

RESEARCH ARTICLE

Editorial Process: Submission:09/26/2019 Acceptance:05/05/2020

Secondhand Smoke Exposure among Nonsmokers in China

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Abstract

Background: China signed the World Health Organization Framework Convention on Tobacco Control and conducted a series of activities to protect people from secondhand smoke exposure. This paper explores the changes in prevalence of secondhand smoke exposure among nonsmokers between 2010 and 2015. **Methods:** Data from the 2010 Global Adult Tobacco Survey and 2015 National Adult Tobacco Survey were used in this study. Due to the complex sample design for these surveys, data were weighted and analyzed using the SAS 9.3 complex survey data analysis procedure. The Chi-square test was used for comparison among different groups. **Results:** From 2010 to 2015, secondhand smoke exposure among nonsmokers decreased in restaurants, government buildings, health-care facilities, schools, and public transportation in China ($p < 0.05$). The relative change was most significant for schools (52.1%), followed by public transportation (49.4%) and government buildings (42.2%). The percentage of secondhand smoke exposure reported in workplaces declined from 55.2% to 45.3%. Secondhand smoke exposure at home reduced from 58.3% to 46.7%. People's awareness that secondhand smoke could cause heart disease in adults, lung illness in children, and lung cancer in adults increased from 24.6% to 36.0%. Additionally, support for smoke-free policies is high among the Chinese population. Even for restaurants, where support for smoke-free policies was lowest, 75.1% of nonsmokers and 55.3% of smokers supported smoke-free policies. **Conclusion:** Secondhand smoke exposure declined from 2010 to 2015 in China but remains a serious problem. Public awareness about the hazards of secondhand smoke is increasing and Chinese people support smoke-free laws.

Keywords: Secondhand smoke- surveillance and monitoring- smoke-free policy

Asian Pac J Cancer Prev, 21, Progress of Tobacco Control in the Western Pacific Region Suppl, 17-22

Introduction

Tobacco use kills approximately 7 million people globally every year and is a significant threat to health and development (World Health Organization, 2017). China is the largest consumer of tobacco in the world. There are 316 million smokers and about 44% of the cigarettes consumed globally are smoked in China (Chinese Center for Disease Control and Prevention, 2016; Michael et al., 2015). Consequently, more than 1 million Chinese die of tobacco-related diseases each year and secondhand smoke exposure remains a serious public health problem (Ministry of Health, 2012).

China has taken a number of steps to prevent people from exposure to secondhand smoke. An important step was banning smoking in health facilities by the Ministry of Health in 2009 (Ministry of Health, 2009), followed by the Ministry of Education banning smoking in primary schools and middle schools in 2010 (Ministry of Education, 2010). In recent years, there have been national and local mass media campaigns to raise awareness about the risks of secondhand smoke and many restaurants and private companies have implemented their own smoke-free policies (Redmon et al., 2014). In 2013, the General Office

of the Communist Party of China Central Committee and the General Office of the State Council issued a notice requiring leading officials to set an example through their own actions, by avoiding tobacco use in public places and supporting the implementation of smoke-free policies (The State Council of the People's Republic of China, 2013). In 2014, smoking was banned in high-speed trains (The State Council of the People's Republic of China, 2014). "No smoking in public places" was included in China's 12th and 13th Five-Year Plans (The National People's Congress of the People's Republic of China, 2011; The State Council of the People's Republic of China, 2017), and passed at the National People's Congress conferences in 2011 and 2016, respectively. Local smoke-free ordinances were enacted in 18 cities, including Beijing and Shanghai. Following this, in 2014, the Legislation Office of the State Council embarked on drafting the first nationwide regulation to ban smoking in indoor public places (Legislation Office of the State Council, 2014; National Health and Family Planning Committee, 2014).

This study explores the changes in prevalence of secondhand smoke exposure among nonsmokers in public places, workplaces, public transportation, and homes, as well as people's knowledge and perceptions about

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secondhand smoke from 2010 to 2015 in China.

Materials and Methods

Data resource

The 2010 Global Adult Tobacco Survey in China and 2015 National Adult Tobacco Survey were nationally representative household surveys conducted by the Chinese Center for Disease Control and Prevention (Tobacco Control Office, Chinese Center for Disease Control and Prevention, 2011; Chinese Center for Disease Control and Prevention, 2016). The target population of the two surveys were non-institutionalized men and women aged 15 and older. The survey questionnaire collected information on demographics; tobacco use; cessation; secondhand smoke exposure; media exposure; and knowledge, attitudes, and perceptions about tobacco use and tobacco control measures. Handheld computers were used to collect data. The key indicators used in this study were measured using the same questions for both surveys.

Outcome variables

Outcome variables used were secondhand smoke exposure among nonsmokers in public places (yes/no), secondhand smoke exposure among nonsmokers at workplaces (yes/no); secondhand smoke exposure among nonsmokers at home (yes/no); knowledge that exposure to secondhand smoke causes heart disease in adults, lung illness in children, lung cancer in adults, and all three diseases (yes/no/don't know); and people's attitude toward smoke-free policy in various public places (support or not). Restaurants, government buildings, health-care facilities, schools, and public transportation were included in public places. Nonsmoker status was determined by the question: "Do you currently smoke tobacco on a daily basis, less than daily, or not at all?" Respondents who answered "not at all" were considered nonsmokers.

The questionnaire did not include a direct measure of secondhand smoke exposure among respondents. Instead, two questions were used to provide an indirect measure of change in prevalence of secondhand smoke in certain public places between 2010 and 2015. For example, respondents were asked: "During the past 30 days, did you visit any government buildings or government offices?" Those who answered "yes" were asked: "Did anyone smoke inside of these government buildings or government offices that you visited in the past 30 days?" Therefore, secondhand smoke exposure in public places was measured by whether respondents who had visited these public places in the past 30 days noticed anyone smoking there. The question about secondhand smoke exposure at workplaces included respondents aged 16 to 60 who had noticed anyone smoke at a workplace. Respondents who reported any frequency of smoking at home (daily, weekly, monthly, or less than monthly) were considered to be exposed to secondhand smoke in the home.

Independent variables

Independent variables used were gender (male/female),

age, education level, resident (urban/rural), and occupation. The age groups in this study were classified into 15-24, 25-34, 35-44, 45-54, and 55+ years old. Education levels included four categories: primary school or less, attended secondary school, high school, and college graduate or above. Occupations were categorized into agriculture worker, business or service employee, medical/health personnel, teaching staff, and others (see Table 1).

Statistical analysis

Due to the complex survey sample design for these surveys, each responding unit was assigned a unique survey weight that was used to produce estimates of population parameters. All computations were performed using the SAS 9.3 complex survey data analysis procedure. Percentage or proportion was used for descriptive statistics. The Chi-square test was used for comparison among different groups. A p value <0.05 was considered statistically significant.

Results

Secondhand smoke exposure among nonsmokers in public places

In 2015, exposure to secondhand smoke among nonsmokers was most commonly reported in restaurants (70.1%). The proportion of nonsmokers exposed to secondhand smoke in other public places included: 32.0% in government buildings, 24.2% in health-care facilities, 17.1% in schools, and 16.1% on public transportation. Secondhand smoke exposure was higher among male than female nonsmokers in restaurants, government buildings, and schools ($p<0.05$). There was no difference between genders in health-care facilities and public transportation. The proportion of people exposed to secondhand smoke in schools was greatest for the 15-24 age group (29.8%) compared with other age groups ($p<0.05$).

Between 2010 and 2015, the proportion of respondents reporting secondhand smoke exposure dropped in all categories of public places ($p<0.05$). The relative change was most significant for schools (52.1%), followed by public transportation (49.4%) and government buildings (42.2%) (see Figure 1).

Secondhand smoke exposure among nonsmokers at workplaces

In 2015, the percentage of nonsmokers working in indoor locations exposed to secondhand smoke at work during the last 30 days was 45.3% (54.6% for males and 39.8% for females). The proportion increased with age ($p<0.001$) and declined with higher education levels (i.e., college or above) ($p<0.001$). There was no significant difference between urban and rural areas ($p=0.757$). By occupational category, the highest proportion of people exposed to secondhand smoke was agriculture workers (68.5%), followed by business or service employees (49.7%), while the proportion among medical/health personnel and teaching staff were 23.7% and 30.2%, respectively.

From 2010 to 2015, the percentage of secondhand smoke exposure in the workplace declined by 9.9%. The

Table 1. Percentage of Nonsmokers ≥ 15 Years Old Exposed to Secondhand Smoke in the Workplace*

	2010		2015	
	%	95%CI	%	95%CI
Overall	55.2	50.4~59.9	45.3	41.4~49.2
Gender				
Male	58	51.9~63.8	54.6	48.7~60.4
Female	53.3	47.6~58.9	39.8	35.9~43.9
Age (years)				
15-24	44.6	38.1~51.2	34.1	27.2~41.7
25-34	55.1	48.0~62.0	42.7	38.2~47.3
35-44	62.1	54.9~68.7	52.2	46.1~58.2
45-54	66.5	57.2~74.7	54.4	48.1~60.6
55-60	67.7	56.8~77.0	60.7	48.2~71.9
Education level				
Primary school or less	67.4	52.8~79.3	55.2	45.5~64.4
Attended secondary school	64.7	58.0~70.9	57.9	50.7~64.8
High school	59	50.7~66.9	49.2	43.2~55.3
College graduate or above	57	48.6~64.9	42.5	37.0~48.2
Resident				
Urban	53.7	47.6~59.7	44.9	40.4~49.5
Rural	57.9	52.0~63.6	46.3	38.8~53.9
Occupation				
Agriculture worker	73.1	56.6~85.0	68.5	48.2~83.6
Business or service employee	60.2	53.5~66.6	49.7	45.0~54.5
Medical/health personnel	51.1	37.4~64.6	23.7	15.6~34.4
Teaching staff	49.2	38.1~60.3	30.2	20.5~42.1
Others	49.2	43.9~54.4	37.2	30.5~44.4

Note: Secondhand smoke exposure in the workplace is calculated only among respondents 16-60 years old; Data sources: 2010 Global Adult Tobacco Survey (GATS) and 2015 National Adult Tobacco Survey (NATS).

proportion dropped more among women (13.5%) than among men (3.4%). By education level, the change was greatest among those with a college education or above – a decrease from 57.0% in 2010 to 42.5% in 2015. By occupational category, the largest changes in exposure were among medical/health personnel and teaching staff, with a decrease from 51.1% to 23.7% among medical/

health personnel ($p=0.017$) and 49.2% to 30.2% among teaching staff ($p<0.001$) (see Table 1).

Secondhand smoke exposure among nonsmokers at home

In 2015, 46.7% of nonsmokers were exposed to secondhand smoke at home. The proportion was higher in rural areas (57.5%) compared with urban areas (36.9%) ($p<0.001$). Secondhand smoke exposure at home differed dramatically among groups with different education levels ($p<0.001$). Exposure was much lower among those with a university education or above (23.5%) compared to those with only a secondary school education (50.9%) or primary school education or less (50.5%).

From 2010 to 2015, the percentage of reported secondhand smoke at home dropped from 58.3% to 46.7% ($p<0.001$). It declined from 48.4% to 37.4% among males and from 63.2% to 51.4% among females. The relative change was much more significant in urban areas (13.4%) than in rural areas (7.7%) and was greatest among those with a university education or above (44.0%) compared to those with lower education levels.

Awareness of the hazards of secondhand smoke

In 2015, the percentage of adults who knew that secondhand smoke causes heart disease in adults, lung illness in children, or lung cancer in adults was 41.7%, 65.2%, and 64.6%, respectively, while 36.0% of adults were aware that secondhand smoke could cause all three diseases. Rural residents had a lower awareness of the health hazards posed by secondhand smoke (27.0%) compared with urban residents (44.7%). Awareness of the health hazards posed by secondhand smoke was closely related to education level ($p<0.01$). Only 16.4% of those with an education level of primary school or less were aware that secondhand smoke could cause all three diseases. The proportion among those with an education level of college or above was 54.9%. Although people's awareness of secondhand smoke hazards is still low, it increased substantially from 2010 to 2015, as shown in Figure 2.

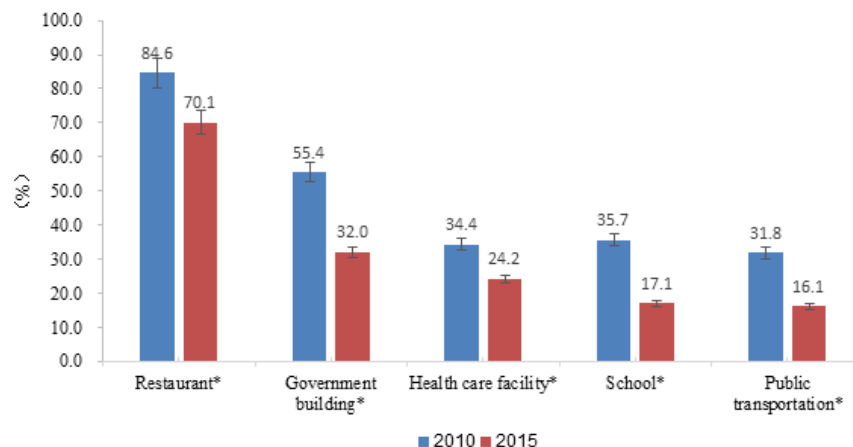


Figure 1. Percentage of Nonsmokers ≥ 15 Years Old Exposed to Secondhand Smoke at Public Places, 2010 and 2015. Note, * $P<0.05$; Data sources, 2010 Global Adult Tobacco Survey (GATS) and 2015 National Adult Tobacco Survey (NATS).

Table 2. People's Support towards Smoke-Free Policies in Public Places in 2015

	Nonsmoker		Smoker		Chi-square	P- value
	%	95%CI	%	95%CI		
Health-care facility	94.7	93.5~95.6	93.8	92.3~94.9	4.74	0.18
Workplace	88.2	85.9~90.1	80.9	77.6~83.8	133.834	<0.001
Restaurant	75.1	71.9~78.0	55.3	51.5~59.0	558.902	<0.001
University	86.9	84.2~89.1	82.6	79.7~85.2	44.877	<0.001
Taxi	87.2	84.5~89.5	79	76.0~81.7	160.44	<0.001
Primary and secondary school	93.4	91.6~94.8	92	90.3~93.5	7.942	0.069

Data source, 2015 National Adult Tobacco Survey (NATS).

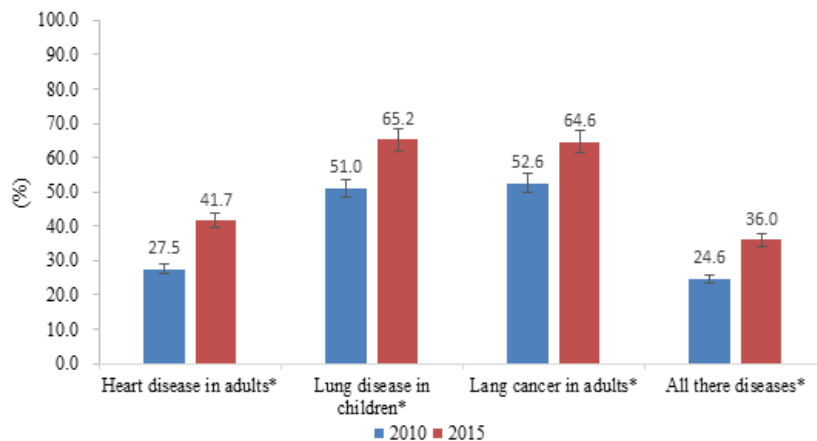


Figure 2. Peoples Awareness of Hazard of Secondhand Smoke , 2010-2015

Public support for smoke-free law

In 2015, more than 90% of respondents (both nonsmokers and smokers) supported banning smoking in indoor spaces at health-care facilities, primary schools, and secondary schools. In terms of smoke-free policies in other public places, nonsmokers were more likely than smokers to support smoke-free policies (although support among both groups was substantial). This included support for smoke-free policies in the workplace (88.2% nonsmokers vs. 80.9% smokers), universities (86.9% vs. 82.6%), restaurants 75.1% vs. 55.3%), and taxis (87.2% vs. 79.0%) (see Table 2).

Discussion

From 2010 to 2015, nonsmokers' exposure to secondhand smoke in public places and workplaces in China declined significantly ($p < 0.001$). Despite this reduction, exposure to secondhand smoke remained high in 2015, with exposure at 70.1% in restaurants and 45.3% in workplaces. These levels are much higher than what has been observed in many other countries (Ministry of Health and Social Development of the Russian Federation, 2017; Pan American Health Organization, INDC Brazil, 2010; Bureau of Tobacco Control, Department of Disease Control (DDC) Ministry of Public Health, 2011). It indicates that secondhand smoke exposure is still a serious public health problem in China.

Starting in 2009, the Chinese Ministry of Health and Ministry of Education implemented regulations to prohibit smoking inside health-care facilities and on primary and

secondary school campuses. Consequently, secondhand smoke exposure in those places was already relatively low in 2010 and declined between 2010 and 2015. Additionally, the proportion of medical/health personnel and teaching staff exposed to secondhand smoke at their workplaces decreased more than for other occupations between the two survey years. Moreover, while 55.4% of nonsmokers were exposed to secondhand smoke in government buildings in 2010 (before the 2013 notice requiring government offices to go smoke-free), this number declined to 32.0% in 2015. These findings provide support for the conclusion that targeted smoke-free environment campaigns are effective. The lowest level of secondhand smoke exposure observed was in public transportation. This is likely due to the fact that smoke-free laws and regulations for public transportation were enacted in 1997 (Civil Aviation Administration of China, 2015). This, in addition to the prohibition of smoking on high-speed trains in 2014 (Civil Aviation Administration of China, 2014), contributed to a further reduction in secondhand smoke exposure on public transportation. This suggests that smoke-free laws or regulations, as shown in the case for the public transportation regulations, are more efficient than a smoke-free campaign alone.

A substantial body of evidence from many countries has shown that comprehensive smoke-free laws can reduce secondhand smoke exposure and improve the air quality of indoor places (Fong et al., 2013; Mulcahy et al., 2005; Hyland et al., 2008). Additionally, in cities in China that have implemented comprehensive smoke-free laws, such as Beijing, secondhand smoke exposure has

decreased much more than at the national level (Xiao et al., 2016). This highlights the need for a comprehensive national smoke-free law to ensure the greatest impact on reducing secondhand smoke exposure in China. Given President Xi Jinping's pronouncement that "An all-around moderately prosperous society cannot be achieved without the people's all-around health," in addition to the "Healthy China" development strategy, a national comprehensive smoke-free law should be enacted for China to protect people from secondhand smoke and its impact on public health.

The results of this paper indicate that there is broad support for smoke-free policies among the Chinese population. The findings of this study show that people are aware that secondhand smoke can cause heart disease in adults, lung illness in children, and lung cancer in adults. Furthermore, smoking in the home declined substantially over the five-year period between 2010 and 2015, especially for those with higher education. This indicates that Chinese people are increasingly aware of the hazards of secondhand smoke and are beginning to take steps to protect themselves and the next generation. In addition, this study found smokers as well as nonsmokers to be in support of smoke-free policies. This demonstrates that a national comprehensive smoke-free law would be welcome in China.

Acknowledgements

This study was supported by the National Health and Family Planning Commission of China, World Health Organization Regional Office for the Western Pacific, and U.S. Centers for Disease Control and Prevention. The authors would like to acknowledge local representatives of the Centers for Disease Control and Prevention and Centers for Health Education for their contribution in data collection.

Conflict of Interest Statement

The authors have no conflicts of interest associated with the material presented in this paper. The ORCID of the corresponding author is 0000-0002-5052-6663.

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