tobacco-Related Inequities Interventions: appendix 1 California Tobacco-Related Inequities Data. California Tobacco Control Program. 2013. http://www.co.merced.ca.us/BoardAgenda/2014/MG189456/AS189489/AS189494/AI189546/DO189378/all_pages.pdf.

15. King BA, Dube SR, Tynan MA. Current tobacco use among adults in the United States: findings from the national adult tobacco survey. *Am J Public Health*. 2012; 102(11): e93–e100.
16. Max W, Sung H-Y, Shi Y. Exposure to SHS at home and work in California. *Public Health Rep*. 2012; 127: 81–88.
17. Zhang X, Martinez-Donate AP, Kuo D, Jones NR, Palmersheim KA. Trends in home smoking bans in the USA, 1995–2007: prevalence, discrepancies and disparities. *Tob control*. 2012;21(3):330–336.
18. Cheng K-W, Glantz SA, Lightwood JM. Association between smokefree laws and voluntary smokefree-home rules. *Am J Prev Med*. 2011; 41(6): 566–572.
19. Moskowitz JM, Lin Z, Hudes ES. The impact of workplace smoking ordinances in California on smoking cessation. *Am J Public Health*. 2000; 90(5): 757.
20. Bauer JE, Hyland A, Li Q, Steger C, Cummings KM. A longitudinal assessment of the impact of smoke-free worksite policies on tobacco use. *Am J Public Health*. 2005; 95(6): 1024.