

Preplanned Studies

Adult Secondhand Smoke Exposure — Shanghai Municipality, 2018

Yuanqiao Sun^{1,*}; De Chen^{1,*}; Jian Wang¹; Lin Xiao²; Kun Xu¹; Chenchen Xie¹; Kunlei Le¹;
Zhengyang Gong¹; Xiaoxian Jia¹; Jingrong Gao^{1,#}; Liming Wu^{1,#}

Summary

What is already known on this topic?

The average secondhand smoke exposure rate was 68.1% in China in 2018. The World Health Organization suggests that legislation must be used to achieve a 100% smoke-free environment and protect nonsmokers from secondhand smoke.

What is added by this report?

This study showed that the implementation of the *Amendment Regulations on Smoking Control in Public Places of Shanghai* had a significant effect on reducing the exposure rate of secondhand smoke. The rate in 2018 was 46.7%, which was significantly lower than that (58.5%) before implementation in 2016.

What are the implications for public health practice?

Considering the high exposure and the harm of secondhand smoke in China, it is necessary to promote smoke-free legislation and enforce tobacco control measures.

Secondhand smoke (SHS) poses serious harms to human health. Currently, there are 316 million smokers in China, and about 740 million non-smokers are exposed to SHS (1). The number of deaths caused by SHS is more than 100,000 every year (2). *The Regulation on Smoking Control in Public Places of Shanghai* was implemented on March 1, 2010. To further strengthening the tobacco control, *Amendment of the Regulation on Smoking Control of Shanghai* was formally implemented on March 1, 2017, restricting smoking in all indoor public places. It is of great significance to understand the level and status of SHS exposure for the formulation of tobacco control policies and intervention strategies (3).

The data of this study was from the Shanghai Adult Tobacco Survey in 2018, which was conducted among the population aged 15 years and older. Multi-stage, geographically clustered sampling was used and covered 100 monitor points from 16 districts. A total

of 3,250 families were sampled, and one individual was randomly selected from each family to complete the survey. The Global Adult Tobacco Survey (GATS) standard questionnaire was used and face-to-face survey was conducted, 3,112 individuals completed the survey (95.8%), and this study analyzes SHS exposure data. SHS exposure of non-smokers refers to exposure to tobacco smoke at least 1 day per week; SHS exposure at home and in public places refers to the proportion of participants, including smokers and non-smokers, who saw someone smoking, smelled smoke, or saw cigarette butts when visiting specific places in the past 30 days (1–3). The data was weighted according to the sampling method and analyzed using SAS software (version 9.3; SAS Institute, Inc. Cary, NC, USA) complex survey design.

The survey included 1,465 males and 1,647 females, and after weighted adjustment, male respondents accounted for 51.6% and female respondents 48.4%. For different age groups, the proportion of participants aged 25 to 44 years was the highest (41.4%), followed by those aged 45 to 64 years (32.3%), and the proportions of different genders and age groups in this study were similar to that of Shanghai overall (4), which indicated good representativeness of the sample data. In terms of education levels, participants with college degree or above accounted for the highest proportion at 40.8%. The highest proportion in terms of occupation was enterprise, business, and service personnel at 44.7%.

According to the survey, the SHS exposure rate of non-smokers among the age of 15 years and above in Shanghai was 46.7% (95% CI: 40.4%–53.0%) in 2018 and was higher in males (52.6%) than in females (42.8%). However, the proportion of women exposed daily was higher than men ($p < 0.001$). Among different occupational groups, the exposure rate in enterprises, businesses, and service personnel was the highest (51.2%), followed by farmers (51.0%), and the unemployed (50.9%), all of which were above 50%;

while medical personnel (38%) and teachers (16.2%) had a relatively lower exposure ($p=0.026$). The proportion of SHS exposure at home in the last 30 days was 23.5%, higher in males than in females ($p<0.001$); however, in the subgroup of non-smokers, the rate was a little higher in females than in males. Based on different age groups, the group aged 15–24 years had the highest exposure rate at 25.6%, followed by the group aged over 65 years at 21.2% ($p<0.001$).

The differences were also significant among different educational levels with education level being inversely related to exposure rate from 24.5% to 8.8% ($p<0.001$) (Table 1).

The proportion of SHS exposure in major public places were, from highest to lowest, 28.1% for restaurants, 17.3% for indoor workplaces, 12.1% for universities, 10.0% for government buildings, 7.7% for primary and secondary schools, 4.2% for medical

TABLE 1. Estimation of exposure of second-hand smoke overall and at home.

Demographic characteristics	Overall of non-smokers [*] (Rate [%] [95% CI])		Home [†] (Rate [%] [95% CI])	
	One day or above/per week	Nearly everyday	Overall	Non-smokers
Gender				
Male	52.6(44.8–60.4)	12.2(7.6–16.8)	28.4(23.6–33.3)	14.1(9.7, 18.6)
Female	42.8(36.7–48.8)	15.1(11.7–18.6)	18.2(13.9–22.4)	17.8(13.6, 22.0)
χ^2	13.869	20.583	32.488	3.782
p value	<0.0001	<0.0001	<0.0001	0.052
Age group				
15–24 years	48.0(35.6–60.4)	13.5(5.6–21.5)	31.9(20.4–43.4)	25.6(15.4, 35.7)
25–44 years	48.5(42.1–55.0)	12.9(8.8–17.0)	17.5(13.4–21.6)	12.6(8.5, 16.6)
45–64 years	46.3(38.1–54.4)	15.7(11.4–20.0)	25.6(19.8–31.5)	14.9(9.8, 20.1)
≥65 years	40.8(34.4–47.2)	14.1(10.1–18.0)	28.3(23.5–33.2)	21.2(16.4, 26.0)
χ^2	3.123	0.541	18.864	18.315
p value	0.373	0.910	<0.0001	<0.0001
Educational level [§]				
Primary school and below	42.1(35.0–49.3)	19.7(14.1–25.3)	34.3(27.0–41.7)	24.5(18.6, 30.5)
Junior high school	53.2(45.7–60.7)	19.2(14.6–23.8)	29.5(24.1–34.8)	20.5(15.4, 25.5)
Senior high school	47.4(37.3–57.5)	16.8(10.8–22.9)	24.8(19.1–30.5)	15.2(9.5, 20.8)
College and above	43.8(36.6–51.1)	8.4(4.5–12.3)	12.6(9.5–15.7)	8.8(5.5, 12.0)
χ^2	7.393	18.290	117.126	50.076
p value	0.060	<0.0001	<0.0001	<0.0001
Occupation				
Farmer	51.0(34.5–67.6)	20.1(7.2–32.9)	36.7(22.9–50.5)	25.7(12.0, 39.5)
Government/public institution personnel	49.5(36.2–62.8)	13.7(4.7–22.7)	18.2(7.3–29.1)	17.2(5.1, 29.3)
Enterprise, commercial, service personnel	51.2(43.2–59.2)	12.4(7.6–17.2)	22.7(17.7–27.6)	13.1(9.1, 17.2)
Teacher	16.2(3.2–29.2)	–	5.6(0.0–14.1)	6.1(0.0, 15.5)
Medical worker	38.0(19.5–56.5)	12.3(0.0–26.2)	13.2(2.2–24.3)	14.3(0.6, 27.9)
Unemployed	50.9(34.5–67.3)	24.9(11.2–38.7)	28.9(16.1–41.8)	25.5(12.9, 38.1)
Others	42.3(34.5–50.1)	14.8(10.2–19.5)	24.3(19.4–29.2)	18.4(13.0, 23.7)
χ^2	14.332	7.227 [¶]	14.425	11.739
p value	0.026	0.204	0.025	0.068
Total	46.7(40.4–53.0)	14.0(10.4–17.6)	23.5(19.2–27.7)	16.3(12.4, 20.3)

^{*} Refers to the frequency of non-smokers' exposure to secondhand smoke per week.

[†] People who report that someone smokes in their home on a daily/weekly/monthly basis.

[§] The educational level of respondents over 25 years old was only reported.

[¶] The category that does not show results is eliminated, when doing Chi-square test.

TABLE 2. Estimation of exposure to second-hand smoke in various indoor public places^{*}.

Demographic characteristics	Rate (%) (95% CI)						
	Workplace	Government buildings	Healthcare facilities	Restaurants	Public transport	Universities	Primary and secondary schools [†]
Gender							
Male	22.4(16.2–28.5)	10.9(5.2–16.6)	3.3(2.1–4.6)	32.7(27.1–38.2)	2.7(1.1–4.3)	17.1(5.4–28.7)	10.1(4.3–15.9)
Female	11.5(8.3–14.8)	8.9(3.0–14.8)	5.0(3.0–6.9)	22.6(17.3–27.8)	0.8(0.3–1.4)	6.1(0.0–14.3)	5.2(1.8–8.5)
χ^2	24.067	0.345	2.272	10.997	8.387	2.285	4.214
<i>p</i> value	<.0001	0.557	0.132	0.0009	0.004	0.131	0.040
Age group							
15–24 years	16.5(6.1–27.0)	–	4.5(0.0–13.4)	32.1(19.2–45.1)	1.6(0.0–3.9)	15.7(0.0–31.6)	13.8(0.0–28.0)
25–44 years	14.9(10.6–19.3)	12.5(6.0–19.1)	2.7(0.7–4.6)	27.5(21.5–33.5)	2.5(0.7–4.3)	10.1(1.5–18.6)	5.5(1.7–9.2)
45–64 years	25.5(18.3–32.8)	5.6(0.0–11.3)	4.4(2.6–6.2)	26.2(20.6–31.8)	1.1(0.4–1.9)	7.8(0.0–19.8)	7.0(2.2–11.8)
≥65 years	33.8(11.2–56.4)	7.4(0.0–16.3)	6.4(3.8–9.0)	29.6(22.9–36.3)	1.3(0.4–2.2)	16.8(0.6–33.0)	12.4(2.8–22.0)
χ^2	9.510	3.788	3.003	1.360	2.874	1.315	5.207
<i>p</i> value	0.023	0.151	0.391	0.715	0.411	0.726	0.157
Educational level [§]							
Primary schools and below	38.7(23.4–54.1)	1.8(0.0–5.6)	6.7(3.7–9.7)	27.9(15.7–40.1)	5.0(0.0–10.8)	–	3.2(0.0–7.9)
Junior high school	29.8(20.6–39)	8.8(0.0–18.3)	4.8(2.4–7.2)	34.7(26.8–42.6)	0.9(0.0–1.7)	16.2(0.0–39.8)	10.0(2.5–17.6)
Senior high school	20.5(12.2–28.9)	8.0(0.0–20.0)	3.0(1.3–4.7)	25.3(18.5–32.1)	1.0(0.2–1.7)	4.5(0.0–11.7)	6.3(0.3–12.2)
College and above	12.7(8.6–16.7)	11.9(6.1–17.8)	3.6(1.3–5.8)	25.4(19.6–31.2)	2.2(0.4–3.9)	10.6(1.6–19.6)	5.1(1.2–9.0)
χ^2	35.508	1.327	4.517	6.173	7.577	1.901	3.162
<i>p</i> value	<0.0001	0.723	0.211	0.104	0.056	0.387	0.367
Occupation							
Farmer	50.7(23.2–78.2)	5.1(0.0–15.0)	8.4(3.6–13.2)	29.4(8.2–50.6)	7.4(0.0–17.8)	–	20.6(0.0–47.5)
Government/public institution personnel	8.3(2.6–14.0)	15.2(4.4–25.9)	3.9(0.0–9.6)	21.9(10.7–33.1)	3.3(0.0–9.8)	7.9(0.0–23.8)	8.0(0.0–23.4)
Enterprise, commercial, service personnel	20.1(14.7–25.5)	8.6(3.5–13.8)	2.4(0.8–4.1)	29.2(22.8–35.5)	1.7(0.4–3.0)	12.2(0.0–25.6)	5.2(1.4–9.0)
Teacher	0.7(0.0–2.3)	25(0.0–72.6)	13.5(0.0–39.5)	27.2(0.0–57.8)	–	–	–
Medical worker	–	–	4.5(0.0–13.5)	18.0(1.9–34.0)	–	–	–
Unemployed	39.7(0.0–100.0)	24.6(0.0–69.7)	0.3(0.0–0.9)	28.8(9.7–48.0)	–	–	16.3(0.0–38.2)
Others	14.8(8.4–21.3)	7.5(0.4–14.6)	5.0(3.1–6.9)	28.6(23.2–34.1)	1.4(0.3–2.5)	14.2(2.5–25.9)	10.5(3.1–17.9)
χ^2	23.246	4.951	8.620	2.569	4.736	0.226	4.030
<i>p</i> value	0.0003	0.422	0.196	0.861	0.192	0.893	0.402
Total	17.3(13.1–21.9)	10.0(5.4–14.7)	4.2(3.0–5.4)	28.1(23.5–32.6)	1.8(0.9–2.6)	12.1(4.4–19.8)	7.7(3.8–11.6)

Note: Unweighted sample size less than 25, no results are shown. The category that does not show results is eliminated, when doing Chi-square test,

^{*} People who have been to this kind of place in the past 30 days.

[†] Including primary school, middle school, high school, technical secondary school, vocational high school, etc.

[§] The educational level of respondents over 25 years old was only reported.

Abbreviation: CI=confidence intervals.

institutions, and 1.8% for public transports. The proportions of SHS exposure of females in indoor workplaces, restaurants, public transport, and primary and secondary schools were lower than that of men ($p < 0.01$). Different age groups, educational levels, and occupations were contributing factors that influenced the proportion of SHS exposure of indoor workplaces (Table 2).

DISCUSSION

This study indicated that the SHS exposure rate of non-smokers in Shanghai was 46.7% in 2018, which was significantly lower than that of 2016 (58.5%) (5) and also lower than the national average rate (68.1%) in 2018 (6). The highest rate of SHS exposure were among enterprises, businesses, and service workers and may be attributed to more opportunities for exposure due to the nature of their jobs, having more social activities and having been to more places in the last 30 days (in China, sharing cigarettes with others is often considered as a means of building social connections).

Although in Shanghai the current smoking rate in females was much lower than in males (0.8% vs. 19.9% in 2018), the rate of daily SHS exposure among non-smoking females was higher than that in males, which may be attributed to females potentially spending more time indoors where some people may smoke illegally or that women may be more sensitive to smoking behavior and tend to report it. When

comparing the proportions of SHS exposure at home based on different characteristics, the exposure proportions were found to be highest in the group aged 15–24 years, or those with lower educational levels being accompanied by higher exposure proportions, which suggests that teenagers and young adults and the group with lower education were key groups affected by SHS.

The World Health Organization (WHO) suggests that achieving a completely smoke-free environment using legislation is the most effective measure to protect non-smokers from SHS (7) and can also encourage smokers to quit smoking (8). *The Amendment Regulations on Smoking Control in Public Places of Shanghai* had been formally implemented on March 1, 2017 and restricted smoking in all indoor places. In 2018, the law enforcement departments of tobacco control from all levels have made 235,483 inspections, and the number of cases resulting in fines increased by about 20% compared with 2017 and 40% compared with 2016. From 2016 to 2018, the incidence of smoking in the workplace also dropped significantly after the legislation, which was 34.4%, 16.3%, and 15.4%, respectively. The proportion of dissuading or enforcing laws against smoking increased year from 2016 to 2018, and were 40.8%, 46.6%, and 49.3%, respectively. The results of tobacco control has been improved remarkably (9). Similar to Beijing (10), SHS exposure in Shanghai is much lower than other domestic city without legislation (11–12).

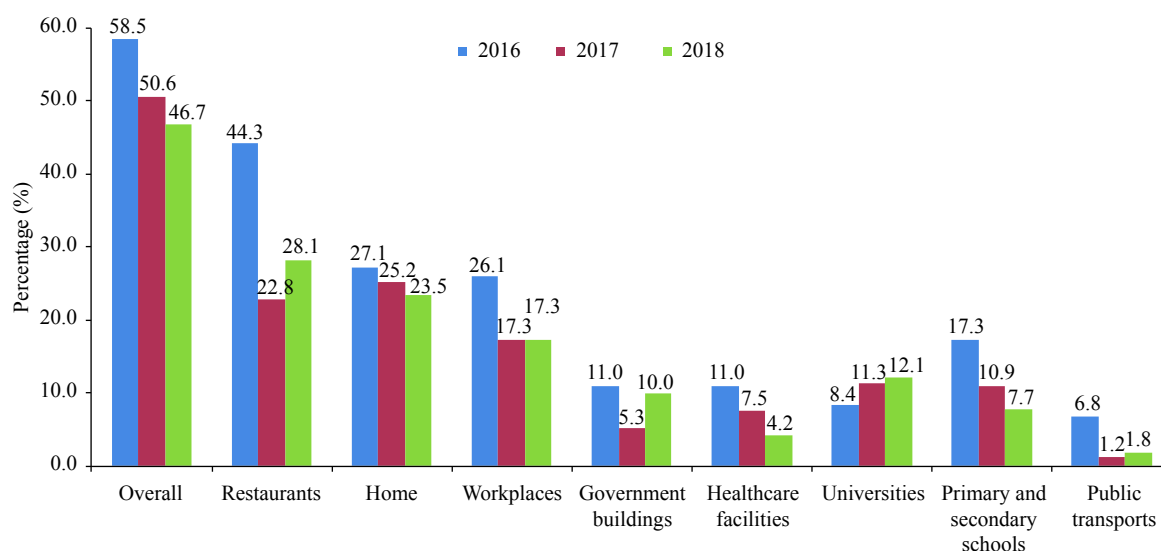


FIGURE 1. Exposure to secondhand smoke inside various public places and overall, GATS Shanghai 2016–2018. Note: The studies used multi-stage, geographically clustered sampling and Global Adult Tobacco Survey (GATS) standard questionnaire, and the data was weighted according to the sampling method, which could represent Shanghai.

Comparing the exposure of SHS before and after the implementation of the regulations (the year of 2007) in various places from 2016 to 2018 (Figure 1), it was found that the exposure dropped significantly after the implementation of the regulations (2017 and 2018) in public transports, medical institutions, indoor workplaces, restaurants, and primary and secondary schools. However, compared with that of 2017, the proportions of those who were exposed to tobacco smoke in the last 30 days in restaurants, government buildings, and universities resurged to a higher level, which was most likely due to weak enforcement of the regulations.

After one year's implementation of *the Amendment Regulation on Smoking Control in Public Places of Shanghai*, the proportion of those who were exposed to tobacco smoke in last 30 days dropped overall and in most indoor places, but some indoor places, such as restaurants, which indicated that regulations enforcement and tobacco control guidance and training needed to be strengthened in addition to public self-discipline and heteronomy in tobacco control.

Acknowledgments: We thank the tobacco control office of Chinese Center for Disease Control and Prevention for their contribution to technical support. We also thank the health education department of Center for Disease Control and Prevention in all districts of Shanghai and all the staff involved in the investigation.

doi: [10.46234/ccdcw2020.102](https://doi.org/10.46234/ccdcw2020.102)

Corresponding authors: Jingrong Gao, 962622384@qq.com; Liming Wu, wlmsh@163.com.

¹ Department of tobacco control and behavioral intervention, Shanghai Municipal Center for Health Promotion, Shanghai, China; ² Tobacco Control Office, Chinese Center for Disease Control and Prevention, Beijing, China.

[§] Joint first authors.

Submitted: May 12, 2020; Accepted: May 22, 2020

REFERENCES

1. Chinese Center for Disease Control and Prevention. 2015 China adult tobacco survey report. Beijing: Chinese Center for Disease Control and Prevention; 2015. (In Chinese).
2. Yang GH, Wang Y, Zeng YX, Gao GF, Liang XF, Zhou MG, et al. Rapid health transition in China, 1990-2010: findings from the Global Burden of Disease Study 2010. *Lancet* 2013;381(9882):1987 – 2015. [http://dx.doi.org/10.1016/S0140-6736\(13\)61097-1](http://dx.doi.org/10.1016/S0140-6736(13)61097-1).
3. Nan Y, Xi Z, Yang Y, Wang LL, Tu MW, Wang JJ, et al. The 2015 China adult tobacco survey: exposure to second-hand smoke among adults aged 15 and above and their support to policy on banning smoking in public places. *Chin J Epidemiol* 2016;37(6):810 – 5. <http://dx.doi.org/10.3760/cma.j.issn.0254-6450.2016.06.014>. (In Chinese).
4. National Bureau of Statistics. The main data bulletin of the sixth national census in Shanghai, 2010. http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/dfkpcgb/201202/t20120228_30403.html. [2020-05-19]. (In Chinese)
5. Chen D, Jiang YY, Wei XX, Wang J, Le KL, Li M, et al. Awareness of tobacco exposure and tobacco hazards among residents of Shanghai in 2016. *Shanghai J Prev Med* 2008;30(8):689 – 93. (In Chinese).
6. Execution in Chinese adult tobacco survey in 2018. http://www.chinacdc.cn/yw_9324/201905/t20190530_202932.html. [2020-04-28]. (In Chinese).
7. Ministry of Health Leader Group Office of the Framework Convention on Tobacco Control, Ministry of Health. 2007 report on tobacco control in China. Beijing: Ministry of Health Leader Group Office of the Framework Convention on Tobacco Control, Ministry of Health;2007. (In Chinese).
8. Luo B, Wan L, Liang L, Li TS. The effects of educational campaigns and smoking bans in public places on smokers' intention to quit smoking: findings from 17 cities in China. *BioMed Res Int* 2015; 2015:853418. <http://dx.doi.org/10.1155/2015/853418>.
9. Central Radio Website. The status of tobacco control in public places in Shanghai 2018 (published the white paper). http://www.cnr.cn/shanghai/tt/20190301/t20190301_524527064.shtml. [2020-04-28]. (In Chinese)
10. Li YQ, Shi JH, Cao Y, Qi L, Liu XR. One year after the implementation of 2015 Tobacco Control Regulation on persons aged 15 years and over tobacco use in Beijing. *Chin J Epidemiol* 2008; 39(9):1188 – 92. <http://dx.doi.org/10.3760/cma.j.issn.0254-6450.2018.09.009>. (In Chinese).
11. Luo Y, Ma LN, Zhou L, Huang XJ, Bian CY, Xu JD. Status of second-hand smoking among adults aged 15 years and above, Hubei. *Mod Prev Med* 2019;46(21):4009 – 13. (In Chinese).
12. Yu GC, Jiang L, Tan F, Wang JJ, Yang Y, Duan ZS, et al. Prevalence of adult smoking and the attitude of banning smoking in indoor public places in Xi'an city. *China J Health Edu* 2008;34(10):882 – 6. <http://dx.doi.org/10.16168/j.cnki.issn.1002-9982.2018.10.004>. (In Chinese).