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The impact of regional economic reliance on the tobacco industry on current smoking in China

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ABSTRACT

The purpose of this study was to conduct a preliminary assessment of province of residence and other contextual factors on the likelihood of being a current smoker in China. A cross-sectional, multistage sampling process was used to recruit participants, and their smoking status and sociodemographic characteristics were obtained through face-to-face interviews. The contextual variables were retrieved from a national database. Multilevel logistic regression analysis was performed to assess the impact of provincial economic reliance on the tobacco industry, as well as individual-level characteristics, on the likelihood of being a current smoker. Participants totaled 20,601 from 27 cities located in 26 of the 31 municipalities/provinces in China. Overall smoking prevalence was 31.3% (95% CI: 19.3–33.2%), with rates being highest in Yinchuan City in Ningxia Province (49.8%) and lowest in Shanghai (21.6%). The multilevel analysis showed an excess likelihood of being a current smoker for individuals living in provinces with the highest rate of cigarette production relative to those with the smallest ($p < 0.001$). Findings underscore the importance of restricting cigarette production and regulating the marketing of tobacco products in China.

1. Introduction

Globally, the tobacco-smoking epidemic is responsible for approximately 5.4 million deaths per year, including more than 600,000 deaths of nonsmokers (World Health Organization, 2011). The annual death toll is projected to exceed 8 million by 2030. More than 80% of these deaths will occur in less developed nations, and the epidemic will strike hardest in those countries with rapidly growing economies (World Health Organization, 2008). China leads the world in tobacco consumption, and approximately one million Chinese die each year from tobacco-related causes. This death toll is projected to reach two million annually by 2025 and three million by 2050 (The People's Republic of China Ministry of Health, 2007). However, despite tobacco imposing tremendous economic and health costs in China, with few exceptions (Pan and Hu, 2008), little attention has been paid to environmental factors which help perpetuate such high rates of smoking and how these may be important in informing tobacco control policies.

Ecological models can allow for smoking being influenced by both individual and environmental characteristics (Yang, 2010). Understanding environmental influences on current smoking is important from a public health perspective, particularly for formulating policy and designing and implementing effective interventions that take account of both environmental and individual influences on health behaviour (Twigg and Cooper, 2009). However, while there has been increasing attention to the role of place or context effects on smoking (Pearce et al., 2012), most smoking studies continue to examine individual-level correlates (Yang, 2010). Where environmental influences have been addressed these have mainly focused on the local neighbourhood scale. Consequently few studies have examined the association between state or regional factors and the likelihood of being a current smoker. With few exceptions (e.g., Hoffer and Pellilo, 2012; Morley and Pratte, 2013), this has been particularly true on how economic reliance on the tobacco industry has shaped local tobacco control policies and the incidence of smoking. The few studies that have been conducted have been largely confined to the

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United States and have shown how the tobacco lobby has been detrimental to tobacco control and a reduction of smoking rates in those states where the industry is most powerful. Such trends call for more research which adopts a political economy approach in order to gain a greater understanding of how special interest groups affect variations in tobacco control and smoking rates in different areas. Unfortunately such factors have tended to be neglected in the tobacco control policy literature and have seldom been investigated in a systematic empirical way (Bump and Reich, 2013). This is particularly true in China. While some studies have attempted to understand regional variations in the importance of the tobacco industry and the importance of different stakeholders in tobacco production and tobacco control (e.g., Li, 2012), none have attempted to link such factors to rates of smoking. This paper fills this research gap. It examines the importance of tobacco cultivation and cigarette manufacturing at the provincial level in China and the extent to which variations in the importance of the industry are related to provincial differences in smoking rates. Since China is the leading tobacco producer and manufacturer in the world (Hu, 2008; Food and Agricultural Organization (FAO), 2009), then greater insight into the links between provincial variations, particularly in tobacco's role in economic development and smoking outcomes, would seem to be a high priority. Knowing the extent of such variations and their significance in influencing smoking is important given the need for researchers to play a more important role in informing tobacco control programmes (Koplan et al., 2013).

In order to understand the extent of provincial variation in smoking in China the paper is structured as follows. First we review current work on regional effects on smoking paying attention to some of the possible pathways linking regional characteristics and smoking outcomes. Second, we provide a brief background on the structure of the tobacco industry in China and how this is shaped by key decision-makers at the national and provincial level. Third, we describe the study methodology and the contextual variables selected for analysis. This is followed by a discussion of results. In the final section of the paper we interpret these results within the wider body of contextual research on smoking and discuss some of the theoretical and policy implications of the study.

2. Regional contextual effects on smoking

Smoking is one of many health behaviours which are influenced by the context in which people live. While most studies of contextual or place effects have focused upon the neighbourhood as the unit of analysis, it is clear that environmental influences on health also operate at other spatial scales (Karvonen and Rimpelä, 1996). However, with the exception of the bourgeoning research into income inequality and health outcomes, there has been little attention of how regional effects influence health behaviours such as smoking (Pampel, 2002). Chaix and Chauvin (2003), Chaix et al. (2004), for example, have noted that local neighbourhood effects have received far more attention than macro-effects which operate at a broader scale. They argue that while one might think that it is more relevant to define contextual effects at the local scale, where there will be greater population homogeneity, amongst urban neighbourhoods for example, contextual studies at higher levels of aggregation are also important as specific processes may operate at the level of these broader areas. In the smoking literature while some studies have examined the independent influence of regional differences in levels of deindustrialisation/economic development (e.g., Audureau et al., 2013; Chaix and Chauvin, 2003) or unemployment (Vuolo, 2012) on smoking overall little attention has been paid to what higher level effects should be important, at what spatial scales and why. The main exception to this trend has been in the income inequality and health literature where much stronger relationships between income inequality and health have emerged at state/regional levels of aggregation compared to more localised levels of analysis. This finding is strongly suggestive of the role of state public policies as being a dominant force in the production of health inequalities (Dunn et al., 2005), including smoking (e.g., Diez Roux, 2001; Graham, 2001) compared to psychosocial interpretations reflecting more local factors.

Differences in national or regional public policies are likely to influence smoking in a number of ways. First differences in political culture may affect smoking rates through a weaker political commitment to smokefree policies. In the USA, for example, various types of state government policies have been consistently associated with political culture, with moralistic political cultures having the most interventionalist governments and traditionalist political cultures the least. These cultures have been associated with different patterns of government intervention, levels of social inequality, as well as health outcomes (Sharkansky, 1969). Morley and Pratte (2013), for example, showed that Republican control of state legislatures was associated with lower excise taxes on cigarettes which in turn were significant predictors of state smoking rates.

Second, in federal political systems variations in state- or provincial-level anti-smoking legislation is also likely to influence community norms and the overall prevalence of smoking. In an early US study, which examined links between community social environments and attitudes to smoking, Ross and Taylor (1998) showed that pro-smoking attitudes were highest in states where libertarian values were important. In Iowa, for example, pro-smoking attitudes persisted due to a lack of policy enforcement at local levels and support for individual rights and freedoms. Similarly in Canada, Corsi et al. (2012) found that collective norms discouraging smoking in a community was the strongest contextual predictor of smoking while provincial-level factors, such as cigarette taxes and workplace bans, also played a role.

Third, while differences in national and local political cultures may be important in influencing variations in policy implementation, so too has been the impact of the tobacco industry. Not surprisingly, Ross and Taylor (1998), for example, showed that pro-smoking attitudes in different US regions were stronger in places economically reliant on the tobacco industry. In the United States, cross-state variation in spending on tobacco control also reflects the impact of local tobacco interests. For example, Hoffer and Pellilo (2012) indicate that geographic differences in tobacco control spending are negatively related to both the level of tobacco production as well as the level of campaign contributions from state tobacco lobbies. Also it has been shown that US states which are more economically reliant upon tobacco manufacturing (as measured by tobacco revenue of a percentage of state gross product) were more likely to have weaker smokefree laws (Morley and Pratte, 2013). As is the case in many other parts of the world, the tobacco lobby has been successful in increasing the number of states that have enacted state pre-exemption of stricter local tobacco control laws and prevented the passage of many policies, particularly those relating to more vigorous smoking bans (Givel and Glantz, 2001).

3. Structure of the tobacco industry in China

Much of the research outlined above has been conducted in high income countries with market economies and not in contexts such as China where the two state organisations, the State Tobacco Monopoly Administration (STMA) and the China National Tobacco Company (CNTC), are dominant monopolies. Consequently it is important to briefly outline the structure of the Chinese tobacco industry, its key stakeholders and their importance at national and provincial levels. It is argued that any analysis of regional variations in smoking in China must take account of the institutional context and the interactions between national and provincial stakeholders

and how these have shaped the operation of the industry and subsequent levels of smoking.

Before 1980 both tobacco production and cigarette production were largely managed by provincial and local governments (Hu, 2008). However, in 1982 Central Government instituted a system of vertical leadership and management and monopolised operation dominated by the STMA/CNTC. The STMA manages the tobacco monopoly and sets overall policies. It then delegates to, and closely monitors, the CNTC which is responsible for all aspects of the production, marketing, distribution, sales and prices of cigarettes (Gao et al., 2012). The CNTC is the largest producer of cigarettes in the world accounting for over 40% global production (Hu et al., 2013). The net profit of the CNTC ranked fifth of all Chinese corporations in 2011. Cigarette production has rapidly grown since 2000 and most cigarettes are consumed domestically (Li, 2012). Tobacco is also the largest source of income for the Chinese government constituting about 10% of all revenues (Cheng, 2014).

Not surprisingly, the STMA/CNTC have not been in favour of tobacco control which is reflected in China's ambivalence towards the WHO Framework Convention for Tobacco Control (FCTC) and the limitations that this could impose (Huang, 2014). Unlike many western governments, the STMA/CNTC has continued to stress the social acceptability of smoking in a variety of ways: by promoting it as an economic pillar of the country, by framing tobacco control as a threat to social stability, and by maintaining that the tobacco industry is a legitimate actor in tobacco control policy making (Jin, 2014). Consequently, unlike its western counterparts the tobacco industry enjoys a certain amount of respectability in China and one that is encouraged by both central and provincial governments, despite the former being a signatory to the FCTC (Hu et al., 2013). The STMA/CNTC, by virtue of its vertical institutional network, also uses its provincial, prefecture/municipal and county branches to promote the tobacco industry at lower levels of government and to ensure a continuous increase in economic returns (Li, 2012).

However, the STMA/CNTC, though crucial, is not the only important part of the tobacco bureaucracy. Despite the centralisation of control over all aspects of tobacco cultivation and cigarette production in the 1980s, provincial governments still remain as important stakeholders as are the tobacco enterprises located within their boundaries. Therefore, provincial level factors must be taken into account in any examination of smoking rates in China. Provincial governments have influenced tobacco cultivation and cigarette production and consumption in a number of ways. First, they maintain liaison offices in Beijing to advance their interests and such lobbying groups (*zhujingban*) have rapidly increased in number (Li, 2012). Second, especially since the abolition of rural agricultural taxes in 2005, provincial governments have encouraged farmers to plant tobacco crops given that the remaining tobacco leaves tax became their only source of revenue from agriculture (Jin, 2014). Although the STMA sets procurement prices of tobacco leaves and the allocation of tobacco production quotas, the stimulation of production by tobacco tax-dependent local governments has meant that the use of price to control production volume has not always proved effective (Hu, 2008). Third, ever since the mid-1990s, when the cigarette market became increasingly saturated, growing competition among producers resulted in increased protectionism and preferential policies to support local cigarette manufacturers (Zhou, 2000). This provincial-based protectionism has taken a number of forms. For example, provincial governments have often instructed local tobacco companies to sell their production locally. Li (2012) reports that only three provinces (Shanghai, Yunnan and Guizhou) sold less than 40% locally made cigarettes, while He (2010) showed that 74% cigarettes manufactured in China were sold in their home province, cross-provincial sales being small. In some cases provincial governments have ordered their public sector workers to smoke local brands in order to boost the local economy (Li, 2012). Jin (2014) reports examples in Hubei Province where various counties within the province issued edicts for quotas of cigarettes to be consumed at official banquets and by teachers at local schools during the global financial crisis in 2009. These edicts also reflect the culture of cigarette gifting in China where the consumption of tobacco products is an important component of social interactions (Rich and Xiao, 2012).

Because the tobacco industry is a major source of tax revenue in many provinces, provincial and other local governments have a vested interest in stimulating higher rates of production and consumption of locally made cigarettes. The introduction of the central-local tax distribution system (*fenshuizhi*) in 1994 resulted in a complex tax sharing arrangement whereby certain taxes are independently raised by central and provincial governments and some are shared, most notably the value-added tax, corporate income tax and the tobacco business income tax. Although provincial governments obtain approximately 19% of all tobacco-related taxes (Li, 2012), this hides the fact that tobacco-related taxes are still a major source of revenue for those provinces most heavily dependent on the industry.

Uneven regional development is characteristic of both the production of tobacco leaves and cigarettes. While tobacco cultivation is heavily concentrated in a limited number of provinces (in 2011 four provinces, namely Yunnan, Guizhou, Henan and Sichuan, accounted for over 70% planting area), this is less true of cigarette manufacturing where the four leading provinces (Yunnan, Hunan, Henan and Shandong) produced only around one third (34.7%) of all cigarettes manufactured in China in 2011 (Table 1). However, given the quest for greater efficiencies this pattern is likely to change as the STMA's quest for greater efficiencies has resulted in an increased number of mergers of cigarette manufacturers.

Despite centralised control of the production process, provincial governments also have important relationships with tobacco manufacturers and local wholesalers. As in the case of the Hongta Group in Yunnan Province, top party and provincial leaders have played a critical role in the rapid development of the industry at the enterprise level. This has taken the form of local financial investments in plant and equipment, political lobbying on behalf of particular factories, or encouraging the production of higher grade cigarettes which in turn help produce more government revenue (Li, 2012). Also in order to help ensure favourable outcomes provincial governments have also played a key role in controlling appointments of the tobacco companies operating in their regions. This has placed tobacco executives in an advantageous position when seeking government help to expand the industry. In the past provincial governments were also instrumental in helping encourage non-official wholesalers (free wholesale markets) especially in rural areas not adequately served by official wholesalers. Zhou (2000) reports that, despite efforts by the STMA/CNTC to shut them down in the 1990s because they eroded central government revenues, at least half nevertheless remained because of the protection they received from provincial governments who had a vested interest in their continued survival.

From the above overview it is clear that, despite the existence of central government monopoly control over the tobacco industry in China, provincial governments still remain important stakeholders and have close ties with the industry, especially in provinces heavily economically dependent upon tobacco. In view of this, it is hypothesized that smoking rates will be higher in such regions given the priority of economic over public health concerns. In order to explore this question further we now turn to the methodology adopted in the study.

4. Methods

4.1. Study area and participants

This study employed a cross-sectional multistage sampling design. We used a variety of provincial and urban contextual characteristics

Table 1
Tobacco cultivation and cigarette production in China by province, 2011 (provinces ranked by level of cigarette production).
Source: China Tobacco Yearbook, 2011–2012 (Beijing: China Economic Publishing House).

Province/municipality	Hectares of tobacco crops (1000 ha)	% China total	Tobacco cultivation (hectares of tobacco crops per 1000 ha total crops)	Cigarette production (100 million pieces)	% China total	Cigarette production (cigarettes per 100 yuan GDP)
Yunnan	495.3	**33.89**	74.3	3649.9	**14.91**	41.0
Hunan	104.8	**7.17**	12.5	1816.2	**7.42**	9.2
Henan	124.7	**8.53**	8.7	1676.1	**6.85**	6.2
Shandong	33.6	**2.30**	3.1	1361.3	**5.56**	3.0
Hubei	67.2	**4.60**	8.4	1347.5	**5.51**	6.9
Guangdong	24.2	**1.66**	5.3	1345.6	**5.50**	2.5
Anhui	11.4	**0.78**	1.3	1258.3	**5.14**	8.2
Guizhou	212.2	**14.52**	42.3	1226.2	**5.01**	21.5
Jiangsu	0.1	**0.01**	0.0	991.1	**4.05**	2.0
Sichuan	117.1	**8.01**	12.2	944.2	**3.86**	4.5
Shanghai	0.0	**0.0**	0.0	896.1	**3.66**	4.7
Zhejiang	1.2	**0.08**	0.5	885.2	**3.62**	2.7
Fujian	67.9	**4.65**	29.7	884.3	**3.61**	5.0
Shaanxi	36.2	**2.48**	8.7	860	**3.51**	6.9
Hebei	2.9	**0.20**	0.3	807.5	**3.30**	3.3
Guangxi	16.5	**1.13**	2.8	741.5	**3.03**	6.3
Jiangxi	20	**1.37**	3.6	584	**2.39**	5.0
Chongqing	46.2	**3.16**	13.5	516	**2.11**	5.2
Heilongjiang	35	**2.39**	2.9	436.1	**1.78**	3.5
Jilin	22.3	**1.53**	4.3	430	**1.76**	4.1
Gansu	3.7	**0.25**	0.9	410	**1.68**	8.2
Inner Mongolia	4.2	**0.29**	0.6	287.5	**1.17**	2.0
Liaoning	10.8	**0.74**	2.6	274.5	**1.12**	1.2
Tianjin	0.0	**0.0**	0.0	226	**0.92**	2.0
Beijing	0.0	**0.0**	0.0	208.9	**0.85**	1.3
Xinjiang	0.0	**0.0**	0.0	160	**0.65**	2.4
Shanxi	3.2	**0.22**	0.8	155	**0.63**	1.4
Hainan	0.1	**0.01**	0.1	95	**0.39**	3.8
Ningxia	0.4	**0.03**	0.3	0.0	**0.00**	0.0
Qinghai	0.2	**0.01**	0.4	0.0	**0.00**	0.0
Tibet	0.0	**0.0**	0.0	0.0	**0.00**	0.0
Total	1461.4	**100.00**		24474	**100.0**	

along with individual sample data collected within particular provincial cities in 2011. While the initial aim was to sample 30 potential study cities, this was not possible. Thus the final study focused on 27 cities located in 26 of the 31 municipalities/provinces of China covering all municipalities/provinces except Beijing, Hubei, Shandong, Tibet and Xinjiang. While Hubei and Shandong are important provinces in terms of cigarette manufacturing this is less true with respect to tobacco cultivation (Table 1). By contrast the other three provinces are relatively unimportant on both counts. Within each province one city was selected to generate the survey data for this study. Most of the sample cities were provincial capitals, but we included a few non-provincial capital cities because of their size (over 1.5 million people) in order to achieve better regional representation. The exception was Jiangsu, China's most economically developed province, where, because of marked cultural and socio-economic differences between the northern and southern parts of the province, two large cities, were selected; Nanjing the provincial capital and Xuzhou, a major military and transport hub.

Stage 2 involved selection of residential districts within each city. Two residential districts were randomly selected in the main urban zone of each city, excluding new building districts and sub-districts. 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 in each community. Individuals aged 15 years and older, who had lived in their home for at least a year, were identified within each household. In Stage 5, the final stage, one eligible participant was randomly selected from each family, with eligibility being determined by birthdate closest to the contact date (Yang et al., 2012).

4.2. Data collection

A total of 22,978 individuals were identified as potential participants in this study, of whom 21,138 were contacted and consented to participate; 20,601 completed valid questionnaires and were included in the analyses.

A face-to-face interview was scheduled once an individual was identified and agreed to participate in the study. All interviews were conducted using a structured self-administered questionnaire. Interviewers were fourth-year medical students from a local medical college who had received one-day training on the study protocol and interview procedures. The survey was administered privately to participants in their home or a designated quiet place, such as a backyard or community park. Interviews were conducted on Saturdays, Sundays, or during the evening or other times when the participants were available. A participant was requested to fill out a survey questionnaire of approximately 30 min' duration, following instructions from an interviewer. Each participant had the opportunity to seek information or clarification about the survey or questionnaire items, and was given adequate time for questionnaire completion. Investigators checked returned questionnaires for completeness. Participants were asked to resolve any omissions, as appropriate. Following questionnaire completion, they were given tokens of appreciation (toothbrush, toothpaste, and other small gifts) with a value of approximately US$ 1.00.

A common research protocol was utilized across all study cities to assure homogeneity of interview and data collection. The study was approved by the Zhejiang University Medical Center Ethics Committee, and verbal consent was obtained from all participants prior

to data collection. Our methods have been extensively employed in smoking research in China, and possess acceptable validity (Yang et al., 2012; Yang, 2010; Chinese Center for Disease Control and Prevention, 2011).

4.3. Measures

4.3.1. Dependent variable

Smoking status: information regarding smoking status, frequency and quantity of smoking, and smoking history were assessed through self-report. For our smoking measure in this paper, we employed the standard method recommended by the World Health Organization (1998). We defined a current smoker as someone who smoked cigarettes at the time of interview (World Health Organization, 1998; Yang, 2010; Yang et al., 2012). Our dependent variable was the individual-level variable, smoking status, coded dichotomously as 1=smoker and 0=nonsmoker. Thus the dependent variable represents the current status of smoking among urban populations within the main cities of each province and thus excludes rural residents. Although cities cannot truly represent provinces, they nevertheless are barometers of provincial economic and social trends.

4.3.2. Individual-level independent variables

Our analyses were adjusted for such potential individual-level demographic confounders as age, gender, ethnicity, educational level, and occupation, all of which have been shown to be related to smoking and smoking cessation in China (e.g., Gruder et al., 2013; Li et al., 2011; Yang et al., 2014; Yong et al., 2013).

4.3.3. Provincial and city-level independent variables

Five contextual variables were selected to represent the key variables of interest in the study and possible confounders. Given evidence that the strength of the provincial tobacco industry is likely to be an important factor influencing smoking rates, two measures relating to the level of tobacco cultivation and cigarette production were included. These pertained to the province in which each study city was located. Data for both variables, collected by the national Tobacco Monopoly Bureau, are only available at the provincial level and are not disaggregated for reporting purposes. Tobacco cultivation was defined as hectares of tobacco crops per 1000 ha total crop cultivation, and was categorized as less than 3, 3–7, and 8 or more. Cigarette production was defined in terms of cigarettes per 100 yuan GDP, and was categorized as less than 5, 5–9 and 10 or more.

However, given that urban differences in smoking rates are also likely to reflect other contextual factors, controls were made for possible socio-economic and other confounders. City population size (1.5–4.99 million, 5–9.99 million, and 10 million plus) was included as a measure of cultural difference. Smoking rates are generally higher in less urbanised areas (Li et al., 2011) and there is also evidence that urban dwellers have a greater knowledge of the health costs of tobacco and anti-tobacco messages (Xu et al., 2013). Two variables relating to level of urban economic development were also included; Gross Domestic Product (GDP) per capita (<40,000, 40,000–49,999, 50,000+ yuan) and disposable income per household (<20,000, 20,000–29,999, 30,000+ yuan). Living in a high income community has been found to be protective of smoking in China (Cai et al., 2013), independent of individual income characteristics, which have also been shown to be important (Yong et al., 2013). The city-level and provincial data were obtained from the National Bureau of Statistics (2013).

In the following analyses in order to take account of the fact that Xuzhou and Nanjing were located in the same province, we used common regional tobacco cultivation and cigarette production variables for both cities. We also undertook sensitivity analyses by alternatively omitting Xuzhou and Nanjing from the sample. However, as our results remained unchanged we decided to include both cities in the analyses.

4.4. Data analysis

All data were entered into a database using Microsoft Excel. The dataset was then imported into SAS (Version 9.3) for the statistical analyses. Descriptive statistics were calculated for smoking prevalence. Chi-square analyses were conducted using the SAS 9.3 survey procedure in determining city-variable differences in smoking, adjusting for individual-level demographic characteristics (SAS Institute Inc, 2011). Associations were confirmed through application of a multilevel logistic regression model using the SAS GLIMMIX procedure. By modeling random variation at both the individual and city levels, we can avoid ecologic and atomistic fallacies, and thus distinguish individual and contextual effects upon smoking (Goldstein, 1995; Grilli and Pratesi, 2004).

We constructed three models for the logistic regression analyses. The first was the 'null' model, a two-level model with random intercepts. It did not include any predictors except a constant, in assessing variation in the likelihood of an individual being a current smoker. From this base model, we entered demographic variables as fixed main effects with smoking to form Model 1, which assessed the possibility of effect modification of demographic characteristics, age, sex, ethnicity, educational attainment, occupation and income, on provincial urban variations in smoking. Finally in Model 2 we included all individual and contextual covariates to assess the impact of the latter on the likelihood of being a current smoker. The association between contextual variables and smoking was expressed in terms of their odds ratios and 95% CI were computed. Model fitting was assessed by the likelihood of a change in the $-2\log$. We assessed the significance of the random parameter variance estimates using the Wald joint X^2 test statistic (Goldstein, 1995).

All analyses were weighted (Grilli and Pratesi, 2004; Pfeffermann et al., 1998; Carle, 2009). The weight for an individual participant was the product of the inverse of the probability of selection across stages of the sampling process, calculated at region, city, district, and community levels. We did not consider households in our weighting, since family size was quite uniform in accordance with population policy and family planning (approximately 3 persons per household). Thus, the probability of participant selection was essentially homogeneous across households. We calculated household-level and individual-level non-participation weights. The household weights were calculated at the city level. Individual-level non-participation weights were based on a combination of city, age, and sex, and were the inverse of the corresponding participation rate. The overall non-participation weight was the product of the household and individual weights. Post-stratification weights reflected a combination of sex (male, female) and age (<25 year, 25–34, 35–44, 45–54, and 55+), based on estimated distributions of these characteristics from a national survey (National Bureau of Statistics, 2013). Final overall weights were computed as the product of the above three weights.

Estimated city-specific smoking prevalence took account of the probability of selection in districts and communities, and the non-participation and post-stratification balance (Storr et al., 2010). Chi-square analyses were weighted using the overall participant-level weights, and the multilevel analysis was weighted using sampling weight in city level and subject-level weights with non-participation and post-stratification weights, respectively (Pfeffermann et al., 1998; Grilli and Pratesi, 2004).

5. Results

5.1. Sample characteristics

A total of 21,601 individuals were participants in the study. In the sample, 53.4% were male. Participants ranged in age from 16 to 85 years; 18.0% were younger than 25, and 17.3% were 50 years and older. The details are reported in Table 2 (unweighted proportion) and 3 (weighted proportion). Demographic characteristics of the sample were similar for gender (53.4% male versus 51.3%) and ethnicity (90.7% Han versus 91.5%) to those of the national population. However, this was less true for age where the sample contained more younger (25–34) persons (+8.4%) and fewer older (55 years and over) people (−6.6%) compared to the national population (National Bureau of Statistics, 2013). It was not possible to compare educational and occupational profiles of the sample with the national population due to different measurement categories.

5.2. Smoking prevalence

The overall smoking prevalence for the sample population was 31.3% (95% CI: 19.3–33.2). However, smoking prevalence varied widely across the study cities. The highest rates were among cities in the western provinces of China (Fig. 1), in Yinchuan (49.8%) in Ningxia Province, in Baotou (45.4%) in Inner Mongolia and in Xining (39.7%) in Qinghai Province. However, some cities in provinces in southern China, most notably Guiyang (Guizhou Province) and Guangzhou (Guandong Province) also had high rates of 40% and over. Cities on the eastern coast had the lowest rates, most notably Shanghai Municipality (21.6%) and Nanjing (24.5%) in Jiangsu Province as did the cities of Changchun (28.6%), Dalian (21.2%) and Harbin (25.7%), in Jilin, Liaoning and Heilongjaing Provinces in Manchuria.

Among the overall sample there was a significant difference by age in smoking prevalence with the highest rates occurring among people aged less than 25 (36.6%) with older people smoking less (Table 3). Nevertheless relatively high smoking rates (28.2%) were still evident for the oldest respondents (aged 55 and over). Significant differences also existed by gender and ethnicity. As in the rest of Asia very high smoking rates were characteristic of males (56.7%) compared to females where smoking rates were low (6.7%). Han Chinese, the dominant ethnic group, were twice as likely to smoke compared to other groups. Significant differences were also evident by socio-economic status, whether defined in terms of education, occupation or income. Persons with elementary school education or less were more likely to smoke (58.2%) as were managers and clerks (52.9%) and commercial and service workers (51.5%). Not surprisingly there was also a strong income gradient. Lower income persons earning less than 10,000 yuan were almost three times more likely to smoke (53.6%) compared to the highest income group earning 20,000 yuan or more (18.2%).

With respect to regional and urban contextual characteristics, smoking prevalence was unrelated to city population. There was some evidence that smoking rates were less in larger cities but the difference was not significant. Nor did smoking prevalence show any relationship to urban GDP per capita, or to urban disposable income per household. Thus while individual income characteristics were related to smoking rates this was not true of area income. By contrast, both regional characteristics indicating the importance of the tobacco economy, namely tobacco crop cultivation as a proportion of the total crop area and cigarettes production per 100 yuan GDP, were significantly related to smoking rates (Table 3).

5.3. Contextual predictors of smoking prevalence

Table 4 depicts the results of the three multi-level logistic regressions. In the Null Model, which estimates that part of that variation that can be explained by the attributes of people living in the regions, it was found that the random part between regions was estimated at 0.1685 ($p<0.01$). This indicates that a significant variation in smoking prevalence occurred across the 27 study cities.

Model 1 estimates the relationship between smoking prevalence and individual demographic variables and shows that gender, occupation and income, but not age or ethnicity, displayed a significant linkage to smoking. The results show that after adjustment for the individual independent variables, the value of region-level random parameters increased slightly from 0.1685 ($p<0.01$) in the Null Model to 0.1690 ($p<0.01$) in Model 1. This indicates that individual characteristics have little influence on the variation due to the two random values which are very similar.

In Model 2 all five contextual variables are added to the model after controlling the individual characteristics. However, only cigarette production remains significant. The odds of smoking were 46% higher in regions most dependent upon cigarette manufacturing (OR=1.46 (95% CI: 1.08–2.01)). Compared with the 'null' model, the random variances in Model 2 decreased from 0.1685 to 0.1190, which indicates that cigarette production may partly explain the variation. However, the variation still is significant at the 0.01 level in this model, thus suggesting that other factors also underlie provincial differences in urban smoking rates.

Table 2
Demographic characteristics of study participants.

Characteristic	*n*	%
Age (years)		
<25	3,891	18.0
25–34	5,690	26.3
35–44	4,738	21.9
45–54	3,551	16.4
55+	3,731	17.3
Gender		
Male	11,537	53.4
Female	10,064	46.6
Ethnicity		
Han	19,588	90.7
Other	2,013	9.3
Education		
Elementary school or less	2,255	10.4
Junior high school	6,223	28.8
High school	6,196	28.7
Junior college or college	6,927	32.1
Occupation		
Managers and clerks	1,998	9.3
Professionals	1,833	8.5
Commerce and service	3,700	17.1
Operations	4,351	20.1
Students	2,481	11.5
Retired	3,054	14.1
Other	4,184	19.4

6. Discussion

This study is the first in China to fully investigate the importance of provincial residence on the likelihood of an individual being a current smoker. While some other studies have examined both urban (e.g., Huang et al., 2013; Yang et al., 2011) and provincial variation (Pan and Hu, 2008) in cigarette purchasing behaviour, awareness of tobacco advertising and smoking prevalence, their analyses have been confined to a limited number of cities or provinces. By contrast this study focused on all but five of China's municipalities/provinces and is the first in China to examine the links between economic reliance on tobacco cultivation and manufacturing and smoking rates. However, since the latter were derived from samples of urban

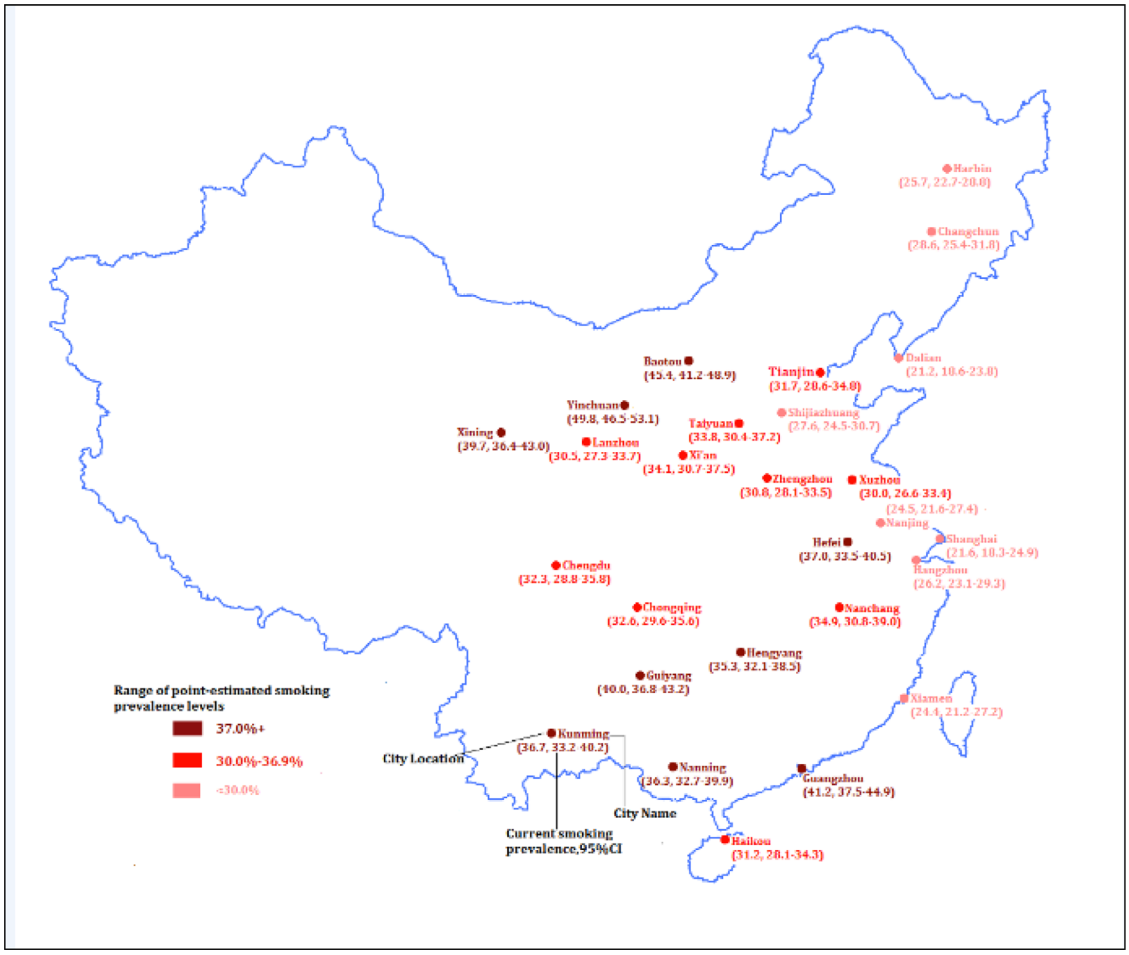

Fig. 1. Estimated smoking prevalence in selected Chinese cities, 2011.

smokers, the results must be considered preliminary. Nevertheless, despite this limitation, a number of key findings emerged.

The key finding of the study is that cigarette production was the only contextual variable to be associated with levels of current smoking, affirming an association found in some Western research (Morley and Pratte, 2013; Yach and Bettcher, 2000). By contrast the only other regional study of smoking in China (Pan and Hu, 2008) found, after controlling for individual influences on smoking, that provincial factors had little influence on smoking prevalence between 1991 and 2004. The two factors which had some small effect, namely community size and the local free market price of cigarettes, were only significant for a limited number of years. The key finding of the present study, that smoking rates are higher in provinces heavily dependent upon cigarette manufacturing is unsurprising. As indicated previously, despite China's system of centralised control over the development of the tobacco industry, provincial governments have also been important stakeholders in this process and have played key roles in stimulating local economic development and increased tobacco consumption.

There are a number of possible pathways which can help to explain why smoking prevalence should be greater in regions with higher levels of cigarette production. First, at the consumer level higher production could mean lower prices which, in turn, results in higher consumption. This is likely to result through the retail system especially given evidence that the main cigarette producing provinces in China are also those with greater numbers of retailers per capita ($r=0.64$, $p<0.0$)[1] (China Tobacco Yearbook, 2011–2012). Elsewhere existing research indicates that retail outlet density is a good predictor of both youth (e.g., Adams et al., 2013; Scully et al., 2013) and adult smoking (e.g., Reitzel et al., 2011). Following the introduction of stricter limitations on advertising the Chinese tobacco industry has increased its investments in retail outlets and point-of-sale advertising. Although there are few studies in China which have examined tobacco retailing, those that exist show that access to retailers is high in tobacco producing districts. Frick et al. (2013), for example, found that in Kunming, in Yunnan, the main tobacco producing province, that 86% schools had at least one tobacco retailer within 50 m and that students reported ease of access to local sources of tobacco. Similarly Gong et al.'s (2013) study of tobacco retail outlets in Hangzhou (in Zhejiang Province) also found a high density of tobacco outlets around schools and tobacco warning signs or signs indicating 'no sales to minors' were almost non-existent.

Despite centralised control of tobacco prices, it is possible that a greater industry presence and higher density of retailers results in more competition and lower prices. Although price setting of all tobacco products is a feature of the Chinese tobacco monopoly, the STMA nevertheless allows retailers to set their retail prices within a limited range (usually 10–15%). This also applies to cigarette factories with respect to producer and wholesale prices (Gao et al., 2012). Consequently some local variation in cigarette prices is likely to occur, but by how much and the extent to which such variations reflect tobacco retailer outlet densities is not known.

[1] Data on the number of provincial retailers was extracted from the 2011–2012 China Tobacco Yearbook and converted into retailers per 10,000 population. This (*footnote continued*) was not included as an independent contextual variable since it was considered to be only one of a number of possible pathways linking provincial cigarette production to smoking.

Table 3
Current smoking prevalence by individual-level and contextual characteristics.

Level		Weighted % sample	Weighted prevalence (%)	Rao-Scott Chi-Square (*p*-value)
Individual				
Age (years)				9.63 (0.0491)
< 25	3,891	16.4	36.6	
25–34	5,690	21.0	32.5	
35–44	4,738	18.8	31.6	
45–54	3,551	19.6	29.3	
55+	3,731	24.2	28.2	
Gender				51.10 < 0.0001
Male	11,537	49.3	56.7	
Female	10,064	50.7	6.7	
Ethnicity				4.96 0.0259
Han	19,588	93.2	32.5	
Other	2,013	6.8	15.9	
Education				31.65 < 0.0001
Elementary school or less	2,255	11.2	58.2	
Junior high school	6,223	26.9	49.3	
High school	6,196	29.7	22.3	
Junior college or college	6,927	32.3	15.4	
Occupation				34.98 < 0.0001
Managers/clerks	1,998	7.6	52.9	
Professionals	1,833	7.1	29.6	
Commerce/service	3,700	7.8	51.5	
Operations	4,351	13.2	43.8	
Students	2,481	7.6	22.1	
Retired	3,054	19.3	20.7	
Other	4,184	21.5	19.8	
Yearly income per person (yuan)				18.80 < 0.0001
< 10,000	5,003	23.1	53.6	
10,000-	6,487	28.2	34.8	
20,000-	10,111	48.7	18.2	
Contextual				
Population (millions)				2.75 0.2525
1.5–4.99	8,695	19.0	34.7	
5–9.99	8,331	34.4	30.2	
10+	4,575	46.6	30.8	
GDP per capita (yuan)				1.39 0.4996
< 20,000	6,313	30.7	33.4	
20,000–29,999	7,861	37.5	30.6	
30,000+	7,427	31.9	30.2	
Disposable income per household (yuan)				0.32 0.8515
< 15,000	14,549	70.6	31.0	
15,000–19,999	4,006	21.3	32.0	
20,000+	3,046	8.1	32.4	
Tobacco crop cultivation (in hectares per 1,000 ha of total crop area)[a]				13.22 0.0013
< 3	10,209	44.4	29.4	
3–7	5,136	42.0	33.5	
8+	4,093	13.6	36.5	
Cigarette production (per 100 yuan GDP)				6.37 0.0414
< 5	9,449	39.1	30.1	
5–9	4,703	40.8	30.0	
10+	6,587	20.0	36.4	

[a] Areal tobacco crop data are missing for Shanghai and Tianjin.

Nevertheless there is some evidence of price discounting. For example, Yang et al. (2010), in their ITC Survey of six cities in China, found that in cities with lower levels of reported tobacco advertising that people had a higher awareness of retailer tobacco promotion activities such as free gifts or special discount offers. For instance, Yinchuan, a relatively poor city had more direct price discounting, while in Guangzhou, a richer city, people reported more value added gifts.

Cheng et al. (2013) report a wide range of cigarette prices nationally from 1.5 yuan per pack to up to 150 yuan per pack for top end brands while Li et al. (2010), in the ITC survey of six cities, found that the median prices paid per pack varied from 7.50 yuan in Shanghai to 3.70 yuan in Shenyang. Access to lower priced cigarettes is especially important for heavier smokers and for those on low incomes (Huang et al., 2013; Li et al., 2010). Cheng et al. (2013), for example, found that the majority of blue collar

Table 4
Multilevel logistic regression analyses (adjusted odds ratios and 95% confidence intervals) of current smoking status (smoker versus nonsmoker).

Level	Null model	Model 1 (OR, 95% C.I)	Model 2 (OR, 95% C.I.)
Fixed parameters constant	0.7981(0.06525) (t:11.86)**	−3.1776(0.08196)**	−2.5009(0.1010)**
Individual			
Gender			
Male		1.00	1.00
Female		0.60(0.02, 0.15)**	0.06(0.03–0.15)**
Occupation			
Managers and clerks		1.00	
Professionals		0.71(0.53, 0.96)*	0.72(0.53–0.98)*
Commerce and service		0.79(0.50, 1.25)	0.78(0.48–1.28)
Operations		0.73(0.52, 1.06)	0.76(0.46–1.16)
Students		0.34(0.16, 0.74)**	0.35(0.16–0.78)**
Retired		0.48(0.27, 0.75)**	0.47(0.28–0.80)*
Other		0.38(0.20, 0.70)88	0.38(0.21–0.69)**
Income per person/year (yuan)			
< 10,000		1.00	1.00
10,000-		0.74(0.27, 0.75)	0.75(0.48, 1.16)
20,000-		0.44(0.27, 0.73)**	0.44(0.27, 0.71)**
Contextual***			
Cigarettes produced per 100 yuan GDP			
< 5			1.00
5–9			1.11(0.83–1.48)
10+			1.46(1.08–2.01)**
Random parameters between regions	0.1685(0.06125)**	0.1690(0.0419)**	0.1190(0.05534)**

* $p < 0.05$.
** $p < 0.01$.
*** As in Table 3, the three city-level variables of population size, GDP per capita, and disposable income per household were not significant.

workers in Kunming bought low priced cigarettes, usually less than 4 yuan per pack, while Yao et al. (2013) also found that young and low income smokers were more likely to purchase cigarettes from cheaper sources. However, because the profit margin on cheaper cigarettes is low then tobacco companies are less likely to produce these than higher cost brands. Consequently these different price margins help contribute to China's large price spread (White et al., 2013) and will encourage retailers, many of whom are part-time traders (Hu et al., 2010), to sell higher priced brands. Because of this the CNTC requires local tobacco companies to produce a certain quota of cheaper cigarettes each year and subsidises them to compensate for lower profit margins. Thus in some respects the CNTC is no different from US tobacco companies which used discount cigarettes in the 1980s and 1990s to retain price sensitive smokers (Cummings et al., 1997). The point is that it is likely that retailers in localities where there is more competition from other retailers will be more likely to engage in price discounting and for consumers to purchase less expensive brands. If this is the case then it will support trends which show that Chinese smokers who buy less expensive brands are less likely to quit (Li et al., 2010). There is also evidence that the price elasticity of demand is much lower in China compared to other countries (White et al., 2013). Part of the reason is that cigarette taxes as a percentage of retail prices have remained low in China compared to the WHO benchmark of 40% (World Health Organization, 2011; Jha and Peto, 2014). Another reason is that in order to maintain levels of consumption the STMA has ensured, as in the 2009 tax increase on cigarettes, that this was not passed on to consumers, but to producers and wholesalers (Gao et al., 2012). This left local retail prices and provincial government revenue unchanged.

Although easier access to cigarettes may favor higher rates of smoking in areas of tobacco production, a second important pathway relates to the lack of enforcement of tobacco control policies in such areas. Given that cigarette manufacturing is a key generator of local government revenue and that cigarette manufacturers are among the few profitable state-owned industries, then there is little incentive for the local enforcement of tobacco control initiatives. In Yunnan, the 'tobacco kingdom' of China, various tax revenues from tobacco production and cigarette manufacturing accounted for nearly 70% provincial government revenue, with almost half of this being used for rural development, education social welfare and industry development (Food and Agricultural Organization (FAO), 2003). Consequently, in view of such trends it is not surprising that provincial governments have tended to focus on regional economic development at the expense of addressing smoking problems and instituting tobacco control (Warner, 2000). Anti-smoking campaigns directly challenge the revenue earnings of local governments and industry profits and thus these parochial local concerns will tend to outweigh any thoughts of tobacco control and China's international FCTC commitments (Li, 2012).

While no data is available on provincial differences in the implementation of tobacco control policies, these trends nevertheless are similar to those reported by Morley and Pratte (2013) for the United States where the implementation of tobacco control measures was negatively related to tobacco revenue as a percentage of state gross product. Thus, as in the case of provinces in China, many US states have tended to perform poorly in terms of spending on tobacco control. This is most evident in states with Republican control of state legislatures and where pro-business, anti-tax political interests are associated with lower excise taxes on cigarettes, weaker smokefree policies and less spending on tobacco control. These trends are especially evident in states heavily dependent on tobacco manufacturing with tobacco-manufacturing states spending nearly 30 percentage points less of the Centre for Disease Control (CDC) recommended amount than non-manufacturing states. Similarly Hoffer and Pellilo (2012) showed that tobacco control spending was negatively related to both the level of tobacco production and the level of campaign contributions from state tobacco lobbies. Not surprisingly, tobacco producing states have much lower rates of smoking cessation (Dwyer-Lindgren et al., 2014). Similarly in other countries, such as Japan, although a national health promotion law has existed since 2003, mandating local prefectures to restrict exposure to second hand smoke, significant regional disparities nevertheless exist in terms of compliance with the legislation. As in poorer countries, such as Tanzania (Kagaruki, 2010) or Vietnam (Higashi et al., 2011), the

implementation of tobacco control measures has been particularly poor in prefectures involved in growing tobacco (Yorifuji et al., 2011).

A third pathway linking higher rates of provincial cigarette production to increased smoking prevalence is the role of the tobacco companies. As in the United States (Hoffer and Pellilo, 2012), the lack of spending on, and local enforcement of, tobacco control in China is influenced by the presence of tobacco special interests. Yang et al. (2010) report that tobacco company lobbies have been aggressive in their marketing activities and that significant regional differences existed in awareness of tobacco advertising and promotion as well as a diversity of implementing a central set of laws designed to restrict tobacco promotion. In a study of tobacco advertising in six cities they found that in the three cities with the greatest industry presence (Changsha, Shenyang and Shanghai) a higher proportion of people recalled noticing tobacco advertising on posters, billboards and newspapers/magazines and this was also true of tobacco advertising and promotional activities at the point of sale.

Although both smokers and the tobacco industry in China are routinely characterized in overwhelmingly negative ways in everyday discourse and through the mass media (Chapman and Freeman, 2008), the above findings suggest that a formidable counterforce is the omnipresent tobacco advertising, promotion, sponsorship, and marketing especially in areas with heavy tobacco cultivation and cigarette production (Li and Yong, 2009; Li et al., 2009). Attesting to their marketing sophistication, tobacco companies also target consumers and potential consumers with culturally-tailored cigarette brands (Yang, 2010). Awareness of tobacco advertising in China is high compared to other countries (Li et al., 2009). One recent study found that 41% of respondents reported 'sometimes' or 'very often' being exposed to tobacco advertising, with the highest exposures occurring through television (54%), billboards (28%), and visits to tobacconists (25%) (Yang et al., 2012). There is little restriction of tobacco company sponsorships, and implementation of these laws and regulations is ineffectual (Li et al., 2009). As a consequence, tobacco promotion and advertising continues virtually unabated.

Tobacco companies also maintain a high community profile by directly making significant contributions to community development. For example, Cheng (2014) cites the Chinese Association on Tobacco Control which indicated that 52 tobacco companies donated to, or sponsored, 79 welfare activities in 40 cities and counties during the last quarter of 2009, including those, such as the Hope Project, designed to help poor children attend school (Jin, 2014), These philanthropic projects are similar to those pursued by any other tobacco company and are important in promoting a positive public image of corporate social responsibility and maintaining public support for the CNTC (Hu et al., 2013; Yang et al., 2010).

Finally, it could also be argued that provinces heavily dependent on cigarette production are more likely to have a culture of pro-smoking. A large body of work in western countries has documented the significance of cultural and social practices on smoking initiation and cessation (e.g., Bell et al., 2007; Christakis and Fowler, 2008). This work has emphasised that smoking is a learned behaviour and that people's smoking habits will be influenced by local social norms with respect to its acceptability (e.g., Ross, 2000). In China these norms have been heavily influenced by the tobacco industry, through its advertising and community activities, which have undermined the acceptance of anti-tobacco messages. Pro-smoking cultures have also been reinforced by the tobacco industry through its promotion of cigarette gifting (Rich and Xiao, 2012). Ding and Hovell (2012) have argued that cigarette gifting should be conceptualised not as a Chinese custom but as a cultural product or social currency engineered by the tobacco industry to build brand identity and increase consumption. Cigarette gifting, although widespread, has become synonymous with having higher social status (Huang et al., 2012) and increased social connections, but also as an action which acknowledges respect. Cigarette gifting has thus become an accepted, expected, and normative practice in Chinese society. Although no studies have assessed the geography of cigarette gifting in China, the practice is likely to be especially important in tobacco growing and cigarette producing provinces where the industry is most powerful. Also attempts, such as the "giving cigarettes is giving harms campaign" (World Lung Foundation, 2010), which have sought to change smoking norms, are less likely to be successful in such contexts.

While the level of cigarette production emerged as an important predictor of provincial urban variations in smoking rates, there was no evidence that areas cultivating tobacco had a higher prevalence of current smokers than those which did not. This stands in contrast to the findings of some other studies. In a study of adults living in rural areas in Yunnan Province Cai et al. (2012, 2013) found that individuals who cultivated tobacco smoked more than those that did not. Similarly, Hoffer and Pellilo (2012), while they did not directly examine the direct effects of tobacco cultivation on smoking, nevertheless found the former to be important factor influencing tobacco control expenditures. In this study the absence of contextual effect may reflect two factors. First, at the ecological level, provinces with high levels of tobacco cultivation were also important cigarette manufacturing centres ($r=0.92$) so it is not surprising that the former did not emerge as a significant contextual factor. Second, the urban nature of the sample also meant that explicitly rural factors would be relatively unimportant in influencing smoking prevalence among urban populations.

Prior studies have also found that economic development was associated with less cigarette use (Chinese Center for Disease Control and Prevention, 2011; Yang et al., 2012). Eastern China is more economically developed than western China, which in turn may promote healthier lifestyles and less smoking. However, this current study found no association between GDP per capita, disposable income per household and the likelihood of being a current smoker. We also added these city-level variables, one at a time to the analysis, but the results remained the same. These discrepant findings suggest that understanding provincial variation in current smoking will require more complex modelling, such as the inclusion of consumerism and other behavioural variables (Chaix and Chauvin, 2003).

The key finding that provincial variation in cigarette production is an important contextual factor influencing variations in smoking prevalence in China is significant for a number of reasons. First, it suggests that, despite the existence of central government monopoly control over the tobacco industry, that provincial governments still play an important role in influencing smoking rates. Provincial governments, because of their current dependence on tobacco revenues, and their historical control of the industry, have not only played important roles in assisting local tobacco manufacturers, but also in terms of stimulating pro-smoking attitudes and local demand. Provincial protectionist measures taken by local governments, only interested in trade volumes within their jurisdictions, have also contributed to weakened central state control and moves to create greater efficiency on the part of state tobacco enterprises (Zhou, 2000). In response in 2007 the CNTC established 16 provincial corporations to assist the CNTC in regulating and monitoring local tobacco markets and inter-jurisdictional sales (He et al., 2013). Second, given their more parochial economic interests, tobacco control is not high on the political agendas of most provincial governments. For example, since the 1990s provincial smokefree policies, most notably the introduction of stronger smokefree policies at the Beijing Olympic Games and the 2010 World Expo in Shanghai (Li et al., 2013), have reflected central, rather than provincial, government initiatives and have been designed to improve the image of China to the world and evidence of its global health commitment as a signatory of the FCTC. Third, given the above two trends, as Cheng et al. (2013) have suggested, there is an urgency to develop tobacco control efforts at the provincial level in the cigarette producing regions, particularly as national smoking rates have increased, rather than decreased, since

China signed the FCTC in 2001 (Katanoda et al., 2013; Lv et al., 2011). Others have similarly stressed the need for population-level interventions that modify the policy and social environments which encourage smoking (Ding and Hovell, 2012). However, in the current policy climate in China, where the same organisations, the STMA and CNTC, are responsible for both tobacco production and tobacco control, this will be difficult but not impossible given evidence of high levels of support for tobacco control policies (Zheng et al., 2013).

Promoting tobacco control policies in rural tobacco growing communities and centres of cigarette manufacturing presents unique challenges. Given the conflict between economic development imperatives and those of health promotion through tobacco control, we suggest that there is a need for more careful political economy analyses of geographic variations in policy implementation (Bump and Reich, 2013) and why these have been more significant in some local contexts compared to others (Wan et al., 2013). To date the development of tobacco control initiatives in difficult policy environments of tobacco production or manufacturing has not been well explored, but the few examples that exist (e.g., Satterlund et al., 2011; Butler et al., 2014; Mamadu et al., 2014) suggest that such studies may be fruitful. Such an approach thus differs from traditional public health approaches which dominate the literature and has the potential to provide a more in-depth understanding of the barriers to effective policy implementation as well as of some of the local 'success' stories (e.g., Li et al., 2013) which have occurred. Thus while the STMA/CNTC remains relatively intractable to further developments in tobacco control, ironically there may be further opportunities at the provincial level particularly in those provinces not heavily dependent upon tobacco for their economic welfare.

There were a number of limitations in this study. One limitation is that our participants were confined to residents of urban areas. Thus, our results cannot be generalised to the wider Chinese population, which also comprises a very substantial rural component. To some extent they also underestimate the level of smoking prevalence since rural smoking rates are generally higher than urban ones but not markedly so (Li et al., 2011). Our sample only included large cities in this study, however, the sample provided a good regional coverage of cities with populations exceeding 1 million in China and included over half the cities with populations exceeding 3 million. A second limitation is that we comingled city and provincial data in creating the various contextual variables. However, this was not thought to be a major limitation since, by definition, tobacco cultivation is a rural activity which feeds cigarette factories most of whom are likely to have urban locations. Perhaps more significant is that we were unable to test the significance of the three different pathways linking provincial cigarette production to urban smoking rates. However, this was beyond the scope of the study and must be considered a priority for further research. Another important limitation is the cross-sectional design of the study, which precludes our capacity to draw causal inferences. On the other hand, we employed a large sample, and our findings met several criteria for inferring causality, including the strength of some associations, their consistency, and plausibility of effect. Future studies need to compile longitudinal surveillance data on smoking. Regarding the latter, it was not possible to estimate the proportion of migrants as a whole, and migrants from rural areas, in our respective city samples. This decision may have inadvertently introduced selection bias, since these in-migrants, who are predominantly of rural origin, tend to be of a lower socioeconomic status than permanent urban residents (National Bureau of Statistics, 2013) and hence more likely to smoke (Yang, 2010).

7. Conclusion

Given the importance of tobacco production in the China's economy, there is a fundamental conflict between the goals of economic development and those of health improvement (Wang, 2006; Hu et al., 2013). Pro-tobacco forces, both at central and regional levels, continue to stress the economic contribution of the tobacco industry as an economic pillar of China and a social currency that contributes to political stability. Thus the official view is one that stresses normalisation, not denormalisation, in its attitude to the tobacco industry. Consequently, although China is a party to the FCTC, the government's implementation and enforcement of tobacco control policies has been limited (Jin, 2014; Samet, 2014) and the ratio of government expenditure on tobacco control to annual tax revenue is one of the lowest globally (Lam and He, 2014). To a large extent this reflects the weakness of anti-tobacco policy networks, which remain marginalised.

Nevertheless the association of cigarette production with the likelihood of being a current smoker possesses very important potential implications for tobacco control in China. It highlights the significant link between the industry presence and health behaviour. Ideally our findings should inform policymakers and legislators who aim to develop and implement more effective tobacco control policies, especially with respect to restricting cigarette production and regulating the marketing of tobacco products. As Hu et al. (2013) and others have noted (e.g., Malone, 2010), the pace of progress in tobacco control in China is too slow. Most tobacco control policy research in China has largely had an econometric focus and paid little attention to environmental causes of smoking. We suggest that both approaches are necessary and that an important next stage is to highlight the actual economic costs of smoking in those provinces most heavily dependent upon tobacco for their revenue. Inputs such as these will help strengthen the anti-tobacco lobby and may go some way to help control China's tobacco epidemic.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

TY conceived the study design and TY and RB conceptualized the ideas; TY and LI supervised the data management and analyses. DW, YY, YX, HJ, WZ conducted the data collection. TY and RB wrote the manuscript. All authors reviewed previous drafts and approved the final version.

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