



Household smoking restrictions among urban residents in China: individual and regional influences

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Abstract

Objectives The present study examines individual and regional influences on household smoking restrictions (HSR) in China.

Methods Participants were 16,866 urban residents, who were identified through a multistage survey sampling process conducted in 21 Chinese cities. The data collection instrument was a self-administered questionnaire. The sample was characterized in terms of the prevalence of complete HSRs. Multilevel logistic regression models were used to examine individual and environmental influences on HSR.

Results Almost 22 % of respondents reported HSR. Both individual and regional-level restrictions on smoking in the workplace were associated with HSR. There was a negative association between individual household income and HSR, and positive associations between HSR awareness of secondhand smoking (SHS), and smoking in smoke-free public places, respectively.

Conclusions This study revealed individual and regional influences on HSR in China. Findings underscore that efforts to restrict smoking in Chinese households should emphasize environmental smoking restrictions, while simultaneously raising public awareness of the perils of SHS. This information should be considered in designing interventions to sustain and promote the adoption of HSR in Chinese and other populations.

Keywords Tobacco control · Secondhand smoke (SHS) · Environmental tobacco smoke (ETS) · Household smoking restrictions (HSR)

Introduction

Ecological models have emphasized that household smoking restrictions (HSR) are influenced by both individual and environmental variables. Many studies have shown that demographic and social variables are associated with HSR (Gilpin et al. 1999; Pizacani et al. 2003; Shelley et al. 2006). Smokers and individuals who lack awareness that secondhand smoke (SHS) is harmful to health are less likely to report a complete household smoking ban compared to non-smokers and those who do believe SHS is harmful (Gilpin et al. 1999; Shelley et al. 2006). Other studies found that indoor clean air laws in public places or smoke-free workplaces are associated with large increases in voluntary HSR (Cheng et al. 2001; Akhtar et al. 2009). A better understanding of these connections would help improve the design and implementation of public health interventions and policies. However, most HSR studies only examined individual-level correlates (Shelley et al. 2006; Cheng et al. 2001; Akhtar et al. 2009). Furthermore, Chinese studies have focused on the description of HSR

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prevalence and associated demographic characteristics (Yang et al. 2011; Wang et al. 2009). This is probably because most were confined to local and community sub-populations, and therefore provided no basis for analyzing regional variation in HSR.

When compared to individual variables, regional variables yield more stable estimates of personal social and economic environments. Furthermore, multilevel analyses can allow for separation of individual and contextual effects upon smoking and thus avoid ecologic and atomistic fallacies (Gilpin et al. 1999). The Chinese mainland is vast and culturally diverse, with disparate economic and social development. By utilizing a large-scale, national population sample, it is possible to accommodate such variability within this study.

The purpose of this research was to examine HSR explanatory variables at both individual and regional levels among Chinese urban residents. We evaluated the hypothesis that individual sociodemographic variables, smoking status, smoking in smoke-free public places, awareness of SHS harmful effects (Yang et al. 2011; Wang et al. 2009; Gilpin et al. 1999; Pizacani et al. 2003; Shelley et al. 2006), and regional location, economic development, and smoking restrictions in public places and workplaces are associated with HSR (Akhtar et al. 2009; Cheng et al. 2001; Gilpin et al. 1999).

Methods

Study area and participants

This study used a cross-sectional multistage sampling design. In Stage 1, twenty-one cities were selected from across China and differentiated by regional location: Nine were located in eastern China, five in central China, and the remaining seven in the west. In Stage 2, two residential districts were randomly selected from the main urban zones of each city. For the purpose of this study, urban zones were those areas where most permanent residents live, excluding new building districts and sub-districts where many rural migrants reside. In Stage 3, four communities were randomly selected within each residential district. In Stage 4, a family household registration (“hukou”) list was used to randomly sample households from the selected communities. Individuals aged 15 years and older, who had lived in their home for at least 1 year, were identified within each household. Finally, one respondent whose birthdate was closest to the date of contact was selected from each family to be surveyed.

Data collection

A self-administered questionnaire was scheduled, once an individual was identified and agreed to participate in the

survey. Field staffs were fourth-year medical students from a local medical college, who had received a 1-day training on the study protocol and interviewing procedures. The questionnaire was administered privately in participants’ homes or in a designated quiet place, such as a backyard or community park. Survey were conducted on Saturdays, Sundays, weekday evenings or other times when participants were available. After receiving oral instructions by staff about the survey and questionnaire, the questionnaire was given to each participant to complete. Completion took approximately 30 min. Participants could ask staff if they were confused about any items on the questionnaire. For participants with low educational levels or physical limitations, a survey staff member read the entire questionnaire. Each participant was given an opportunity to clarify confusing questions and adequate time to questionnaire completion.

The same survey protocol was used across the 21 cities to assure homogeneity of interview and data collection. The study was approved by the Ethics Committee of the Medical Center, Zhejiang University, and verbal consent was obtained from all respondents prior to its commencement.

Dependent variable

HSRs respondents were asked what HSRs they currently had in their homes, with options covering no restrictions, restrictions in some places, or restrictions in all places. Their responses were recorded dichotomously as 1 = no smoking restrictions or partial restrictions and 2 = complete restrictions.

Individual-level independent variables

Sociodemographics Individual-level data were collected on age, gender, ethnicity, marital status, education, occupation, and per capita household income.

Smoking variables Smoking status, including frequency and quantity of smoking, smoking history, and smoking situation, was assessed through self-report. For these variables, standard measures developed for use in previous studies were utilized (World Health Organization 1998; Chinese Center for Disease Control and Prevention 2011; Yang et al. 2013). Several other variables related to smoking were also included. Respondents were asked whether they most frequently smoked alone or with others (smoking types). Smoking in smoke-free public venues was measured with several questions. First, they were asked if they had been in public places, including restaurants, hospitals, and shops in their city with the last 6 months (yes/no)? Following this question they were asked whether they observed any “no smoking” signs in

these venues, with response options of yes or no, if these two questions were answered “yes”, they were then asked if they had ever smoked at the non-smoking locations, responses were coded 1 if they had not smoked and 2 if they had (Yang et al. 2011). If they were smokers, they were also asked whether they thought that their smoking was harmful to the health of others (awareness of SHS harm). SHS exposure was measured by asking respondents whether they were exposed to SHS daily, and for at least 15 min (Yang et al. 2011).

Environmental smoking restrictions

Two aspects of this variable were measured: smoking restrictions in public places and smoking restrictions in workplaces (Yang et al. 2011, 2013). In order to examine smoking restrictions in public places, respondents were asked two questions. First, they were asked if they had been in public places, including restaurants, hospitals, and shops in their city with the last 6 months (yes/no)? They were then asked whether they observed any “no smoking” signs in these venues, Optional responses were no restrictions/restrictions. To examine smoking restrictions in workplaces, respondents were asked what restrictions were implemented at their current workplace, with options covering none/restrictions in some places/restrictions in all places. Responses were recoded dichotomously as 1 = no smoking restrictions or partial restrictions and 2 = complete restrictions. For retired or unemployed respondents, ‘workplace’ referred to the place where they went for temporary work, leisure, or community activities. For students, the workplace covered classrooms and libraries (Yang et al. 2011).

Regional-level independent variables

There were three regional-level independent variables representing different aspects of the concept of region. The first was location, and was categorized as east, central, and west. The second aspect was level of economic development, as measured by per capita Gross Domestic Product (GDP). GDP was categorized as <40,000, 40,000–49,999, and 50,000+ Yuan. The data were obtained from the Department of Comprehensive Statistics in the National Bureau of Statistics (2012). Finally, individual-level responses were aggregated to construct contextual variables of smoking restrictions in public places and workplaces (Yang et al. 2011).

Data analysis

All data were entered into a database using Microsoft Excel. The dataset was then imported into SAS (version

9.3) for statistical analyses (SAS Institute Inc 2011). Descriptive statistics were calculated for complete HSR prevalence. Analyses were stratified by smoking and non-smoking status. Chi-square analyses were conducted to determine associations between smoking restrictions and the selected regional and individual variables, using the SAS survey procedure (SAS Institute Inc 2011). These associations were confirmed employing a multilevel logistic regression model using the SAS NLMIXED procedure (Grilli and Pratesi 2004). Series models were built for each primary predictor, with adjustment for the influence of potentially confounding sociodemographic characteristics.

We started with the Null Model, a two-level model with random intercepts in building the HSR multilevel logistic regression model. The constant was the sole predictor in accounting for cross-city variation in HSR. To this base, we added sociodemographic variables and one primary predictor as fixed main effects to form a multi-level model for evaluating the impact of HSR. For this analysis, we operationalized HSR as a binary response (no or partial smoking restriction = 1, complete smoking ban = 2). All regional and individual variables, with categories, are listed in Table 1. The first category for each variable served as the referent in the logistic regression analysis. We utilized backwards elimination stepwise regression, as the preferred method for exploratory analyses, where analysis begins with a full or saturated model and variables are eliminated iteratively from the model. Model fitting was assessed by the likelihood of a change in the $-2\log$. Significance of the random parameter variance estimates was assessed using the Wald joint χ^2 test statistic (Wang et al. 2008).

All analyses were weighted (Grilli and Pratesi 2004). Weights included (1) sampling weights, as the inverse of the probability of selection, calculated at region, city, district, and community, lastly were multiplied together. (2) Non-response weights consisted of household and individual aspects. (3) Post-stratification weights were calculated using the combination of sex (male, female) and age (<25 years, 25-, 35, 45, 55 and more), based on estimated distributions of these characteristics from a national survey (National Bureau of statistics 2012). The final overall weights were computed as the product of the prior three sets of weights. Chi-square analyses were weighted using the overall weights, and the multilevel analysis was weighted using the sampling weights at the city and subject-levels, with non-participation and post-stratification weights, respectively (Grilli and Pratesi 2004). Since there is no weight statement available for the NLMIXED procedure, these analyses were weighted though a macro method (Grilli and Pratesi 2004).

Table 1 Household smoking restrictions (HSR) prevalence by demographic characteristics of the urban sample, China, 2011

Group	Smokers			No smokers		
	N (% of sample)	HSR prevalence (%)	Adjusted OR	N (% of sample)	HSR prevalence (%)	Adjusted OR
Individual variables						
Age (years)		0.61			2.55	
<25		0.9623			0.6355	
25–34	900 (15.5)	43.3		1856 (13.5)	9.8	
35–44	1333 (20.4)	44.8		2651 (18.5)	10.9	
45–54	1346 (20.5)	45.2		2537 (19.3)	11.5	
55+	1135 (19.6)	44.3		1620 (19.4)	12.3	
Gender	946 (24.0)	41.6		1878 (25.5)	14.7	
		0.61			16.13	
		0.4359			0.0008	
Male	5048 (88.4)	44.8	1.00	3742 (28.6)	21.6	1.00
Female	612 (11.6)	36.0	0.60 (0.25, 1.91)	7459 (71.4)	8.4	0.53 (0.32, 0.90)**
Ethnicity		10.85			4.98	
		0.0010			0.0256	
Han	5427 (96.9)	44.3		9776 (89.7)		
Other	233 (3.1)	26.9		1430 (10.3)		
Education		49.20 < 0.001			10.08 0.0028	
Elementary school or less	1265 (22.8)	70.4	1.00	634 (5.3)	19.5	
Junior high school	2828 (46.9)	46.4	0.76 (0.53, 1.10)	2390 (18.3)	19.6	
High school	825 (16.4)	25.5	0.49 (0.19, 1.27)	4089 (37.4)	10.4	
Junior college or higher	747 (13.8)	12.5	0.35 (0.11, 1.04)	4093 (39.0)	9.2	
Occupation		45.24 < 0.0001			40.38 < 0.0001	
Managers and clerks	977 (15.1)	78.9	1.00	576 (4.2)	25.5	1.00
Professionals	711 (15.1)	79.0	1.15 (0.74, 1.80)	580 (4.1)	38.5	1.80 (0.96, 3.45)
Commerce and service	1660 (28.6)	52.1	0.27 (0.11, 0.66)**	1254 (10.0)	22.3	0.63 (0.31, 1.28)
Operations	1079 (17.1)	14.8	0.05 (0.01, 0.21)**	2811 (24.7)	10.8	0.24 (0.12, 0.63)**
Students	445 (13.0)	21.9	0.15 (0.05, 0.44)**	1841 (24.7)	10.1	0.40 (0.16, 0.99)*
Retired	222 (3.3)	16.3	0.10 (0.04, 0.23)**	1319 (8.5)	5.5	0.19 (0.11, 0.35)**
Other	566 (12.2)	20.4	0.11 (0.04, 0.32)**	2879 (25.9)	6.9	0.25 (0.12, 0.50)**
Income/person/year (yuan)* in household (inc)		82.69 < 0.0001			19.36 < 0.0001	
<10,000	1441 (24.8)	60.1	1.00	1416 (20.5)	22.4	1.00
10,000–19,999	1960 (32.6)	46.1	1.07 (0.55, 2.07)	3130 (24.8)	17.2	0.64 (0.30, 1.35)
20,000	1298 (26.1)	15.0	0.20 (0.11, 0.37)**	6660 (62.3)	7.9	0.34 (0.17, 0.68)**

* $p < 0.05$, ** $p < 0.01$

Results

A total of 18,875 individuals were identified as potential participants for this study, of whom 17,124 (90.7 %) were contacted and agreed to participate in the survey. Of the 17,124 questionnaires, 16,866 (98.5 %) were valid and analyzed. Of the 16,866 participants, 5660 were smokers—a prevalence of 31.6 %. Nearly 22 % (95 % CI 15.7, 24.9) of the surveyed households reported complete HSRs. The prevalence of secondhand smoke exposure among non-smokers in surveyed households was 56.2 % (95 % CI 40.2, 72.3).

The Chi-square analyses demonstrated that HSR prevalence varied significantly across gender, ethnicity, education, occupation, income, smoking, awareness of SHS harms, smoking types, smoking in smoke-free public places, and restrictions on smoking in public places and workplaces at the individual level, and restrictions on workplace smoking at the regional level (Tables 1, 2).

The multilevel analyses showed that professionals, managers and clerks, had a higher HSR prevalence than did operations workers, students, retirees, and others; there was a negative association between household income and HSR whether in the smoking or no smoking group (Tables 1, 2). There was a positive association between HSR and individual smoking types, smoking in smoke-free public place, awareness of SHS harms, and public place smoking restrictions in the smoking group. There was a positive association between HSR and individual and regional workplace smoking restrictions in both the smokers and non-smokers. There was no interaction between individual and regional restrictions on smoking in the workplace among the smokers (estimate 0.0967, $p > 0.05$) and non-smokers (estimate 0.0786, $p > 0.05$).

Discussion

Twenty-two percent (95 % CI 15.7, 24.9) of the respondents reported that smoking was banned in their home, a lower prevalence than reported in the western world (Farkas et al. 2000; Gilpin et al. 1999; Pizacani et al. 2003; Wakefield et al. 2000), and lower still than in Chinese homes in the US (Shelley et al. 2006). Another study found that only 6.3 % of families banned smoking at home in Chinese rural areas (Wang et al. 2009). More than half of Chinese populations are being exposed to SHS in their homes, which is a major health threat to family members.

This study identified individual and regional differences in HRS among this representative sample. Professionals, managers and clerks had a higher prevalence of HSR, which aligns with other reports. This finding has been explained by assuming that these groups have a greater awareness of the harm of SHS (Gilpin et al. 1999;

King et al. 2011), taking account of our finding that educational level was not associated with HSR. The observation that occupation and HSR were associated may reflect the influence of professional “roles” and “habits”. Since the professional, managerial, and clerical group conformed to occupational norms that restrict smoking in their job venues, they may also have deemed it prudent to ban smoking in their households (Yang et al. 2013). This study found that males experience a higher prevalence of HSR than females among the non-smoking group, and may be due to excess SHS exposure. This study showed that SHS exposure prevalence was significantly higher in males than in females (50.1 vs. 19.2 %), and SHS exposure was significantly associated with HSR (OR 2.06, 95 % CI 1.16–3.64).

Some researchers reported that indoor smoking bans in households are less common among low-income households, and speculated that this relationship existed because those with higher incomes had higher educational attainment and were more aware of the hazards of SHS (Pizacani et al. 2003; Bolte and Fromme 2009; King et al. 2011). Our study found that per capita household income was negatively associated with HSR, which is contrary to findings from preceding studies. Furthermore, our study found that knowledge of the harmful effects of SHS was positively associated with HSR, but found no association between education and HSR. We speculate that our result may reflect a social and culture phenomenon unique to China. Smoking often accompanies social activities (Yang 2010). High-income people tend to engage in more social activities, and the most common sites for these activities is the home; thus inhibiting the implementation of HSR there (Yang 2010). This finding calls for further research. Only a few Chinese studies have addressed this issue. One reported no association between household income and HSR (Ji et al. 2009). This study also found regional economic development level was not associated with HSR.

Similar to previous studies (Gilpin et al. 1999; Shelley et al. 2006), this study shows that individual awareness of SHS harm plays a protective role regarding implementation of HRS. However, only 43.8 % of smokers in our sample were aware that ETS harms others. This finding indicates the necessity to call for strengthening efforts to promote public education about SHS harmfulness. Chinese culture emphasizes collective values, which puts the family in an important position in the nature of individual life and behavior. A strong sense of obligation and responsibility to family is a cherished virtue. In this context, smoking may be perceived as a threat to familial health and financial solvency. From this perspective, it would be advantageous to conduct a household smoking intervention in China. Innovative campaigns are needed that will take into account cultural norms, including norms regarding the

Table 2 Multilevel analysis of individual behavioral and environmental influences of household smoking restrictions (HSR) on smoking status in China, 2011

Group	Smokers			No smokers		
	<i>N</i> (% of sample)	HSR prevalence (%)	Adjusted OR	<i>N</i> (% of sample)	HSR prevalence (%)	Adjusted OR
Individual behavioral variables						
Awareness of SHS harms among smokers		82.69 < 0.0001				
No	3149 (56.2)	13.4	1.00			
Yes	2511 (43.8)	35.6	3.25 (1.65, 6.42)**			
Smoking types		5.34				
		0.0208				
Smoking with others	3862 (65.1)	50.8				
Smoking alone	1798 (34.9)	30.7				
No	2933 (55.6)	33.4	1.00			
Yes	2727 (44.4)	59.8	2.60 (1.23, 5.53)*			
Smoking in smoke-free venues		17.36 < 0.0001				
No	2424 (44.6)	15.0	1.00			
Yes	3434 (37.1)	59.8	2.60 (1.23, 5.53)**			
Smoking restrictions in workplace		16.25 < 0.0001			21.21 < 0.0001	
None or partial	2424 (44.6)	15.0	1.00	8766 (79.0)	7.6	1.00
Complete	3434 (37.1)	37.1	5.68 (2.76, 11.72)**	2440 (21.0)	29.1	3.87 (2.06, 7.25)**
Smoking restrictions in public places		14.06 < 0.0001			1.01	
					0.3145	
None or partial	2643 (48.9)	14.1	1.00	2337 (21.4)	9.4	
Complete	5028 (55.7)	46.9	2.41 (1.36, 4.26)**	7670 (78.6)	12.7	
Regional variables						
Location		0.41			0.14	
		0.8141			0.9323	
East	1913 (45.9)	47.6		4556 (51.8)	12.2	
Central	902 (12.3)	46.7		1664 (9.8)	9.2	
West	2845 (4.8)	38.6		4986 (38.6)	12.6	
Per Capita GDP (yuan)		2.73			11.39	
		0.2552			0.0034	
<40,000	2745 (42.2)	30.2		4968 (37.6)	17.7	
40,000–49,999	1278 (25.7)	54.1		2666 (26.4)	15.4	
40,000+	1637 (32.1)	53.3		3572 (36.0)	3.8	
Smoking restrictions in workplace		6.55			7.81	0.021
		0.0377				
<30 %	1723 (28.4)	25.6	1.00	3295 (25.4)	12.1	1.00
30 %	2964 (56.4)	46.2	3.89 (2.10, 7.20)**	5394 (56.5)	9.9	1.02 (0.46, 2.22)
40 %	973 (15.2)	68.4	5.88 (1.14, 30.39)**	2517 (18.1)	18.8	1.87 (1.06, 3.32)*
Smoking restrictions in public places		4.13			1.98	
		0.1267			0.3722	
<70 %	2970 (43.5)	51.5		5704 (41.9)	12.3	
70 %	1472 (28.2)	19.8		2740 (25.4)	12.8	
80 %	1218 (28.3)	55.7		2762 (32.7)	5.8	

* $p < 0.05$, ** $p < 0.01$

Adjusted for the sociodemographic characteristics

assertiveness of family members, especially female members, and also explore the possibilities for empowering them to advocate for smoke-free homes (Cheng et al. 2001).

This study found that smoking in smoke-free public venues was positively associated with HSR. This finding may be explained using “behavioral transformation” theory (Yang 2010), a special phenomenon in China. By contrast, a report from Switzerland stated that, when tobacco use is still allowed there, a dedicated smoker may prefer to stay home rather than go to a bar to smoke (Schulz et al. 2012). However, smoking represents normative behavior for male adults in China, and most people do not consider the act of smoking in smoke-free public places as shameful.

Behavioral susceptibility theory argues that if a given behavior becomes inconvenient or difficult, it will gradually decline (Yang 2010). This theory apparently pertains to smoking in smoke-free public venues in China. Currently, smoke-free policies in public places are commonly implemented there (Li et al. 2010; Yang et al. 2013). However, in contrast to the western world and other industrially developed areas implementation of these regulations has been challenged or ignored by many in China (Li et al. 2010; Yang et al. 2013). Due to the low adherence to the existing smoke-free regulations, exposure to tobacco smoke in public places is still common, including in restaurants, schools, hospitals, government buildings, and train stations (Li et al. 2010; Stillman et al. 2007). Currently, Chinese mainland culture still largely adheres to agrarian social mores (Yang 2010). This suggests that the social values may frame people’s behavioral response models differently from those in the western world (Tian and Ma 2008; Yang 2010; Rööslı and Rajkumar 2013; Lazuras et al. 2012). Although legal compliance is often taken for granted in the western world, China operates somewhat differently. The Chinese are often unaware of or unwilling to follow such regulations. It is plausible to adapt smoking behavior from households to other venues, including to smoke-free public places. It is urgent to create positive attitudes towards on smoking bans in indoor places, while campaigning to change societal attitudes and norms about smoking.

Both individual and regional-level results show that workplace smoking restrictions are positively associated with HSR. The findings were consistent with those from some previous reports (Cheng et al. 2001; Akhtar et al. 2009; Rohrbach et al. 2002). One explanation might lie in changes in the social acceptability and understanding of smoking and SHS through implementation of workplace smoking restrictions (Rohrbach et al. 2002). More likely is that the smoke-free workplaces have more readily picked up new messages, popular in the contemporary

world, including the various tobacco control approaches (Moore et al. 2012). Our finding lends weight to the argument that China should implement strong workplace smoking bans.

Major strengths of this study are the use of large, broadly representative samples of smokers and non-smokers from 21 cities. There were several limitations. First, data were based on self-reports, and HSR assessments may introduce information bias. However, since smoking behavior is normative for Chinese adults, social inhibition of accurate reports is a plausible although minimal concern. Secondly, since information on self-reported HSRs was not provided by every member in a household, different adults living in the same household might provide contradictory or inconsistent responses. We conducted a survey among 56 households in Hangzhou, and 94.6 % of responses from different adults living in the same household were concordant for complete HSRs. Another study also found that inconsistent responses were rare, and when those were eliminated from the analysis they did not change the results (Shelley et al. 2006; Cheng et al. 2001). Thirdly, HSRs should be associated with some family variables, such as family construction and behavior. Our study did not factor them in, but their exclusion raises important empirical questions for future research. Fourthly, the study was cross-sectional, which precludes drawing causal inferences regarding the association between independent and dependent variables. The longitudinal follow-up will provide an opportunity to explore mediating influences involved in decisions regarding HSR. Finally, our study found that per capita household income was negatively associated with HSR, a finding which aligns with those from many other studies (Pizacani et al. 2003; Bolte and Fromme 2009; King et al. 2011). Although this finding may reflect a social and culture phenomenon unique to China, we cannot eliminate hidden effect modification or data error.

Conclusion

This study explored individual and regional variation in urban HSR status in China. The ensuing information will contribute to the development and implementation of effective tobacco control policies and household interventions. Effective control of ETS pollution in households will require continued support in the form of public education campaigns and workplace smoking bans given the importance of awareness of SHS harm among Chinese urban populations, and the influence of workplace smoking bans on household smoke-free policies.

Conflict of interest The authors declare that they have no competing interests.

References

- Akhtar PC, Haw SJ, Currie DB, Zachary R, Currie CE (2009) Smoking restrictions in the home and secondhand smoke exposure among primary schoolchildren before and after introduction of the Scottish smoke-free legislation. *Tob Control* 18(5):409–415. doi:10.1136/tc.2009.030627
- Bolte G, Fromme H (2009) Socioeconomic determinants of children's environmental tobacco smoke exposure and family's home smoking policy. *Eur J Public Health* 19:52–58. doi:10.1093/eurpub/ckn114
- Cheng KW, Glantz SA, Lightwood JM (2001) Association between smokefree laws and voluntary smokefree-home rules. *Am J Prev Med* 41(6):566–572. doi:10.1016/j.amepre.2011.08.014
- Chinese Center for Disease Control and Prevention (2011) Global adult tobacco survey (GATS) China 2010 country report. China Sanxia Press, Beijing, pp 8–95
- Department of Comprehensive Statistics of National Bureau of Statistics (2012) China statistical yearbook for regional economy 2011. China Statistics Press, Beijing, pp 111–342
- Farkas AJ, Gilpin EA, White MM, Pierce JP (2000) Association between household and workplace smoking restrictions and adolescent smoking. *J Am Med Assoc* 284(6):717–722. doi:10.1001/jama.284.6.717
- Gilpin EA, White MM, Farkas AJ, Pierce JP (1999) Home smoking restrictions: which smokers have them and how they are associated with smoking behavior. *Nicotine Tob Res* 1(2):153–162. doi:10.1080/14622299050011261
- Grilli L, Pratesi M (2004) Weighted estimation in multilevel ordinal and binary models in the presence of informative sampling designs. *Surv Methodol* 30(1):93–104
- Ji M, Ding D, Hovell MF, Xia X, Zheng P, Fu H (2009) Home smoking bans in an urbanizing community in China. *Am J Prev Med* 37(2):132–136. doi:10.1016/j.amepre.2009.04.019
- King BA, Hyland AJ, Borland R, McNeill A, Cummings KM (2011) Socioeconomic variation in the prevalence, introduction, retention, and removal of smoke-free policies among smokers: findings from the International Tobacco Control (ITC) Four Country Survey. *Int J Environ Res Public Health* 8(2):411–434. doi:10.3390/ijerph8020411
- Lazuras L, Zlatev M, Rodafinos A, Eiser JR (2012) Smokers' compliance with smoke-free policies, and non-smokers' assertiveness for smoke-free air in the workplace: a study from the Balkans. *Int J Public Health* 57(5):769–775. doi:10.1007/s00038-012-0338-0
- Li J, Tu Y, Huang Y (2010) Review about tobacco control law in world and China. *J Public Health Prev Med* 21(4):71–75
- Moore K, Borland R, Yong HH, Siahpush M, Cummings KM, Thrasher JF, Fong GT (2012) Support for tobacco control interventions: do country of origin and socioeconomic status make a difference? *Int J Public Health* 57(5):777–786. doi:10.1007/s00038-012-0378-5
- National Bureau of statistics (2011) China statistical yearbook. <http://www.stats.gov.cn/tjsj/ndsj/2012/indexch.htm>. Accessed on 16 Sep 2013
- Pizacani BA, Martin DP, Stark MJ, Koepsell TD, Thompson B, Diehr P (2003) Household smoking bans: which households have them and do they work? *Prev Med* 36(1):99–107. doi:10.1006/pmed.2002.1123
- Rohrbach LA, Howard-Pitney B, Unger JB, Dent CW, Howard KA, Cruz TB, Johnson CA (2002) Independent evaluation of the California Tobacco Control Program: relationships between program exposure and outcomes, 1996–1998. *Am J Public Health* 92(6):975–983. doi:10.2105/AJPH.92.6.975
- Röösli M, Rajkumar S (2013) How long is the yardstick for smoking bans in Switzerland? *Int J Public Health* 58:797–798. doi:10.1007/s00038-013-0516-8
- SAS Institute Inc (2011) SAS/STAT 9.3 user's guide survey data analysis (Book Excerpt). SAS Institute Inc, Cary
- Schulz PJ, Hartung U, Fiorelli M (2012) Effect of smoke-free legislation on Ticino gastronomy revenue. *Int J Public Health* 57:861–866. doi:10.1007/s00038-012-0402-9
- Shelley D, Fahs MC, Yermeni R, Qu J, Burton D (2006) Correlates of household smoking bans among Chinese Americans. *Nicotine Tob Res* 8(1):103–112. doi:10.1080/14622200500431825
- Stillman F, Navas-Acien A, Ma J, Ma S, Avila-Tang E, Breyse P, Yang G, Samet J (2007) Second-hand tobacco smoke in public places in urban and rural China. *Tob Control* 16:229–234. doi:10.1136/tc.2006.018333
- Tian S, Ma X (2008) China ancient northern nomadic culture studies. *West Stud* 2:16–19 (in Chinese)
- Wakefield M, Banham D, Martin J, Ruffin R, McCaul K, Badcock N (2000) Restrictions on smoking at home and urinary cotinine levels among children with asthma. *Am J Prev Med* 19(3):188–192. doi:10.1016/S0749-3797(00)00197-5
- Wang J, Xie H, Jiang B (2008) Multilevel models: methods and application. Higher education Press, Beijing, pp 127–168
- Wang CP, Ma SJ, Xu XF, Wang JF, Mei CZ, Yang GH (2009) The prevalence of household second-hand smoke exposure and its correlated factors in six counties of China. *Tob Control* 18(2):121–126. doi:10.1136/tc.2008.024836
- World Health Organization (1998) Guidelines for controlling and monitoring the tobacco epidemic. World Health Organization, Geneva, pp 61–99
- Yang T (2010) Tobacco control theory and implement. People's Medical Publishing House, Beijing, pp 77–85
- Yang T, Xu X, Rockett IRH, Guo W, Zhou H (2011) Effects of household, workplace, and public place smoking restrictions on smoking cessation. *Health Place* 17(4):954–960. doi:10.1016/j.healthplace.2011.04.003
- Yang T, Abdullah AS, Li L, Rockett IRH, Lin Y, Ying J, Guo W, Wu D, Li M (2013) Public place smoke-free regulations, secondhand smoke exposure and related beliefs, awareness, attitudes, and practices among chinese urban residents. *Int J Environ Res Public Health* 10(6):2370–2383. doi:10.3390/ijerph10062370