

# The belief that secondhand smoke causes serious illness among Chinese smokers: Smoking cessation and intention to quit

Zachary Joseph Madewell<sup>1</sup>

## ABSTRACT

**INTRODUCTION** Approximately 70% of Chinese adults are exposed to secondhand smoke (SHS) each week and 100 000 people die from SHS every year in China. This study evaluates associations between the belief that SHS causes serious illness and intention to quit, attempts to quit, and quitting smoking, among Chinese adult smokers.

**METHODS** A nationally representative sample of 4866 current and former adult smokers in the Global Adult Tobacco Survey was used for analysis. Multivariable weighted regression models were built to determine significant associations between smoking cessation behavior and the belief that SHS causes serious illness.

**RESULTS** The belief that SHS causes serious illness was associated with intention to quit (AOR 1.62, 95% CI: 1.24, 2.12) and quitting smoking (AOR 1.44, 95% CI: 1.15, 1.81). Other variables associated with smoking cessation behavior included not permitting smoking at home (intending: AOR 1.59, 95% CI: 1.10, 2.31; attempting: AOR 1.73, 95% CI: 1.25, 2.40; quitting: AOR 2.71, 95% CI: 1.90, 3.89) and the belief that smoking causes serious illness (attempting: AOR 1.63, 95% CI: 1.14, 2.33; quitting: AOR 1.66, 95% CI: 1.21, 2.28).

**CONCLUSIONS** These results indicate that believing SHS causes serious illness may play a role in quitting smoking. In China's collectivistic culture, interventions should focus on how SHS exposure affects the health of friends and family. This message can be combined with other proven tobacco control methods such as: smoking bans in public places, warning labels on cigarette packages, high cigarette taxes, and mass media campaigns to reduce tobacco use.

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## KEYWORDS

smoking cessation, secondhand smoke, China

Received: 15 September 2017

Revised: 7 January 2018

Accepted: 12 January 2018

Tob. Prev. Cessation 2018;4(February):5

<https://doi.org/10.18332/tpc/82813>

## INTRODUCTION

China is the world's largest producer, manufacturer, and consumer of tobacco<sup>1,2</sup>. Chinese men consume over one-third of the world's cigarettes<sup>3,4</sup>. The prevalence of smoking in China among people 15 years or older was 28.1% in 2010, including 52.9% of men and 2.4% of women<sup>2</sup>. Although the quit rate has increased from 3% in 1991 to 9% in 2006, one-third of male smokers will eventually die from tobacco-related disease<sup>3</sup>.

Each year, exposure to secondhand smoke (SHS) causes over 435 000 adult and 165 000 childhood

deaths globally<sup>5</sup>. Worldwide, 40% of children, 35% of women, and 33% of men are exposed to SHS indoors<sup>5</sup>. Adverse health outcomes including ischemic heart disease, lower respiratory infections, asthma, and lung cancer may be reduced with interventions limiting SHS exposure<sup>5</sup>.

Belief that SHS causes serious illness, and that it is associated with smoking behavior, has been studied extensively in Western nations<sup>6,7</sup>. The belief that SHS causes illness, particularly in children, is positively associated with quit attempts among smokers<sup>6,7</sup>. In Australia, one in five smokers attempted to quit due

to concerns that their behavior was causing problems among friends and family<sup>6</sup>.

There is less information in China about the associations between adults' belief that SHS causes serious illness, and behavioral intention to quit, attempts to quit, and quitting smoking. Approximately 70% of adults are exposed to SHS each week and 100 000 people die from SHS every year in China<sup>8</sup>. Of all Chinese adults, 54.3% reported being exposed to SHS at work, 76.3% at restaurants, and 16.4% on public transportation<sup>9</sup>. Lower levels of income and education are associated with higher exposure to SHS in China<sup>10</sup>.

Positive associations were demonstrated between the awareness of personal health risks of smoking, and quit-smoking behavior<sup>11,12</sup>. Results from China's International Tobacco Control survey indicate pressure from friends and family motivate Chinese adults to attempt to quit smoking<sup>11,12</sup>. Health concerns for oneself and one's family were also cited as a primary reason for attempting to quit smoking in a study of male smokers in Hangzhou<sup>13</sup>. It is unclear, however, whether personal health concerns or SHS were the primary motivator for attempting to quit. It remains to be determined whether knowledge that SHS can harm friends and family has an impact on successfully quitting smoking. Described herein is a cross-sectional study of current Chinese smokers, age 15 years and older, surveyed in 2010, to evaluate the associations between the belief that SHS causes serious illness and intention to quit, attempts to quit, and quitting smoking tobacco.

## METHODS

### Questionnaire

The World Health Organization (WHO) and US Centers for Disease Control and Prevention (CDC) launched the Global Adult Tobacco Survey (GATS) in 2007. GATS uses a standardized questionnaire to measure and track smoking, and key tobacco control indicators, in 25 low and middle income countries (LMIC), that account for over half of the world's adult population and smokers<sup>2,4,14,15</sup>. Results from GATS are used to implement tobacco control, prevention measures, and to make comparisons with other countries<sup>2</sup>.

GATS China, a cross-sectional, nationally representative survey, was completed in 2010 and included: population demographics, tobacco usage, quitting behaviors, SHS exposures, economics; and knowledge, attitudes and perceptions about tobacco use<sup>2</sup>. GATS China included

males and females age 15 years and older, excluding those living in dormitories, barracks, prisons, nursing homes, or hospitals<sup>2,4</sup>. Details of the interview, and the data compilation process, are available elsewhere<sup>2,4</sup>.

### Study population

Stratified multi-stage cluster sampling was used, with probability-proportional-to-size random methods, for household selection. The first stage included urban districts or rural counties, the second stage identified neighborhood communities or villages, and the third stage selected groups of households at random<sup>2</sup>. One person was selected randomly from each household to participate in the survey<sup>2</sup>.

GATS China aimed at a sample size of 15 000 participants, representative of China's six geographic regions<sup>2</sup>, each of which were further stratified into urban and rural areas<sup>4</sup>. Following exclusion criteria, 13 562 household interviews were completed, with an overall household response rate of 97.5%<sup>2</sup>. With an individual-level response rate of 98.5%, 13 354 nationally representative men and women age 15 years and older completed the interview in 2010, with 5832 and 7522 participants from urban and rural areas, respectively<sup>2</sup>. There were 4866 ever-smokers (current and former smokers) included for analyses of quitting smoking<sup>2</sup>. Analyses of attempts and intention to quit smoking included 4010 current smokers.

### Variables

The outcome variables for this study included 'ever intended to quit smoking' (yes, no), 'attempted to stop smoking' (yes, no), and 'quit smoking' (current smoker, former smoker). 'Intended to quit' included 'within the next month', 'within the next year', and 'someday but not within the next year'. 'Current' smokers were those who smoked any tobacco product on a daily or less than daily basis. 'Former' smokers were those who, in the past, had smoked any tobacco product daily.

The key exposure variable was 'belief that breathing smoke from other people's cigarettes causes serious illness in non-smokers (yes, no)'.

Covariates included 'believed smoking causes serious illness, stroke, heart disease, or cancer' (yes, no). 'No' also included 'do not know'. Other covariates were 'had seen or heard information about

the dangers of smoking in newspapers, magazines, television, billboards, posters, promotional materials, public transportation vehicles, stations, or somewhere else' (yes, no). 'Somewhere else' included radio, public walls, cinemas, internet, or elsewhere. Another covariate was 'had noticed any advertisements or signs promoting cigarettes anywhere' (yes, no). 'Anywhere' included point of sale, television, radio, billboards, posters, promotional materials, newspapers, magazines, cinemas, internet, public transportation vehicles, stations, public walls, or elsewhere. Other variables were 'visited a doctor or another healthcare provider in the last 12 months' (yes, no) and 'the rule about smoking at home' (allowed, not allowed). 'Allowed' also included 'no rules', and 'don't know'. 'Not allowed' included 'never allowed', and 'not allowed, but exceptions'.

Additional covariates were gender, age group (15-24, 25-44, 45-64, 65+), highest level of education completed (no formal schooling, completed primary, completed secondary, university or higher), employment status over the previous 12 months (agriculture/forestry/fishery employee, transportation/equipment operator, business/service industry employee, other occupation, unemployed), residence (urban, rural), region (North, North-East, East, Mid-South, South-West, North-West).

## Analysis

Descriptive frequencies are reported for current smokers and ever-smokers. Odds ratio (OR) was used to evaluate the magnitude of the associations between exposures of interest (beliefs that smoking or SHS causes illness, stroke, lung cancer, or heart attack; noticed smoking warnings in newspapers, television, billboards, posters, public transportation, or elsewhere; noticed signs promoting cigarettes; the rule about smoking at home; doctor visits; gender; age; education; employment; residence; and region) and outcomes (intention to quit, attempts to quit, and quitting smoking).

Statistical significance was evaluated through the Wald chi-square test. Variables found to be significant at  $p < 0.10$  from bivariate analyses were included in step-wise multivariable logistic regression models to evaluate associations with the outcomes of interest (intention to quit, attempts to quit, and quitting smoking). Variables associated with outcomes at  $p < 0.05$ , as well as the main exposure, the belief that

SHS causes serious illness, were retained in the final models. The order of variables included in models was determined by significance. After significant variables were entered into the models from bivariate analyses, interaction terms cited in the literature were assessed, including the belief that SHS causes serious illness by gender, education, and home smoking rules<sup>2,16,17</sup>. Pairwise correlation coefficients, tolerance values, and the condition number (CN) were examined to assess interrelationships among covariates similar in construct for collinearity<sup>18</sup>. Adjusted ORs and 95% Confidence Intervals (CIs) are reported. All analyses were calculated using SAS V.9.4 (SAS Institute, Inc., Cary, North Carolina). The *surveyfreq* and *surveylogistic* procedures were used to account for cluster, strata, and weight factors.

## RESULTS

Of the nationally representative sample of 13 354 men and women in China in 2010, current smokers were 4010 and former smokers were 856. After accounting for cluster, strata, and weight factors, this represents 28.1% as current smokers and 5.4% as former smokers (Table 1). Correlation matrices revealed no highly correlated interrelationships among any of the covariates examined, the tolerance values were well above 0.10, and the CN=3.36 was far below the rule-of-thumb of 30 (not tabulated)<sup>18</sup>. Therefore, there was no evidence of collinearity.

## Intended to quit

Variables associated with intention to quit from bivariate analyses at  $p < 0.10$  included the belief that: SHS causes serious illness ( $p < 0.001$ ); the belief that smoking causes serious illness ( $p < 0.001$ ) or lung cancer ( $p = 0.001$ ); home smoking rules ( $p = 0.005$ ); noticed information about the dangers of smoking on billboards ( $p = 0.022$ ), on television ( $p = 0.020$ ), or on public vehicles ( $p < 0.001$ ); noticed signs promoting cigarettes ( $p = 0.018$ ); age ( $p < 0.001$ ); and education ( $p = 0.001$ ) (Table 2).

The final model for current smokers intending to quit smoking included the belief that SHS causes serious illness (AOR: 1.62; 95% CI: 1.24, 2.12, Table 2), the belief that smoking causes lung cancer (AOR: 1.36, 95% CI: 1.00, 1.83), and rules not allowing smoking at home (AOR: 1.59, 95% CI: 1.10, 2.31). Interaction terms were not significant at  $p < 0.05$ .

**Table 1. Descriptive statistics<sup>a</sup> of current and former smokers, 2010 China Global Adult Tobacco Survey**

Characteristic	Current smokers Proportion % (Std Err %)	Former smokers Proportion % (Std Err %)
<b>Believe SHS causes illness</b>		
Yes	59.4 (2.3)	67.0 (2.7)
No	40.6 (2.3)	33.0 (2.7)
<b>Believe smoking causes Serious illness</b>		
Yes	79.7 (1.6)	86.7 (2.0)
No	20.3 (1.6)	13.3 (2.0)
<b>Lung cancer</b>		
Yes	81.8 (1.6)	82.0 (2.2)
No	18.2 (1.6)	18.0 (2.2)
<b>Stroke</b>		
Yes	32.2 (1.9)	36.4 (2.7)
No	67.8 (1.9)	63.6 (2.7)
<b>Heart attacks</b>		
Yes	42.5 (1.8)	48.7 (3.0)
No	57.5 (1.8)	51.3 (3.0)
<b>Rule about smoking at home</b>		
Not allowed	12.7 (1.4)	27.2 (3.5)
Allowed	87.3 (1.4)	72.8 (3.5)
<b>Noticed smoking warnings (ref: no)</b>		
<b>In newspapers</b>		
Yes	22.1 (2.0)	23.4 (2.6)
No	77.9 (2.0)	76.6 (2.6)
<b>On billboards</b>		
Yes	20.6 (2.2)	19.8 (2.3)
No	79.4 (2.2)	80.2 (2.3)
<b>On television</b>		
Yes	46.8 (2.9)	47.9 (2.9)
No	53.2 (2.9)	52.1 (2.9)
<b>On posters</b>		
Yes	9.7 (1.5)	8.8 (1.5)
No	90.3 (1.5)	91.2 (1.5)
<b>On vehicles</b>		
Yes	21.0 (2.4)	17.9 (2.3)
No	79.0 (2.4)	82.1 (2.3)
<b>Elsewhere</b>		
Yes	15.6 (1.7)	15.0 (2.5)
No	84.4 (1.7)	85.0 (2.5)
<b>Noticed cigarette promotions</b>		
Yes	19.1 (2.0)	12.8 (1.8)

Continued

**Table 1.** Continued

Characteristic	Current smokers Proportion % (Std Err %)	Former smokers Proportion % (Std Err %)
No	80.9 (2.0)	87.2 (1.8)
<b>Visited a doctor in past year<sup>b</sup></b>		
Yes	29.2 (1.8)	-
No	70.8 (1.8)	-
<b>Gender</b>		
Male	95.8 (0.5)	93.4 (1.0)
Female	4.2 (0.5)	6.6 (1.0)
<b>Age</b>		
15-24	10.9 (1.4)	5.8 (1.9)
25-44	42.4 (1.7)	24.3 (2.3)
45-64	37.6 (1.3)	41.7 (3.0)
65+	9.1 (0.6)	28.2 (2.6)
<b>Education</b>		
<Primary	11.8 (1.1)	17.8 (2.0)
<Secondary	18.6 (1.6)	23.7 (2.2)
Secondary	59.8 (2.0)	49.4 (2.7)
College	9.8 (1.2)	9.1 (1.6)
<b>Employment</b>		
Unemployed	12.0 (1.3)	32.5 (3.4)
AFF	34.5 (4.0)	31.0 (4.2)
Transportation	19.6 (1.9)	8.9 (1.7)
Business/service	16.5 (1.6)	10.2 (1.5)
Other	17.4 (1.7)	17.4 (3.1)
<b>Residence</b>		
Rural	57.2 (5.5)	54.6 (5.5)
Urban	42.8 (5.5)	45.4 (5.5)
<b>Region</b>		
North	13.1 (2.0)	8.4 (1.5)
North-East	10.7 (0.9)	19.0 (2.9)
East	28.0 (3.0)	32.2 (4.1)
Mid-South	17.8 (1.7)	17.1 (2.1)
South-West	23.7 (2.3)	17.7 (4.2)
North-West	6.7 (1.6)	5.6 (1.8)

SHS: secondhand smoke; AFF: agriculture, forestry, fishing

<sup>a</sup> Sample weights were used to account for clustering and stratification factors

<sup>b</sup> Collected for current smokers only

### Attempted to quit

Variables associated with attempts to quit from bivariate analyses at  $p < 0.10$  included the belief that smoking causes serious illness ( $p = 0.004$ ) and heart attacks

Table 2. Intended to quit smoking: unadjusted and adjusted associations<sup>a</sup> with the belief that secondhand smoke causes serious illness among current smokers, 2010 China Global Adult Tobacco Survey

Characteristic	Intended to quit prevalence % (Std Err %)	Unadjusted OR (95% CI)	p-value	Adjusted <sup>b</sup> OR (95% CI)	p-value
Believe SHS causes illness (ref: no)	46.8 (2.9)	1.79 (1.40, 2.29)	<0.001	1.62 (1.24, 2.12)	<0.001
Believe smoking causes (ref: no)					
Serious illness	45.6 (2.6)	2.67 (2.07, 3.45)	<0.001	-	-
Lung cancer	43.3 (2.6)	1.65 (1.23, 2.20)	0.001	1.36 (1.00, 1.83)	0.044
Stroke	41.6 (3.6)	1.02 (0.75, 1.41)	0.882	-	-
Heart attacks	43.2 (3.2)	1.15 (0.89, 1.49)	0.283	-	-
Smoking not allowed at home (ref: allowed)	53.2 (4.2)	1.74 (1.18, 2.57)	0.005	1.59 (1.10, 2.31)	0.013
Noticed smoking warnings (ref: no)					
In newspapers	45.5 (3.7)	1.25 (0.92, 1.70)	0.149	-	-
On billboards	48.1 (4.2)	1.43 (1.05, 1.94)	0.022	-	-
On television	44.6 (2.6)	1.30 (1.04, 1.62)	0.020	-	-
On posters	45.4 (5.9)	1.21 (0.78, 1.87)	0.388	-	-
On vehicles	49.6 (3.1)	1.54 (1.23, 1.93)	<0.001	-	-
Elsewhere	48.2 (6.5)	1.40 (0.89, 2.21)	0.140	-	-
Noticed cigarette promotions (ref: no)	48.2 (4.5)	1.42 (1.06, 1.91)	0.018	-	-
Visited a doctor in past year (ref: no)	43.6 (2.1)	1.15 (0.92, 1.44)	0.225	-	-
Male (ref: female)	41.5 (2.3)	1.39 (0.90, 2.17)	0.136	-	-
Age (ref: 15-24)			<0.001		-
25-44	44.4 (3.2)	1.32 (0.75, 2.30)		-	
45-64	41.3 (2.6)	1.16 (0.72, 1.88)		-	
65+	30.2 (2.9)	0.71 (0.41, 1.25)		-	
Education (ref: <primary)			0.001		-
<Secondary	38.3 (2.4)	1.32 (0.97, 1.80)		-	
Secondary	44.5 (3.0)	1.71 (1.31, 2.24)		-	
College	37.8 (3.8)	1.29 (0.89, 1.88)		-	
Employment (ref: unemployed)			0.144		-
AFF	43.0 (4.7)	1.10 (0.76, 1.60)		-	
Transportation	38.4 (2.2)	0.91 (0.66, 1.26)		-	
Business/service	49.1 (4.7)	1.41 (1.00, 1.98)		-	
Other	37.0 (3.4)	0.86 (0.61, 1.21)		-	
Rural residence (ref: urban)	41.1 (2.5)	0.99 (0.68, 1.42)	0.941	-	-
Region (ref: South-West)			0.954		-
North	43.2 (4.7)	0.84 (0.45, 1.57)		-	
North-East	39.0 (4.3)	0.90 (0.53, 1.53)		-	
East	38.9 (5.6)	1.00 (0.57, 1.76)		-	
Mid-South	40.7 (3.9)	0.84 (0.48, 1.46)		-	
North-West	44.5 (5.8)	1.06 (0.56, 1.97)		-	

CI: confidence interval; OR: odds ratio; SHS: secondhand smoke; AFF: agriculture, forestry, fishing

<sup>a</sup> Sample weights were used to account for clustering and stratification factors

<sup>b</sup> Adjusted for all of the other variables listed in the model

(p=0.092), home smoking rules (p<0.001), noticed information about the dangers of smoking in newspapers (p=0.016) or on billboards (p=0.001), visited a doctor

(p=0.010), and age (p=0.065) (Table 3).

The final model for current smokers attempting to quit smoking included the belief that SHS causes

**Table 3. Attempted to quit smoking: unadjusted and adjusted associations<sup>a</sup> with the belief that secondhand smoke causes serious illness among current smokers, 2010 China Global Adult Tobacco Survey**

Characteristic	Attempted to quit prevalence % (Std Err %)	Unadjusted OR (95% CI)	p-value	Adjusted <sup>b</sup> OR (95% CI)	p-value
Believe SHS causes illness (ref: no)	38.0 (2.7)	1.05 (0.79, 1.40)	0.745	0.84 (0.60, 1.16)	0.282
Believe smoking causes (ref: no)					
Serious illness	39.6 (2.3)	1.58 (1.15, 2.16)	0.004	1.63 (1.14, 2.33)	0.007
Lung cancer	38.0 (2.2)	1.13 (0.85, 1.52)	0.398	-	-
Stroke	38.8 (2.6)	1.09 (0.84, 1.40)	0.522	-	-
Heart attacks	40.0 (2.7)	1.20 (0.97, 1.49)	0.092	-	-
Smoking not allowed at home (ref: allowed)	50.2 (3.5)	1.82 (1.32, 2.50)	<0.001	1.73 (1.25, 2.40)	0.001
Noticed smoking warnings (ref: no)					
In newspapers	42.8 (2.5)	1.33 (1.05, 1.68)	0.016	-	-
On billboards	44.6 (2.8)	1.45 (1.15, 1.83)	0.001	1.34 (1.03, 1.75)	0.026
On television	39.7 (1.9)	1.19 (0.90, 1.57)	0.225	-	-
On posters	40.8 (4.1)	1.16 (0.82, 1.64)	0.387	-	-
On vehicles	37.0 (3.4)	0.97 (0.72, 1.31)	0.860	-	-
Elsewhere	38.9 (4.0)	1.07 (0.77, 1.50)	0.675	-	-
Noticed cigarette promotions (ref: no)	35.7 (3.2)	0.91 (0.68, 1.22)	0.515	-	-
Visited a doctor in past year (ref: no)	43.6 (2.6)	1.43 (1.09, 1.88)	0.010	1.46 (1.12, 1.90)	0.005
Male (ref: female)	37.6 (2.0)	1.06 (0.71, 1.59)	0.759	-	-
Age (ref: 15-24)			0.065		-
25-44	35.8 (2.4)	1.48 (0.88, 2.49)		-	
45-64	42.2 (2.5)	1.94 (1.08, 3.49)		-	
65+	38.4 (3.0)	1.65 (0.84, 3.24)		-	
Education (ref: <primary)			0.128		-
<Secondary	40.2 (2.8)	1.30 (1.04, 1.63)		-	
Secondary	37.6 (2.5)	1.17 (0.89, 1.53)		-	
College	36.2 (3.4)	1.10 (0.79, 1.53)		-	
Employment (ref: unemployed)			0.616		-
AFF	37.6 (3.6)	0.80 (0.54, 1.19)		-	
Transportation	35.2 (4.0)	0.73 (0.48, 1.11)		-	
Business/service	37.1 (3.1)	0.79 (0.51, 1.21)		-	
Other	36.7 (2.8)	0.77 (0.52, 1.16)		-	
Rural residence (ref: urban)	38.6 (2.7)	1.12 (0.83, 1.50)	0.463	-	-
Region (ref: South-West)			0.188		-
North	37.6 (2.5)	1.31 (0.81, 2.12)		-	
North-East	44.5 (4.4)	1.75 (1.00, 3.06)		-	
East	34.5 (3.8)	1.15 (0.66, 1.98)		-	
Mid-South	44.6 (4.3)	1.75 (1.01, 3.04)		-	
North-West	41.3 (5.5)	1.53 (0.82, 2.85)		-	

CI: confidence interval; OR: odds ratio; SHS: secondhand smoke; AFF: agriculture, forestry, fishing

<sup>a</sup> Sample weights were used to account for clustering and stratification factors

<sup>b</sup> Adjusted for all of the other variables listed in the model

serious illness (AOR 0.84, 95% CI: 0.60, 1.16, Table 3), the belief that smoking causes serious illness (AOR: 1.63, 95% CI: 1.14, 2.33), rules not allowing

smoking at home (AOR: 1.73, 95% CI: 1.25, 2.40), noticed smoking warnings on billboards (AOR: 1.43, 95% CI: 1.03, 1.75), and visited a doctor within the

past year (AOR: 1.46, 95% CI: 1.12, 1.90). Interaction terms were not significant at  $p < 0.05$ .

### Quit smoking

Variables associated with quitting smoking from bivariate analyses at  $p < 0.10$  included the belief that SHS causes

serious illness ( $p = 0.004$ ), the belief that smoking causes serious illness ( $p = 0.001$ ) or heart attacks ( $p = 0.006$ ), home smoking rules ( $p < 0.001$ ), noticed signs promoting cigarettes ( $p = 0.004$ ), gender ( $p = 0.005$ ), age ( $p < 0.001$ ), education ( $p = 0.001$ ), employment ( $p < 0.001$ ), and region ( $p < 0.001$ ) (Table 4).

**Table 4. Quit smoking: unadjusted and adjusted associations<sup>a</sup> with the belief that secondhand smoke causes serious illness among ever-smokers<sup>b</sup>, 2010 China Global Adult Tobacco Survey**

Characteristic	Prevalence % among former smokers (Std Err %)	Unadjusted OR (95% CI)	p-value	Adjusted <sup>b</sup> OR (95% CI)	p-value
Believe SHS causes illness (ref: no)	17.7 (1.5)	1.38 (1.10, 1.73)	0.004	1.44 (1.15, 1.81)	0.002
Believe smoking causes (ref: no)					
Serious illness	17.2 (1.3)	1.66 (1.21, 2.27)	0.001	1.66 (1.21, 2.28)	0.002
Lung cancer	16.1 (1.2)	1.01 (0.77, 1.32)	0.946	-	-
Stroke	17.8 (1.9)	1.21 (0.93, 1.56)	0.148	-	-
Heart attacks	18.8 (1.7)	1.43 (1.10, 1.85)	0.006	-	-
Smoking not allowed at home (ref: allowed)	29.1 (3.5)	2.57 (1.86, 3.56)	<0.001	2.71 (1.90, 3.89)	<0.001
Noticed smoking warnings (ref: no)					
In newspapers	16.8 (2.1)	1.08 (0.78, 1.49)	0.661	-	-
On billboards	15.5 (2.0)	0.95 (0.69, 1.30)	0.732	-	-
On television	16.4 (1.3)	1.04 (0.78, 1.41)	0.774	-	-
On posters	14.8 (2.3)	0.90 (0.62, 1.33)	0.599	-	-
On vehicles	14.0 (2.0)	0.82 (0.59, 1.16)	0.255	-	-
Elsewhere	15.5 (2.7)	0.96 (0.65, 1.41)	0.817	-	-
Noticed cigarette promotions (ref: no)	11.4 (1.7)	0.62 (0.45, 0.86)	0.004	-	-
Male (ref: female)	15.7 (1.1)	0.62 (0.44, 0.87)	0.005	-	-
Age (ref: 15-24)			<0.001		<0.001
25-44	9.9 (1.5)	1.06 (0.54, 2.08)		1.02 (0.54, 1.92)	
45-64	17.5 (1.2)	2.06 (0.97, 4.38)		1.92 (0.97, 3.80)	
65+	37.2 (2.5)	5.76 (3.01, 11.03)		4.72 (2.68, 8.32)	
Education (ref: <primary)			0.001		-
<Secondary	19.5 (1.9)	0.84 (0.60, 1.19)		-	
Secondary	13.6 (1.4)	0.55 (0.41, 0.74)		-	
College	15.1 (2.0)	0.62 (0.41, 0.93)		-	
Employment (ref: unemployed)			<0.001		<0.001
AFF	14.7 (1.6)	0.33 (0.24, 0.46)		0.60 (0.44, 0.82)	
Transportation	8.0 (1.5)	0.17 (0.10, 0.27)		0.29 (0.17, 0.49)	
Business/service	10.5 (1.7)	0.23 (0.16, 0.33)		0.39 (0.27, 0.57)	
Other	16.0 (2.8)	0.37 (0.24, 0.58)		0.56 (0.36, 0.89)	
Rural residence (ref: urban)	15.4 (1.3)	0.90 (0.67, 1.20)	0.468	-	-
Region (ref: South-West)			<0.001		0.001
North	10.9 (1.5)	0.86 (0.47, 1.56)		1.62 (0.87, 3.02)	
North-East	25.4 (3.1)	2.39 (1.31, 4.36)		1.52 (0.85, 2.72)	
East	18.0 (2.4)	1.54 (0.84, 2.82)		0.76 (0.38, 1.49)	
Mid-South	15.5 (2.0)	1.29 (0.71, 2.33)		2.23 (1.23, 4.05)	
North-West	13.8 (3.0)	1.13 (0.55, 2.31)		0.88 (0.39, 1.99)	

CI: confidence interval; OR: odds ratio; SHS: secondhand smoke; AFF: agriculture, forestry, fishing

<sup>a</sup> Sample weights were used to account for clustering and stratification factors

<sup>b</sup> Ever-smokers include current and former smokers

<sup>c</sup> Adjusted for all of the other variables listed in the model

The final model for ever-smokers quitting smoking included the belief that SHS causes serious illness (AOR: 1.44; 95% CI: 1.15, 1.81, Table 4), the belief that smoking causes serious illness (AOR: 1.66, 95% CI: 1.21, 2.28), and rules not allowing smoking at home (AOR: 2.71, 95% CI: 1.90, 3.89). The final model also included age ( $p < 0.001$ ), employment ( $p < 0.001$ ), and region ( $p = 0.001$ ) (Table 4). Interaction terms were not significant at  $p < 0.05$ .

## DISCUSSION

The results of this study demonstrate that current smokers' attitudes about exposure to SHS could play an important role in the overall strategy to reduce tobacco use in China. The aim of this study was to ascertain whether the belief that SHS causes serious illness was associated with intention to quit, attempts to quit, and quitting smoking among Chinese adult smokers. After adjusting for covariates, there was a significant association between the belief that SHS causes serious illness and intention to quit and quitting smoking. But the association between the belief that SHS causes serious illness and attempting to quit smoking did not reach statistical significance. Analyses also indicated significant associations with several covariates: rules about smoking at home, noticed information on billboards about the dangers of smoking, noticed signs promoting cigarettes, visited a doctor within the past year, and the belief that smoking causes lung cancer. The belief that exposure to SHS causes serious illness is an additional element to include in a comprehensive tobacco-control strategy.

The finding that smokers who believe SHS exposure causes serious illness were more likely to intend to quit smoking or quit smoking is consistent with other studies<sup>6,19</sup>. Concern about exposing others, particularly children, to SHS has been cited as one of the strongest indicators for quitting smoking<sup>19,20</sup>. Increasing knowledge of the dangers of SHS also decreases tolerance for smoking at home<sup>6,19,20</sup>. This finding may in part be explained by Chinese culture, which values responsibility to one's family and filial piety respect for one's parents and ancestors<sup>11,13</sup>. China has a highly collectivistic culture in which the needs of the group come before the needs of the individual<sup>21</sup>. If smoking is perceived as a threat to the health of one's family, collectivism may explain a

willingness among Chinese smokers to quit smoking in order to protect members of their in-group<sup>21,22</sup>. Social disapproval of smoking is a more significant predictor of regretting smoking in China than in Western countries, which may induce quitting smoking behavior<sup>22,23</sup>. Strong family relationships are also associated with abstaining from smoking in China<sup>25</sup>. Future anti-tobacco campaigns should focus on education about the dangers of exposures to SHS in the context of one's in-group and family<sup>25,26</sup>.

Although only 2.4% of women smoke in China, 72.4% are exposed to SHS, with 38.0% exposed on a daily basis, many of whom do not recognize the dangers of SHS exposure<sup>27</sup>. Consequently, women bear nearly 80% of the burden of disease due to SHS exposure<sup>28</sup>. Children in China with chronic exposure to SHS have respiratory problems that continue into adulthood, including impaired lung function, coughing, sneezing, and phlegm<sup>29</sup>. Smoke-free laws that are strictly enforced have resulted in a significant reduction in SHS exposure in the public places of Guangzhou, Harbin, Shanghai, Shenzhen, and Tianjin<sup>30</sup>. Greater efforts are required to promote smoke-free environments that weaken smoking customs<sup>30</sup>.

After adjusting for covariates, the belief that SHS causes serious illness did not reach statistical significance for attempting to quit smoking. Previous research has demonstrated that health concerns for friends and family are among the primary reasons Chinese adult smokers attempt to quit smoking<sup>11,12</sup>. However, quit attempts are less successful in China among smokers without firsthand experiences of the adverse health effects of smoking tobacco, personally or within the family<sup>11,12</sup>. Education must also include outreach to smokers living alone and who may not feel the onus of protecting family and friends.

The finding that adult smokers who did not allow smoking at home were 2.46 times more likely to quit smoking is in accord with published data<sup>31,32</sup>. Home-smoking bans have proven to be powerful smoking interventions: they reduce the likelihood of being a current smoker, reduce the number of cigarettes consumed per day, and increase the number of quit attempts<sup>31</sup>. In China, concern regarding the health effects of SHS exposure was the greatest reason for not allowing smoking at home, but most families still allow smoking in at least one room<sup>2,32</sup>. Current laws

in China ban smoking in selected outdoor locations and all indoor public places, including gymnasiums, libraries, museums, trains, classrooms, dorms, and schools<sup>2</sup>. There is a paucity of information about penalties for violations of these regulations however, and there is no national ban on smoking in the workplace in China<sup>2</sup>.

The result that smokers who noticed information about the dangers of smoking on billboards were more likely to have attempted to quit also aligns with the literature, which demonstrates that mass media campaigns are effective tobacco-control methods<sup>33,34</sup>. Of the media analyzed that displayed smoking, only billboards reached statistical significance for attempted to quit. Visually explicit advertisements are particularly successful for increasing quit attempts<sup>34</sup>. Billboards displaying adverse health outcomes of smoking increase public awareness of smoking dangers and decrease smoking prevalence<sup>33</sup>. Billboards may also include *Quitline* service information, which has shown promise as a smoking cessation service in Hong Kong<sup>35</sup>.

The results further suggest that adult smokers who believe smoking causes serious illness were more likely to have intended or attempted to quit, which is in accord with other studies<sup>25,26</sup>. Most former smokers cite health concerns as the primary motivation for quitting smoking, but the perceived risks and harms of smoking are low in China compared to other countries<sup>25,26</sup>. Among Chinese smokers, the greatest factor for attempting and intending to quit is knowledge of the adverse health effects of smoking, but misconceptions regarding health consequences of smoking remain pervasive among Chinese smokers<sup>11,12</sup>. Educational campaigns to improve public perceptions of smoking risks, combined with social support and accessible smoking cessation clinics, are effective strategies to increase quit attempts<sup>11,12,36</sup>.

Noticing signs promoting cigarettes was not significantly associated in this study with quitting smoking behavior, and numerous studies have demonstrated that tobacco advertisements foster positive attitudes about tobacco use<sup>37,38</sup>. At the time GATS was conducted in 2010, China did not have laws or regulations for restricting the advertising or promoting of tobacco products<sup>2,38</sup>. Since GATS was conducted, a subsequent law banned the use of signs

and mass media to advertise or promote cigarettes<sup>2</sup>. The challenge is to ensure that these new regulations are enforced<sup>2</sup>.

Smokers who attempted to quit smoking were more likely to have visited a doctor within the past year, which also agrees with the literature<sup>20,39</sup>. Simple advice or brief interventions from nonsmoking physicians have been shown to be a cost-effective means to increase quit attempts and quit rates<sup>20,39</sup>. Larger interventions and pharmacotherapy are even more successful for smokers with high nicotine dependence in China<sup>39,40</sup>. However, this message may be muted by virtue of the fact that 46.7% of male physicians in China have been reported as active smokers<sup>41</sup>.

### Limitations

The findings of this study are subject to limitations. The use of cross-sectional survey data limits our ability to make causal inferences between the exposure variables and quitting smoking behavior. Furthermore, the overall prevalence of smoking has likely been under represented as roughly 200 million Chinese workers, who are known to have a disproportionately high number of smokers compared to the rest of the country, work and live in temporary accommodation away from their registered household<sup>2</sup>. Another limitation is that GATS data include only one smoker per household, which precludes the analysis of the influence of other smokers on smoking proclivity<sup>2</sup>. Other survey limitations include self-reporting and recall biases<sup>2</sup>.

### CONCLUSIONS

The results of this study contribute an additional significant tenet to a comprehensive tobacco-control strategy, namely, the belief that exposure to SHS causes serious illness. This message can be incorporated into the other, established control methods like explicit warning labels, high taxes, physician advice, and mass media campaigns, to help decrease the overall burden of tobacco use.

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#### ACKNOWLEDGEMENTS

The author appreciates the encouragement, assistance and advice from Dr. Thomas Novotny, MD, MPH, Deputy Assistant Secretary for Health (Science and Medicine), U.S. Department of Health & Human Services.

#### CONFLICT OF INTEREST

Author has completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

#### FUNDING

There was no source of funding for this research.

#### PROVENANCE AND PEER REVIEW

Not commissioned; externally peer reviewed