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Secondhand smoke exposure at home in rural China

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Abstract

Purpose—This study estimated secondhand smoke (SHS) exposure at home among nonsmoking children (age 0–18) and adults (age 19) in rural China, and examined associated socio-demographic factors.

Methods—A total of 5,442 nonsmokers (including 1,456 children and 3,986 adults) living in six rural areas in China were interviewed in person. The standardized questionnaire obtained information on their demographic characteristics and SHS exposure at home. Differences in SHS exposure were assessed by use of the chi-squared test. Logistic regression analysis was used to examine the associated factors.

Results—Occurrence of SHS exposure at home among nonsmoking children and adults was 68.0 and 59.3%, respectively. Logistic regression analysis found that children living in households with married, low-education, and low-income heads of household, and those who resided in the Qinghai province of China were more likely to be exposed to SHS. Among adults, those who were female, aged 19–34, single, low-education, and low-income, and those who lived in Qinghai province were more likely to be exposed to SHS at home.

Conclusions—Our findings of substantial SHS exposure at home in rural China emphasize the importance of implementing interventions to reduce SHS exposure among this population.

Keywords

Secondhand smoke; Rural; Home; China

Introduction

China has the largest number of smokers of any country in the world. In 2010, prevalence of smoking among adults in China was 28.1%: 52.9% for men and 2.4% for women [1]. More than 556 million nonsmoking adults in China were exposed to secondhand smoke (SHS) [2]. Adult current smoking prevalence in China decreased from 31.1% in 2002 to 28.1% in 2010 [1, 3]. However, there was an overall increase in the number of adults exposed to SHS during this period (from 540 million to 556 million) [2, 3]. In rural areas, the prevalence of SHS exposure greatly increased from 54.0% in 2002 to 74.2% in 2010 [2, 3].

Studies in developed countries have revealed that SHS exposure is associated with negative effects on health including respiratory illness, cancer, and heart disease [4, 5]. There are very few studies examining SHS exposure and its effect on health or economic burden in China. In one study, Gan and colleagues estimated that exposure to SHS was associated with more than 22,000 deaths from lung cancer and 33,800 ischemic heart disease deaths in China in 2002, equivalent to half a million years of healthy life lost [6]. In another study, Li and colleagues estimated the total economic costs attributable to SHS exposure in China at 29.4 billion Yuan (US\$ 4.3 billion) in 2005 [7] (exchange rate: 1US\$ = 7.0 Yuan)

In China, the term *rural areas* is usually used to refer to areas other than cities, and these areas are often characterized by relatively low population density and socioeconomic status [8]. According to the 2009 China Statistical Yearbook [9], 721.3 million Chinese people lived in rural areas in 2008, accounting for over half (54.3%) of China's population. Compared with the urban population, the rural population in China had much lower per capita net annual income (15,781 Yuan vs. 4,761 Yuan, equal to approximately US\$2,254 vs. US\$680). Furthermore, whereas the number of people completing only elementary school education or less was 16.5% in the urban population, it was fully 38.2% in the rural population [9]. It is common that a household consists of multiple generations in rural China; most residents are living at home and working in the family business. A previous study reported that SHS exposure in rural China was higher than that in urban areas (74.2 vs. 70.5% in 2010) [2]. Another study found that the prevalence of SHS exposure at home (82.0%) is greater than in public places (67.0%) and workplaces (35.0%) in China [3]. Therefore, persons living in rural China are more likely to be exposed to SHS at home than those living in urban settings. Several studies have been conducted on SHS exposure in work places and public places in China [10–12]. However, little research has focused on SHS exposure and associated factors in the home environment in rural China.

The objective of this study was to examine SHS exposure at home and its associated sociodemographic factors in rural China. The study examined SHS exposure for two age groups: children (age 0–18) and adults (age 19). A number of terms are used to describe exposure to other people's smoking, including environmental tobacco smoke (ETS), sidestream smoke, and passive smoking. The term "SHS" was used in this study. This paper addressed two questions:

1. What is the prevalence of SHS exposure at home among children and adults in rural China?

2. What are the factors associated with exposure to SHS at home in rural China?

This information will enable policymakers to better understand the prevalence of SHS exposure in rural China, and will provide evidence of the circumstances and individual characteristics that lead to the greatest likelihood of being exposed.

Methods

Data source

We used data from the 2008 China National Rural Household Survey (NRHS). The NRHS is a survey of Chinese rural households conducted by the China National Health Development Research Center in 2008 in six of China's provinces (or province-level municipalities): Qinghai (northwest), Anhui (east), Hubei (middle), Yunnan (west), Jiangsu (east), and Chongqing (southwest, a province-level municipality). These provinces cover approximately one sixth of the entire area of China and account for 21% of China's population [9]. Using multistage stratified random sampling methods, three rural villages were randomly selected in each province. The NRHS contains data from 18 villages from widely scattered geographic locations, indicating that the data cover a large variety of rural areas in China.

Study design and sample

A total of 1,801 households participated in this survey. Using a standardized questionnaire, a face-to-face interview was conducted with the head of household, who reported all the information including smoking behavior in the NRHS questionnaire on behalf of every household member. The questionnaire consisted of three sections:

1. Sociodemographic characteristics (including age, gender, marital status, education, family net income in previous year, and region).
2. Smoking status. The smoking status section contained two questions: "Have you ever smoked?", and "Did you smoke cigarettes in the previous 30 days". If the answer to the second question was "yes", the participant was classified as a current smoker.
3. The relationship with the head of household, which was used to define whether a participant lived with current smokers.

Although smokers may also suffer harmful health effects from SHS exposure, it is hard to separate the effects from those due to active smoking. Thus, our analysis of SHS exposure focused only on nonsmokers, who were not "current smokers" as defined above. Eight children and 1,545 adults were classified as current smokers and hence were excluded. In this study, a person was defined as being exposed to SHS at home if they lived with at least one current smoker. After further excluding two respondents with missing smoking status and sociodemographic factor data, a total of 5,442 nonsmokers (1,456 children and 3,986 adults) were included in the final study sample.

Sociodemographic measures

Sociodemographic characteristics include age, gender, marital status, education, income, and region. Marital status was classified as single, married, and divorced or widowed. Education was categorized as low education (less than high school), middle education (high school), and high education (more than high school). The per capita net income in the previous year was the ratio of family net income in the previous year to the number of household members. We then classified per capita net income in the previous year into three categories based on the cut-offs for the rural area from the 2009 China Statistic Yearbook [9]: low

income (<2,218 Yuan, equal to US\$317), middle income (2,218–5,066 Yuan, equal to US\$317–723) and high income (>5,066 Yuan, equal to US\$724). For children, their marital status, education, and income were defined by the status of the head of household.

Statistical analysis

All analyses were conducted with STATA, version 11.0 (Stata, College Station, TX, USA). Differences in SHS exposure by sociodemographic characteristics were tested by use of chi-squared statistics. We used two logistic regression models to analyze factors associated with SHS exposure at home in rural China—one for children and one for adults. Adjusted odds ratios (AOR) and the corresponding 95% confidence intervals (CI) were computed to assess the strength of association. For the two logistic regression analyses, the dependent variables were whether children were exposed to SHS at home, and whether adults were exposed to SHS at home: 1 represented exposure and 0 represented non-exposure. The independent variables included all the sociodemographic characteristics. A two-tailed *p* value of <0.05 was considered statistically significant.

Results

Sociodemographic characteristics

Among children (Table 1), half (52.4%) were male, 60.4% aged 0–12, and 65.4% lived in a household headed by a married person. Most of them lived in households headed by someone with low education (75.6%) and low-middle income (81.9%). Two-thirds (67.7%) of nonsmoking adults were female (Table 2); one third (33.7%) were aged 19–34; and most were married (78.7%) and lived in low education (87.3%) and low-middle income (75.5%) households. As shown in Tables 1 and 2, the sample of nonsmoking adults was distributed quite evenly across regions, and the largest sample size for children was from Yunnan (23.8%).

SHS exposure by sociodemographic characteristics

The prevalence of SHS exposure at home in rural China was 61.3% for all ages—68.0% for children and 59.3% for adults. The chi-squared test (Table 1 and 2) in univariate analysis showed that all the sociodemographic characteristics examined in this study were significantly related to SHS exposure at home.

Factors associated with SHS exposure

In the logistic regression analysis, we found that all the sociodemographic factors considered in this study were statistically significantly associated with SHS exposure at home for both children (Table 3) and adults (Table 4), except that gender and age were not significant for children. For children, SHS exposure at home was more likely:

- among those living in households headed by a married person than among those living in households headed by a single person;
- among those living in households headed by a low education person than among those living in households headed by high education person;
- among those living in low income households than among those living in high income households; and
- among those residing in Qinghai, Yunnan, Chongqing, or Anhui province than among those residing in Hubei province.

For adults, females, single people, and young adults aged 19–34 were more likely to be exposed to SHS exposure at home than males, married people, and adults aged 65 and older.

Similar to children, adults who had low education, low income, and who lived in Qinghai or other provinces were more likely to be exposed to SHS than those with high education, high income, and from Hubei.

Discussion

The findings of this study indicate very high prevalence (61.3%) of SHS exposure at home in rural China in 2008, with prevalence significantly higher among children than adults (68.0 vs. 59.3%). We found SHS exposure at home among adults in rural China (59.3%) was higher than previously reported by Wang et al. (48.3%) [13]. Our findings of substantial SHS exposure at home in rural China, coupled with the fact that 54.3% of China's population lives in rural areas, emphasize the importance of implementing tobacco control intervention to reduce SHS exposure among this population.

Previous studies have shown that health education is critical to improving people's knowledge about the harm of SHS and attitudes towards SHS exposure [14–16]. For children, school-based education which adds appropriate content on SHS-related matters, for example information about the harm of SHS exposure and skills in persuading smokers not smoke in front of them, into school curricula could have a positive effect on reducing SHS exposure. For adults, it has been shown that health-education programs can increase knowledge about the harm of SHS exposure, move attitudes towards stronger disapproval, and increase the likelihood of taking assertive action when exposed to SHS in the family [17].

Also, smoke-free law in public places could be another effective way of reducing SHS at home in rural China. A recent study conducted in the US found that strong clean indoor air laws in public places and work places are associated with large increases in voluntary smoke-free-home policies in homes both with and without smokers [18]. China passed a smoke-free rule in all public indoor spaces (including restaurants, bars, Internet cafes, and public transport) on May 1, 2011, but violators can be still seen everywhere because of lack of enforcement. Thus, smoke-free laws plus strict enforcement are needed in China.

In addition, we found that the rural area in Qinghai province had the highest SHS exposure, consistent with the 2007 China Tobacco Control Report [19]. Qinghai is located in the northwest part of China, with an economy amongst the smallest in all provinces of China. Its nominal GDP for 2009 was just 108.1 billion RMB (US\$15.8 billion) and contributes approximately 0.3% of national GDP. Per capita GDP was 19,407 RMB (US\$2,841), the second lowest in China [20]. This emphasizes the importance of implementing tobacco-control programs in these less-developed areas in China.

Furthermore, we found that women and low socio-economic status (SES) groups (low education and income) were more likely to be exposed to SHS. This is consistent with a previous study in China, which showed that females and those with low education level were more likely to be exposed to household SHS, because most women are housewives in the county area of China and thus spend most of their time at home [13]. Several studies have shown that SHS exposure increases the risk of premature death among women and children [21], breast cancer among women [22], and asthma among children [23]. However, there is not yet enough awareness of this significant public health issue among women in rural China. In rural areas of China, most women work at home in family businesses. Thus, our findings indicate the importance of creating a smoke-free home environment for low SES children and women, as they may more often live in households with smokers where smoking occurs.

This study revealed that single adults were more likely to be exposed to SHS at home than married adults. This may be explained by the fact that more than half (56.6%) of the single adults from the 2008 NRHS survey were aged 19–34. It is common for three generations to live together in rural China. Because smoking prevalence among the older generation aged 35 was higher than among the young adult generation aged 19–34 (31.1 vs. 20.6%, according to 2008 NRHS data), the young adult generation is more likely to live with current smokers than the older generation, which results in more SHS exposure at home. This phenomenon is consistent with the findings that children were more likely than adults to be exposed to SHS at home. However, more studies are needed to further examine the association between marital status and SHS exposure at home.

This study has several limitations. First, only one representative per family was interviewed, and he/she reported smoking status information for all the other family members. This response by proxy could potentially cause underestimation of the prevalence of SHS exposure. This might explain the different level of adult SHS exposure at home in rural China found in the 2010 Global Adults Tobacco Survey in China compared with this study (67.3 vs. 59.3%), given that the former interviewed individuals directly. Second, because of the design of the NRHS questionnaire, SHS at home was measured by whether or not a nonsmoker lives with at least one current smoker at home, which could lead to overestimation of the prevalence of SHS exposure, because a smoking family member might not smoke inside the home and expose others to SHS. Ideal measures might be a question such as “How many days per week did a smoker smoke in front of you?” [13] or biomarker measures, for example hair and urine nicotine [24, 25]. Unfortunately, this information is not available in this study. However, because many persons in rural areas lack knowledge about SHS exposure, they may not be aware of the fact that smoking in front of nonsmokers exposes them to SHS. As a result, we believe that living with a current smoker is a good proxy for SHS exposure at home for rural China. Third, Chinese parents might not be willing to report that their children smoke, because smoking is not regarded as good behavior for women and children in China. This could lead to social desirability bias in which SHS exposure is underestimated because the numbers of smokers in a household is underreported or children reported as exposed are, in fact, smokers. However, it is not clear what the effects on the estimates would be. Despite these limitations, this study indicates the potential need to develop a comprehensive intervention program for reducing SHS exposure at home in rural China.

In conclusion, this study documents high prevalence of SHS exposure at home among nonsmoking children and adults living in rural China. Given the large proportion of Chinese people who live in rural areas, there is great potential to reduce the harmful effects of tobacco exposure by designing intervention that reduce SHS exposure among this population.

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Table 1

Prevalence of exposure of nonsmoking children to SHS, by sociodemographic characteristics; Rural China, 2008

Demographic characteristic	Children (<i>n</i> = 1,456)		
	Total % (<i>n</i>)	SHS exposure (%)	<i>p</i> value
Gender			
Male	52.4 (763)	65.4	.030 *
Female	47.6 (693)	70.7	
Age			
0–12	60.4 (879)	70.2	.025 *
13–18	39.6 (577)	64.6	
Marital status (of head of household)			
Single	32.9 (478)	62.4	.001 *
Married	65.4 (953)	71.2	
Divorced and widowed	1.7 (25)	52.0	
Education (of head of household)			
Low (<high school)	75.6 (1,100)	68.5	.010 *
Middle (high school)	22.7 (331)	68.3	
High (>high school)	1.7 (25)	40.0	
Per capita net income (of head of household)			
Low	38.4 (559)	71.1	.047 *
Middle	43.5 (633)	67.4	
High	18.1 (264)	62.9	
Region			
Hubei	17.3 (252)	54.08	<.001 *
Qinghai	18.4 (269)	78.1	
Yunnan	23.8 (346)	66.6	
Chongqing	12.1 (177)	67.2	
Anhui	18.4 (268)	73.2	
Jiangsu	9.9 (144)	66.7	
Total		68.0	

*
 $p < 0.05$ (2-tailed, chi-squared test)

Table 2

Prevalence of exposure of nonsmoking adults to SHS, by sociodemographic characteristics; Rural China, 2008

Demographic characteristic	Adults (<i>n</i> = 3,986)		<i>p</i> value
	Total % (<i>n</i>)	SHS exposure (%)	
Gender			
Male	32.3 (1,286)	41.8	<.001 *
Female	67.7 (2,700)	67.7	
Age			
19–34	33.7 (1,345)	67.3	<.001 *
35–64	53.8 (2,144)	54.8	
65	12.5 (497)	57.5	
Marital status			
Single	13.4 (537)	67.7	<.001 *
Married	78.7 (3,135)	58.5	
Divorced and widowed	7.9 (314)	52.9	
Education			
Low (<high school)	87.3 (3,479)	59.9	.026 *
Middle (high school)	9.6 (381)	53.0	
High (>high school)	3.2 (126)	52.7	
Per capita net income			
Low	31.9 (1,270)	61.8	.047 *
Middle	43.6 (1,739)	59.0	
High	24.5 (977)	56.7	
Region			
Hubei	20.0 (797)	47.6	<.001 *
Qinghai	17.5 (698)	67.5	
Yunnan	15.0 (597)	67.2	
Chongqing	15.8 (630)	57.8	
Anhui	17.4 (693)	60.5	
Jiangsu	14.3 (571)	58.0	
Total		59.3	

* $p < 0.05$ (2-tailed, chi-squared test)

Table 3

Adjusted odds ratios from logistic regression model predicting SHS exposure at home for children

Demographic characteristic	Children (<i>n</i> = 1,456)	
	Adjusted odds ratio	95% CI
Gender		
Male	Reference	
Female	1.24	.99–1.56
Age		
0–12	Reference	
13–18	.94	.70–1.28
Marital status (of head of household)		
Single	Reference	
Married	1.40 *	1.01–1.92
Divorced and widowed	.62	.27–1.45
Education (of head of household)		
Low (<high school)	2.69 *	1.17–6.20
Middle (high school)	3.08	1.31–7.27
High (>high school)	Reference	
Per capita net income (of head of household)		
Low	1.51 *	1.08–2.11
Middle	1.21	.89–1.66
High	Reference	
Region		
Hubei	Reference	
Qinghai	2.54 *	1.54–3.25
Yunnan	2.23 *	1.72–3.75
Chongqing	1.66 *	1.10–2.49
Anhui	1.48 *	1.04–2.09
Jiangsu	1.53	1.00–2.37

* $p < 0.05$ (2-tailed)

Table 4

Adjusted odds ratios from logistic regression model predicting SHS exposure at home for adults

Demographic characteristic	Adults (n = 3,986)	
	Adjusted odds ratio	95% CI
Gender		
Male	Reference	
Female	3.34 *	2.88–3.86
Age		
19–34	1.34 *	1.03–1.75
35–64	.77 *	.62–.97
65	Reference	
Marital status		
Single	1.68 *	1.30–2.18
Married	Reference	
Divorced and widowed	.64	.48–.83
Education		
Low (<high school)	1.56 *	1.01–2.41
Middle (high school)	1.12 *	0.71–1.76
High (>high school)	Reference	
Per capita net income		
Low	1.23 *	1.02–1.48
Middle	1.08	.91–1.28
High	Reference	
Region		
Hubei	Reference	
Qinghai	2.13 *	1.70–2.66
Yunnan	1.86 *	1.48–2.35
Chongqing	1.42 *	1.14–1.77
Anhui	1.48 *	1.19–1.84
Jiangsu	1.36 *	1.08–1.70

*
 $p < 0.05$ (2-tailed)