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Effect of characteristics and life in cities in China on residents' smoking behaviour

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Abstract

Objective: This study aimed to identify the relationship between city-level economic development and smoking behaviour.

Methods: Using multilevel mixed-effects logistic methods, we examined the relationship between smoking/passive smoking and respondents' lifestyles in the city.

Results: We found that respondents living in cities with higher per capita gross domestic product (GDP) were less likely to smoke than those living in cities with lower per capita GDP (odds ratio [OR] = 0.977, 95% confidence interval [CI]: 0.958–0.997). Further, respondents with higher levels of life satisfaction and subjective social status were less likely to smoke than those with lower levels of these variables (OR = 0.942, 95% CI: 0.893–0.994; OR = 0.955, 95% CI: 0.928–0.983, respectively). In terms of passive smoking, respondents with higher levels of subjective social status in their cities were less likely to smoke than those with lower levels (OR = 0.972, 95% CI: 0.948–0.996). Smoking and exposure to second-hand smoke were more common among those with lower socioeconomic status.

Conclusions: Smoking is one of the most serious public health hazards in China. People's smoking behaviour is significantly related to characteristics of their cities and their socioeconomic status. Improved smoking-prevention measures are urgently required in China.

Keywords

City life, smoking behaviour, passive smoking, health hazard, China, socioeconomic status

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Background

China's economy has rapidly developed since implementation of the reform and opening-up policy in 1978. However, the level of economic development between cities has widely varied, and this has coincided with huge differences in residents' health.[1–3] Current unhealthy behaviour in the Chinese population has partly been caused by the country's rapid process of urbanization and economic development.[4,5] People living in areas experiencing rapid urbanization tend to engage in less physical exercise, which has a negative effect on their health.[6] Although the relationship between urbanization and health in China has attracted the attention of numerous researchers,[1,3,4,7] little is known about the relationship between the characteristics of China's cities and residents' health behaviour. The question remains whether residents of developed cities are more likely to engage in unhealthy behaviour, such as smoking, compared with residents of less developed cities.

Smoking is an important issue regarding the health of Chinese residents.[8] Using data from the China Health and Nutrition Survey, Li et al.[9] found that between 1991 and 2011, the total number of deaths caused by smoking increased from 800,000 to 900,000. Further, in 2015, a previous study reported that China's adult smoking rate was 27.7%, the number of smokers in China had reached 316 million, and more than 700 million non-smokers were exposed to second-hand smoke.[10] Chen et al.[8] even proposed that the annual number of deaths in China caused by tobacco will rise from 2 million in 2030 to 3 million by 2050. Regardless of these predictions, cigarette smoking has already caused significant health problems for and become a considerable economic burden on Chinese society.[11,12]

A growing body of research in this field has focussed on the relationship between city-related contextual factors (e.g., economic conditions and urbanization) and the health behaviour of residents.[3,13,14] However, few studies have focussed on the relationship between characteristics of cities and residents' smoking behaviour.[15] Issues of whether the likelihood of smoking among residents in economically prosperous cities is lower than that for residents of less economically developed cities and whether residents of big cities are less likely to smoke remain to be addressed. Furthermore, whether residents' satisfaction with their city lives affects their likelihood of smoking is unclear. This study attempted to investigate these issues. We aimed to examine the per capita gross domestic product (GDP) and population size of cities to represent the level of economic development and size of cities, respectively. Simultaneously, life satisfaction and subjective social status were used as indicators of residents' living conditions in the cities. Furthermore, for residents with differing socioeconomic status and for those who have differing health behaviours,[16] we discuss the associations between individual socioeconomic status and smoking behaviour.

Methods

Data

The data used in this study were sourced from the 2014 China Labor-force Dynamics Survey (CLDS; see http://css.sysu.edu.cn for more information on CLDS data).[17] Therefore, ethical approval for the study was not required. Verbal informed consent was obtained from all participants before data collection and all participants were anonymised. CLDS data were collected by the Center for Social Science Survey at Sun Yat-sen University in Guangzhou, China. The 2014 CLDS was a nationwide, cross-sectional survey that covered 29 mainland provinces and municipalities (excluding Tibet and

Hainan), and applied multistage clustering and a stratified probability sampling strategy. Further, the 2014 CLDS established a tracking database with three levels: individual, neighbourhood, and city. A prefecture-level city refers to the second administrative division and neighbourhoods refer to fifth-level administrative divisions in China.[3] A neighbourhood is nested within a prefecture. The data of city variables were gathered from the China City Statistical Yearbook. For this study, after excluding samples with missing data, 14,509 valid respondents were obtained from 396 neighbourhoods that were nested within 122 Chinese cities.

Statistical analysis

Multilevel mixed-effects logistic regression analysis was used in this study. To examine the influence of cities on smoking (0 = do not smoke, 1 = smoke) and passive smoking (0 = few people in the area smoke, 1 = many people in the area smoke), we built two regression models. In these models, city variables and city life variables were set as the independent variables. We chose demographic and socioeconomic factors as controlled variables. The city variables were per capita GDP in 2014 (continuous variable) and population size (continuous variable). The city life variables were life satisfaction in the city (continuous variable) and subjective social status in the city (continuous variable). Demographic and socioeconomic variables included age (continuous variable), sex (male or female), marital status (single, divorced, or widowed or married), years of schooling (continuous variable), employment status (unemployed or employed), occupational identity (employee, employer, self-employed or unemployed, and farmer), logarithm of annual personal income (continuous variable), hukou status (non-local hukou and local hukou), length of residence in the current city (continuous variable), and the number of close friends in the city (continuous variable). Data were analysed using Stata 13.1 (StataCorp LLC, College Station, TX, USA).

Results

Descriptive statistics

Table 1 shows the descriptive statistics for non-smokers and smokers among the respondents, and these can be generalized to account for the entire Chinese population. With regard to city variables, mean per capita GDP and population size in 2014 were significantly higher in cities where the non-smokers lived than in cities where smokers lived ($P < 0.001$ and $P = 0.016$, respectively). With regard to city life variables, mean life satisfaction and subjective social status in non-smokers were significantly higher than those in smokers (both $P < 0.001$). Further, the mean age of non-smokers was significantly younger than that of smokers ($P < 0.001$), and the proportion of male smokers was higher than that of female smokers ($P < 0.001$). For marital status, the proportion of married smokers was significantly higher than that of single, divorced, or widowed smokers ($P < 0.001$). The proportion of employed smokers was significantly higher than that of unemployed smokers ($P < 0.001$). Smokers had a slightly higher annual personal income than did non-smokers ($P < 0.001$). A significantly higher proportion of respondents with local hukou were smokers compared with those without local hukou ($P < 0.001$). Smokers also had a significantly longer length of residence in the city than did non-smokers, and non-smokers had slightly fewer friends than did smokers (both $P < 0.001$).

Multilevel mixed-effects logistic regression models for smoking and passive smoking

Table 2 shows the multilevel mixed-effects logistic regression analysis results for

Table 1. Descriptive statistics for non-smokers and smokers in China.

	Non-smokers		Smokers		Test statistics[a]	P value
	Mean	SD	Mean	SD		
Per capita GDP in 2014 (in RMB 10,000)	6.01	5.12	5.54	3.86	6.31	<0.001
Population size (in millions of people)	6.26	4.74	6.09	4.57	2.41	0.016
Life satisfaction in the city (scored from 1–5)	3.68	0.91	3.57	0.95	8.20	<0.001
Subjective social status in the city (1–10)	4.58	1.66	4.34	1.67	9.10	<0.001
Age	42.97	14.80	46.88	13.06	−17.55	<0.001
Sex (%)					6.6×10^3	<0.001
Female	66.59		4.12			
Male	33.41		95.88			
Marital status (%)					99.06	<0.001
Single, divorced, or widowed	20.34		14.34			
Married	79.66		85.66			
Years of schooling (years)	3.61	2.41	3.40	1.98	5.92	<0.001
Employment status (%)					17.34	<0.001
Unemployed	7.67		5.81			
Employed	92.33		94.19			
Occupational identity (%)					23.63	<0.001
Employee	43.65		41.82			
Employer	1.77		1.84			
Self-employed or unemployed	12.63		15.48			
Farmer	41.95		40.86			
Logarithm of annual personal income	9.70	1.22	9.87	1.16	−7.79	<0.001
Hukou status (%)					21.92	<0.001
Non-local hukou	19.03		16.24			
Local hukou	80.97		83.76			
Length of residence in the current city (years)	38.55	17.87	42.23	17.47	−13.36	<0.001
Number of close friends in the city (in hundreds of people)	0.14	0.85	0.17	0.61	−2.53	0.011

[a]The t-test was used to assess mean differences in continuous variables between smokers and non-smokers. The chi-square test was used for categorical variables. SD: standard deviation, GDP: gross domestic product.

smoking and passive smoking. In Model 1, city variables had significant effects on respondents' smoking behaviour. Among the city variables, people living in cities with higher per capita GDP were less likely to smoke than those living in cities with lower per capita GDP (odds ratio [OR] = 0.977, 95% confidence interval [CI]: 0.958–0.997, $P < 0.05$). We also found that the population size and population density (results available upon request) of a city had no significant effect on the likelihood of residents' smoking. For city life variables, people with higher levels of life satisfaction and subjective social status were less likely to smoke than those with lower levels of life satisfaction and subjective social status (OR = 0.942, 95% CI: 0.893–0.994, $P < 0.05$; OR = 0.955, 95% CI: 0.928–0.983, $P < 0.01$). Among the controlled variables, sex, educational attainment, and logarithm of annual personal income had significant effects on respondents' smoking behaviour. Men were more likely to smoke than women (OR = 73.560, 95% CI: 60.334–89.685, $P < 0.01$). The proportion of female

Table 2. Multilevel mixed-effects logistic regression models for smoking and passive smoking.

	Model 1: smoking		Model 2: passive smoking	
City variables	OR	95% Confidence interval	OR	95% Confidence interval
Per capita GDP in 2014	0.977**	[0.958, 0.997]	0.984	[0.954, 1.014]
Population size	1.009	[0.989, 1.030]	0.989	[0.958, 1.022]
City life variables				
Life satisfaction in the city	0.942**	[0.893, 0.994]	1.018	[0.973, 1.064]
Subjective social status in the city	0.955***	[0.928, 0.983]	0.972**	[0.948, 0.996]
Controlled variables				
Age	1.005	[0.999, 1.011]	0.992***	[0.987, 0.998]
Sex (reference: female)	73.560***	[60.334, 89.685]	1.928***	[1.784, 2.084]
Marital status (reference: single, divorced, or widowed)	1.017	[0.880, 1.174]	1.124*	[0.996, 1.268]
Years of schooling	0.881***	[0.858, 0.904]	0.991	[0.969, 1.013]
Logarithm of annual personal income	1.045*	[0.992, 1.100]	1.088***	[1.043, 1.134]
Hukou status (reference: non-local hukou)	1.008	[0.876, 1.159]	1.108*	[0.987, 1.245]
Employment status (reference: unemployed)	0.950	[0.774, 1.165]	0.956	[0.815, 1.120]
Occupational identity (reference: employee)				
Employer	0.769	[0.559, 1.059]	0.725**	[0.549, 0.958]
Self-employed and unemployed	0.939	[0.815, 1.082]	0.709***	[0.627, 0.803]
Farmer	1.010	[0.877, 1.163]	0.673***	[0.592, 0.764]
Length of residence in the current city	0.996	[0.992, 1.001]	0.994***	[0.990, 0.998]
Number of close friends in the city	1.067	[0.982, 1.159]	1.137***	[1.036, 1.249]
Number of individuals	14509		14509	
Number of cities	122		122	
Number of neighbourhoods	396		396	
Log likelihood	−5968.485		−8890.753	
Chi-square	1930.727***		517.341***	

*P < 0.10, **P < 0.05, ***P < 0.01. OR: odds ratio, GDP: gross domestic product.

smokers in the total Chinese population was much lower than that of male smokers. The higher the educational level of the respondents, the less likely they were to smoke (OR = 0.881, 95% CI: 0.858–0.904, P < 0.01). Moreover, respondents with higher annual personal incomes were more likely to smoke than those with lower personal incomes (OR = 1.045, 95% CI: 0.992–1.100, P < 0.10).

Model 2 shows the regression analysis results for passive smoking. With regard to city life variables, only subjective social status in the city had a significant relationship with passive smoking. People with higher levels of subjective social status in their cities were less likely to be exposed to passive smoking than those with lower levels of subjective social status in their cities (OR = 0.972, 95% CI: 0.948–0.996, P < 0.05). For controlled variables, age, sex, marital status, income, hukou status, occupational identity, length of residence in the current city, and the number of close friends in the city had significant associations with passive smoking. The older the respondent, the less likely they were to be exposed to second-hand smoke

(OR = 0.992, 95% CI: 0.987–0.998, $P < 0.01$). Men were more likely to be exposed to second-hand smoke than women (OR = 1.928, 95% CI: 1.784–2.084, $P < 0.01$). Married respondents were more likely to be exposed to second-hand smoke than single, divorced, or widowed respondents (OR = 1.124, 95% CI: 0.996–1.268 $P < 0.10$). Moreover, the higher the respondent's personal income, the more likely they were to be exposed to second-hand smoke (OR = 1.088, 95% CI: 1.043–1.134, $P < 0.01$). Employers (OR = 0.725, 95% CI: 0.549–0.958, $P < 0.05$), along with the self-employed and unemployed (OR = 0.709, 95% CI: 0.627–0.803, $P < 0.01$) and farmers (OR = 0.673, 95% CI: 0.592–0.764, $P < 0.01$) were less likely to be exposed to second-hand smoke compared with employees. Respondents with a local hukou were more likely to be exposed to second-hand smoke than those who did not have a local hukou (OR = 1.108, 95% CI: 0.987–1.245, $P < 0.10$). The longer the respondent's stay in the city, the less likely they were to be exposed to second-hand smoke (OR =0.994, 95% CI: 0.990–0.998, $P < 0.01$). Finally, the more friends a respondent had, the more likely they were to be exposed to second-hand smoke (OR = 1.137, 95% CI: 1.036–1.249, $P < 0.01$).

Discussion

Although China is the world's main producer and consumer of tobacco products, cigarette use in China is not under strict control.[18,19] In 2010, approximately 28.1% of adults in China were current smokers.[19] Cigarette advertising is also common in China and, unlike in developed countries, there are no prominent warnings on cigarette boxes informing the user that smoking is harmful to their health. Beginning a smoking habit is easy because of the effects of peer and parental influence, social pressures, social norms, and entertainment media.[20–22] Additionally, sharing and gifting cigarettes has become fashionable in some cities in China, and this has also affected smoking behaviour.[23] There are also significant regional variations in cigarette consumption in China;[24] the cultural contexts and behavioural norms of China's cities vary widely. These geographic differences also affect the smoking behaviour of residents. Restrictions on smoking behaviour are particularly lax in rural areas, and the above-mentioned custom of sharing and gifting cigarettes is widespread in these areas, which increases the residents' likelihood of smoking.[23] However, surprisingly, residents in urban areas may be more likely to have smoking habits. Living in urban areas and/or enduring unsafe living conditions (i.e., unsafe neighbourhoods) can cause greater life-related stress, and many urban people may seek to relieve this stress by resorting to smoking.[25,26]

Smoking is an important health-related issue factor in China. As a type of common behaviour, smoking has a close relationship with cities. However, previous studies on smoking and passive smoking behaviours have mainly focussed on individual characteristics, socioeconomic status, workplaces, and living environments.[16,27,28] Few studies have focussed on the relationship between cities and smoking behaviour and the likelihood of exposure to passive smoking.[15] Consequently, in this study, we addressed this research gap, and found that city characteristics and city life are significantly related to smoking and passive smoking.

In terms of smoking behaviour, higher per capita GDP is associated with a lower likelihood of smoking. Therefore, in China, residents living in economically developed cities are less likely to smoke, while residents living in economically underdeveloped cities are more likely to smoke. This indicates that the rapid development of China's economy has changed people's

health behaviour, improving residents' health awareness. Some previous studies have also suggested that, as a result of China's process of rapid urbanization and modernization, an increasing number of people are adopting sedentary lifestyles.[1,6] Furthermore, people's engagement in physical activity has been significantly reduced. In a 2011 national survey of urban residents in China, Chen et al.[4] found that a higher level of urbanization at the county level negatively affected self-reported physical health. Monda et al.[5] reported that light occupational activity linearly increases with increasing urbanization, resulting in an increase in the numbers of overweight and obese individuals. In contrast, our study showed that economic development could reduce people's smoking behaviour. However, compared with economically underdeveloped cities, China's economically developed cities have adopted more stringent tobacco control measures. In 2015, the Beijing government introduced a policy that prohibits people from smoking in public places. As a result of this legislation, in Beijing, smoking has been prohibited in all indoor public places, workplaces, and on public transport, and all tobacco-promotion activities have been completely halted. Such urban tobacco control initiatives and promotion of awareness of the health hazards of smoking have had a positive effect on reducing the likelihood of smoking among residents.

The higher the socioeconomic status of residents, the less likely they are to smoke. In the current study, we found that higher life satisfaction and subjective social status in the city were associated with a lower likelihood of smoking. Further, individuals with higher levels of educational attainment were less likely to smoke. One possible reason for these findings is that, as mentioned above, relieving life-related stress through smoking is an important motivation for people to smoke.[29] People who are not satisfied with their lives may suffer greater psychological stress, and thus they are more likely to smoke. This finding is consistent with that of other studies.[25] Additionally, people with low subjective social status in the city were more likely to be exposed to second-hand smoke, and their smoking behaviour was easily influenced by their peers' smoking.

Our study's findings have direct policy implications for China's government, as follows. First, prohibiting smoking in public places is an effective method of reducing people's smoking and passive smoking. In China, the tobacco control policies that have been implemented to date in economically developed cities have achieved good results, but economically underdeveloped cities need to improve their policies. Second, reducing residents' life-related stress and improving life satisfaction can reduce the likelihood of their smoking; in particular, residents of large cities generally have higher life-related stress. Therefore, the availability of public spaces (such as green spaces) needs to be increased, which would encourage people to engage in physical exercise to relieve pressure, rather than resorting to smoking.

There are some limitations of our study. First, a person's smoking behaviour is related to their personal social capital, neighbourhood, workplace, family, and physiological status.[30,31] Compared with these micro-factors, macro-factors may not play decisive roles.[32,33] Although we found that the population size and population density (results available upon request) of a city had no significant effect on the likelihood of residents' smoking or passive smoking, this may be because these variables are on the city scale. If neighbourhood-scale population size or population density variables are used, the results may differ. Second, because we used cross-sectional data rather than panel data, we did not analyse the effect of the cities' economic

changes on smoking behaviour of Chinese residents, but rather examined the effect of different types of cities on smoking of residents. China has experienced almost 40 years of rapid economic development, and the living environments and the residents' lifestyles of its cities widely vary. However, the effect of differences of cities on the health behaviour of residents has not received much attention. Despite these limitations, this study showed the relationships between city characteristics/city life and residents' smoking behaviour, which could contribute to a better understanding of the health behaviour of the residents of Chinese cities.

Conclusion

This study shows that people's smoking behaviour has significant relationships with characteristics and life in cities. In China, a higher per capita GDP is associated with a lower likelihood of smoking. Furthermore, higher life satisfaction and subjective social status in the city are associated with a lower possibility of smoking. Although smoking is one of China's greatest public health hazards, efforts to control tobacco have been limited to date. We propose that increasing the number and accessibility of public activity spaces and advocating healthy lifestyles can effectively reduce residents' smoking behaviour.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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