Methods of the International Tobacco Control (ITC) China Survey

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ABSTRACT

This paper describes the design features, data collection methods and analytical strategies of the ITC China Survey, a prospective cohort study of 800 adult smokers and 200 adult non-smokers in each of six cities in China . In addition to features and methods which are common to ITC surveys in other countries, the ITC China Survey possesses unique features in frame construction, a large first phase data enumeration and sampling selection; and it uses special techniques and measures in training, field work organisation and quality control. It also faces technical challenges in sample selection and weight calculation when some selected upper level clusters need to be replaced by new ones owing to massive relocation exercises within the cities.

INTRODUCTION

The International Tobacco Control (ITC) Policy Evaluation Project was created in 2002. It was conceived as a research tool to measure the effectiveness of national-level tobacco control policies in selected countries which signed and ratified the Framework Convention on Tobacco Control (FCTC). The ITC project possesses several unique features that set it apart among studies on tobacco control. It was designed based on a conceptual model which assumes that each tobacco control policy ultimately has an influence on behaviour through a specific causal chain of psychological events.[1] While the formulation and inclusion of survey questions (variables) are guided by the assumed conceptual model and the provisions of the FCTC, two other key features of the study are the *longitudinal* and *international* aspects of its design. The longitudinal data structure allows the psychosocial and behavioural changes before and after the implementation of a particular tobacco control policy in a country to be measured and compared; and the use of same model and tools in different countries permits one or more countries to be used as control groups when cross-country comparisons are made, and the impact of culture, geographical and economical differences on the effectiveness of certain tobacco control policies is studied.

The ITC survey first started in four large English speaking countries—namely, Canada, USA, Australia and the UK (the ITC-4 Survey). It is a random digit dialled telephone survey of over 2000 adult smokers in each of the four countries. The first wave of the survey was conducted in 2002. In subsequent waves, the initial group of respondents was followed and a new cross-sectional replenishment sample was added to make up for the reduced size of the longitudinal sample owing to attrition. The dual design (longitudinal and cross-sectional) is another important feature of the ITC survey, which allows the examination of the effects of attrition and time-in-sample. Thompson *et al*[2] contains details on the features, data collection methods and statistical methods for the ITC-4 Survey.

The ITC project has been growing steadily, with many countries of geographical and strategic importance being added to the initial ITC-4 Survey. Among the significant expansions was the launch of the ITC China Survey in 2006. The ITC China Survey is a prospective cohort study of 800 adult smokers and 200 adult non-smokers in each of six cities in China: Beijing, Shanghai, Guangzhou, Shenyang, Changsha and Yinchuan.[i] In addition to features and methods which are common to ITC surveys in other countries, the ITC China Survey possesses unique features in frame construction, a large first phase data enumeration and sampling selection. It uses special techniques and measures in training, fieldwork organisation and quality control. It also faces technical challenges in sample selection and weight calculation when some selected upper level clusters need to be replaced by new ones owing to massive relocation exercises within the cities, as occurred with two of the cities at Wave 1 and Wave 2.

This paper describes methods used in the ITC China Survey. Special attention is given to design features, training, fieldwork organisation and quality control measures. Additional details are provided in the ITC China Survey Wave 1 Technical Report, which can be found at http://www.itcproject.org.

DESIGN FEATURES

It was clear at the beginning of the planning stage that a national representative sample was not feasible, and that the survey would have to be carried out through face-to-face interviews. First, any attempt to cover the vast rural areas in China would require tremendous resources and staff levels, and the ITC China project is clearly not equipped to achieve that goal. Second, most Chinese people are not used to accepting long interviews by telephone. Given the complexity, the sophistication and the longitudinal nature of the ITC survey, it was decided

[i] There was a seventh city in the first two waves—Zhengzhou—but the quality of the data from that city was not sufficiently high; thus, the data from that city are not included in the overall ITC China Survey dataset.

that the survey should be conducted in selected cities through face-to-face interviews. Another important consideration was that any tobacco control policy to be implemented by the Chinese government will probably first start in major cities. A prominent example is the introduction of new regulations and restrictions on smoking in public venues in Beijing, put in place prior to the Beijing Olympics in the summer of 2008.

The target population

The six cities in the ITC China survey do not constitute a random sample of the entire population of China. They were judiciously selected based on geographical representations and levels of economic development. Beijing, Shanghai and Guangzhou are the three largest cities in the north, east and south of China, and these three cities are all in the forefront of China's economic development in recent years. Shenyang is the largest city in the north east. Changsha is a mid-sized city in the southern central part of China and is also one of the major bases for the Chinese tobacco industry. Yinchuan is an economically less developed city in the northwest region.

The mobile population in these cities are not eligible for the study owing to the requirement of follow-ups in subsequent years. The well established city registration system for permanent residents makes the exclusion an easy task to execute. The target population of the ITC China Survey consists of smokers and non-smokers who are 18 years or older and are permanent residents and live in residential buildings in each of the six cities. Smokers are defined as those who have smoked at least 100 cigarettes in their lifetime and are currently smoking at least once a week. Ex-smokers are not considered as a separate category at Wave 1 ITC China Survey.

Sample size

The overall sample size of the survey is 4800 for adult smokers and 1200 for adult non-smokers for the baseline Wave 1, with 800 smokers and 200 non-smokers surveyed in each of the six cities. This choice of sample sizes was based not primarily on power calculations but rather on a practical allocation of available resources. However, the sample size for smokers is large enough not only to obtain reliable statistics at the aggregated level but also to have meaningful estimates for each city. The sample of non-smokers with smaller sizes is constrained by the available resources but it nonetheless provides opportunities to examine differences in some of the key psychosocial and behavioural measures between smokers and non-smokers. At subsequent waves replenishment samples of smokers as well as non-smokers are added to compensate for the losses to follow-up owing to attrition in the longitudinal sample.

Frame construction and sample selection

The ITC China Survey employs a stratified multistage cluster sampling design. Each city is treated as a stratum and within each city, there is a natural and well established hierarchical administrative system which provides excellent coverage of the target population:

City→ street district (Jie Dao)→ residential block (Ju Wei Hui)→ household

The Jie Dao and Ju Wei Hui are two levels of administrative units under the city government. More importantly, the ITC China team has strong communication links with the Jie Dao and Ju Wei Hui staff members, who play crucial roles in the first phase data enumeration as well as coordination for the survey interview.

In each of the six cities, 10 Jie Dao were randomly selected, with probability of selection proportional to the population size of the Jie Dao. Within each of the 10 sampled Jie Dao, two Ju Wei Hui were selected, again with probability proportional to the population size of the Ju Wei Hui. The randomised systematic PPS sampling method was used to select the Jie Dao and Ju Wei Hui. Within each selected Ju Wei Hui, a complete list of addresses of the dwelling units (households) was first compiled from administrative data, and then a sample of 300 households was drawn from the list by simple random sampling without replacement. In this way, the second phase sampling frame of 6000 households was constructed in each city, and the frame itself can be viewed as a first phase sample from the city population. The use of PPS sampling at each of the first two stages (Jie Dao and Ju Wei Hui), and a simple random sample of an equal number (300) of households in each selected Ju Wei Hui, ensured that each eligible household in the city had approximately the same chance of being included in the frame of 6000.

A complete enumeration of the 6000 households was conducted prior to the selection of individuals. In the process, information on age, gender and smoking status for all adults living in these households was collected. The enumerated 300 households within each Ju Wei Hui were randomly ordered, and adult smokers and non-smokers were then approached following the randomised order until 40 adult smokers and 10 adult non-smokers were surveyed. Because of low smoking prevalence among women, one male smoker and one female smoker from each selected household were surveyed whenever possible to increase the sample size for women smokers. At most one non-smoker was interviewed per household. Where there was more than one person in a sampling category to choose from in a household, the next birthday method was used to select the individual to be interviewed, and the selection was done prior to the household visit. Proxy interviews were not allowed in the ITC China Survey.

In order to deal with the potential impact of attrition in this cohort survey, at each subsequent wave, those respondents from the previous wave who are lost to attrition are to be replaced (ie, the cohort is to be replenished) by extending the sampling procedure using the same sampling frame that has been constructed at Wave 1. The way that the initial sampling frame was constructed allows this to be a practical possibility. The Wave 2 replenishment survey, for example, drew its sample from the same list of 300 enumerated households that was constructed in the Wave 1 survey for each Ju Wei Hui; households that were not surveyed in Wave 1 were randomly ordered, and adult smokers and non-smokers were recruited in accordance with the procedures described above for Wave 1. If the list of 300 households was exhausted before the desired quota was reached, available households from an adjacent Ju Wei Hui were used to fill the quota. In Wave 2, this happened four times in Shanghai, three times in Changsha and not at all in the other four cities. In Shenyang, there was a massive loss of Wave 1 respondents within one Jie Dao because they were living in an area where all of the residents were moved under the city's relocation exercise. They could not be contacted at Wave 2. To compensate for this dramatic and unforeseen loss, an entire new Jie Dao was selected in that city, following the procedures that had been used to construct the sampling frame for Wave 1; the 300 enumerated households thus constituted the sampling frame for the Wave 2 replenishment survey in the new Jie Dao, and sampling proceeded as above. In Guangzhou, a similar scenario occurred for one Ju Wei Hui, and a new Ju Wei Hui within the same Jie Dao was added to the Wave 2 replenishment survey. The impact of substituting an upper level cluster on the inclusion probabilities of the resulting sampling design under an

initial multistage PPS sampling scheme is further discussed in the section on statistical methods.

The stratified multistage cluster sampling design used for the ITC China Survey is very attractive in terms of frame construction and coverage properties. This type of design is generally popular and efficient for large-scale population surveys and was well documented by Kish[3] and Lohr.[4] There exist several PPS sampling procedures in the survey literature, and the one used for selecting the first stage clusters Jie Dao and second stage clusters Ju Wei Hui in the ITC China Survey was the randomised systematic PPS sampling method. The procedure was first described in Goodman and Kish[5] as a controlled selection method, and was later refined by Hartley and Rao.[6] It is the simplest procedure to implement among alternative PPS sampling methods.

The 10 selected Jie Dao in each city comprise the first stage sample of clusters. The sampling fractions of Jie Dao in the six cities are given in table 1.

The next-birthday method was used to select a respondent where there was more than one person in a sampling category to choose from in a household. Two other existing methods for selecting individuals within a household are the Kish method and the last-birthday method. Binson *et al*[7] compared the effectiveness of the three methods using data from a national telephone survey and showed that the next-birthday method had a higher rate of retaining respondents in subsequent waves, although the differences between the last-birthday method and the next-birthday method are not statistically significant. Cooperation rates and response rates of wave 1 ITC China Survey data will be given in the section on sample data.

Survey measures and questionnaire development

The ITC China Survey, as with each ITC Survey being conducted across 20 countries of the ITC Project (at the time of this writing), was designed to measure (1) important smoking and smoking-related behaviours; (2) important psychosocial precursors to smoking and to cessation (eg, intention to quit smoking, self-efficacy for quitting, beliefs about smoking and about quitting, perceived risk, societal and subjective norms, attitudes, denormalisation beliefs); (3) important policy-relevant measures for each of the demand reduction policy domains of the FCTC, including those relevant to health warnings (eg, salience, perceived effectiveness, behaviours relating to reactions to the warnings such as forgoing a cigarette because of the warnings), advertising/promotion (overall salience of pro-tobacco messages and anti-tobacco messages, noticing of tobacco sponsorships), purchasing and price-relevant behaviour, smoke-free laws, cessation, education. The survey also included key psychosocial mediators and (possible) moderators (eg, time perspective, depression) of policy impact.

The development of the ITC China Survey was driven strongly by ITC surveys conducted in other countries, in keeping with the ITC Project's objective of conducting surveys with common measures across the 20 countries. We created the ITC China Survey through a collaborative team effort that involved (1) extensive email exchanges and conference calls between our ITC Project Team centered at the University of Waterloo (and including ITC team members from Roswell Park Cancer Institute), (2) a three-day meeting held at the University of Waterloo with our China National CDC research team, (3) a three-day meeting held two weeks later in Beijing with five ITC team members attending along with the China National CDC research team and the entire research team of 15 CDC officials and researchers across each of the participating China cities, (4) follow-up conference calls and email exchanges to resolve remaining issues. The result was an ITC China Survey in which most of the measures were either identical or, given linguistic and cultural groups existing in China, as functionally similar as possible, to those included in ITC surveys in other countries, but which also included some questions and question options that were unique to China, in accordance with the China team's expertise and experience in tobacco use in China. The ITC China Survey was constructed originally in English, but then was translated into Chinese through a system of multiple translators and with discussion of differences and resolution of those differences.

Table 1 Sampling fractions (f=n/N) of Jie Dao in the six cities

City	Shenyang	Shanghai	Yinchuan	Changsha	Beijing	Guangzhou
f=n/N	10/75	10/66	10/19	10/59	10/132	10/110

Despite the extensive collaborative process that we used to create the ITC China Survey—including both the identification of important China-specific factors by the China CDC team (from the China National CDC and from each of the local CDC offices)—and a multistage collaborative translation process, it may be the case that the ITC China Survey may fall short in failing to measure important constructs. Nonetheless, we believe that the resulting ITC China Survey represents a reasonable attempt, given the time constraints, to measure key constructs that are relevant in describing smoking behaviour and in measuring, predicting, and understanding smoking behaviour and the impact of tobacco control policies among smokers in China.

The main questionnaire for the adult smoker survey includes measures of the demand reduction policies of the FCTC, such as labelling, price/taxation, advertising/promotion, smoke-free, cessation, education, and measures on behaviour and psychosocial characteristics. Most of these measures are common for all ITC surveys but some are specifically designed for the ITC China Survey. For example, the Wave 1 surveys (for both smokers and non-smokers) included a set of questions on the International Quit-and-Win Competition, an ongoing event organised by the Office of Tobacco Control of China CDC. The Wave 2 smoker survey included questions on alcohol consumption, intended to bring statistical evidence to bear on hypothesised psychological and behavioural linkages between drinking and smoking.

The Wave 1 final versions of the smoker and non-smoker surveys were pre-tested in a pilot survey conducted in Wuhan and Shenyang in September and October 2005. The pre-test gave the ITC China team an opportunity of going through the entire process of conducting face-to-face interviews and identifying areas for improvement before the formal launch of the survey in the six cities. One particular aspect of the ITC China Survey is how to effectively use the Ju Wei Hui staff members to play a pivotal role in making the initial contact with the respondents and helping the interviewers to approach and enter the household for the survey. The pre-test also provided valuable feedback on unclear or even confusing wordings of some of the health knowledge and attitude-related questions, which led to further changes and improvement to the surveys.

PROCEDURE

The ITC China Survey was conducted through face-to-face interviews. After the potential respondent was provided with information about the survey and completion of the consent form, the average time to complete a survey was 31.4 minutes for smokers and 10.6 minutes for non-smokers, with respective

interquartile ranges (IQR) around 10 minutes and 5 minutes. Interviewers followed a strict protocol in their interview session with each respondent. Up to four visits to a household were made in order to interview the target person(s) within that household.

Survey team

The ITC China team consists of members from the Chinese Center for Disease Control and Prevention (China CDC) and international members from the ITC project. At each city, a project coordinator was appointed at the provincial or city CDC, and the project coordinator subsequently assembled a team consisting of one or two deputy team leaders, one data manager, one quality controller and 20 interviewers. Most of these people were staff members at the local CDC, Jie Dao or Ju Wei Hui, who were associated with the China CDC system. Some of the interviewers in Yinchuan were recruited from students at a local medical school. Team members at the China National CDC as well as international team members were overseeing all major steps in the survey execution.

Training

All survey-related materials, including questionnaires, training and quality control manuals, were fully discussed and finalised at a pre-survey workshop. Participants of the workshop included the international team members, members from the China National CDC and representatives from each of the cities. The workshop provided a platform for key team members to have some commonality on the ITC China Survey project, to work out details for the training and fieldwork organisation, to foresee potential problems and to suggest possible solutions.

There were two training manuals developed, one for the enumeration process and one for the survey interview. The complete enumeration of all adults living in the 300 randomly selected households within each selected Ju Wei Hui for basic demographic information and smoking status is the first crucial step of the survey. The enumeration data not only served as a basis for the final stage sample selection of individuals but also provided a rich source for the estimation of prevalence for different age-gender groups. This task was carried out by local Ju Wei Hui staff members, with training provided by each city. Training of interviewers was also organised at the city level, with support and supervision from the ITC China team members both at the China National CDC and at the ITC Project Data Management Centre at the University of Waterloo.

Quality control

Several quality control procedures were put in place. One was a three-level checking of finished questionnaires. The ITC China team established an efficient reporting and communication system among the interviewers, the data manager and the quality controller of each city, and the central team members at the National CDC. A standard checklist was created for each of the three levels: the interviewer, the city quality controller and the designated central team member. Another major quality control procedure was the practice of making MP3 recordings for each of the 800 smoker interviews in each of the six cities. These recordings were valuable not only in monitoring the quality of each interviewer's work, but also in alerting the research team to ways of improving the interview script for the survey and in identifying and correcting errors occurred during the data entry process.

SAMPLE DATA

Wave 1 of the ITC China Survey was conducted in February to April 2006, and the Wave 2 survey was conducted from October to February 2008. The final sample sizes in each of the six cities varied slightly from the target of 800 smokers and 200 non-smokers. There were consistency and validity checks on all respondents, which excluded several cases from the final datasets. One scenario for exclusion was that a respondent in the smoker survey answered "No" to the screening question "Have you smoked 100 cigarettes or more in your lifetime?" Other scenarios included that a respondent had missing values on gender or birth date, or there were mismatches on key identification variables between Wave 1 and Wave 2 data entries for the same respondent.

Table 2 Wave 1 cooperation and response rates

City	Shenyang	Shanghai	Yinchuan	Changsha	Beijing	Guangzhou
Cooperation	81.2	84.2	90.3	95.0	80.0	80.0
Response	50.0	61.3	39.4	50.0	50.0	50.0

Cooperation and response rates at Wave 1

The Wave 1 cooperation and response rates (%) for the six cities are summarised in table 2 for the adult smoker survey. The cooperation rate is calculated as the ratio of the number of completed interviews and the total number of successful contacts which include both completed interviews and refusals. The response rate is computed as the ratio of the number of completed interviews and the total number of smokers selected in the initial sample. The cooperation rates and response rates presented in table 2 for Shenyang, Shanghai and Yinchuan are exact. The project coordinators at the other three cities unfortunately did not give clear instructions prior to the field work on collecting these data and the interviewers did not keep records on the number of refusals and the number of unsuccessful contacts. The cooperation rates and response rates for these three cities are estimates only, with the missing numbers recalled by the interviewers and the Ju Wei Hui staff members who accompanied the interviewers through the entire course of field work.

The cooperation rates are comparable to those in the ITC-4 Survey but the response rates are generally higher than the telephone interview response rates in the ITC-4 Survey.

Retention and replenishment at Wave 2

The overall retention rates for the combined six cities were 81.6% for smokers and 83.9% for non-smokers. The number of respondents retained, as well as the corresponding retention rates (in parentheses), for each of the six cities, are given in table 3 for smokers and in table 4 for non-smokers. The retention rates for Shenyang and Guangzhou are much lower than for the other four cities, owing to the replacement of an entire Jie Dao or Ju Wei Hui from the Wave 1 sample. The replenishment sample sizes are also included in tables 3 and 4.

STATISTICAL METHODS

Substitution of units

The ITC China Survey employed a stratified multistage cluster sampling design. The primary sampling units, the Jie Dao, and

Table 3 Wave 2 retention rates and replenishment sample sizes for smokers

City	Shenyang	Shanghai	Yinchuan	Changsha	Beijing	Guangzhou
Wave 1 n	781	784	791	800	785	791
Lost	198	81	132	152	75	231
Retained	583 (74.7)	703 (89.7)	659 (83.3)	648 (81.0)	710 (90.5)	560 (70.8)
Replenished	198	77	101	98	54	236

Table 4 Wave 2 retention rates and replenishment sample sizes for non-smokers

City	Shenyang	Shanghai	Yinchuan	Changsha	Beijing	Guangzhou
Wave 1 n	196	204	214	203	218	224
Lost	24	17	34	45	8	75
Retained	172 (87.8)	187 (91.7)	180 (84.1)	158 (77.8)	210 (96.3)	149 (66.5)
Replenished	22	17	24	25	7	60

the secondary sampling units, the Ju Wei Hui, were selected using the randomised systematic PPS sampling method, with selection probabilities proportional to the unit population size. The list of 300 households enumerated for each selected Ju Wei Hui was initially conceived as large enough to meet the sampling requirement for not only the first wave baseline survey but also the replenishment samples in subsequent waves. The inclusion probabilities, which are required for weight calculation, can be obtained through a simple rescaling of the Jie Dao or Ju Wei Hui population sizes under the initial PPS sampling design.

The original ITC China Survey sampling design was altered in Guangzhou, where one Ju Wei Hui was replaced by a substitute unit, and also in Shenyang, where one Jie Dao (two Ju Wei Hui) was replaced by another one, because of unforeseeable changes in these two cities. When a multistage cluster sampling design is modified by substitution of units, the inclusion probabilities for the modified design can no longer be computed by the same method based on the initial sampling procedure. For the ITC China Survey, the question can be formulated more specifically as follows: when the original sample units were selected by a randomised systematic PPS sampling method, and some units were later replaced by substitute units, selected from units not included in the original sample by the randomised systematic PPS sampling method, how should the inclusion probabilities for the final sample be computed?

The question is not only of practical interest here for the ITC China Survey Project but also of theoretical interest since substitution of units often occurs in other surveys. Unfortunately, this seemingly simple question does not have a simple answer. Motivated by this particular need from the ITC China Survey, Thompson and Wu[8] proposed a simulation-based approach to assessing the effect of substitution of units for the randomised systematic PPS sampling methods. When all design information is available, which is the case for the ITC China Survey, the inclusion probabilities for the final modified design can be approximated through Monte Carlo simulations. Two important observations are especially relevant to the ITC China Survey: (i) when a PPS sampling procedure is modified owing to substitution of units, the resulting inclusion probabilities are no longer proportional to the size measure, even if the substitute units are selected by the same PPS sampling method; (ii) the impact of substitution of units on the final inclusion probabilities depends on the sizes of the units being replaced. If the units being replaced are of average size, the final inclusion probabilities under the modified sampling design are nearly proportional to the unit size. The replaced Ju Wei Hui in Guangzhou and the substituted Jie Dao in Shenyang were both of average size. It was decided that weight calculations for both cities could proceed as if the sampling design was still PPS after the replaced unit was removed from the sampling frame.

Weight calculation

For Wave 1 data, the weights were simply calculated as the reciprocal of the inclusion probabilities, and were constructed separately for male adult smokers, female adult smokers, and adult non-smokers. While the inclusion probabilities under a multistage sampling design are usually calculated as a product of the sequence of conditional inclusion probabilities from top to bottom, the weights are most conveniently constructed from bottom to top at the four levels of sample selection: individual, household, Ju Wei Hui and Jie Dao. The final Wave 1 weight for a sampled individual was the number of people in the city population and the sampling category represented by that individual.

For Wave 2 data, two sets of weights were calculated: the Wave 2 longitudinal weights for all successful re-contacts, and the Wave 2 cross-sectional weights for all individuals surveyed at Wave 2, including both the re-contacts and the replenishment sample. The Wave 2 longitudinal weights were based on the Wave 1 weights but were re-scaled at both the household and individual level to adjust for attrition; the Wave 2 cross-sectional weights were constructed by pooling together the re-contacts and the replenishment sample, and computations conducted were guided in accordance with features from the combined sampling design (cohort and cross-sectional) at Wave 2.

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Competing interests None.

Patient consent Obtained.

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Individual-level factors associated with intentions to quit smoking among adult smokers in six cities of China: findings from the ITC China Survey

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ABSTRACT

Background Over 350 million smokers live in China, and this represents nearly one-third of the smoking population of the world. Smoking cessation is critically needed to help reduce the harms and burden caused by smoking-related diseases. It is therefore important to identify the determinants of quitting and of quit intentions among smokers in China. Such knowledge would have potential to guide future tobacco control policies and programs that could increase quit rates in China.

Objective To identify the correlates of intentions to quit smoking among a representative sample of adult smokers in six cities in China.

Methods Data from wave 1 (2006) of the International Tobacco Control (ITC) Policy Evaluation Project China Survey, a face-to-face survey of adult Chinese smokers in six cities: Beijing, Shenyang, Shanghai, Changsha, Guangzhou and Yinchuan, was analysed. Households were sampled using a stratified multistage design. About 800 smokers were surveyed in each selected city (total n=4815).

Results Past quit attempts, duration of past attempts, Heaviness of Smoking Index (HSI), outcome expectancy of quitting, worry about future health and overall opinion of smoking were found to be independently associated with intentions to quit smoking, but demographic characteristics were not.

Conclusions The determinants of quit intentions among smokers in China are fairly similar to those found among smokers in Western countries, despite the fact that interest in quitting is considerably lower among Chinese smokers. Identifying the determinants of quit intentions provides possibilities for shaping effective policies and programs for increasing quitting among smokers in China.

INTRODUCTION

Currently, approximately 1.3 billion people smoke worldwide and, consequently, 5.4 million people die from tobacco use each year. Tobacco is now ranked as the world's leading killer, as it is a risk factor for six of the eight leading causes of death worldwide.[1] Though tobacco use is steadily declining in developed countries, smoking prevalence and cigarette consumption are increasing in developing countries.[2 3] It is projected that tobacco use will kill up to 1 billion people during this century, of which 80% will be in developing countries.[1]

As one of the largest developing countries, China is home to nearly one-third of the world's smokers: a total of about 350 million. At present, an estimated 1 million deaths from smoking occur in China each year,[4] and if current smoking rates continue, as many as 100 million people currently under the age of 30 in China will die from tobacco use. Thus, it is clear that tobacco control in China plays a critical role in global tobacco control efforts.

Smoking cessation is a priority for preventing smoking-attributable disease and reducing its burden.[5 6] Quitting smoking at any age confers substantial and immediate health benefits, including reduced risks of stroke, cardiovascular disease and smoking-related cancers,[6–9] and quitting smoking by the age of 30 reduces the risk of dying from tobacco-related diseases by almost 90%.[10] The World Bank suggests that if adult cigarette consumption were to decrease by half in the year 2020, approximately 180 million tobacco-attributable deaths could be avoided.[2] Therefore, promotion of smoking cessation has been proposed as a primary focus of tobacco control efforts, especially in developing countries where smoking prevalence and cigarette consumption are both still relatively high.

According to stage-based models of behaviour change,[11] individual smokers must progress through several stages of behaviour change in order to quit smoking. They begin with no plan to stop smoking, then form an intention to quit, prepare themselves to quit, enact the new behaviour of quitting and finally maintain this behaviour. Having a quit intention is thus a prerequisite for preparing and taking action.[12 13] Although having an intention to quit is not the only determinant of successful smoking cessation, it is strongly associated with making quit attempts and smoking cessation.[14 15] In Western countries making quit attempts has been found to be associated with the following sociodemographics: being male,[16] younger,[14 17–19] well educated,[19] and of white race.[20] The other reported correlates of quit attempts include level of nicotine dependence,[14 18 21–24] measures of motivation,[14 24 25] self-efficacy,[26 27] and past quit attempts.[14 17 25] China, as with many other developing countries, has little data on levels and correlates of smokers' intentions to quit. A national study on smoking behaviour conducted in 1996 found that smokers' self-reported health status, health concern, family opinions, as well as education and financial status were associated with their quitting behaviour.[28 29] These are similar to the recent findings from the National Health Service Surveys.[30] Two studies conducted among

medical workers, teachers, factory workers and secondary students in Hong Kong and mainland China found that being male, married and having high quitting self-efficacy were associated with the intention to quit smoking.[31 32] However, to our knowledge, there are no population-based studies of intentions to quit smoking in China.

The purpose of this study was to examine the associations between intentions to quit smoking and a range of individual-level predictors, including measures of demographics, quitting history, nicotine dependence and motivation to quit.

METHODS

Data source

The International Tobacco Control (ITC)[30] Policy Evaluation Project China Survey is a prospective cohort survey conducted in six cities in China: Beijing, Shanghai, Guangzhou, Shenyang, Changsha and Yinchuan. (A seventh city (Zhengzhou) was dropped because of poor data quality.) These cities were selected based on geographical representations and levels of economic development. The target population of the ITC China Survey consists of smokers and non-smokers who are 18 years or older and are permanent residents who live in residential buildings in each of the six cities. Smokers are defined as those who have smoked at least 100 cigarettes in their lifetime and are currently smoking at least once a week. Within each city there was a random sample selected using a stratified multistage design, with inclusion probabilities proportional to size at the first few stages in each stratum. In each of the 6 cities, 10 Jie Dao (street districts) were randomly selected at the first stage, with probability of selection proportional to the population size of the Jie Dao. Within each selected Jie Dao, two Ju Wei Hui (residential blocks) were selected, again using probability proportional to the population size of the Ju Wei Hui. Within each selected Ju Wei Hui, a complete list of addresses of the dwelling units (households) was first compiled, and then a sample of 300 households was drawn from the list by simple random sampling without replacement. In the enumeration process, information on age, gender and smoking status for all adults living in these 300 households was collected. The enumerated 300 households were then randomly ordered, and adult smokers and non-smokers were then approached following the randomised order until 40 adult smokers and 10 non-smokers were surveyed. In each city, 800 smokers and 200 non-smokers were selected, so that the overall sample size of the survey is 4815 adult smokers and 1200 adult non-smokers. However, only smokers were included in the analyses for this paper. The wave 1 survey was conducted from February to April of 2006. The cooperation rates ranged from approximately 80.0% in Beijing and Guangzhou to 95.0% in Changsha, and the response rates ranged from 39.4% in Yinchuan to 66.0% in Guangzhou. Additional information about the ITC China survey methodology and sampling is provided by Wu *et al*[33] and available at http://www.itcproject.org.

The survey was conducted in Mandarin through face-to-face interviews. After providing the potential respondent with information about the survey and completion of the consent form, the average time to complete the survey was 31.4 min for smokers. A small gift worth about ¥10 was given to each participant as compensation. All materials and procedures used in the ITC China Survey were reviewed and cleared for ethics by the Research Ethics Boards at the University of Waterloo and The Cancer Council Victoria, and by the Institutional Review Boards at the China National Centers for Disease Control and Prevention.

Dependent variable

Intentions to quit were based on responses to the question: 'Do you plan to quit smoking?'. Subjects who selected 'in the next month', 'in the next 6 months' or 'sometime in the future after 6 months' were defined as having an intention to quit, and those who responded 'not at all' were defined as having no intention to quit. This measure was dichotomised for two reasons. First, our primary interest was not on the strength of the intention but rather whether people had an interest in quitting or not. Second, the frequency distribution of this measure was highly skewed with the majority being in the no intention category.

Independent variables

Sociodemographic variables were gender (female, male), age at survey (18–24=1, 25–39=2, 40–54=3, 55 and older=4), income (those with monthly household income less than ¥1000 were coded as 'low income', those between ¥1000–3000 were coded as 'medium income' and those equal or greater than ¥3000 were coded as 'high income', those who did not provide an answer to this question were coded as 'don't know'), education ('low education' levels were based on those who reported as either illiterate or having only primary school education, 'medium education' levels were those with high school or technical secondary school education and 'high education' levels were those with university or junior college education).

Motivational variables assessed were outcome expectancy of quitting, worries about health in the future, favourable attitudes towards smoking and overall opinion about smoking. Outcome expectancy of quitting was measured using the question: 'How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?'. Response categories included: 'not at all', 'a little', 'very much' and 'don't know'. Worries about health in the future were measured by asking: 'How worried are you, if at all, that smoking will damage your health in the future?'. Response categories included: 'not at all', 'a little', 'very much' and 'don't know'. Favourable attitude towards smoking was measured by asking for rating of agreement with the statement: 'You enjoy smoking too much to give it up'. The variable was coded into a three-category variable because of small numbers for some categories: disagree (strongly disagree, disagree), neither disagree nor agree and agree (agree, strongly agree). Overall opinion about smoking was measured by asking: 'What is your overall opinion of smoking?'. This variable was also coded as a three-category variable because of small numbers for some categories: good (very good, good), neither good nor bad and bad (bad, very bad).

Quitting history variables assessed were: tried to quit smoking within last year (yes, no) and longest time off smoking (never, less than 1 month, between 1–6 months, 6 months or more, don't know).

Nicotine dependence was measured using the Heaviness of Smoking Index (HSI), which was based on the sum of two categorical variables: number of cigarettes smoked per day (scored as 0: 0–10 cigarettes per day (CPD), 1: 11–20 CPD, 2: 21–30 CPD, 3: >31 CPD) and time to first cigarette (scored as 0: >61 min, 1: 31–60 min, 2: 6–30 min, 3: 5 min or less).

Statistical analysis

For wave 1 data, the weights were simply calculated as the reciprocal of the inclusion probabilities, the final weight for a sampled individual was the number of people in the city population and the sampling category represented by that individual.[33] Unless otherwise indicated, data analyses were conducted on weighted data using SPSS V.17.0 Complex Survey

procedures (SPSS, Chicago, Illinois, USA). Logistic regression models were employed to determine the correlates of intentions to quit, first bivariately just between the dependent variable and each of the independent variables of interest, and then multivariately where the association between each independent variable and the dependent variable was adjusted for all other variables in the models. For multivariate analysis, all independent variables were entered into the multivariate logistic regression model to determine their independent effects. An α level of $p<0.05$ was used to determine the level of statistical significance.

RESULTS

Table 1 shows the sample characteristics by city. Of the 4815 smokers interviewed, 4574 were men (95.0%) and 241 women (5.0%), with an average age of 50.1 years (SD=12.67). The 18–24 years age group was under-represented in our sample. The majority (95.0%) of the respondents were Han Chinese, with other ethnic groups accounting for the rest. Most of the subjects had a medium level of education (high school and technical secondary school, 65.5%). Almost half of the sample had an average family monthly income of ¥1000–3000 (48.4%), while those making more than ¥3000 or less than ¥1000 accounted for 30.5% and 21.1%, respectively. More than half of the smokers surveyed (53.1%) had attempted to quit smoking before, and almost one-quarter (23.6%) planned to quit.

Table 2 shows the results for univariate and multivariate analyses. The proportion of smokers with an intention to quit smoking was not significantly different across gender, age groups and income levels. Compared to smokers with a low education level, those with either a medium education level (OR 1.39, 95% CI 1.00 to 1.92), or a high education level (OR 1.60, 95% CI 1.10 to 2.32) had significantly greater intentions to quit smoking, but the differences were no longer significant once we controlled for other covariates in the multivariate analysis. Smokers who had made a quit attempt within the last year and also those who had longer time off smoking were more likely to have an intention to quit smoking (significant in the univariate and multivariate analyses). However, smokers who scored higher on the HSI were less likely to have an intention to quit smoking in the univariate and multivariate analyses. Motivational variables, including greater perceived benefits from quitting, worry about the health effects of smoking, negative attitudes towards smoking and low overall opinion of smoking were found to be significantly associated with having an intention to quit in the univariate and multivariate analyses.

DISCUSSION

One key finding from this study is that the level of interest in quitting among Chinese smokers from the six cities studied was found to be generally low (ranging from 15% to 31%) and certainly considerably lower than that reported by Hyland *et al* in four developed countries in the West that ranged from 65% to 81%.[34] This finding underscores the need for greater effort to be made to stimulate interest in quitting among Chinese smokers in order to help China make significant inroad in reducing the health burden due to tobacco-related diseases.

Despite the low level of interest in quitting, consistent with the findings from Western countries,[14 35 36] intentions to quit smoking among smokers from the six cities in China were found to be influenced by similar individual-level factors such as the HSI, a behavioural measure of nicotine dependence, past quitting behaviour and motivational variables.

Table 1 Sample characteristics by city

Variables	Total, n=4815	Beijing, n=804	Shenyang, n=801	Shanghai, n=801	Changsha, n=803	Guangzhou, n=804	Yinchuan, n=802
Ethnicity							
Han	95.0	94.5	94.9	98.6	98.6	99.3	84.2
Other	5.0	5.5	5.1	1.4	1.4	0.7	15.8
Gender							
Male	95.0	94.5	97.6	91.5	94.4	97.4	94.5
Female	5.0	5.5	2.4	8.5	5.6	2.6	5.5
Age							
18–24	1.4	2.0	1.6	1.0	1.7	0.9	1.1
25–39	17.6	13.6	12.6	10.5	23.4	14.0	31.5
40–54	49.4	47.4	57.9	57.8	45.3	44.4	43.4
≥55	31.6	37.0	27.9	30.7	29.6	40.7	24.0
Household income per month*							
Low (<¥1000)	19.6	9.3	31.5	14.3	28.3	12.1	22.1
Medium (¥1000–3000)	44.9	40.8	55.5	44.0	41.8	37.1	49.9
High (≥¥3000)	28.3	41.6	10.0	37.8	24.7	36.2	19.5
Don't know	7.3	8.2	3.0	4.0	5.2	14.7	8.5
Education							
Low	13.1	9.6	7.9	6.0	17.7	23.8	13.6
Medium	65.5	62.9	73.1	74.4	60.8	59.9	61.7
High	21.5	27.5	19.0	19.6	21.5	16.4	24.7
Ever tried to quit smoking							
No	46.9	48.6	48.8	59.8	40.8	44.4	38.8
Yes	53.1	51.4	51.2	40.3	59.2	55.6	61.2
Intention to quit							
No	76.4	75.3	69.2	83.6	74.4	85.1	71.1
Yes	23.6	24.7	30.8	16.4	25.6	14.9	28.9

*¥1=US$0.1464 (as of 30 May 2010). Equivalents are low income: <US$146, medium income: US$146–439, high income: ≥US$439.

Table 2 Individual-level factors associated with intentions to quit smoking

	n	Intention to quit(%)	Univariate analysis		Multivariate analysis	
			OR	95% CI	OR	95% CI
Gender						
Female	232	25.3	Reference		Reference	
Male	4481	24.3	0.95	0.56 to 1.61	0.81	0.43 to 1.54
Age						
18–24	66	29.6	Reference		Reference	
25–39	828	25.4	0.81	0.41 to 1.61	0.95	0.43 to 2.11
40–54	2330	24.6	0.77	0.35 to 1.69	1.08	0.44 to 2.64
≥55	1489	23.2	0.72	0.35 to 1.46	0.94	0.40 to 2.23
Household income per month						
Low (<¥1000)	923	22.8	Reference		Reference	
Medium (¥1000–3000)	2125	25.6	1.17	0.92 to 1.47	1.13	0.87 to 1.47
High (≥¥3000)	1323	25.5	1.16	0.87 to 1.54	1.29	0.94 to 1.77
Don't know	339	16.6	**0.67**	0.46 to 0.99	0.92	0.55 to 1.57
Education						
Low	619	19.1	Reference		Reference	
Medium	3085	24.7	**1.39**	1.00 to 1.92	1.21	0.84 to 1.74
High	1004	27.3	**1.60**	1.10 to 2.32	1.29	0.83 to 1.98
Tried to quit within last year						
No	3939	18.7	Reference		Reference	
Yes	777	51.0	**4.52**	3.74 to 5.45	**2.29**	1.81 to 2.89
Longest time quit smoking						
Never quit	2211	13.2	Reference		Reference	
Less than 1 month	1027	32.7	**3.19**	2.70 to 3.78	**1.34**	1.04 to 1.71
1–6 months	893	36.8	**3.84**	2.66 to 5.53	**1.91**	1.39 to 2.61
6 months or more	548	34.5	**3.46**	2.67 to 4.49	**2.19**	1.64 to 2.92
Don't know	30	22.3	1.89	0.78 to 4.56	1.90	0.66 to 5.49
HSI						
0–6	4381		**0.83**	0.79 to 0.88	**0.87**	0.82 to 0.93
Outcome expectancy of quitting (benefit from quitting in the next 6 months)						
Not at all	942	7.3	Reference		Reference	
A little	1523	21.0	**3.37**	2.25 to 5.05	**2.14**	1.41 to 3.25
Very much	1608	43.3	**9.71**	6.33 to 14.87	**3.84**	2.44 to 6.04
Don't know	638	7.7	1.06	0.65 to 1.73	1.01	0.60 to 1.70
Worried about health in the future						
Not at all	1634	8.5	Reference		Reference	
A little	1976	27.3	**4.05**	3.04 to 5.40	**2.04**	1.58 to 2.62
Very much	853	49.5	**10.59**	7.96 to 14.09	**3.36**	2.32 to 4.88
Don't know	249	13.6	1.70	0.99 to 2.92	1.54	0.85 to 2.76
Favourable attitudes about smoking						
Neither disagree nor agree	456	14.2	Reference		Reference	
Agree	2591	23.0	**1.81**	1.19 to 2.75	**2.01**	1.08 to 3.74
Disagree	1584	30.0	**2.60**	1.77 to 3.81	**2.09**	1.18 to 3.71
Overall opinion of smoking						
Neither good nor bad	1800	13.6	Reference		Reference	
Bad	2480	34.9	**3.42**	2.87 to 4.07	**1.70**	1.33 to 2.16
Good	315	6.4	**0.44**	0.27 to 0.72	0.66	0.40 to 1.09

Bold values indicate a significant difference at $p<0.05$.
HSI, Heaviness of Smoking Index.

The majority of previous studies have shown that demographic characteristics such as gender, age, income and education are associated with making serious quit attempts and smoking cessation,[15 17–19 37–39] but the relation between demographic characteristics and intentions to quit smoking are not always consistent.[29 36 40 41] In our study, quitting intention was not independently associated with age, income and education levels. The lack of an independent effect for education might be because it was confounded with other variables in the model, such as the HSI, which has been shown previously to be associated with socioeconomic status.[42] The lack of demographic differences in quit intentions might also reflect cultural differences,[41] a possibility that awaits further research. A recently published study which used data from China National Health Service Surveys conducted in 1993, 1998 and 2003 found that quitting increased with age among Chinese smokers, and a considerable proportion of former smokers (40.6%) quit because of illness.[30] As mentioned earlier, a cross-sectional study among Hong Kong Chinese smokers conducted by Abdullah and Yam found that being male was associated with intention to quit,[31] but this was not found in our study. One possible reason for this difference is the small sample size of our study, especially for women smokers (Abdullah and Yam's study had a much bigger sample size; 11 700 persons were included). Another possible explanation for the difference in predictors of intention to quit between the Hong Kong and mainland Chinese smokers

could be the difference in tobacco control culture in Hong Kong versus mainland China. Compared to mainland China, Hong Kong has a much longer history in tobacco control. It has had well implemented smoke-free policies in workplaces and public venues, and much more substantial anti-smoking campaigns and cessation services. Compared to smokers in this study, the Hong Kong Chinese smokers had a much higher rate of intention to quit; of the daily smokers, 52% intended to quit.[31]

Previous research in the West has found that nicotine dependence is a significant barrier to making quit attempts and smoking cessation.[14 15 36] Using intentions to quit as an outcome variable, we found a similar negative relation, that is, the higher the level of nicotine dependence, the lower the willingness to quit. This finding suggests that cessation strategies should be tailored to the smoker's level of nicotine dependence. Smokers with low dependence should be encouraged to make quit attempt. Smokers with higher nicotine dependence should be treated with interventions that help to reduce consumption in order to increase their chances of being able to quit successfully in the future.[43–45]

Consistent with the findings from Western countries showing that past quitting experiences are associated with subsequent quitting attempts,[14 35] we found the same factor predicted intentions to quit smoking. This suggests that smokers without a quit history may have no intention to quit, and thus brief interventions can be designed to stimulate motivation to quit smoking among this group. Brief interventions involve opportunistic advice, discussion, negotiation or encouragement. They are often delivered by a range of primary and community care professionals. For smoking cessation, brief interventions typically take between 5–10 min.[46] Given that successful quitting requires repeated interventions and multiple attempts to quit,[47] professional counselling and medical treatments should also be provided to increase the chances of successful quitting. However, cessation services and quitting medications (eg, nicotine replacement therapy medications) are not generally available in China, especially in rural areas. Efforts need to be made to train doctors and health professionals in providing brief cessation interventions or making referrals to cessation services.[30 48]

Our finding of an independent effect of motivational variables on quit intentions is consistent with the evidence from other studies including national surveys in China, which show that major reasons for quitting include present illness[29 49] and future health concerns.[50 51] Misconceptions and lack of awareness of health risks are common among Chinese smokers,[52] so public education campaigns are needed to increase smokers' awareness of the health harms of smoking, which in turn can increase their interest in quitting.

Smokers' intentions to quit smoking are also clearly influenced by their attitudes towards smoking. Smoking is common in China, especially among men. Many regard smoking and exchanging cigarettes as a normal part of life.[53] Consequently, there is a critical need to change the social acceptability of smoking in order to change the attitudes of smokers towards smoking. Health warnings on cigarette packaging are one of the most cost-effective approaches in communicating the harms of smoking to smokers, and where pictorial warnings are used, they will have even stronger effects, especially among those with low literacy.[1] However, China currently uses only text-based warnings that have been proven to be ineffective, so the implementation of pictorial warnings should be advocated.

This study has some limitations. One limitation is the use of respondent reports to provide information, which may be subject to recall bias and social desirability. Furthermore, survey response rates in the first wave were moderate to low, therefore, the findings are limited by potential non-response differentials. Socioeconomic variables were relatively difficult to measure (as a construct and its relationship to health and disease factors), and certain measures in our data (ie, income) had a large proportion of 'unknown' responses, which potentially limited the findings. In addition, our survey was limited to urban areas (ie, six selected cities) that are inhabited mainly by the Han ethnic Chinese. In reality, the vast majority of the Chinese smoking population still live in rural areas, where they have a higher smoking prevalence.[30 49] Therefore, caution needs to be exercised to generalise the findings to rural areas and/or minority ethnic groups.

Data analysed in this paper are from the first wave of the ITC China survey, and so causal directionality is somewhat unclear. With the subsequent waves of the data, we will be able to examine prospectively the predictors of making quit attempts. In addition to individual factors, social environmental factors may also be important drivers of quitting and these will be examined in future papers. It is reassuring that the findings from this study are generally consistent with those from the Western countries despite the linguistic and/or cultural differences which could potentially affect the interpretation of survey questions, including factors associated with intentions to quit.

In summary, like their Western counterparts, interest in quitting among smokers from six cities in China is influenced by similar individual-level factors such as past quitting experiences, nicotine dependence, health concerns and their attitudes towards smoking, underscoring the need to consider these factors when designing cessation intervention programs to ensure that they are effective.

What this paper adds

- Interest in quitting is considerably lower among Chinese smokers.
- Individual-level factors such as past quit attempts, duration of past attempts, Heaviness of Smoking Index (HSI), outcome expectancy of quitting, worry about future health and overall opinion of smoking were found to be independently associated with intentions to quit smoking.
- Demographic characteristics were not associated with intentions to quit smoking.

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Competing interests None.

Patient consent Obtained.

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Quitting smoking in China: findings from the ITC China Survey

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ABSTRACT

Background Few studies have examined interest in quitting smoking and factors associated with quitting in mainland China.

Objective To characterise interest in quitting, quitting behaviour, the use of cessation methods and reasons for thinking about quitting among adult urban smokers in six cities in China.

Methods Data is from Wave 1 of the ITC China Survey, a face-to-face household survey of 4732 adult smokers randomly selected from six cities in China in 2006. Households were sampled using a stratified multistage design.

Findings The majority of smokers had no plan to quit smoking (75.6%). Over half (52.7%) of respondents had ever tried to quit smoking. Few respondents thought that they could successfully quit smoking (26.5%). Smokers were aware of stop-smoking medications (73.5%) but few had used these medications (5.6%). Only 48.2% had received advice from a physician to quit smoking. The number one reason for thinking about quitting smoking in the last 6 months was concern for personal health (55.0%). Most smokers also believed that the government should do more to control smoking (75.2%).

Conclusion These findings demonstrate the need to: (1) increase awareness of the dangers of smoking; (2) provide cessation support for smokers; (3) have physicians encourage smokers to quit; (4) denormalise tobacco use so that smokers feel pressured to quit; (5) implement smoke-free laws to encourage quitting; (6) develop stronger warning labels about the specific dangers of smoking and provide resources for obtaining further cessation assistance; and (7) increase taxes and raise the price of cigarettes.

INTRODUCTION

China is facing a public health crisis with current smoking rates estimated at 320 million people.[1] The majority of adult males (57%), and 3% of adult females in China are current smokers.[2] Given these smoking rates, it is estimated that one million smokers in China die from tobacco-related illnesses each year[1] and this number is expected to rise to 2.2 million deaths by 2020.[3] Smoking also poses an enormous health risk to non-smokers in China as it is estimated that 52% of non-smokers are exposed to tobacco smoke pollution for at least 15 minutes daily for more than 1 day every week.[4]

To reduce the health burden of smoking, smokers in China need to be prevented from smoking and encouraged to quit smoking. Recent studies have demonstrated that quitting even after many years of smoking can greatly reduce the risk of cancer, stroke and cardiovascular diseases.[5 6] However, research conducted in 1996 and 2002 suggests that the majority of smokers in China (71.8% and 74%, respectively) have no intention of quitting smoking.[4 7] Further studies examining intentions to quit smoking in China have not been conducted. It is unclear whether interest in quitting smoking has changed since this time.

The goal of this paper is to examine whether smokers in China are interested in quitting smoking, whether they have attempted to quit smoking and whether they have been successful. We will examine how smokers have attempted to quit smoking and whether smokers in China have received encouragement and support to successfully quit smoking. A recent study in China suggests that only 48% of physicians ask their patients about their smoking status and only 64% offer cessation advice to these smoking patients.[8] Research evidence suggests that physicians' advice is a powerful motivator to encourage quitting.[9–11] This study will therefore examine, from the smokers' perspective, whether smokers in China have received advice about quitting smoking from their physician or healthcare providers.

The use of other cessation methods that have proved to be effective will also be explored. For example, how many smokers in China have heard about and how many have used nicotine replacement therapy? Studies have demonstrated that this is one of the most effective cessation aids available.[12] However, it is not known how common these medications are in China.

Another effective cessation strategy is the use of "quit and win" competitions to encourage smokers to quit. The Chinese International Quit and Win competition is currently one of the largest cessation activities in China. This strategy began in 1996 in Beijing, Shanghai and Tianjin. By 2006 the quit and win service had expanded to 31 provinces with approximately 130 000 smokers participating.[13 14] No studies to date have examined whether the majority of urban smokers in China are aware of the programme and how many have used this service.

Finally, this paper will explore smokers' reasons for thinking about quitting smoking. These reasons will provide important insights into which factors are salient to Chinese smokers and which policies/programmes need to be strengthened in order to increase smokers' motivation to quit smoking.

METHOD

The following is a brief outline of the methods employed in the ITC China Survey. Additional detail is provided by Wu *et al*[15] and in the ITC China Survey Wave 1 Technical Report, which can be found at http://www.itcproject.org.[16]

Participants

The ITC China Survey is a prospective cohort survey of 800 adult smokers and 200 adult non-smokers in each of six cities in China: Beijing, Shanghai, Guangzhou, Shenyang, Changsha and Yinchuan. A seventh city (Zhengzhou) was originally included in Wave 1 and Wave 2 of the ITC China Survey; however, the data from this city were later discarded after data quality testing suggested that the information was not reliable and therefore suspect. The overall sample size of the survey is 4800 for adult smokers and 1200 for adult non-smokers. This paper examines quitting behaviour of current smokers (defined as having smoked at least 100 cigarettes in a lifetime and currently smoking at least once a week). The Wave 1 survey was conducted in February–April 2006.

Sampling design

The six cities in the ITC China Survey do not constitute a random sample of the entire population of China. They were judiciously selected based on geographical representations and levels of economic development.

In each city, the ITC China Survey employed a multistage cluster sampling design. In each of the six cities, 10 street districts (Jie Dao) were randomly selected, with probability of selection proportional to the population size of the Jie Dao. Within each of these Jie Dao, two residential blocks (Ju Wei Hui) were selected, again with probability proportional to the population size of the Ju Wei Hui. Within each selected Ju Wei Hui, a complete list of addresses of the dwelling units (households) was first compiled, and then a sample of 300 households were drawn from the list by simple random sampling without replacement. In this way, the sampling frame was constructed in each city.

Information on age, gender and smoking status for all adults living in these 300 households was collected in the enumeration process. The enumerated 300 households were then randomly ordered, and adult smokers and non-smokers were then approached following the randomised order until 40 adult smokers and 10 adult non-smokers were surveyed. Because of low smoking prevalence among women, one male smoker and one female smoker from every selected household were surveyed whenever possible to increase the sample size for women. At most one non-smoker was interviewed per household. Where there was more than one person in a sampling category to choose from in a household, the next birthday method[17] was used to select the individual to be interviewed.

A table demonstrating the sample characteristics for the Wave 1 respondents in this study can be found in the paper by Elton-Marshall *et al* (this issue).[18]

Procedure

The enumerators and survey interviewers were organised and trained by the CDC staff in each city, with support and supervision from the ITC China team members both at the China National CDC and at the ITC Project Data Management Centre at the University of Waterloo.

The ITC China Survey was conducted through face-to-face interviews. The average time to complete a survey was 31.4 minutes for smokers (interquartile range around 10 minutes and 5 minutes). Interviewers followed a strict protocol in their interview session with each respondent. Up to four visits to a household were made in order to interview the target person(s) within that household.

All materials and procedures used in the ITC China Survey were reviewed and cleared for ethics by the research ethics board at the University of Waterloo and by the institutional review boards at the Chinese National Center for Disease Control and Prevention.

The Wave 1 cooperation rates were: 80.0% in Beijing (estimated), 80.0% in Guangzhou (estimated), 81.2% in Shenyang (exact), 84.2% in Shanghai (exact), 80.0% in Changsha (estimated) and 90.3% in Yinchuan (exact). The response rates range from 39.4% in Yinchuan to 66.0% in Guangzhou.

Weight construction

Sampling weights were constructed separately for male adult smokers, female adult smokers and adult non-smokers. Wave 1 weights were constructed by taking into account the four levels of sample selection: Jie Dao, Ju Wei Hui, household and individual. The final Wave 1 weight for a sampled individual was the number of people in the city population and the sampling category represented by that individual.

Measures

Quitting behaviour and attitudes towards quitting

Quit intentions were measured by asking respondents: "Are you planning to quit smoking?" (within the next month, within the next 6 months, sometime in the future beyond 6 months, not planning to quit/don't know). History of quitting was assessed by asking respondents whether they had ever tried to quit smoking (yes/no) and for those who had tried to quit smoking, the number of previous quit attempts (1, 2–5, 6–10, >10). Self-efficacy was measured by asking respondents "how sure are you that you would succeed at quitting?" (not at all sure, somewhat sure, very sure, extremely sure).

To assess attitudes towards quitting smoking we asked: "how much do you think you would benefit from health and other gains if you were to quit smoking?" To determine whether smokers thought that the government should be more involved with tobacco control we asked whether respondents thought that: "the government should do more to control smoking".

Awareness and use of cessation aids and services

We assessed whether respondents were aware of smoking cessation aids, including stop smoking medications, Chinese traditional stop-smoking medications and stop-smoking acupuncture. We also asked respondents whether they had ever used stop-smoking medications. For those respondents who had used stop-smoking medications, we asked which medications they had used (nicotine gum, nicotine lozenges, nicotine nasal spray, Chinese traditional medicine, acupuncture, other).

To assess whether respondents had access to stop-smoking services, we asked those respondents who had visited a doctor or health professional in the last 6 months, whether they had received: Advice to quit smoking, additional help or referral to another service to help quit, a pamphlet or brochures on how to quit. In addition, we asked respondents whether they had received advice or information about quitting smoking in the last 6 months from: Telephone or quit line services, and local stop-smoking services (ie, hospitals or clinics). Finally, we asked respondents whether they were aware of the International Quit and Win contest in China.

Reasons for thinking about quitting

We asked respondents whether any of the following reasons had made them think about quitting in the last 6 months: Concern for personal health, concern about the effect of your cigarette smoke on non-smokers, China society disapproves of smoking, the price of cigarettes, smoking restrictions in public and work

places, advertisements or information about the health risks of smoking, health warning labels on cigarette packages, setting an example for children, family disapproves of smoking. Response options were: not at all, a little, very much, don't know.

Statistical analyses

Weighted frequencies were conducted using Complex Samples in SPSS version 17.0.

RESULTS

Table 1 presents the weighted frequencies for quitting and attitudes towards quitting. The majority of smokers had no plan to quit smoking now or in the future (75.6%). Over half (52.7%) of respondents had ever tried to quit smoking and had attempted to quit 2–5 times (53.2%). A minority of respondents felt that they could successfully quit smoking (26.5% were 'very sure' or 'extremely sure'). There was some acknowledgement that the respondent would benefit from health and other gains if they were to quit smoking in the next 6 months (35.1% said 'very much'). Most smokers also believed that the government should do more to control smoking (75.2%).

Smokers in China were aware of stop-smoking medications (73.5%) (table 2); however, less than half were aware of Chinese traditional stop-smoking medications (37.9%) and stop-smoking acupuncture (27.6%). Despite an awareness of stop-smoking medications, few smokers in China had actually used these medications (5.6%). Among those who had ever used stop-smoking medications, nicotine gum was the most popular (33.2%).

The majority of smokers in China had not received any advice to help them quit smoking. Among those who visited a doctor or other healthcare professional in the last 6 months, only 48.2% had received advice to quit smoking. Almost no one had received additional help or a referral to another service to help quit (4.3%). Smokers were also not given pamphlets or brochures on how to quit (1.6%). In the last 6 months, most smokers (1.2%) did not contact telephone or quit line services to get advice or information about quitting. Smokers were also unlikely (8.4%) to have received advice or information to quit smoking from local stop-smoking services (ie, hospitals or clinics). In all, 13.2% of the smokers were aware of the International Quit and Win

Table 1 Quitting behaviour and attitudes towards quitting

	n	Weighted %	95% CI
Quit intention			
Within the next month	377	8.0%	7.0% to 9.0%
Within the next 6 months	297	6.7%	5.3% to 8.5%
Sometime in the future beyond 6 months	437	9.7%	7.9% to 12.0%
Not planning to quit/don't know	3602	75.6%	71.9% to 79.5%
Ever tried to quit smoking?			
Yes	2512	52.7%	50.7% to 54.7%
No	2219	47.3%	45.2% to 49.3%
Number of previous quit attempts			
NA/Don't know/can't say	45	1.8%	1.2% to 3.0%
1	810	32.3%	30.2% to 34.5%
2–5	1368	53.2%	50.2% to 56.1%
6–10	151	6.8%	5.0% to 9.1%
>10	149	5.9%	4.8% to 7.1%
How sure are you that you would succeed at quitting?			
Don't know/can't say	334	6.5%	5.4% to 7.9%
Not at all sure	2004	42.9%	40.3% to 45.5%
Somewhat sure	1158	24.1%	22.4% to 25.9%
Very sure	622	13.9%	12.1% to 15.9%
Extremely sure	612	12.6%	11.2% to 14.1%
How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?			
Not at all	944	19.4%	17.6% to 21.4%
A little	1532	32.0%	29.1% to 35.1%
Very much	1613	35.1%	31.8% to 38.6%
Don't know/can't say	639	13.4%	11.7% to 15.4%
The government should do more to control smoking			
Strongly agree/agree	3539	75.2%	69.9% to 80.9%
Strongly disagree/disagree/neutral/don't know	1193	24.8%	21.0% to 29.5%

Table 2 Awareness and use of cessation aids and services

	n	Weighted %	95% CI
Aware of stop smoking medications			
Yes	3509	73.5%	71.1% to 75.9%
No	1221	26.5%	24.0% to 28.9%
Aware of Chinese traditional stop-smoking medications			
Yes	1830	37.9%	35.7% to 40.0%
No	2883	62.1%	60.0% to 64.3%
Aware of stop-smoking acupuncture			
Yes	1363	27.6%	25.1% to 30.2%
No	3354	72.4%	69.8% to 74.9%
Ever used stop-smoking medications?			
Yes	274	5.6%	4.8% to 6.6%
No	4444	94.3%	93.2% to 95.1%
Cannot remember	8	0.1%	0.1% to 0.4%
Among those who used cessation aids,* medications/treatments ever used:			
Nicotine gum	68	33.2%	20.3% to 52.3%
Nicotine lozenges	18	11.4%	4.6% to 28.3%
Nicotine nasal spray	21	15.3%	6.4% to 35.1%
Chinese traditional medicine	50	24.4%	16.4% to 36.2%
Acupuncture	15	10.1%	3.8% to 25.4%
Other	106	50.9%	33.0% to 74.1%
Among those who visited a doctor or other health professional in the last 6 months, percentage who received:			
Advice to quit smoking	583	48.2%	45.0% to 51.4%
Additional help or referral to another service to help quit	51	4.3%	2.9% to 6.3%
Pamphlet or brochures on how to quit	26	1.6%	1.0% to 2.7%
Received advice or information about quitting smoking in the last 6 months from:			
Telephone or quit line services	53	1.2%	0.9% to 1.7%
Local stop-smoking services (ie, hospitals or clinics)	389	8.4%	7.4% to 9.6%
Aware of the International Quit and Win contest in China			
Yes	597	13.2%	11.7% to 14.9%
No	4117	86.8%	85.1% to 88.3%
Of those who were aware, % participated	18†	3.3%	1.8% to 5.8%

*Not every respondent who had ever used a cessation aid answered each question. There was some variability in the number of respondents who answered each question so the denominator for the percentage who used each could be different.
†47 respondents who were aware of the International Quit and Win contest did not answer this question.

contest in China, but only 3.3% had participated in this programme.

The number one reason for thinking about quitting smoking in the last 6 months was concern for personal health with 55.0% of respondents endorsing this belief (see table 3). The next most important reasons were: the impact of smoking on others, the effect of smoke on non-smokers (44.5%), normative reasons, such as family disapproval (42.0%) and concern for setting an example for children (40.5%). A minority of respondents identified health information campaigns designed to deter smoking such as advertisements (28.3%) and warning labels (22.2%) as reasons to think about quitting. Smokers were least likely to say that price was a reason for thinking about quitting smoking in the last 6 months (21.8%).

DISCUSSION

The majority of smokers in China do not intend to quit smoking (75.6%). This finding is consistent with a 1996 national prevalence study and a 2002 study in which the majority of smokers had no intention of quitting.[4 7] Clearly the smoking situation in China has not improved and may have even got worse. Over half of smokers had made one or more quit attempts but continue to smoke. It is possible that smokers are not able to quit successfully because cessation services and medications are not widely available in China. Alternatively, smokers may not feel pressured to remain smoke-free because they are not as concerned about the health effects of smoking. Indeed, few smokers reported that they would benefit from health or other gains if they were to quit. Increasing knowledge about the health effects of smoking could therefore increase interest in quitting and remaining smoke-free.

In addition to increasing public awareness about the risks of smoking, it is also important to increase smokers' confidence that they can quit smoking.[19] These findings demonstrate that smokers lack the self-efficacy to be able to quit smoking. This may be due in part to a perceived lack of support in quitting.

One method that has been demonstrated to help smokers quit smoking is the use of stop-smoking medications.[12] While smokers in China are aware of stop smoking medications, few smokers have actually used them. Anecdotal evidence suggests that smokers are aware of these medications because of news stories about stop-smoking medications. Despite the fact that nicotine replacement therapy (NRT) does not require a prescription, few pharmacies actually sell these products and access is therefore limited. Additionally, as this study has demonstrated, few smokers in China are interested in quitting smoking and therefore wouldn't need to use these medications. Indeed, NRT has been available in China for about 10 years; however, there was little interest in this product and it was removed from the Chinese market. NRT was later reintroduced to the market in 2007. Future research should explore the potential reasons why Chinese smokers are not interested in stop-smoking medications, and barriers to using these medications.

Awareness of Chinese traditional medicine to aid in smoking cessation was very low particularly compared to smoking cessation medications. Anecdotal evidence suggests that this is because there is little dissemination about the use of Chinese traditional medicine to aid in smoking cessation.

Physicians can provide smokers with the knowledge that smoking is harmful as well as assist smoker cessation. In fact, research in other countries has demonstrated that physicians' advice is an effective strategy to motivate smokers to quit.[9] However, this research demonstrates that physicians are not advising smokers to quit, providing smokers with information about how to quit (pamphlets/brochures) and referring smokers to other stop-smoking services to help them quit. The reason why physicians are not providing cessation advice may include a lack of cessation training in medical schools, and a lack of knowledge about the harmful effects of smoking.[8] Future research could attempt to identify ways to encourage physicians to become more involved in encouraging smokers to quit.

Other cessation resources such as the Chinese International Quit and Win Campaign could also focus on educating smokers about the dangers of smoking while also providing support for quitting. This campaign was not well known among respondents in our survey, which therefore indicates that increased promotion of this service may increase smokers' participation. Telephone or quit services were also rarely used; however, this is not surprising given that these services were only available in Beijing in a limited scale at the time of our survey. Health information campaigns warning smokers about the dangers of smoking will soon be implemented in China in accordance with the Framework Convention on Tobacco Control (FCTC). Consequently, it is expected that more smokers in China will consider quitting smoking. It is therefore imperative that programmes to encourage smoking cessation are immediately developed and implemented in China to assist the anticipated increase in the number of health-concerned smokers.

The majority of smokers in China were not interested in quitting; however, it is important to examine which factors influence thinking about quitting. Understanding which factors are associated with thinking about quitting can inform how quitting campaigns should be targeted and which policies/programmes need to be improved to encourage quitting.

The most popular reason for thinking about quitting smoking (in the next 6 months) was concern for personal health. This

Table 3 Reasons for thinking about quitting in the last 6 months

Reason	Not at all	A little	Very much	Don't know	n
Concern for personal health	42.9% (40.3% to 45.5%)	35.4% (33.1% to 37.8%)	19.6% (17.8% to 21.5%)	2.1% (1.4% to 3.1%)	4723
Concern about the effect of your cigarette smoke on non-smokers	52.8% (49.7% to 55.9%)	32.7% (30.2% to 35.4%)	11.8% (10.3% to 13.4%)	2.7% (2.0% to 3.7%)	4723
China society disapproves of smoking	66.2% (63.3% to 69.0%)	25.3% (22.9% to 27.9%)	6.2% (5.2% to 7.3%)	2.3% (1.6% to 3.2%)	4723
The price of cigarettes	76.7% (74.5% to 78.8%)	17.2% (15.5% to 19.1%)	4.6% (3.9% to 5.5%)	1.5% (1.0% to 2.4%)	4722
Smoking restrictions in public and work places	56.3% (52.1% to 60.5%)	30.9% (27.7% to 34.3%)	9.8% (8.4% to 11.4%)	2.9% (2.2% to 3.9%)	4720
Advertisements or information about the health risks of smoking	68.9% (65.5% to 72.1%)	24.4% (21.5% to 27.5%)	3.9% (3.1% to 4.9%)	2.8% (2.1% to 3.8%)	4723
Health warning labels on cigarette packages	75.3% (72.6% to 77.7%)	19.5% (17.3% to 22.0%)	2.7% (2.1% to 3.4%)	2.5% (1.9% to 3.4%)	4722
Setting an example for children	55.8% (52.4% to 59.1%)	27.9% (25.6% to 30.4%)	12.6% (11.0% to 14.4%)	3.7% (2.9% to 4.8%)	4722
Family disapproves of smoking	55.7% (53.0% to 58.3%)	28.7% (26.9% to 30.6%)	13.3 (11.6% to 15.1%)	2.3% (1.7% to 3.1%)	4721

finding is consistent with a 1996 study demonstrating that 47% of smokers reported being sick as a reason to quit smoking and 34% reported that worrying about their health in the future was a reason to quit.[7] Compared to other countries, however, endorsement of this belief was low in China (55.0%) compared to respondents in our ITC South Korea project (80.5%), for example. Again this suggests that further education about the health risks of smoking could increase the likelihood that Chinese smokers will quit smoking.

Concern for close friends and relatives seems to be another important motivator for smokers to quit. This is consistent with China as a collectivistic culture where, culturally, people in China tend to place more importance on the norms of their in-group.[20] If the norm is that you shouldn't smoke, the smoker would therefore feel more pressure to quit smoking. The finding also demonstrates that tobacco control policies in China could be improved to increase interest in quitting. Smoking restrictions,[21] ads warning about the dangers of smoking,[22] warning labels on cigarette packages[23 24] and the price of cigarettes[25] are all policies that have been effective in encouraging quitting in other countries. However, these policies are not listed as reasons to think about quitting smoking in China.

These findings are not surprising given that China does not have strong anti-smoking advertising. Few places in China are smoke-free and warning labels are text-only with the vague message 'smoking harms your health'. The price of cigarettes in China is also very low; the cigarette tax rate in China is about 40% of the retail price (compared to 79% in Thailand, another developing country in Asia). The China Tobacco Monopoly actually subsidises tobacco factories for their production of less expensive cigarettes, which guarantees a supply of less expensive cigarettes.

Implications

Overall, these findings demonstrate the need to: (1) increase awareness of the dangers of smoking in China; (2) provide cessation support for smokers; (3) encourage physicians and other health professionals in China to become involved in encouraging and supporting smokers to quit; (4) denormalise tobacco use so that smokers feel increasing pressure to quit smoking particularly from close friends and family; (5) implement smoke-free laws to encourage quitting; (6) develop stronger warning labels about the specific dangers of smoking and provide resources for obtaining further cessation assistance; (7) increase the price of cigarettes in China by increasing taxes on cigarettes.

Finally, some have argued that China is not ready for strong tobacco control policies. However, this study found that the majority of smokers agreed that the government should do more to control tobacco. Clearly it is time to implement stronger tobacco control policies that will encourage smokers to quit.

What this paper adds

Few studies have examined interest in, and factors associated with quitting smoking among Chinese smokers. Those studies that have been conducted were completed 6 years or more ago. Therefore, it is important to examine up-to-date findings on whether: (1) smokers in China are interested in quitting; (2) whether smokers are accessing cessation support services and, if so, which services; (3) whether physicians and other healthcare professionals are encouraging smokers to quit; and (4) what factors are associated with thinking about quitting smoking in China. These findings will have implications for how tobacco control policies can be implemented in China to support and encourage smokers to quit smoking. It is imperative that China starts to implement effective cessation strategies because China currently has the highest smoking rate in the world and the potential loss of life if smokers continue to smoke is enormous.

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Health knowledge and perception of risks among Chinese smokers and non-smokers: findings from the Wave 1 ITC China Survey

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ABSTRACT

Background Awareness of health risks of smoking is strongly associated with smoking behaviour. However, there are no population-based studies of smoking-related health knowledge in China.

Objective The aim of current study was to use a population-based sample from the International Tobacco Control China Wave 1 survey to examine variations between current, former and never smokers' health knowledge about smoking and the impact of health knowledge awareness on smokers' intention to quit.

Methods A face-to-face interview was conducted with 5986 adult smokers and non-smokers from six cities in China. Respondents were asked whether they believed smoking causes heart disease, stroke, impotence, lung cancer, emphysema, stained teeth, premature ageing in smokers and lung cancer in non-smokers. Current smokers were also asked additional questions on how smoking affects their current and future health as well as whether they had plans to quit smoking and if they believe they would have health benefit from quitting.

Findings The overall awareness of health risks of smoking in China was low compared to developed countries. Current smokers in China were less likely than non-smokers and former smokers to acknowledge the consequences of smoking. Current smokers who were more aware of the health consequences of smoking were more likely to intend to quit smoking.

Conclusion These findings highlight the need to increase awareness about the health effects of smoking in China, particularly among current smokers to increase quitting.

INTRODUCTION

At present, approximately 1.3 billion people smoke and more than 5 million people die globally from smoking each year.[1] In contrast to the decline in smoking prevalence among high income countries, tobacco use continues to rise in low and middle-income countries.[1] As a consequence, global tobacco consumption is still increasing and smoking attributable death is projected to rise beyond eight million deaths per year by 2030.

Approximately one-third of the world's smokers—350 million— live in China. Recent estimates suggest that more than a third of Chinese over the age of 15 are smokers, with dramatic differences between genders: approximately 66% of Chinese males smoke compared to only 3% of Chinese females.[2] In addition, more than 70% of all Chinese, or over 600 million Chinese people, are regularly exposed to secondhand smoke.[3] Given that smoking is a major contributor to chronic obstructive pulmonary disease and lung cancer, both of which are leading causes of death in China, the health burden from tobacco use in China is daunting: tobacco use is estimated to have caused approximately one million premature deaths in 2000 and the death toll is projected to double by 2020 if the present smoking trends continue.[4 5] Overall, up to 100 million Chinese smokers currently under 30 years old are projected to die from smoking.[1] Thus, the success of global tobacco control relies to a large extent upon reductions of smoking in China.

Tobacco control policies have emerged more slowly in China than in many other countries in the region. Until October 2008, Chinese cigarette packages carried obscure health warnings printed on the side of the pack with the vague text-only message that, 'Smoking may harm your health'. Although tobacco advertisements have been banned from mass media, such as TV, radio and newspapers, tobacco companies have successfully used sponsorships and promotions to maintain a visible marketing presence.[6] To date, China does not have a national law to restrict smoking in workplaces and other indoor public venues, while smoking remains common in healthcare facilities and educational facilities.[7] In short, both the state of existing tobacco control regulations in China and their enforcement remain at an early stage.

A primary focus of tobacco control is to raise awareness of the health risks of smoking, and this may be particularly true in low and middle-income countries, most of which have not engaged in campaigns to educate the public on the hazards of smoking. Although increases in perceptions of risk are not always sufficient to reduce smoking on their own, increases in health knowledge are strongly associated with reductions in smoking initiation, increases in cessation behaviour and long-term abstinence from smoking.[1 8 9] Increases in health knowledge also provide support for other tobacco control measures, such as increases in taxation and more comprehensive workplace smoking restrictions.

In China, as in many other low and middle-income countries, there is little published information about the level of health knowledge about smoking.[1] A study conducted among industrial workers in Shanghai two decades ago found that only 53% of smokers and 76% of non-smokers were generally aware that smoking is harmful to health, and only 51% of smokers reported that smoking

causes lung cancer.[10] A more recent study among Chinese physicians found that a majority knew that smoking causes lung cancer and other chronic obstructive pulmonary disease, but only two-thirds (67%) knew that smoking could cause heart disease.[11] These findings are particularly troubling given that smoking is a primary risk factor for heart disease, another leading cause of premature death in China.[12] Similar gaps in knowledge have been identified in other studies with healthcare providers.[13 14] However, to our knowledge, there are no population-based studies of smoking-related health knowledge in China.

The purpose of this study was to examine beliefs about the health risks of smoking in China among never, former and current smokers. The study also examined sociodemographic differences in the levels of health beliefs, as well as associations with intentions to quit smoking among current smokers.

METHODS

The ITC China Survey is a prospective cohort survey of 800 adult smokers and 200 adult non-smokers in each of six cities in China: Beijing, Shanghai, Guangzhou, Shenyang, Changsha and Yinchuan. The six cities in the ITC China Survey were selected based on geographical representativeness and levels of economic development. In each city, the ITC China Survey employed a multistage cluster sampling design. Ten street districts (Jie Dao) were randomly selected from each city with probability of selection proportional to the population size of the Jie Dao. Within each of these Jie Dao, two residential blocks (Ju Wei Hui) were selected, again with probability proportional to the population size of the Ju Wei Hui. Within each selected Ju Wei Hui, a complete list of addresses of the dwelling units (households) was first compiled, and then a sample of 300 households were drawn from the list by simple random sampling without replacement in each city.

In the enumeration process, information on age, gender and smoking status for all adults living in these 300 households was collected. The enumerated 300 households were then randomly ordered, and adult smokers and non-smokers were subsequently approached following the randomised order until 40 adult smokers and 10 adult non-smokers were surveyed. Because of low smoking prevalence among women, one male smoker and one female smoker from every selected household were surveyed whenever possible to increase the sample size for female smokers. At most, one non-smoker was interviewed per household. Where there was more than one person in a sampling category to choose from in a household, the next birthday method was used to select the individual to be interviewed. Up to four visits to a household were made in order to interview the target person(s) within that household. All surveys were conducted 'face-to-face.'

The findings reported here are from Wave 1 of the ITC China Survey, which was conducted between April and August 2006. The Wave 1 cooperation rates, calculated as ratio of completed interviews among the total number of successfully contacts in the initial sample recruitment plan, ranged from 80.0% in Beijing and Guangzhou to 95.0% in Changsha. The response rate, calculated as the ratio of completed interviews among the total number of respondents selected in the initial sample plan, ranged from 39.4% in Yinchuan to 66.0% in Guangzhou. Additional information on survey rates is available in the ITC China technical report.[15]

The enumerators and survey interviewers were organised and trained by China Center for Disease Control (CDC) staff in each city, with supervision from the ITC China Project team at the China National CDC. Several quality control procedures were put in place, including making MP3 recordings for each of the 800 smoker interviews in each of the six cities, with subsequent random monitoring. All materials and procedures used in the ITC China Survey were reviewed and cleared for ethics by the research ethics board at the University of Waterloo and by the institutional review board at China National Center for Disease Control and Prevention. Additional detail on the ITC China survey is described elsewhere.[15]

Measures

Demographic variables

Age, gender, education and income were recorded in the survey. Age was categorised into four groups as '18–24; 25–39; 40–54; 55+'. Education level was categorised into 'low (no education and elementary school); middle (junior high school and high school); high (college and higher)'. Household monthly income was classified as '1000 yuan and under; 1001–5000 yuan; 5001 yuan and above'.

Smoking status classification

Respondents who had smoked at least 100 cigarettes in their lifetime and who were smoking at the time of the survey were classified as current smokers. Smokers who smoked at least 100 cigarettes in their lifetime but who were not smoking at the time of the survey were classified as former smokers. Those respondents who had smoked fewer than 100 cigarettes were classified as never smokers.

For current smokers, intention to quit was measured by 'Are you planning to quit in the next month, 6 months, beyond 6 months, or not at all?' and categorised into two groups; 1='In the next month/6 months/beyond 6 month' and 0='not at all'.

Health knowledge of smoking

Respondents were asked whether they believed smoking causes heart disease, stroke, impotence, lung cancer, emphysema, stained teeth, premature ageing in smokers and lung cancer in non-smokers. Responses were coded as 0='no/don't know' versus 1='yes.' A *health knowledge scale* was created by summing the number of 'yes' responses across the 8 diseases/health effects (range=0 to 8).

Other health beliefs

For current smokers, other health beliefs were measured by asking if respondents agreed with the following statements: (1) 'Every cigarette you take damages your health'; (2) 'Tobacco is addictive'; and (3) 'Your cigarette smoke is dangerous to non-smokers'. Responses were given on a five-point Likert scale where 1='strongly disagree' and 5='strongly agree'. Current smokers were also asked three additional questions: (1) 'How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months'; (2) 'To what extent, if at all, has smoking damaged your health'; and (3) 'How worried are you, if at all, that smoking will damage your health in the future?' Response categories were 'not at all', 'a little', 'very much' and 'don't know'.

ANALYSIS

All statistical analyses were performed using SAS version 9.1 (SAS Institute Inc). Analyses were weighted on sex and age within each city to account for the sampling design of the ITC China Survey. χ^2 Tests were conducted to examine bivariate differences with smoking status. All odds ratios presented for

Table 1 Sample characteristics (n=5986)

		Never smokers		Former smokers		Current smokers		Overall	
		%	n	%	n	%	n	%	n
Sex	Male	32.4	348	90.8	168	95.1	4494	83.7	5010
	Female	67.6	726	9.2	17	4.9	233	16.3	976
Age	18–24	5.0	54	0.0	0	1.4	66	2.0	120
	25–39	22.4	240	8.7	16	17.6	831	18.2	1087
	40–54	42.3	454	27.6	51	49.4	2335	47.4	2840
	55+	30.4	326	63.8	118	31.6	1495	32.4	1939
Income	Low	18.5	199	18.9	35	19.6	925	19.4	1159
	Moderate	71.1	764	71.9	133	69.6	3291	70.0	4188
	High	2.9	31	2.2	4	3.7	173	3.5	208
	No answer	7.4	80	7.0	13	7.2	338	7.2	431
Education	Low	10.3	111	20.5	38	13.1	620	12.8	769
	Moderate	60.1	645	55.1	102	65.5	3098	64.2	3845
	High	29.6	318	24.3	45	21.3	1009	22.9	1372
Cigarette smoked/day	0–10					34.9	1639		
	11–20					49.0	2304		
	21–30					8.6	404		
	31+					7.5	354		

the logistic regression model were adjusted for gender, age, income and education.

RESULTS

Sample characteristics

As shown in table 1, more than 90% of current and former smokers surveyed were male. The majority of respondents (65.6%) were 25–54 years old and 83.9% of current smokers smoked fewer than 20 cigarettes per day.

Health knowledge overall

Table 2 shows the extent to which respondents agreed that smoking was indeed a cause of each of the eight health effects. Overall, respondents were most likely to agree that smoking causes stained teeth and lung cancer, followed by emphysema and lung cancer from secondhand smoke. Only about 40% of respondents agreed that smoking causes coronary heart disease (CHD), while only one-fifth agreed that smoking causes stroke and impotence. Approximately 7% of respondents agreed that smoking caused all eight of the health effects.

Significant differences were observed in health knowledge between current, former and never smokers. Overall, current smokers agreed with fewer health effects (mean=3.82 out of 8) compared to former smokers (mean=5.5; p<0.001) and never smokers (mean=5.5; p<0.001). For individual health effects, only 68% of current smokers agreed that smoking causes lung cancer in smokers, compared to more than 90% of former and never smokers. In addition, only 36% of current smokers agreed that smoking causes CHD, compared to more than half of former and never smokers.

Logistic regression models were conducted to examine differences between current, former and never smokers for each health effect, adjusting for sex, age, income and education. Current smokers were significantly less likely than never and former smokers to agree with each of the eight health effects (p<0.001 in all cases). No significant differences were observed between former and never smokers for any of the eight health effects. Linear regression models were also conducted to examine potential differences in the overall health knowledge scale, adjusting for age, sex, income and education. The pattern was the same as for the individual health effects: current smokers had significantly lower health knowledge scores than never smokers (mean difference=−1.5; p<0.001) and former smokers (mean difference= −1.8; p<0.001), with no difference between never and former smokers.

Additional analyses were conducted to examine the association between sociodemographic factors and measures of health knowledge among current smokers. Higher levels of health knowledge were observed among: older smokers (40–54 years vs 25–39 years, OR=1.78 p=0.018); more educated smokers (high vs. low, OR= 2.56 p=0.007); and smokers with lower daily cigarette consumption (21–30 vs 0–10 CPD, OR=0.42 p=0.008; 11–20 vs 0–10 CPD, OR=0.72 p=0.02). No other significant

Table 2 Agreement of each knowledge of health effect by smoking status (n=5986)

	Never smokers (n=1074)		Former smokers (n=185)		Current smokers (n=4732)		Overall	
Knowledge of health effect	%	n	%	n	%	n	%	n
Smoking causes stained teeth	95.0	1026	96.1	178	85.0	4024	87.2*	5288
Smoking causes lung cancer in smokers	91.8	996	90.2	162	68.1	3,244	73.0*	4402
Smoking causes emphysema	86.9	935	87.2	158	59.4	2858	65.2*	3951
Secondhand smoke causes lung cancer in non-smokers	83.2	889	76.9	135	53.2	2,531	59.2*	3555
Smoking causes premature ageing	76.0	821	74.2	131	47.3	2,268	53.3*	3220
Smoking causes CHD	54.2	581	59.2	101	36.3	1,737	40.2*	2419
Smoking causes stroke	35.4	401	37.5	60	16.0	791	20.1*	1252
Smoking causes impotence	29.2	320	29.3	46	16.6	814	19.2*	1180
Knowledge of all health effects	13.2	151	16.3	26	5.2	261	7.0*	438

*Differences between never, former and current smokers significant at p<001.

Table 3 Association between covariates/selected health beliefs and intention to quit among current smokers (n=4673)

Health beliefs		%	OR (95% CI)
Smoke is dangerous to non-smokers	Disagree	4.6	1.00
	Neither	4.1	0.41 (0.16 to1.07)
	Agree	88.5	1.82 (1.24 to3.21)
	Don't know	2.9	0.37 (0.16,0.83)
Tobacco is addictive	Disagree	9.1	1.00
	Neither	5.2	0.63(0.39 to 1.00)
	Agree	83.4	1.26 (0.90 to 1.76)
	Don't know	2.4	0.91(0.38,2.19)
Every cigarette damages health	Disagree	10.6	1.00
	Neither	10.3	1.14 (0.70 to 1.84)
	Agree	75.4	5.11 (3.32 to 7.86)
	Don't know	3.7	1.64 (0.67 to 4.00)
Worried about future damage from smoking	Not at all	33.7	1.00
	A little	41.7	4.01 (3.02 to 5.33)
	Very much	18.9	10.44 (7.59 to 14.38)
	Don't know	5.7	1.75 (0.99 to 3.09)
Smoking has damaged health	Not at all	33.2	1.00
	A little	40	2.71 (2.19 to 3.36)
	Very much	17.5	5.70 (4.35 to 7.47)
	Don't know	9.4	1.13 (0.69 to 1.85)
How much benefit if quit smoking	Not at all	19.3	1.00
	A little	32.1	3.50 (2.36 to 5.20)
	Very much	35.2	9.96 (6.64 to 14.94)
	Don't know	13.4	1.11 (0.70 to 1.77)
Knowledge of health effects scale (0–8)	Mean among those NOT intending to quit	3.53	
	Mean among those intending to quit	4.71	
	OR for 1 unit increase in score		1.27 (1.21 to 1.34)

OR, 'unadjusted' odds ratio of intending to quit smoking (0, not planning to quit/don't know; 1, within the next month/within the next 6 months/sometime in the future, beyond 6 months).

differences were observed among sex, income and health knowledge levels.

Other health beliefs

Current smokers were asked to report additional health beliefs (see table 3). The vast majority of current smokers agreed that smoke is dangerous to non-smokers (88.5%) and tobacco is addictive (83.4%). About three-quarters of current smokers agreed that every cigarette damages health. In contrast, less than one-fifth of smokers agreed that smoking has damaged his/her health, one-third of current smokers (33.7%) reported no worry about the future damage from smoking and approximately 35% of current smokers agreed that that they would experience future health benefits very much if they quit smoking within the next 6 months.

Predictors of health belief perception among current smokers

Analyses were conducted to examine the extent to which health knowledge and other health beliefs among current smokers predicted intention to quit. Overall, 31.9% of current smokers intended to quit at some point in the future. Most of the selected health beliefs were significantly associated with intentions to quit in bivariate analyses, except the belief that 'tobacco is addictive' (see table 3).

We conducted multivariate analyses to examine the predictive relation of health knowledge and health beliefs on intention to quit in greater detail. Measures of health beliefs and the health knowledge scale were entered in a logistic regression model predicting intention to quit, adjusting for sex, age, income and education (see table 4). The health knowledge scale, and the health beliefs of 'smoke is dangerous to non-smokers; tobacco is addictive' were not significantly associated with intentions to quit; however, all other health beliefs significantly predicted intentions to quit among current smokers.

DISCUSSION

The findings of this study shed light onto beliefs about smoking in China—one of the leading public health threats to the country. The results indicate reasonable levels of health knowledge for health effects such as lung cancer, comparable with levels in Western countries.[16] However, the findings reveal major gaps in the knowledge of other health effects. For example, approximately 40% of respondents endorsed smoking as a risk factor for heart disease and only one-fifth acknowledged smoking causes stroke—both leading causes of death in China.[12] In addition, less than two-thirds of respondents agreed that secondhand smoke can cause lung cancer.

In terms of health knowledge towards smoking among different smoking status groups, the findings indicate that Chinese smokers were less likely to agree to health effects than either never smokers or former smokers. For example, over 90% of never and former smokers agreed that smoking causes lung cancer, compared to only two-thirds of smokers. Similarly, about 83% of never smokers and 77% of former smokers agreed that secondhand smoke causes lung cancer compared to only half of smokers. These differences persisted even after adjusting for sociodemographic factors, which suggests that the lower levels of health beliefs among Chinese smokers may reflect either an optimistic bias, lower exposure to health information or both. This finding is similar to patterns observed in Western countries, where smokers systematically underestimate their personal risk from smoking, presumably in attempt to minimise cognitive dissonance from smoking and shield themselves from worry.[17–19]

Compared to historical estimates, the findings suggest that levels of health knowledge about the dangers of smoking may be increasing in China. In particular, data from two decades ago shows that only 51% of smokers know smoking causes lung cancer,[10] although differences in the sample profiles complicate comparisons between studies. In addition, the current study only included respondents living in highly developed, urban areas. One might expect levels of health knowledge to be lower in rural areas of China, where access to health information is typically lower. More generally, levels of health knowledge among Chinese smokers were considerably lower than levels previously reported in Western countries.[16] For example, in Canada and Australia—countries widely acknowledged to be leaders in tobacco control—approximately 90% of smokers agreed that smoking causes heart disease and 80% agreed that smoking causes stroke.[16] In contrast, only 36% and 16% of Chinese smokers in the current study agreed that smoking causes heart disease and stroke, respectively. The knowledge awareness gap also exists in secondhand smoke. In Canada and Australia, over 70% of smokers agreed cigarette smoking causes lung cancer in non-smokers, while only about half of Chinese smokers agree with this statement in current study.

The findings of this study indicate that relatively few Chinese smokers intend to quit smoking. Less than a third of smokers indicated that they intend to quit at any point in the future—levels far below Western countries such as Canada and Australia, where approximately three-quarters of all smokers

Table 4 Adjusted odds ratios† from logistic regression of selected health beliefs on intention to quit (n=4673)

Covariate		OR (95% CI)
Sex	Male	1.00
	Female	1.07 (0.58 to 1.95)
Age	18–24	1.00
	25–39	1.02(0.45 to 2.32)
	40–54	1.28 (0.50 to 3.27)
	55+	1.23 (0.51 to 2.97)
Income	Low	1.00
	Moderate	1.09 (0.87 to 1.37)
	High	1.36 (0.77 to 2.41)
	No answer	0.91 (0.57 to 1.46)
Education	Low	1.00
	Moderate	0.91 (0.67 to 1.24)
	High	0.92 (0.66 to 1.28)
Cigarettes smoked/day	0–10	1.00
	11–20	0.68 (0.57 to 0.81)
	21–30	0.49 (0.35 to 0.68)
	31+	0.48 (0.33 to 0.70)
Knowledge of health effects scale (OR for 1 unit increase)	1.03 (0.98 to 1.09)	
Smoke is dangerous to non-smokers	Disagree	1.00
	Neither	0.62 (0.29 to 1.32)
	Agree	0.97 (0.59 to 1.60)
	Don't know	0.52 (0.21, 1.28)
Tobacco is addictive	Disagree	1.00
	Neither	1.02 (0.57 to 1.84)
	Agree	1.05 (0.67 to 1.65)
	Don't know	1.50 (0.54, 4.20)
Every cigarette damages health**	Disagree	1.00
	Neither	0.98 (0.61 to 1.57)
	Agree	1.65 (1.15 to 2.38)
	Don't know	2.05 (1.07,3.93)
Worried about future damage from smoking***	Not at all	1.00
	A little	2.13 (1.63 to 2.78)
	Very much	3.70 (2.35 to 5.83)
	Don't know	1.90 (1.18, 3.08)
Smoking has damaged health*	Not at all	1.00
	A little	1.18 (0.87 to 1.60)
	Very much	1.48 (1.13 to 1.94)
	Don't know	0.91 (0.56, 1.47)
How much benefit if quit smoking***	Not at all	1.00
	A little	2.00 (1.40 to 2.86)
	Very much	3.85 (2.52 to 5.88)
	Don't know	0.91 (0.57 to 1.45)

Significant levels are indicated as follows:
*p<0.05; **p<0.01; ***p<0.001.
†Odds of having intention to quit (0, not planning to quit/don't know, 1, within the next month/within the next 6 months/sometime in the future, beyond 6 months).

intend to quit smoking.[14] As in other studies, intention to quit was positively associated with health beliefs about smoking.[16 20] In particular, smokers who reported greater worry about the future health effects of smoking and smokers who reported health benefits from quitting were most likely to intend to quit. The direction of this association is likely to be a reciprocal one: greater health beliefs are likely to increase intentions to quit, just as greater intentions are also likely to increase perceived risk and agreement with health effects.

Surveys capable of monitoring perceptions of risk and health knowledge among smokers are not well established globally and they are particular rare among low and middle income countries.[1]What few data exist from low and middle-income countries, suggest that health knowledge is considerably lower than in high-income countries, consistent with the current findings from China.[21–24] However, more direct comparisons across studies are precluded by different sample profiles and the use different measures to asses health knowledge.

LIMITATIONS

The limitations of this study are common to population-based surveys, including potential biases from non-response. For example, in this study, respondents were usually interviewed at night which resulted in lower proportion of young people, especially in the age group 18–24, in the sample than in the general population. The findings should also be interpreted within the context of the sampling frame: only smokers in large urban areas were sampled in this study and one would expect different results in rural areas. It should also be noted that the measures of health knowledge used in this study—agreement with a list of health effects—represents a fairly low threshold for measuring health knowledge. For example, one might expect lower levels with the use of unprompted questions.

IMPLICATIONS

China accounts for approximately one-third of the world's smokers and China is one of the biggest cigarette production countries in the world.[1 25] As a result, health knowledge about smoking in China represents an important indicator for tobacco control in China and global efforts to reduce the health burden from tobacco use. Whereas research from high-income countries shows increasing public concern about the health effects of smoking, the current findings suggest that China lags in this key outcome. However, China has ratified the Framework Convention on Tobacco Control—the world's first treaty devoted to public health—which includes provisions in key areas of tobacco control, including more prominent health warnings, restrictions on tobacco marketing and more prominent public smoking restrictions. Effective implementation of these policy measures will be critically important to increasing perceptions of risk from smoking and helping China to avert the looming public health crisis from tobacco use.

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Ethics approval All materials and procedures used in the ITC China Survey were reviewed and cleared for ethics by the Research Ethics Board at the University of Waterloo and by the Institutional Review Board at China National Center for Disease Control and Prevention.

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A cross-sectional study on levels of second-hand smoke in restaurants and bars in five cities in China

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ABSTRACT

Objectives: To assess indoor second-hand smoke (SHS) exposure in restaurants and bars via $PM_{2.5}$ (fine particles 2.5 μm in diameter and smaller) level measurements in five cities in China.

Methods: The study was conducted from July to September in 2007 in Beijing, Xi'an, Wuhan, Kunming and Guiyang. Portable aerosol monitors were used to measure $PM_{2.5}$ concentrations in 404 restaurants and bars. The occupant density and the active smoker density were calculated for each venue sampled.

Results: Among the 404 surveyed venues, 23 had complete smoking bans, 9 had partial smoking bans and 313 (77.5%) were observed to have allowed smoking during sampling. The geometric mean of indoor $PM_{2.5}$ levels in venues with smoking observed was 208 μg/m^3 and 99 μg/m^3 in venues without observed smoking. When outdoor $PM_{2.5}$ levels were adjusted, indoor $PM_{2.5}$ levels in venues with smoking observed were consistently significantly higher than in venues without smoking observed ($F = 80.49$, $p<0.001$). Indoor $PM_{2.5}$ levels were positively correlated with outdoor $PM_{2.5}$ levels (partial rho = 0.37 $p<0.001$) and active smoker density (partial rho = 0.34, $p<0.001$).

Conclusions: Consistent with findings in other countries, $PM_{2.5}$ levels in smoking places are significantly higher than those in smoke-free places and are strongly related to the number and density of active smokers. These findings document the high levels of SHS in hospitality venues in China and point to the urgent need for comprehensive smoke-free laws in China to protect the public from SHS hazards, as called for in Article 8 of the Framework Convention on Tobacco Control, which was ratified by China in 2005.

Second-hand smoke (SHS) is the combination of smoke emitted from a cigarette or other burning tobacco products and the smoke exhaled by the smoker. SHS is a complex mixture of gases and particles, with the particles of fine to ultrafine size ranging from 0.02 μm to 2 μm.[1] These particles can be easily inhaled deep into lungs causing various diseases to multiple systems and organs in humans. Although not specific to SHS, large quantities of respirable particles (RSP) are emitted from burning cigarettes. Xiu *et al* found that indoor RSP levels in offices with smoking occurring were three times higher than levels with no smoking.[2] Alpert *et al* also found that 93% of the indoor RSP were attributable to tobacco smoke during active smoking.[3] Measuring the concentration of indoor fine particles with mean aerodynamic diameter no more than 2.5 μm ($PM_{2.5}$), which are recognised as a significant threat to public health, offers another assessment of indoor air pollution.[4–6]

SHS exposure is a completely preventable health risk factor, and there is no known safe level of SHS exposure.[7] In May 2003, the member countries of the World Health Organization (WHO) adopted a historic tobacco control treaty, the Framework Convention on Tobacco Control (FCTC). Article 8 of FCTC calls for the expansion of smoke-free places at the national and other jurisdictional levels in signatory countries to protect people from SHS hazards. On 4 July 2007, the second session of Conference of the Parties to the WHO FCTC drew up Guidelines on Protection from Exposure to Tobacco Smoke to assist parties in meeting their obligations under Article 8 of the WHO FCTC and to identify key elements of legislation necessary to effectively protect people from exposure to SHS.

In China, there are 350 million smokers. The overall prevalence is 35.8% (66.0% of males and 3.1% of females),[8] which means that the risk for non-smokers to be exposed to SHS is very high. Some national prevalence studies in China reported that 53.0% of non-smokers in China were regularly exposed to SHS in 1996,[9] and 51.9% in 2002.[8] SHS exposure occurs in various places, and the National Prevalence Survey in 2002 showed 82% of those passive non-smokers reported their SHS exposure in homes, 67% in public places and 35% in workplaces.[8]

Hospitality venues—restaurants, bars and night-clubs, for example—are both workplaces for hospitality workers and places where the public spend, potentially, a considerable amount of time. Due to the lack of smoking regulations in these kinds of venues in China, hospitality workers and patrons alike are exposed to high levels of SHS. A study conducted in Beijing in 2004 on SHS levels of 14 public places, including 5 restaurants, showed that airborne nicotine concentrations in the 5 restaurants ranged from 2.07 to 28.72 μg/m^3, with a median of 4.91 μg/m^3, more than 14 times the concentration in hospitals and over 7 times that in schools.[10] A cross-sectional study of SHS in 92 restaurants and bars in Beijing China in 2006 showed that the average of the indoor $PM_{2.5}$ levels in venues where smoking was allowed was 280 μg/m^3, 200% higher than that in venues with smoking restrictions (93 μg/m^3).[11]

In China, objective assessments of SHS exposure are quite limited, especially in hospitality venues. As a party to the WHO FCTC, China is obligated to take effective measures to protect its public from SHS exposure as stated in Article 8. In recognition of its FCTC obligations, and as host of

the 2008 Olympic Games, China promised that the Games would be smoke-free. Mostly driven by these two factors, China initiated a series of tobacco control activities in public places including hospitality venues to reduce SHS exposure. This study aims to describe a convenient and practical method to assess indoor SHS exposure in China and to provide scientific evidence for the Chinese government to adopt effective measures to reduce or eliminate SHS hazards in hospitality venues.

METHODS

Sampling

The study was conducted from July to September in 2007 in five cities in China: Beijing, the capital of China, located in northern China; Xi'an, a city in the Central Western part of China; Wuhan, a city in the Central part of China; and Kunming and Guiyang, two cities in southwest China.

In each city, hospitality venues were sampled from two districts following three steps. First, all the hospitality venues were divided into five categories according to Standards of Industry Classification issued by the National Statistics Agency of China, which are Chinese restaurants, Chinese fast food restaurants, Western restaurants, Western fast food restaurants and bars.[12] Second, venues were sampled from each of the five restaurant types in the ratio 10:1:1:1:3 according to the number of restaurants and bars listed as hospitality venues on Yellow Pages websites; 50 Chinese restaurants, 5 Chinese fast food restaurants, 5 Western restaurants, 5 Western fast food restaurants and 15 bars were selected in each city. Third, restaurant size and average expenses per patron per visit according to the owners' reports were taken into account to keep a balance to some extent in these two aspects for the sampled venues. Via this procedure, a total of 405 hospitality venues were selected and surveyed in the 5 cities.

Instruments and measures

Fine respirable particles ($PM_{2.5}$) were used as the proxy measure for SHS. Data collectors in each city were trained directly to use a standard measurement protocol, which was consistent to the method detailed in the web-based training course (http://www.tobaccofreeair.org) developed by the Roswell Park Cancer Institute, New York, USA, and used in previous studies.[5] Portable battery-operated aerosol monitors (TSI SidePak AM510 Personal Aerosol Monitors; TSI Incorporated, Shoreview, Minnesota, USA) fitted with 2.5 μm impactors were used to sample the outdoor and indoor $PM_{2.5}$ levels in each venue. The airflow rate was set at 1.7 litre/min using a Drycal DC Lite (BIOS, Butler, New Jersey, USA) flowmeter to ensure proper operation of the size-selective impactor. The calibration factor setting of 0.32, suitable for SHS,[5 13] was used and the monitor was set to a 1-min data log interval, which averages the 60 previous 1-s measurements. The portable device was calibrated to zero prior to each use by attaching a high efficiency particulate air filter according to the manufacturer's instructions.

To avoid disturbing people's normal behaviour during sampling, the monitor was placed in a bag with a short length of Tygon tubing (Saint-Gobain, Paris, France) attached to the inlet and left protruding on the outside. Logging of $PM_{2.5}$ levels began at least 5 min outside of a venue before entering to provide baseline measurements. Since the monitor was in a bag worn by a data collector, it sampled the air from the zone around the data collector's waist. After outdoor measurements, the monitor kept logging when collectors entered a venue as patrons: they bought some food or drink and stayed for at least 30 min for indoor air sampling, and they tried to find a table as close as possible to the central position of the venue. The bag was placed on the table rather than on the floor or a chair, so that the air being sampled was at the level of occupants' normal breathing zone. The number of patrons and the number of burning cigarettes were recorded at the time of entry into the venue, at the time of exiting and every 15 min during the visit itself. The volume of each venue was calculated by using a sonic device (Zircon Corporation, Campbell, California, USA) to measure each of the linear dimensions of the room. If the room was irregular in shape, making it impossible to measure the volume using the sonic device, then the dimensions and volume were estimated by the trained data collectors. If a venue had a partial smoking ban, then the measurements were taken in the non-smoking area. Times of entry and exit, counts and occupants' smoking behaviours (eg, number of lit cigarettes) were recorded.

Data analysis

Data from each venue visit was downloaded to a computer using the TSI Trackpro V 3.4.1 software (TSI, Shoreview, Minnesota, USA). For each venue, the data logged during the minute of entry and exit was removed so that the remaining data points were either all from the indoor of a venue or all from its outdoor. These were averaged respectively to provide a mean $PM_{2.5}$ level inside or outside the venue. The $PM_{2.5}$ data from a bar in Wuhan was excluded from analysis due to its unexplainable extremely high indoor $PM_{2.5}$ level considering the smokers, patron numbers, outdoor $PM_{2.5}$ levels and other possible $PM_{2.5}$ sources; thus, data from 404 venues were finally used for analysis.

For the $PM_{2.5}$ data was log normally distributed, all statistical analyses used log-transformed $PM_{2.5}$ concentrations. Pearson χ^2 tests and Fisher exact tests were used to test proportion differences; geometric means of $PM_{2.5}$ levels were compared between different cities, different venue types, and outdoors versus indoors using analysis of variance (ANOVA) tests and Student t tests. Univariate analysis of variance (UNIANOVA) tests were used to compare the indoor $PM_{2.5}$ levels in different venues with or without smoking observed after controlling for outdoor $PM_{2.5}$ levels.

The occupant density (OD: the number of occupants per 100 m^3) and the active smoker density (ASD: the number of burning cigarettes per 100 m^3) were calculated for each establishment sampled. Spearman rho as well as partial correlation analyses were performed to determine the correlations between the OD, ASD, outdoor $PM_{2.5}$ levels and indoor $PM_{2.5}$ levels. Additionally, linear regression models were used to examine the relationship between indoor $PM_{2.5}$ levels with outdoor $PM_{2.5}$ levels, ASD, OD, different cities and different types of venues.

RESULTS

Table 1 presents the general characteristics of the hospitality venues where samples were taken in the 5 cities. The numbers of the five types of hospitality venues in each city were basically consistent with the proportion of 10:1:1:1:3 (as described in the Methods section), and the Pearson χ^2 test (χ^2 (16) = 1.98, p = 1.00) indicated no statistical differences among the proportions of different types of restaurants and bars in different cities. Maximum occupancy at 42.6% of the venues was $\leqslant$100 patrons, while 33.2% of venues had a capacity of 101 to 300

Table 1 Characteristics of hospitality venues surveyed in five cities during July to September 2007

	Beijing, n (%)	Wuhan, n (%)	Xi'an, n (%)	Kunming, n (%)	Guiyang, n (%)	Total, n (%)
Venue type:						
Chinese dinner	52 (61.2)	50 (63.3)	52 (64.2)	50 (63.3)	49 (61.3)	253 (62.6)
Chinese fast food	8 (9.4)	5 (6.3)	5 (6.2)	5 (6.3)	6 (7.5)	29 (7.2)
Western dinner	6 (7.1)	5 (6.3)	4 (4.9)	6 (7.6)	5 (6.3)	26 (6.4)
Western fast food	5 (5.9)	5 (6.3)	5 (6.2)	4 (5.1)	6 (7.5)	25 (6.2)
Bar	14 (16.5)	14 (17.7)	15 (18.5)	14 (17.7)	14 (17.5)	71 (17.6)
Holding capacity:						
⩽100 seats	36 (42.4)	35 (44.3)	40 (49.4)	38 (48.1)	23 (28.8)	172 (42.6)
101–300 seats	27 (31.8)	28 (35.4)	26 (32.1)	19 (24.1)	34 (42.5)	134 (33.2)
⩾301 seats	14 (16.5)	16 (20.3)	8 (9.9)	13 (16.5)	23 (28.8)	74 (18.3)
Missing	8 (9.4)	0 (0.0)	7 (8.6)	9 (11.4)	0 (0.0)	24 (5.9)
Average expense per patron:						
⩽20 RMB	16 (18.8)	17 (21.5)	31 (38.3)	37 (46.8)	34 (42.5)	135 (33.4)
21–50 RMB	43 (50.6)	47 (59.5)	30 (37.0)	27 (34.2)	30 (37.5)	177 (43.8)
⩾50 RMB	26 (30.6)	14 (17.7)	17 (21.0)	12 (15.2)	14 (17.5)	83 (20.5)
Missing	0 (0.0)	1 (1.3)	3 (3.7)	3 (3.8)	2 (2.5)	9 (2.2)
Smoking ban:						
Complete	7 (8.2)	2 (2.5)	8 (9.9)	3 (3.8)	3 (3.8)	23 (5.7)
Partial	2 (2.4)	4 (5.1)	1 (1.2)	2 (2.5)	0 (0.0)	9 (2.2)
No bans	76 (89.4)	73 (92.4)	72 (88.9)	73 (93.7)	77 (96.3)	372 (92.1)
Total	85 (21.0)	79 (19.8)	81 (20.0)	79 (19.5)	80 (19.8)	404 (100.0)

patrons. About 44% of the venues had an average expense per patron per visit of 21–50 RMB and a third of venues had an average expense per patron of 20 RMB or lower, which suggests that most of the venues surveyed were frequented by people with moderate incomes. Only 23 restaurants completely banned smoking, and 7 restaurants and 2 bars had non-smoking areas, 4 of which were not completely separated from the smoking areas. In 1 of the 23 venues with complete smoking bans and in 5 of the 9 venues with partial smoking bans, smoking occurred during sampling, and only in 1 venue was there an intervention to stop the smoking.

Although there were numerically more restaurants with smoking bans in Beijing and Xi'an than the other cities, a Fisher exact test showed that there were no statistically significant overall differences across the five cities in the proportions of venues with no smoking regulations (χ^2 (8) = 10.12, p = 0.199).

Table 2 presents the data collected from the 404 hospitality venues, which includes active smoking behaviours observed during sampling and geometric means of outdoor and indoor $PM_{2.5}$ levels. Smoking was observed in 77.5% (313) of the surveyed venues during sampling and the overall average active smoker density of these 313 venues was 1.0 burning cigarettes per 100 m^3. Pairwise comparisons showed no statistically significant differences in average ASD among the five cities, while it was statistically higher in bars (1.9) than that in restaurants (0.8) (t (76.67) = 3.84, p<0.001, data not shown). The outdoor and indoor $PM_{2.5}$ levels were 79 $\mu g/m^3$ and 99 $\mu g/m^3$, respectively, in the 91 places without smoking observed, and they were 77 $\mu g/m^3$ and 208 $\mu g/m^3$, respectively, in the 313 smoking venues. Follow-up UNIANOVA tests showed that in each city, when the outdoor $PM_{2.5}$ levels were controlled for as a covariate, the indoor $PM_{2.5}$ levels of venues with active smoking observed were consistently significantly higher than that of venues without smoking observed (F = 80.49, p<0.001).

Table 3 shows the $PM_{2.5}$ levels in venues stratified by smoking bans and cities. A paired sample Student t test indicated that there was a significant statistical difference between indoor and outdoor $PM_{2.5}$ levels (t(403) = 19.95, p<0.001). When stratified by whether smoking was observed or not, outdoor $PM_{2.5}$ levels were all similar to or lower than corresponding indoor $PM_{2.5}$ levels even in venues without smoking observed (table 2), but for venues with complete smoking bans, outdoor $PM_{2.5}$ levels were all similar to or higher than corresponding indoor $PM_{2.5}$ levels (table 3). This indicated that though there was no observed smoking during sampling in some venues allowing smoking, smoking might have happened before sampling or may have been missed by surveyors during observation, thus some $PM_{2.5}$ may be produced and kept inside the venue, leading to higher indoor $PM_{2.5}$ levels than outdoors.

Table 2 Observation of cigarette smoking and $PM_{2.5}$ (fine particles 2.5 μm in diameter and smaller) levels ($\mu g/m^3$) in restaurants and bars in five cities in China, July to September 2007

	Smoking not observed								Smoking observed							
			Outdoor $PM_{2.5}$ level			Indoor $PM_{2.5}$ level					Outdoor $PM_{2.5}$ level			Indoor $PM_{2.5}$ level		
	n	ASD	GM	Min	Max	GM	Min	Max	n	ASD	GM	Min	Max	GM	Min	Max
Beijing	23	0	101	41	234	131	45	662	62	0.9	134	45	377	275	54	1087
Wuhan	11	0	36	21	73	47	21	113	69	0.9	50	15	168	188	32	1424
Xi'an	25	0	184	120	317	196	58	523	56	1.5	193	32	309	404	165	1459
Kunming	16	0	29	19	44	40	16	206	63	1.1	33	12	105	110	14	1007
Guiyang	16	0	71	34	118	94	36	197	63	0.8	76	14	294	183	76	815
Total	91	0	79	19	317	99	16	662	313	1.0	77	12	377	208	14	1459

ASD, active smoker density: number of smokers per 100 m^3; GM, geometric mean with unit of $\mu g/m^3$.

Table 3 Geometric mean outdoor and indoor $PM_{2.5}$ (fine particles 2.5 μm in diameter and smaller) levels (μg/m³) in venues with different smoking policies

	Complete bans			Partial bans			No bans			Total		
		$PM_{2.5}$ level			$PM_{2.5}$ level			$PM_{2.5}$ level			$PM_{2.5}$ level	
	n	Outdoor	Indoor	n	Outdoor	Indoor	n	Outdoor	Indoor	n	Outdoor	Indoor
Beijing	7	120	102	2	89	93	76	126	248	85	124	225
Wuhan	2	64	54	4	46	55	73	47	169	79	48	155
Xi'an	8	163	130	1	146	159	72	194	361	81	190	323
Kunming	3	26	19	2	32	162	74	32	94	79	32	90
Guiyang	3	110	106	0	–	–	77	74	163	80	75	160
Total	23	103	85	9	56	89	372	77	187	404	78	176

Table 4 shows the Spearman and partial correlation analysis of $PM_{2.5}$ levels, ASD and OD. Indoor $PM_{2.5}$ levels were significantly positively correlated with the outdoor $PM_{2.5}$ level (Spearman rho = 0.58, $p<0.001$), ASD (Spearman rho = 0.52, $p<0.001$) and OD (Spearman rho = 0.33, $p<0.001$) for bivariate Spearman correlation analysis. Partial correlation analysis also showed significant positive correlation between indoor $PM_{2.5}$ levels and outdoor $PM_{2.5}$ levels (partial rho = 0.37 $p<0.001$), and between indoor $PM_{2.5}$ levels and ASD (partial rho = 0.34, $p<0.001$). There existed no significant correlation between indoor $PM_{2.5}$ levels and OD when the outdoor level and ASD were controlled.

Linear regression analysis (table 5) also indicate that when other factors were adjusted, the occupant density and city were not significantly statistically related to the indoor $PM_{2.5}$ level, while the outdoor $PM_{2.5}$ level, the active smoker density and the type of the venues were all significantly statistically related to the indoor $PM_{2.5}$ level. When the active smoker density was removed from the second model, the R^2 decreased 16% (0.08/0.49 = 0.16), that is, without the predictor of the active smoker density, the model's potentiality to explain the variability of the indoor $PM_{2.5}$ level decreased 16%, and this confirms the significant correlation between smoking and indoor $PM_{2.5}$ level.

DISCUSSION

The study showed indoor $PM_{2.5}$ levels are highly related to active smoking density. Places with smoking observed had much higher indoor $PM_{2.5}$ levels than where no smoking was observed, while in places completely banning smoking, indoor $PM_{2.5}$ levels were similar with outdoor levels. Even for venues with really high outdoor $PM_{2.5}$ levels such as those in Xi'an and Beijing, indoor $PM_{2.5}$ levels in venues with active smoking observed were significantly higher than in venues without smoking observed, adjusting for the outdoor $PM_{2.5}$ levels. These indicate that although tobacco smoke is not the sole source of indoor $PM_{2.5}$ in these venues, it is a major source.

$PM_{2.5}$ levels in smoking places are consistently higher than that in smoke-free places across different countries. Hyland *et al* assessed indoor $PM_{2.5}$ levels in 1822 public places across 32 countries from September 2005 to November 2006,[5] using a standard measurement protocol that was adopted by this study. Figures 1 and 2 compare the results of that study and the present study. $PM_{2.5}$ levels were measured in 92 hospitality venues in Beijing, China in 2006, we can see from fig 1 that, indoor $PM_{2.5}$ levels either in places with smoking observed or in those without smoking observed were lower than indoor levels assessed in the present study. For places without smoking observed, this might be caused by the correspondingly higher outdoor $PM_{2.5}$ levels possibly due to different seasons when the two studies were conducted. Venues in Beijing in this study were sampled in July and August, 2007, while the other study was conducted from February to August, which included the spring season with relatively lower outdoor $PM_{2.5}$ levels. For places with smoking observed, the increased indoor $PM_{2.5}$ level may be attributed to the correspondingly increased outdoor $PM_{2.5}$ levels and the higher active smoker density. Additionally, indoor $PM_{2.5}$ levels in places with smoking observed in this study are higher than that in places with almost equal ASD in the USA, and it is also higher in places without smoking observed than that in the USA and Ireland, which has enacted national comprehensive smoke-free indoor air laws (fig 2). This probably resulted from the higher outdoor $PM_{2.5}$ levels in the five cities in China.

The only effective way to protect people from SHS is creating 100% smoke-free environments by implementing smoke-free laws and legislations. As of 1 April 2008, 15 countries and 45 regions, including Hong Kong, have enacted national or local comprehensive smoke-free laws and regulations in restaurants and bars.[14 15] However, in mainland China, smoking regulations have been limited to places such as museums, libraries and waiting rooms, and only Guangzhou and Shenzhen in Guangdong Province prohibit smoking in restaurants with air conditioning.[16] So, at the time of this study, hospitality venues in mainland China had smoking policies dependent on their owners. This study shows that only 23 of the 404 (5.7%) surveyed venues have smoking bans, and the indoor $PM_{2.5}$ levels are very high in restaurants and bars, indicating that in mainland China, hospitality workers as well as patrons of these venues were at high risk of SHS exposure.

Table 4 Correlation analysis of indoor $PM_{2.5}$ (fine particles 2.5 μm in diameter and smaller) level with outdoor $PM_{2.5}$ level, ASD and OD

	Spearman correlation		Partial correlation analysis		
	rho	p Value	rho	p Value	Control variables
Outdoor $PM_{2.5}$ level	0.58	<0.001	0.37	<0.001	ASD, OD
ASD	0.52	<0.001	0.34	<0.001	Outdoor $PM_{2.5}$ level, OD
OD	0.33	<0.001	−0.05	0.352	Outdoor $PM_{2.5}$ level, ASD

ASD, active smoker density: number of smokers per 100 m³; OD, occupant density: number of occupants per 100 m³.

Table 5 Regression models on the log value of indoor $PM_{2.5}$ (fine particles 2.5 μm in diameter and smaller) level and its related influential factors

	Model 1			Model 2			Model 3		
	Coefficient	t	p Value	Coefficient	t	p Value	Coefficient	t	p Value
log(outdoor $PM_{2.5}$ level)	0.52	4.43	0.000	0.54	15.06	0.000	0.57	14.84	0.000
ASD	0.41	6.45	0.000	0.41	7.30	0.000	–	–	–
OD	−0.03	−0.57	0.568	–	–	–	–	–	–
Restaurants or bars*	0.29	6.67	0.000	0.29	6.68	0.000	0.30	7.91	0.000
Type_ASD†	−0.20	−3.05	0.002	−2.0	−3.13	0.002	–	–	–
Wuhan	−0.31	−0.90	0.371	–	–	–	–	–	–
Xi'an	0.13	0.24	0.814	–	–	–	–	–	–
Kunming	−0.25	−0.67	0.502	–	–	–	–	–	–
Guiyang	0.41	1.04	0.299	–	–	–	–	–	–
Wuhan_pmout‡	0.39	1.28	0.202	–	–	–	–	–	–
Xi'an_pmout	−0.11	−0.20	0.845	–	–	–	–	–	–
Kunming_pmout	0.20	0.63	0.531	–	–	–	–	–	–
Guiyang_pmout	−0.43	−1.13	0.258	–	–	–	–	–	–
R^2		0.51			0.49			0.41	

All coefficients were standardised.
*Restaurants were coded as "0" (reference group) and bars were code as "1"; †interaction item of type of venues (restaurants or bars) with ASD; ‡interaction items of city and outdoor $PM_{2.5}$ (pmout) levels.
ASD, active smokers density: number of smokers per 100 m^3; OD, occupant density: number of occupants per 100 m^3.

According to a study on hospitality patronage's attitudes towards smoke-free regulations in public places, only 30.0% and 19.8% of the patrons support completely banning smoking in restaurants or bars, respectively,[17] and according to China Tobacco Control Report 2007, 52.2% of restaurant owners worry that smoking bans would reduce their revenues,[18] a common belief that has been demonstrated to be false in systematic reviews of the economic impact of smoke-free laws across many jurisdictions in North America, Australia and other Western countries.[19] These public opinion data as well as the observed smoking during samplings in non-smoking areas of 5 of the 9 venues with partial smoking bans and in 1 of the 23 venues with complete smoking bans demonstrate that challenges exist in China to implement legislation to protect the public from SHS hazards, particularly in hospitality venues.

This study demonstrated high levels of outdoor particle air pollution in some big cities in China and also demonstrated that levels are substantially worse than outdoors in indoor environments with smoking. There is currently a great deal of discussion on reducing the very high air pollution levels in China, which lead to over 400 000 premature deaths each year, and result in total associated health costs estimated at 157 to 520 billion Yuan in 2003.[20] In fact, billions of dollars were spent to improve outdoor air quality for the recent 2008 Beijing Olympic Games.[21] For exposed individuals, indoor smoking represents a harmful air pollution exposure at least as bad as outdoor pollution. However, comprehensive smoke-free indoor air policies are a simple, virtually cost-free solution that will dramatically reduce this exposure.

The current study measured $PM_{2.5}$ exclusively, whereas other investigators have relied on nicotine measures for greater specificity to tobacco smoke exposure. $PM_{2.5}$ is still an effective marker for SHS and also provides a more general air pollution measure that is effective for comparisons to other sources of pollution, such as outdoor particle levels. The laser photometer used in this study also provides continuous measurements demonstrating immediate changes in particle levels as conditions change or the device is moved between different microenvironments (fig 3).

Although this study adopted a convenience sample of venues, the results of this study were able to reflect the general situation of tobacco control and SHS exposures in hospitality venues in the five cities in China, as we have taken into account different types of venues, their possible proportions, their holding capacity and average expense.

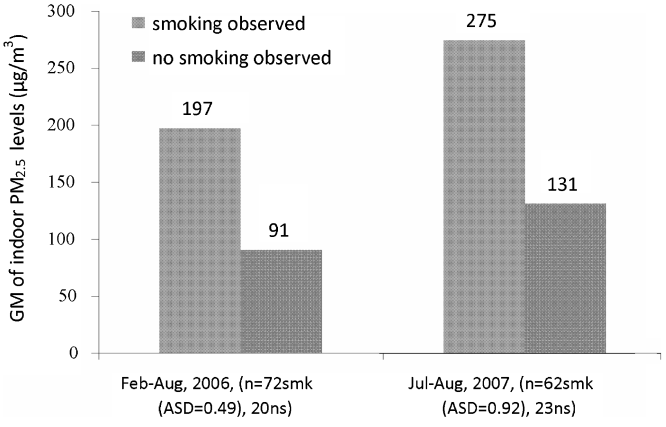

Figure 1 Geometric mean of $PM_{2.5}$ levels of venues in Beijing by study (smk, smoking observed; ns, no smoking observed).

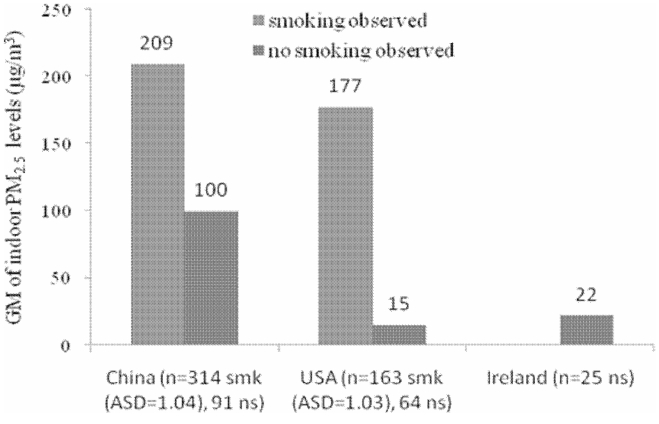

Figure 2 Geometric mean of indoor $PM_{2.5}$ levels in China, USA and Ireland (smk, smoking observed; ns, no smoking observed).

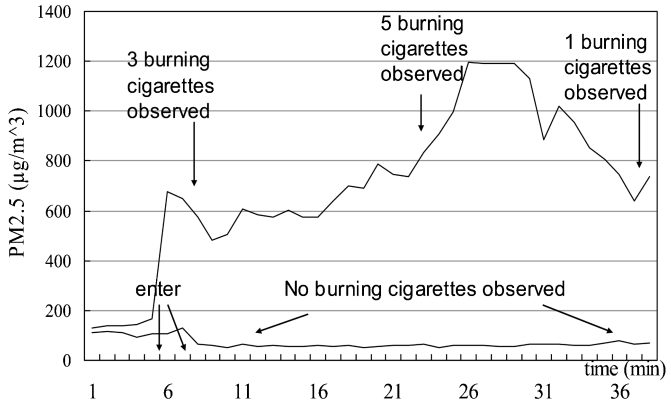

Figure 3 Real-time monitoring of $PM_{2.5}$ levels in a restaurant with smoking observed and in another premises without smoking observed in Beijing.

What this paper adds

- The World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) calls for the expansion of smoke-free places in signatory countries to protect people from second-hand smoke (SH) hazards. However, up to the time when this study was conducted, smoking regulation was rare in hospitality venues in mainland China and quantitative assessments of SHS exposure in these venues were quite limited. This study is the largest study to assess indoor SHS exposure in hospitality venues in mainland China to date, and provides scientific evidence for the Chinese government to adopt effective measure to reduce or eliminate SHS hazards in hospitality venues.
- The results of this study show that, without smoking regulation, only a few (7.9%) of restaurants and bars had smoking regulations, and SHS exposure in these places was very high. The PM_{25} levels in venues with observed smoking was more than two times the level in venues without smoking, and only when smoking was completely banned could the indoor PM_{25} levels become similar to corresponding outdoor levels. These results underline the importance of a comprehensive smoke-free policy in accordance with the FCTC.
- For the purpose of the 2008 Olympic Games, China initiated a series of tobacco control activities in public places, including hospitality venues, to reduce SHS exposure; this study could provide baseline information for further studies aimed at evaluating the effectiveness of the tobacco control activities in hospitality venues.

Conclusions

$PM_{2.5}$ levels in places with smoking are significantly higher than those in smoke-free places and are statistically associated with active smoker densities. SHS exposures are very serious in hospitality venues in the five cities in China and comprehensive smoking regulations are commonly wanted to protect the public from SHS hazards.

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Risk factors associated with smoking behaviour in recreational venues: findings from the International Tobacco Control (ITC) China Survey

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ABSTRACT

Objective: To explore the determinants of smoking behaviour in recreational venues and to provide scientific bases for establishing smoke-free measures applying to these locations.

Methods: The International Tobacco Control (ITC) China Survey—a face-to-face cross-sectional survey of representative adult smokers from six cities (Shenyang, Beijing, Shanghai, Guangzhou, Changsha and Yinchuan) was conducted between April and August 2006. A total of 4815 smokers were selected using multistage sampling methods, and final analyses were conducted on 2875 smokers who reported patronising recreational venues at least once in the last six months. Multivariate logistic regression models were used to identify factors influencing the smoking behaviour within recreational settings.

Outcome measure: Whether a smoker reported smoking in recreational venues during the last 6 months.

Results: There are 84% subjects reported smoking in recreational venues. Analyses showed that smoke-free laws had been exempted, 32.0% of the patrons reporting bans on smoking in these locations. The following factors were significant predictors of smoking in recreational venues: absence of bans on smoking, support for non-bans, being aged 18–24 years, positive smoking-related attitudes, low number of health effects reported and not living in Beijing.

Conclusions: The findings point to the importance of informing Chinese smokers about the active smoking and passive smoking harmfulness in both building support for smoke-free laws and in reducing smokers' desire to smoke within recreational venues. They also point to the importance of good enforcement of smoke-free laws when implemented. Such strategies could also serve to de-normalise smoking in China, a key strategy for reducing smoking in general.

Developing countries (with low and middle incomes) are facing a rapidly growing epidemic of tobacco use; rates in these regions began increasing in the early 1970s, and currently, 82% of the world's 1.1 billion smokers are in developing countries, with over 50% in Asia alone.[1–3] One such country, the world's largest producer, consumer and victim of tobacco, is China.[4] Currently, China is home to 350 million smokers (30% of the world's smokers) and loses approximately one million people per year directly or indirectly because of tobacco-related deaths.[5–7] If the smoking situation cannot be controlled effectively, it is estimated that about two million smoking-related deaths will occur among Chinese men by the year 2025,[8] and 200 million children currently living in China will become smokers, 50 million of whom will die from smoking-attributable diseases.[9] According to the Report on Tobacco Control in China for 2007, 540 million non-smokers are suffering from secondhand smoke, including 180 million children aged below 15.[10]

Recreational venues (for example, restaurants, coffee shops and karaoke lounges) that allow smoking expose people to contexts in which smoking may be viewed as the norm. This may encourage their progression to more regular smoking.[11 12] Further, the tobacco industry is actively promoting tobacco in recreational settings which may contribute to smoking uptake and relapse back to smoking for those trying to quit.[13–15] Recreational venues tend to be frequented by the trend-setters in society: the elite, in China. If smoking goes on in these recreational venues, then people get the idea that smoking is acceptable and that smoking in these public places is just the way things are. Thus, smoke-free laws in recreational settings would be a powerful way to ''de-normalise'' smoking in China.

China's high prevalence of smoking and tremendous burden from tobacco-induced diseases make tobacco prevention an essential health priority.[6 16] However, China currently has no smoke-free law at the national level, let alone one aimed at the population within recreational venues, which are all common venues for smoking and passive smoking exposure. Most current prevention programmes are based on the social influence approach, which targets the proximal psychosocial variables believed to promote individuals to smoke.[17–19] Although such programmes are somewhat effective, the smoking-related risk factors utilised are based mainly on Western studies.[20 21] Whether these factors have the same influence on Chinese smoking behaviour, especially in recreational venues, has not been identified to date. An examination of the behaviour, beliefs and characteristics of smokers who frequently patronise recreational venues may help in designing an appropriate and effective smoking prevention programme applying to these venues.

To bridge this data gap, the present study focused on smoking among adults within recreational settings. To the best of our knowledge, this is the first reported study to identify potential risk factors for smoking behaviour within recreational settings in China. In this study, we attempted to provide information on the determinants of smoking behaviour in recreational venues, and to develop a practical and effective

smoking intervention strategy for recreational venues by examining the behaviour, beliefs and opinions of smokers who patronised these venues.

METHODS

This section provides an outline of the methods used in the ITC China Survey. A more detailed description can be found in the paper by Wu *et al*.[22]

Sampling design

This study was the baseline survey for the International Tobacco Control (ITC) China Survey, a cohort survey of adult smokers and non-smokers, designed to evaluate tobacco control policies. Survey waves are being conducted every year over a five-year period.

The ITC China Survey used a stratified multistage cluster sampling design in which six cities were first selected based on geographical representations and levels of economic development. These six cities were Shenyang, Beijing, Shanghai, Guangzhou, Changsha and Yinchuan. Within each city, 10 street districts (Jie Dao) were randomly selected, with probability of selection proportional to the population size of the Jie Dao. Within each of these Jie Dao, two residential blocks (Ju Wei Hui) were selected, again with probability of selection proportional to the population size of the Ju Wei Hui, from which a city-identified list of family households was used to sample 300 dwelling units (households) from every Ju Wei Hui using a simple random sampling method without replacement. Information on age, gender and smoking status for all adults living in these 300 households was collected. The enumerated 300 households were then randomly ordered, and individuals 18 years or older who had smoked at least 100 cigarettes in their lifetime were then approached following the randomised order until 40 adult smokers were surveyed. To increase the sample size for women smokers, one male smoker and one female smoker from every selected household were surveyed whenever possible. The next birthday method[23] was used to select a respondent in households with more than one eligible male smoker.

Procedure

Once an individual was identified and agreed to participate, a face-to-face interview was scheduled. All interviews for adult smokers, lasting an average of 31 minutes, were conducted by trained research interviewers who administered a standardised questionnaire, including all the core items of the ITC policy surveys across the many countries (eight other countries at the time of the creation of the ITC China Survey) and some China-specific measures. The same interview protocol was used across every city to ensure identical interview and data collection procedures. The present analysis is limited to respondents from Wave 1, conducted between April and August 2006.

Measures

Demographic variables

Information regarding present residential city, age, gender, ethnicity, education (no education or elementary school = ''low''; junior high school or high school/technical high school = ''medium''; college, university or higher = ''high''), marital status, and per month household income (HH income) (where: <1000 yuan (1 yuan = £0.09; €0.1) = ''low''; 1000–2999 yuan = ''medium''; ⩾3000 yuan = ''high''; don't know = ''DK'') was obtained through self-report. For daily smokers, we directly asked on average, how many cigarettes, including factory made and ''hand-rolled'' cigarettes, they smoke per day. Weekly smokers were asked for the average cigarettes they smoked per week.

Reported smoking in entertainment venues

Smokers were asked a series of questions on whether they had gone to each of several entertainment venues in the past 6 months, and for each venue, whether they had smoked. The entertainment venues were restaurants, coffee shops and karaoke lounges.

Knowledge of health effects

Knowledge of the harmful effects of smoking was assessed by asking the respondents if they believed that cigarette smoking can cause coronary heart disease (CHD), stroke, impotence, premature ageing, emphysema, stained teeth in smokers, lung cancer in smokers, lung cancer in non-smokers and addiction to tobacco.

Extent of smoking restrictions

Reported smoking restrictions for the recreational venues were assessed by asking: ''Which of the following best describes the rules about smoking in indoor entertainment places such as restaurants, coffee shops, and karaoke lounges that you go most often?'' Response options include: (1) smoking is not allowed in any indoor areas; (2) smoking is allowed only in some indoor areas; and (3) no rules or restrictions.

Support for smoking restrictions

Support for smoking restrictions for these venues were established by asking: ''For the restaurants or bars venues, please tell me if you think smoking should be allowed in all indoor areas, some indoor areas, not allowed indoors at all or DK (don't know)?''

Influence of surrounding friends/acquaintances

Friends/acquaintances smoking behaviour's influence was identified by asking: ''Of the five closest friends or acquaintances that you spend time with on a regular basis, how many of them are smokers?'' Responses were rated on a six-point scale (0 = none, 1 = one, 2 = two, 3 = three, 4 = four and 5 = five).

Attitude and belief factors

Smoking is a very common social practice in China and non-smoking is not yet adopted as a social norm. The beliefs of smoking among smokers may influence their openness to smoking within recreational settings. These effects were measured with three statements. The first statement was ''You enjoy smoking too much to give it up.'', with a five-point scale from strongly disagree to strongly agree. In analysis, these who chose ''strongly disagree'' or ''disagree'' are identified as ''disagree'', on the contrary those who chose ''strongly agree'' or ''agree'' are identified as ''agree''. Then, all were asked ''What do you think about the smoking behaviour?'' The possible answers are very good, good, neither good nor bad, bad and very bad. Those respondents who chose ''good'' or ''very good'' are identified as having positive beliefs for smoking. The last statement was ''What do you think about the attitude of Chinese society to smoking?'', with a five-point scale: ''support'', ''disapprove'', ''neither supports nor disapproves'' or ''DK, cannot say''.

Table 1 Demographic characteristics of those smoking in recreational venues vs those not smoking in those venues

	Smoking	Not smoking	
Variables	**No (%)**	**No (%)**	**Test of significance**
Total	2403 (83.6)	472 (16.4)	
Region			
Beijing	294 (75.4)	96 (24.6)	
Shenyang	385 (87.7)	54 (12.3)	
Shanghai	460 (87.1)	68 (12.9)	
Changsha	387 (83.4)	77 (16.6)	
Guangzhou	484 (84.3)	90 (15.7)	
Yinchuan	393 (81.9)	87 (18.1)	$\chi^2(5) = 30.60$, $p<0.001$
Gender			
Male	2342 (84.0)	446 (16.0)	
Female	61 (70.1)	26 (29.9)	$\chi^2(1) = 11.86$, $p = 0.001$
Age			
18–24	49 (87.5)	7 (12.5)	
25–39	515 (83.5)	102 (16.5)	
40–54	1290 (87.3)	187 (12.7)	
55+	549 (75.7)	176 (24.3)	$\chi^2(3) = 48.45$, $p<0.001$
Ethnicity			
Han nationality	2289 (83.5)	452 (16.5)	
Others	114 (85.1)	20 (14.9)	$\chi^2(1) = 0.23$, $p = 0.633$
Marital status			
Single	122 (80.8)	29 (19.2)	
Married	2166 (84.1)	411 (15.9)	
Others	115 (78.2)	32 (21.8)	$\chi^2(2) = 4.34$, $p = 0.114$
Education			
Low	196 (80.7)	47 (19.3)	
Medium	1593 (84.2)	300 (15.8)	
High	614 (83.1)	125 (16.9)	$\chi^2(2) = 2.10$, $p = 0.351$
Household income per month			
Low	333 (83.5)	66 (16.5)	
Medium	1566 (83.7)	306 (16.3)	
High	326 (83.8)	63 (16.2)	
DK (don't know)	178 (75.7)	57 (24.3)	$\chi^2(3) = 0.12$, $p = 0.989$
Continuous variable			
Age (years)			
Mean (SD)	47.36 (8.53)	50.41 (11.86)	$t(2873) = 4.56$, $p<0.001$

Data analysis

The data were analysed using SPSS for Windows, version 13.0. Pearson's χ^2 tests for categorical variables and t tests for continuous variables were employed to examine differences between those smoking in recreational venues and those not. For further analyses of the association between selected factors and smoking behaviour in recreational venues, we conducted both bivariate and multiple logistic regression analyses. In the adjusted analyses, we added demographic variables along with the predictor variables to obtain adjusted odds ratios for each of the predictor variables and their corresponding 95% confidence intervals (AOR, 95% CI). All analyses were conducted with weighted data using the "Complex samples" feature in SPSS to take the complex sampling design into account.

RESULTS

Demographic characteristics of the sample

The Wave 1 cooperation rates range approximately from 80.0% in Beijing and Guangzhou to 95.0% in Changsha. The response rates range from 39.4% in Yinchuan to 66.0% in Guangzhou. Data used in this study come from the 2875 smokers who completed the baseline survey and who reported visiting recreational venues during the last 6 months. The age of these respondents ranged between 18 and 82 years, with an average age of 47.9 (7.9) years.

Table 1 summarises the demographic characteristics of the subjects stratified by smoking status. A large majority (83.6%) of the patrons reported ever smoking in these venues, with 84.0% for males and 70.1% for females, respectively. The majority of patrons were males (97.0%), married (89.6%) and of Han ethnicity (95.3%). About 65.8% had completed high school education, and more than 86% reported per month household income greater than 1000 yuan. This is a high level of income relative to the average household income in China, which would be expected because the current sample was drawn from six major metropolitan cities in China, and because we restricted our analysis to those who went to recreational venues this population tends to have higher income.

Bivariate results

Comparisons of demographic characteristics between two groups are shown in table 1. Overall, both the educational attainment distribution and the marital status were almost equivalent across the two groups, and there were also no major differences regarding average monthly HH income (p values not significant at the α level of 0.05). However, compared with

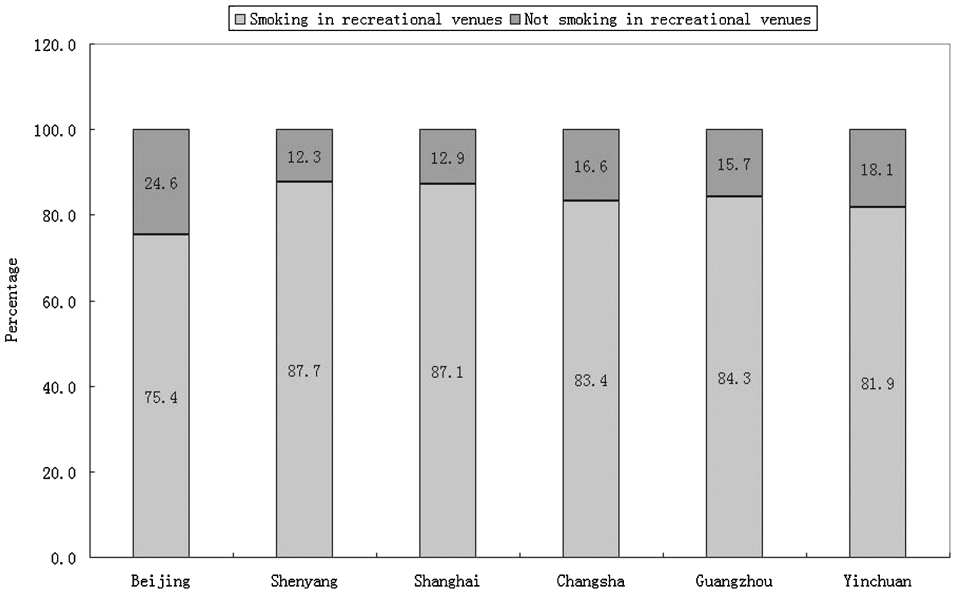

Figure 1 Smoking behaviour within recreational settings among smokers who had been to these venues in the last six months across six urban cities of China.

those not smoking in recreational venues, those smoking in recreational venues were more than three years younger (50.4 versus 47.4). Figure 1 presents the percentage of these smoking in recreational venues among all smokers reporting patronising recreational venues across six cities. A larger proportion of Shanghai and Shenyang respondents reported smoking in these venues compared to their counterparts in Changsha, Guangzhou and Yinchuan, with Beijing having the lowest percentage.

Associations between variables of interest and smoking behaviour within recreational venues are presented in table 2. There was considerable variation ($\chi^2 = 386.1$, $p<0.001$) in the reported extent of smoking restrictions. Only 32.0% of the patrons reported partial or complete bans on smoking in recreational venues of China, far fewer than that of bars in the United Kingdom, Canada, United States and Australia, which are considered to have the lowest levels of restrictions (fig 2).[24–26] Those not smoking (55.5%) in recreational venues were likely to express greater approval of bans on smoking, compared to those smoking (33.7%). Great variation was also observed for all individual smoking-related health effects, with the exception of stroke ($\chi^2 = 3.55$; $p = 0.06$). Patrons were most likely to agree that smoking causes stained teeth (87.7%) and lung cancer (72.9%). However, less than half (49.0%) agreed that smoking causes premature ageing. Only 36.2% and 18.1% agreed that smoking causes heart disease and impotence, respectively, and stroke was recognised by the lowest percentage of respondents as being caused by smoking (16.3%) (fig 3). There was also a significant difference between groups in the total number of diseases endorsed by respondents ($\chi^2 = 27.6$; $p<0.001$), with those smoking in recreational venues endorsing fewer diseases than those who did not smoke in recreational venues. Having a positive attitude towards smoking was more prevalent among those smoking in recreational venues. Those who perceived smoking as a good behaviour and that smoking is supported by Chinese society were more likely to smoke in recreational venues. "Enjoying smoking too much to give it up" was the most frequently cited reason for tobacco use within recreational settings. Those smoking in recreational venues were also far more likely to report having a greater number of their five closest friends who were also smokers.

Multivariate results

We next performed a complex sample multivariate logistic regression to assess the smoking risk factors within recreational settings. Table 3 displays the results of the logistic regression analyses, where the dependent variable was smoking vs not smoking in recreational settings. An overall opinion toward smoking of "very good" (AOR 30.64, 95% CI 3.94 to 238.25) and reported no bans or restrictions on smoking (AOR 14.36, 95% CI 9.41 to 21.91) were most strongly associated with smoking behaviour in recreational venues. Support for non-bans was also significantly related to this behaviour (OR 2.84, 95% CI 2.09 to 3.86). The strength of this association was increased after adjustment for demographic characteristics (AOR 2.87, 95% CI 2.12 to 3.89). Health knowledge of whether smoking causes lung cancer in smokers was associated with smoking behaviour within recreational settings (OR 0.63, 95% CI 0.47 to 0.84), and this protective association was reduced (AOR 0.62, 95% CI 0.45 to 0.84) after adjusting the demographic characteristics including marital status, education attainment, ethnicity, and average monthly HH income, but remained significant. For all other smoking-related diseases mentioned, with the exception of stroke and stained teeth, similar findings emerged. Most notably, the odds of not smoking in recreational settings were greater among patrons who endorsed all the eight diseases, and increased in a linear fashion with the total number of health effects reported ($\chi^2_{trend} = 28.4$; $p<0.001$). Those smokers living in Shenyang, Shanghai, Guangzhou, Changsha and Yinchuan were also more likely than those living in Beijing to smoke in recreational venues.

DISCUSSION

Bans on smoking in public spaces are becoming increasingly common in many countries.[27–31] There are variations between countries where smoking is prohibited and in the strategies used to achieve these bans. In China, governments have imposed some smoke-free laws in public places, but many areas, especially recreational venues, such as restaurants and bars, have been exempted (fig 2). As a result, smokers within these settings have been able to smoke anywhere, at any time, and with little awareness of the dangers of smoking to themselves

Table 2 Characteristics associated with whether smoking respondents reported smoking in recreational settings

Variables	Smoking No (%)	Not smoking No (%)	Test of significance
Reported level of bans			
Total indoor area	124 (5.2)	131 (27.8)	
Some indoor area	463 (19.3)	179 (37.9)	
No restrictions	1816 (75.6)	162 (34.3)	$\chi^2(2) = 386.1$, $p<0.001$
Support for indoor restrictions			
Total indoor area	351 (14.6)	143 (30.3)	
Some indoor area	459 (19.1)	119 (25.2)	
DK (don't know)	113 (4.7)	33 (7.0)	
No restrictions	1480 (61.6)	177 (37.5)	$\chi^2(3) = 107.6$, $p<0.001$
Smoking causes lung cancer in smokers			
Yes	1724 (71.7)	373 (79.0)	
No/DK	679 (28.3)	99 (21.0)	$\chi^2(1) = 10.60$, $p = 0.001$
Smoking causes CHD			
Yes	842 (35.0)	199 (42.2)	
No/DK	1561 (65.0)	273 (57.8)	$\chi^2(1) = 8.66$, $p = 0.003$
Smoking causes stroke			
Yes	379 (15.8)	91 (19.3)	
No/DK	2024 (84.2)	381 (80.7)	$\chi^2(1) = 3.55$, $p = 0.060$
Smoking causes impotence			
Yes	411 (17.1)	110 (23.3)	
No/DK	1992 (82.9)	362 (76.7)	$\chi^2(1) = 10.23$, $p = 0.001$
Smoking causes emphysema			
Yes	1470 (61.2)	317 (67.2)	
No/DK	933 (38.8)	155 (32.8)	$\chi^2(1) = 6.01$, $p = 0.014$
Smoking causes stained teeth			
Yes	2102 (87.5)	420 (89.0)	
No/DK	301 (12.5)	52 (11.0)	$\chi^2(1) = 0.83$, $p = 0.361$
Smoking causes premature ageing			
Yes	1141 (47.5)	267 (56.6)	
No/DK	1262 (52.5)	205 (43.4)	$\chi^2(1) = 13.03$, $p<0.001$
Smoking causes lung cancer in non-smokers			
Yes	1312 (54.6)	300 (63.6)	
No/DK	1091 (45.4)	172 (36.4)	$\chi^2(1) = 12.86$, $p<0.001$
Total number of health effects reported			
$\leqslant 1$	411 (17.1)	64 (13.6)	
2	272 (11.3)	32 (6.8)	
3	348 (14.5)	49 (10.4)	
4	366 (15.2)	81 (17.2)	
5	404 (16.8)	90 (19.1)	
6	301 (12.5)	76 (16.1)	
7	183 (7.6)	46 (9.7)	
8	118 (4.9)	34 (7.2)	$\chi^2(7) = 27.6$, $p<0.001$
Tobacco is addictive			
Disagree	199 (8.3)	41 (8.7)	
Neither disagree nor agree	133 (5.5)	37 (7.8)	
Agree	2071 (86.2)	394 (83.5)	$\chi^2(2) = 3.95$, $p = 0.139$
Enjoying smoking too much to give it up			
Disagree	823 (34.2)	193 (40.9)	
Neither disagree nor agree	273 (11.4)	50 (10.6)	
Agree	1307 (54.4)	229 (48.5)	$\chi^2(2) = 7.68$, $p = 0.022$
Overall opinion of smoking behaviour			
Very good	42 (1.7)	1 (0.2)	
Good	121 (5.0)	19 (4.0)	
Neither good nor bad	1047 (43.6)	153 (32.4)	
Bad	870 (36.2)	203 (43.0)	
Very bad	322 (13.4)	96 (20.3)	$\chi^2(4) = 36.76$, $p<0.001$

Continued

Table 2 Continued

Variables	Smoking No (%)	Not smoking No (%)	Test of significance
Attitude of Chinese society to smoking			
Disapprove/neither/DK	1303 (54.2)	296 (62.7)	
Support	1100 (45.8)	176 (37.3)	$\chi^2(1) = 11.51$, $p = 0.001$
Cigarettes per day			
0–10	720 (30.0)	251 (53.2)	
11–20	1267 (52.7)	165 (35.0)	
21–30	212 (8.8)	29 (6.1)	
31+	204 (8.5)	27 (5.7)	$\chi^2(3) = 95.1$, $p<0.001$
Smokers of five closest friends			
None	37 (1.5)	15 (3.2)	
One	66 (2.7)	25 (5.3)	
Two	157 (6.5)	67 (14.2)	
Three	402 (16.7)	91 (19.3)	
Four	462 (19.2)	93 (19.7)	
All	1278 (53.2)	181 (38.3)	$\chi^2(5) = 62.32$, $p<0.001$

and others. The continuing problem of smoking in recreational venues has resulted in pressure on governments to ban smoking in these locations where it is still allowed. But the efficacious design of smoking control strategies for these venues is hampered by the relative absence of information, because few studies have focused specifically on this population. This study, to our knowledge, is the first publicly to explore the determinants of indoor smoking within recreational settings in China.

Tobacco consumers' beliefs about the harmfulness of secondhand smoke and their support for smoke-free laws are an important determinant of their smoking behaviour. For comparable respondents who supported no restrictions or bans in some indoor areas, the odds of smoking increased by 187% and 34%, respectively (table 3). It has been well documented that an individual's own smoking behaviour influences their attitudes to tobacco control policies.[32 33] However, these attitudes, in turn, may vary according to the enforcement status of restrictions.[34] It could be argued that patrons in recreational venues without any smoking restrictions would be more susceptible to smoking. As shown in table 3, the odds of those who are exposed to limited bans or no bans at all to take up smoking more were 3.1 and 14.4 times higher than those exposed to total bans on smoking in recreational venues. Similar to previously published results, smokers were less likely to support smoke-free laws than non-smokers,[35] with only 37.3% respondents showing support for such laws, a considerably lower rate than found in the ITC Four Country Survey.[36] Additionally, our respondents who were in favour of smoking bans, more often advocated technical solutions (such as ventilation and smoking rooms) with support rates as high as 54%; however, these concepts are often rejected by public health advocates.

The extent to which smokers understand the magnitude of these health risks has a strong influence on their smoking behaviour. Consistent with previous studies,[37–39] both table 2 and table 3 indicated that smokers who haven't perceived greater health risk from smoking are more likely to smoke within recreational settings. Although there was a poor level of knowledge both in those smoking in recreational venues and those not (fig 3) in this study, the association increased after adjusting the demographic characteristics including marital status, education attainment, ethnicity and average monthly HH income (table 3). Different findings were noted by Smith[40] and Rosliza,[41] but Oncken[42] and the present study showed evidence to support that the intention to give up smoking in public places is more prevalent among smokers with a good knowledge of the effects of smoking compared with smokers with poor knowledge. Figure 3 showed that only 18.1% believed it could lead to impotence and only 17% acknowledged a potential relation between smoking and stroke risk. This illustrates the significant gaps in smokers' understanding of the risks of smoking. To bridge these gaps, antismoking education campaigns are needed in China.

The higher support rates in the US, Canada, UK and Australia are in large measure due to the dissemination of the strong evidence from many studies about the harmfulness of secondhand smoke. In these four countries, as in many other Western countries, knowledge about the harmfulness of secondhand smoke is considerably higher than in China. It thus would seem to follow that efforts to inform the Chinese public of the same studies about the harmfulness of secondhand smoke would help build the foundation for stronger support for smoke-free laws, and also for lowered prevalence of smoking in recreational venues and in other places where secondhand smoke would be particularly important to decrease or eliminate, such as in one's home and in cars, particularly in the presence of children.

The most important determinant of behaviour is behavioural intention, which, in turn, is influenced by one's overall evaluation of the behaviour (attitude).[43] A positive attitude towards smoking was more prevalent among those recreational venues smokers, as shown in table 2. The percentage of those smoking within recreational settings and those not, who enjoyed smoking too much to give it up, and who believed that Chinese society supported smoking, was 54.4% versus 48.5%, and 45.8% versus 37.3%, respectively. Parallel to the findings of previous research,[44–46] positive beliefs about smoking were also found to be related to the smoking behaviour in public places. A smoker who responded with an attitude towards smoking of "very good" will be about 31 times more likely to smoke in public compared to a smoker who perceives it as "very bad".

Offering cigarettes to one another has become a means of social interaction and a friendly gesture, especially in entertainment spaces. Meanwhile, the need to gain social acceptance from peers exerting tacit pressure and influence also promotes smoking. To this end, smoking is used as a symbol of personality and independence. Therefore, it is no surprise to find that having "closet" smoking friends increased the odds of

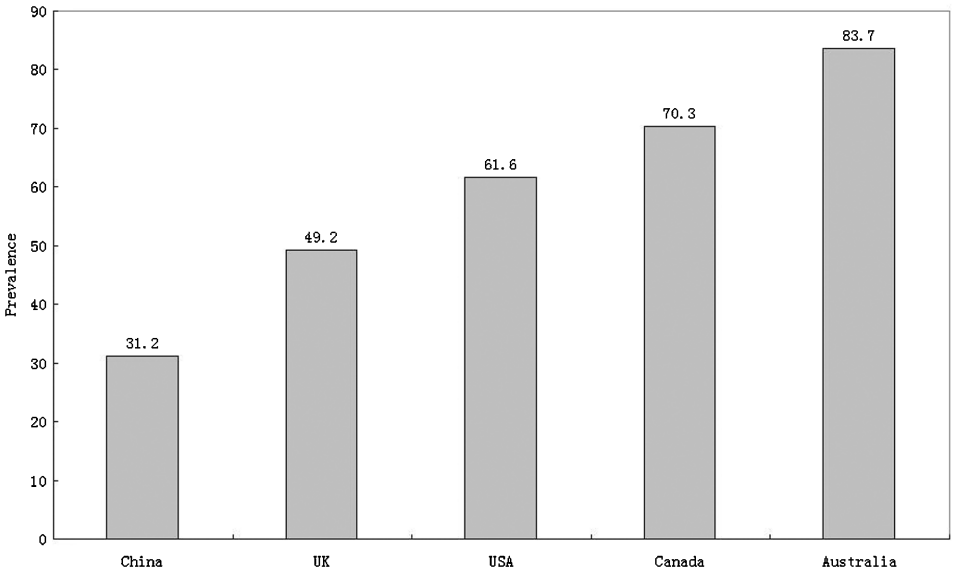

Figure 2 Reported prevalence of bans on smoking in recreational venues of China and bars of the UK, US, Canada and Australia, among smokers who had been to these venues in last six months.

smoking more by 3.81 times, increasing in a linear fashion with the number of "closet" smoking peers reported (table 3). This was consistent with previously published reports.[46–48] Of course, this phenomenon is possibly due to overstating the influence of peers, with selection and projection increasing the relation between peers' and smokers' behaviour. It could be argued that those who already smoke are more likely to seek out and spend time with other smokers, and those who smoke tend to overestimate the smoking prevalence of their friends.

As shown in table 3, compared to smokers in Beijing, smokers in Yinchuan, Changsha, Guangzhou, Shanghai and Shenyang are more likely to smoke in recreational venues, with the odds ratios ranging from 1.77 to 2.74. This phenomenon may be partly due to the variations between districts where smoking is prohibited and in the strategies used to achieve these bans.

Limitations

Our results need to be considered in light of the following limitations. First, these results are based on the baseline data from the ITC China survey. The cross-sectional nature of these data cannot address the causality of the associations between variables. The second limitation of this study is the lack of information on the absent smokers. It is possible that absentees had a higher smoking possibility within recreational settings and a lower level of health effects than those surveyed. This may have caused underestimation of the smoking prevalence and the influence of the health effects. Third, cigarette smoking among women was traditionally unacceptable in Chinese culture. For a long time, this had served as a protective factor against smoking among women; so the sample and results of the present study are almost exclusively male. Thus, the suggested interventions based on the current study should be targeted more towards men. Finally, it is important to note that these results derive from smokers in the most affluent and most highly educated cities, with the most comprehensive tobacco control policies, in China. As such, the findings may not be generalised to the rest of the people living in rural areas. Similarly, we should expect health knowledge to be substantially lower among the majority of Chinese smokers,

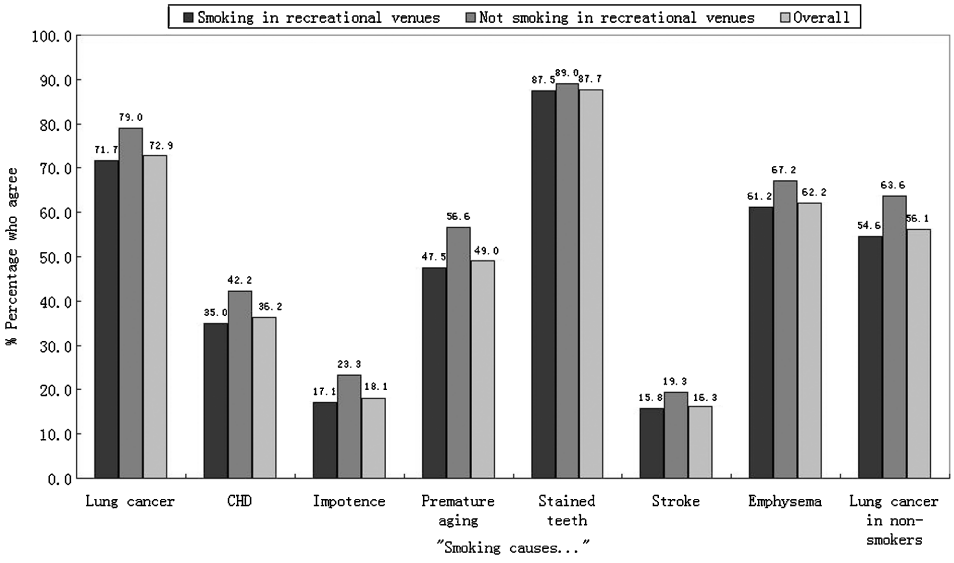

Figure 3 "Proportion who agree that smoking can cause…" by smoking-related diseases.

Table 3 Crude and adjusted odds ratio of recreational venues smoking risk factors and its 95% confidence interval

Variables	Crude OR (95% CI)	AOR (95% CI)*
Reported level of bans		
Total indoor area	Reference	Reference
Some indoor area	3.12 (2.21 to 4.39)	3.14 (2.18 to 4.53)
No restrictions	14.05 (9.28 to 21.28)	14.36 (9.41 to 21.91)
Support for indoor restrictions		
Total indoor area	Reference	Reference
Some indoor area	1.31 (1.00 to 1.73)	1.34 (1.01 to 1.77)
DK	1.61 (0.92 to 2.83)	1.62 (0.93 to 2.81)
No restrictions	2.84 (2.09 to 3.86)	2.87 (2.12 to 3.89)
Believe smoking causes lung cancer in smokers	0.63 (0.47 to 0.84)	0.62 (0.45 to 0.84)
Believe smoking causes CHD	0.75 (0.58 to 0.95)	0.74 (0.58 to 0.96)
Believe smoking causes stroke	0.86 (0.63 to 1.16)	0.86 (0.63 to 1.19)
Believe smoking causes impotence	0.66 (0.48 to 0.91)	0.66 (0.48 to 0.91)
Believe smoking causes premature ageing	0.69 (0.54 to 0.88)	0.68 (0.53 to 0.88)
Believe smoking causes stained teeth	0.85 (0.60 to 1.22)	0.85 (0.59 to 1.21)
Believe smoking causes emphysema	0.73 (0.58 to 0.92)	0.72 (0.58 to 0.90)
Believe smoking causes lung cancer in non-smokers	0.68 (0.51 to 0.90)	0.68 (0.51 to 0.91)
Total number of health effects reported		
$\leqslant 1$	Reference	Reference
2	0.97 (0.56 to 1.67)	0.96 (0.56 to 1.66)
3	0.86 (0.55 to 1.34)	0.84 (0.55 to 1.29)
4	0.60 (0.36 to 0.10)	0.58 (0.36 to 0.95)
5	0.61 (0.43 to 0.86)	0.60 (0.41 to 0.86)
6	0.51 (0.32 to 0.81)	0.50 (0.31 to 0.79)
7	0.57 (0.36 to 0.91)	0.56 (0.34 to 0.91)
8	0.47 (0.27 to 0.82)	0.45 (0.25 to 0.81)
Trend test	$\chi^2_{trend} = 28.4$,	$p_{trend} < 0.001$
Tobacco is addictive		
Agree	Reference	Reference
Neither disagree nor agree	0.84 (0.53 to 1.35)	0.82 (0.51 to 1.30)
Disagree	0.98 (0.64 to 1.48)	0.99 (0.65 to 1.51)
Enjoying smoking too much to give it up		
Disagree	Reference	Reference
Neither disagree nor agree	1.01 (0.61 to 1.66)	1.13 (0.74 to 1.74)
Agree	0.89 (0.63 to 1.25)	1.10 (0.78 to 1.55)
Overall opinion of smoking behaviour		
Very good	30.40 (3.93 to 235.46)	30.64 (3.94 to 238.25)
Good	2.19 (1.17 to 4.07)	2.20 (1.16 to 4.18)
Neither good nor bad	1.76 (1.21 to 2.56)	1.80 (1.23 to 2.63)
Bad	1.20 (0.86 to 1.66)	1.24 (0.90 to 1.70)
Very bad	Reference	Reference
Attitude of Chinese society to smoking		
Disapprove/neither/DK	Reference	Reference
Support	1.27 (1.00 to 1.60)	1.27 (1.00 to 1.60)
Cigarettes per day		
0–10	Reference	Reference
11–20	2.75 (2.15 to 3.52)	2.81 (2.17 to 3.64)
21–30	2.95 (1.65 to 5.26)	2.99 (1.67 to 5.33)
31+	2.30 (1.40 to 3.79)	2.43 (1.48 to 3.40)
Smokers of five closest friends		
None	Reference	Reference
One	1.99 (0.66 to 6.01)	2.13 (0.72 to 6.32)
Two	1.52 (0.64 to 3.64)	1.55 (0.66 to 3.61)
Three	2.60 (1.05 to 6.41)	2.56 (1.09 to 6.05)
Four	2.89 (1.07 to 7.83)	2.79 (1.08 to 7.23)
All	4.05 (1.70 to 9.65)	3.81 (1.67 to 8.68)
Region		
Beijing	Reference	Reference
Shenyang	2.80 (1.83 to 4.28)	2.74 (1.75 to 4.29)
Shanghai	2.57 (1.83 to 3.63)	2.68 (1.90 to 3.79)
Changsha	2.04 (1.46 to 2.84)	2.06 (1.45 to 2.92)
Guangzhou	1.92 (1.41 to 2.60)	2.12 (1.54 to 2.92)

Continued

Table 3 Continued

Variables	Crude OR (95% CI)	AOR (95% CI)*
Yinchuan	1.84 (1.27 to 2.67)	1.77 (1.21 to 2.61)
Gender		
Male	1.85 (0.97 to 3.53)	1.84 (0.96 to 3.49)
Female	Reference	Reference
Age		
18–24	2.74 (0.97 to 7.74)	3.27 (1.05 to 10.17)
25–39	1.15 (0.78 to 1.70)	1.21 (0.82 to 1.80)
40–54	1.74 (1.11 to 2.72)	1.74 (1.10 to 2.76)
55+	Reference	Reference

OR, odds ratio; CI, confidence interval; AOR, adjusted odds ratio.
*Adjusted odds ratio: adjusting the potential confounding demographic characteristics including marital status, education attainment, ethnicity, and average monthly household (HH) income. DK, don't know.

particularly those living in middle-income and lower-income areas where smoke-free restrictions are non-existent.

Implications

Compared with Western countries, little has been done with regard to tobacco control in China, especially in recreational venues. Although only a first step, the findings from this survey present a valuable basis to move forward on tobacco control within recreational settings, by exploring the determinants of public smoking behaviour in these venues. All such information is of great importance in policy-making, which is urgently needed to decrease the high smoking prevalence within recreational settings. Results of this study call for a prevention policy aimed at this special population, and strategies to reduce smoking in recreational venues, as in smoking behaviour in general, should involve educating the Chinese public about the hazards of secondhand smoke, associating smoking behaviour with negative rather than positive images, and in trying to denormalise smoking. These are the strategies that have proved to be effective in many other countries, and provide a superb set of strategies for China to apply as it increases its efforts to combat the single most important cause of death and disability in the world's most populous country.

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Support for smoke-free policies among smokers and non-smokers in six cities in China: ITC China Survey

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ABSTRACT

Objective: To examine levels of support for comprehensive smoke-free policies in six large Chinese cities.

Methods: Data from Wave 1 of the International Tobacco Control (ITC) China Survey (April–August 2006) were analysed. The ITC China Survey employed a multistage sampling design in Beijing, Shenyang, Shanghai, Changsha, Guangzhou and Yinchuan (none of which has comprehensive smoke-free policies in place). Face-to-face interviews were conducted with 4815 smokers and 1270 non-smokers. Multivariate logistic regression models were used to identify factors associated with support for comprehensive smoke-free policies.

Results: About one in two Chinese urban smokers and four in five non-smokers believed that secondhand smoke (SHS) causes lung cancer. The majority of respondents supported comprehensive smoke-free policies in hospitals, schools and public transport vehicles while support for smoke-free workplaces, restaurants and bars was lower. Levels of support were generally comparable between smokers and non-smokers. Support for comprehensive smoke-free policies was positively associated with knowledge about the harm of SHS. Respondents who worked in a smoke-free worksite or who frequented smoke-free indoor entertainment places were more likely to support comprehensive smoking restriction in bars and restaurants.

Conclusion: Considerable support for smoke-free policies exists in these six large cities in China. Greater public education about the dangers of SHS may further increase support. Experiencing the benefits of smoke-free indoor entertainment places and/or workplaces increases support for these policies and suggests that some initial smoke-free policy implementation may hasten the diffusion of these public health policies.

Secondhand smoke (SHS) exposure causes death, disease and disability.[1] In China, the biggest tobacco producer and consumer in the world, SHS is a serious public health problem. The 2002 China national epidemiological survey on smoking behaviour suggested that 51.9% of the Chinese non-smokers were exposed to SHS for at least 15 minutes daily for more than one day every week.[2] It was estimated that in 2002, more than 100 000 Chinese died from diseases associated with SHS exposure.[3]

Workplaces and public venues are common sources of SHS exposure; therefore, restricting smoking in these venues through smoke-free policies is an effective way to reduce SHS exposure and to protect health.[4–6] The World Health Organization Framework Convention on Tobacco Control (FCTC) requires ratifying countries, which China ratified in October 2005, to "adopt and implement in areas of existing national jurisdiction as determined by national law and actively promote at other jurisdictional levels the adoption and implementation of effective legislative, executive, administrative and/or other measures, providing for protection from exposure to tobacco smoke in indoor workplaces, public transport, indoor public places and, as appropriate, other public places". Studies suggest that to achieve the best SHS reductions the smoke-free policies must be comprehensive[7]—that is, all indoor workplaces and public places must be smoke-free without exception. In comparison, partial smoke-free policies that allow designated smoking areas or rooms do not offer adequate SHS protection. Today, 16 countries have comprehensive smoke-free indoor air laws at the national level; and some countries have substantial levels of comprehensive subnational smoke-free policies including Canada, Australia and the United States.[7]

China does not have a comprehensive smoke-free law at the national level. However, several national laws and policies regulate smoking in public places. For example, *Regulations on the Sanitary Administration of Public Places* bans smoking in gymnasiums, libraries, museums, art galleries, marketplaces, bookstores, public transport waiting rooms, trains, passenger liners and aeroplanes. *Law of the People's Republic of China on Tobacco Monopoly* "bans or restricts smoking in public transportation vehicles and public venues". *Law of the Peoples Republic of China on the Protection of Minors* bans smoking in the classrooms, dorms and activity rooms of middle or primary schools, kindergartens and nurseries. No national level laws restrict smoking in workplaces, restaurants and bars, which are all common venues for SHS exposure. Although these national level laws are not comprehensive and not well enforced,[8] they were the first smoke-free laws in China and became the templates for subsequent local level smoke-free laws and policies. About half of the Chinese cities have city level smoke-free policies, although most of these policies are just mirroring the national level laws and the enforcement is limited.[8 9] Only a few cities' local laws are more stringent than the national laws. For example, Guangzhou's local smoke-free law bans smoking in workplaces and restaurants with air conditioning, which is beyond the scope of the national laws.

By ratifying the FCTC, China has agreed that all workplaces and public places should be smoke-free by 2011. Recently, efforts have been made in China to expand smoke-free places. At the national level, the central government is revising the *Regulations on the Sanitary Administration of Public Places*. At the

local level, many cities are also strengthening smoke-free policies. For example, in March 2008, Beijing released its new regulations on the scope of banning smoking in public places, which restrict smoking in workplaces though they are not comprehensive and designated smoking rooms are still allowed. In addition, the new regulations require restaurants to set up non-smoking areas, which makes Beijing the third city (along with Guangzhou and Shenzhen) in China that partially bans smoking in restaurants. Just like in the United States where the first smoke-free policies were incremental but they laid the framework for subsequently stronger policies, the new Beijing regulations are considered an important step towards the fulfilment of Article 8 of the FCTC and will lead the way for the rest of China.

Despite the progress being made, China is still far from 100% smoke-free in public venues and workplaces, though the deadline to fulfil the country's commitment to Article 8 in FCTC is very close. We expect that China will formulate stronger smoke-free policies in the coming years. Thus, to study China's attitudes towards smoke-free policies and factors associated with support for smoking bans is valuable and has important policy implications. Previous studies suggest that comprehensive smoke-free policies are popular,[7 10] well complied with[7 11 12] and that support for smoke-free policies is associated with knowledge about the adverse health effects of SHS.[11] There is also evidence that public support for smoke-free policies increases after the smoke-free policies are implemented.[13 14] However, all of these studies were conducted in Western countries with different cultural norms about smoking, and it is unclear if these findings will generalise to China, where one-third of the world smokers live.

The current study uses data from six cities in China to address three research questions: (1) what are the smoke-free policies in six large Chinese cities; (2) what percentage of smokers and non-smokers support comprehensive smoke-free policies in different public venues and workplaces; and (3) what factors are associated with support for comprehensive smoke-free policies?

METHODS

Participants

The ITC China Survey is a prospective cohort survey in six large cities in China: Beijing, Shanghai, Guangzhou, Shenyang, Changsha and Yinchuan. The Wave 1 survey was conducted between April and August 2006. About 800 smokers and 200 non-smokers were interviewed in each city for a total of 4815 smokers and 1270 non-smokers completing the Wave 1 survey across cities. Subsequent waves of data collection are being performed in this cohort, but for the purposes of this paper only data from the baseline 2006 survey are analysed.

In this paper, a smoker refers to a respondent who had smoked more than 100 cigarettes in lifetime and smoked at least weekly at recruitment, and a non-smoker refers to a respondent who had not smoked 100 cigarettes in lifetime or who didn't smoke weekly at recruitment.

Sampling design

The six cities were selected based on their size, diverse geographic location and level of economic development (see fig 1). Table 1 shows the population size and the smoke-free policies in the six cities at the time the survey was conducted in 2006. The registered population in each city is 11 million in Beijing, 5 million in Shenyang, 13 million in Shanghai, 2 million in Changsha, 6 million in Guangzhou and 1 million in Yinchuan.[15] In 2006, all the six cities had comprehensive or partial smoke-free policies for hospitals, conference rooms, public transportation vehicles and schools. However, for restaurants and workplaces, only Guangzhou had partial smoke-free policies (places with air conditioning are required to be smoke-free), and the other five cities had no restrictions on smoking in these two kinds of venues.

Figure 1 The geographical distribution of the ITC China cities.

In each city, the ITC China Survey employed a multistage cluster sampling design where 10 street districts (Jie Dao) were randomly selected, with probability of selection proportionate to the population size of the Jie Dao. Within each of these Jie Dao, two residential blocks (Ju Wei Hui) were selected with probability proportionate to the population size of the Ju Wei Hui. Within each selected Ju Wei Hui, a complete list of addresses of the dwelling units (households) was compiled and a simple random sample without replacement of 300 households was drawn from the list to construct the sampling frame.

Each of these 300 households was visited to attempt to complete a survey(s), and information on age, gender and smoking status for all adults living in each household was collected. The enumerated 300 households were then randomly ordered, and adult smokers and non-smokers were then approached face to face following the randomised order until 40 adult smokers and 10 adult non-smokers were surveyed. Because of low smoking prevalence among women, one male smoker and one female smoker from every selected household were surveyed whenever possible to increase the sample size for women. At most one non-smoker was interviewed per household. Where there was more than one person in a sampling category to choose from in a household, the next birthday method was used to select the individual to be interviewed.

Procedure

After providing the potential respondent with information about the survey they completed the consent form, the average time to complete a survey was 31.4 minutes for smokers and 10.6 for non-smokers, with respective interquartile ranges of approximately 10 minutes and 5 minutes, respectively.

Interviewers followed a strict protocol in their interview session with each respondent. Up to four visits to a household were made in order to interview the target person(s) within that

Table 1 Population size and the smoking policies in different venues in the six cities in 2006

	Venues					
	Beijing	**Shenyang**	**Shanghai**	**Changsha**	**Guangzhou**	**Yinchuan**
Registered population (million people)	11	5	13	2	6	1
Smoking policy						
Hospitals	Partial ban	Partial ban	Partial ban	Partial ban	Partial ban	Partial ban
Workplaces	No rules	No rules	No rules	No rules	Partial ban	No rules
Conference rooms	Total ban	Partial ban	Total ban	Total ban	Partial ban	Total ban
Restaurants or bars	No rules	No rules	No rules	No rules	Partial ban	No rules
Bars	No rules	No rules	No rules	No rules	No rules	No rules
Public transportation vehicles	Total ban	Total ban	Total ban	Partial ban	Partial ban	Total ban
Schools	Partial ban	Partial ban	Partial ban	Partial ban	Partial ban	Partial ban

household. The Wave 1 cooperation rates, defined as the proportion of all respondents interviewed of all eligible subjects ever contacted, ranged from approximately 80% in Beijing and Guangzhou to 95% in Changsha. The response rates, defined as the proportion of all cases interviewed of all subjects that we tried to reach, ranged from 39.4% in Yinchuan to 66.0% in Guangzhou. All materials and procedures used in the ITC China Survey were reviewed and cleared for ethics by the research ethics board at the University of Waterloo and by the institutional review boards at the China National Centers for Disease Control and Prevention.

To understand the current smoke-free law in each city, during the field work we collected the local smoke-free law in each city. These laws were reviewed to address the first research question.

Measures

The dependent variable in this study is support for comprehensive smoke-free policies in various public places. In the survey, respondents were asked, ''for each of the following public places, please tell me if you think smoking should not be allowed in any indoor areas, should be allowed only in some indoor areas, or no rules or restrictions.'' Venues being asked include hospitals, workplaces, conference rooms, restaurants or bars, public transportation vehicles, and schools.

The major independent variables and control in this study include:

- City (Beijing, Shenyang, Shanghai, Changsha, Guangzhou, Yinchuan)
- Gender (male, female)
- Age (18–34 years, 35–44 years, 45–54 years, 55 years or older).
- Highest level of education (low = no education or elementary school, medium = junior high school or high school/technical high school, high = college, university or higher)
- Household income per month (low: <1000 yuan per month, medium: 1000 yuan to 2999 yuan, high: >3000 yuan, don't know/cannot say)
- Ethnicity (Han, others)
- Whether respondents believe that ''smoking causes lung cancer in non-smokers from second hand smoke'' (yes, no)
- Self-reported smoking rules at workplaces: In the survey respondents were asked, ''Which of the following best describes the smoking policy where you work?'' Response options include smoking is not allowed in any indoor areas, smoking is allowed only in some indoor areas, no rules or restrictions, and others.
- Self-reported smoking rules in indoor entertainment places that the respondents go most often: In the survey respondents were asked, ''Which of the following best describes the rules about smoking in indoor entertainment places such as restaurants, coffee shops, and karaoke lounges that you go most often?'' Response options include smoking is not allowed in any indoor areas, smoking is allowed only in some indoor areas, no rules or restrictions, and others.
- Cigarettes smoked per day (1–10, 11–20, 21–30, 31+, only used in the analysis of smokers)

Weighting procedures

Sampling weights were constructed to provide the best possible prevalence estimates. The weights were constructed separately for male adult smokers, female adult smokers, and adult non-smokers.

Table 2 Sample characteristic, belief about the harm of secondhand smoke (SHS) of the ITC China baseline respondents

	Smokers	**Non-smokers**
	No (%)	**No (%)**
City		
Beijing	804 (16.7)	219 (17.2)
Shenyang	801 (16.6)	200 (15.8)
Shanghai	801 (16.6)	204 (16.1)
Changsha	803 (16.7)	205 (16.1)
Guangzhou	804 (16.7)	227 (17.9)
Yinchuan	802 (16.7)	215 (16.9)
Gender		
Male	4570 (94.9)	528 (41.6)
Female	245 (5.1)	742 (58.4)
Age (years)		
18–34	473 (9.9)	201 (15.9)
35–44	1162 (24.2)	264 (20.8)
45–54	1648 (34.3)	355 (28.0)
55 or older	1519 (31.6)	448 (35.3)
Ethnic group		
Han	4575 (95.0)	1192 (93.9)
Others	240 (5.0)	78 (6.1)
Highest education		
Low	629 (13.1)	152 (12.0)
Middle	3147 (65.5)	752 (59.2)
High	1032 (21.5)	366 (28.8)
Household income		
Low	942 (19.6)	238 (19.0)
Middle	2158 (44.9)	595 (47.6)
High	1361 (28.3)	343 (27.4)
Don't know	350 (7.3)	75 (6.0)
Believe smoking causes lung cancer in non-smokers from SHS		
No/don't know	2231 (46.4)	236 (18.6)
Yes	2577 (53.6)	1032 (81.4)
Total	4815	1270

Numbers are unweighted results.

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Wave 1 weights were constructed by taking into account the four levels of sample selection: Jie Dao, Ju Wei Hui, household and individual. The final weight for a sampled individual was the number of people in the city population and the sampling category represented by that individual. A full description of the weighting methodology is available at http://www.itcproject.org. All results reported in this paper are weighted statistics unless otherwise noted.

Statistical analyses

SPSS for Windows version 13.0 was used for all analyses. The percentages of respondents who support comprehensive smoke-free policies in different venues were computed. Multivariate logistic regression models were developed to examine factors associated with comprehensive smoke-free policies. The analyses were conducted with the SPSS complex samples module to account for the possible nested effects within cities. All the analyses were stratified by smoking status.

RESULTS

Table 2 describes the sample characteristics and the belief about the adverse health effects of SHS. The majority (94.9%) of the smoking respondents are male, but among non-smokers, females represented a majority of the sample. More than 30% of the study respondents were aged 55 years or older. Over 90% of both non-smokers and smokers belonged to the Han ethnic group. A key group difference was noted for knowledge of SHS effects—53.6% of the smokers and 81.4% of the non-smokers endorsed the belief that SHS causes lung cancer in non-smokers.

Figure 2 shows the percentages of support for comprehensive smoke-free policies in different venues among smokers and non-smokers. Smokers' support is highest for public transportation vehicles (93.6%) and schools (93.5%), followed by hospitals (73.7%), conference rooms (73.4%), workplaces (42.8%) and restaurants or bars (21.3%). Non-smokers' support tends to be higher than smokers, but shows similar patterns.

Tables 3 and 4 show the results of logistic regression models predicting support for total smoking bans in workplaces (table 3) and restaurants/bars (table 4), the two venues with the lowest support level for total smoking ban. Several factors were associated with support for total ban in both venues. For example, knowledge about the adverse health effects of SHS was positively associated with smokers' support for total ban in both venues and non-smokers' support for total ban in restaurants/bars. Older and lighter smokers were more likely to support smoke-free policies in these two venues compared with younger and heavier smokers. Self-reported smoking rules at workplaces were associated with support for total ban at workplaces among both smokers and non-smokers. Compared to respondents who work at places without restrictions on smoking, those who work at places with total a smoking ban were more likely to support total ban. Similarly, self-reported smoking rules in indoor entertainment places that the respondents go to most often were also associated with support for a total ban in restaurants and bars among smokers. Respondents who went to indoor entertainment venues with total smoking bans were more likely to support total ban in restaurants or bars. Several factors differed in terms of the association with support for total ban in the two venues. Female smokers were more likely to support total smoking ban in workplaces, but this association only showed borderline significance for restaurants or bars (OR = 1.61, 95% CI 0.99 to 2.59). With regard to the differences between cities, smokers and non-smokers in Yinchuan were more likely to support a total ban in workplaces than those in Beijing; while for restaurants or bars, smokers in Shenyang and non-smokers in Guangzhou were more likely to support total ban compared to those in Beijing.

DISCUSSION

This study is the first to examine the support for smoke-free policies in different venues among urban residents in China. The major findings of the current study include: (1) in the six cities, support for total smoking ban in schools, public transportation vehicles, hospitals, and conference rooms was relatively high among both smokers and non-smokers, while support for total a ban in workplaces, restaurants and bars was present in a sizeable minority of respondents; (2) knowledge about the adverse health effects of SHS and the presence existing smoke-free policies was associated with increased support for a total smoking ban in workplaces, restaurants and bars.

Studies in other countries suggest that support for bans was strongest for those with bans already in place.[11] In other words,

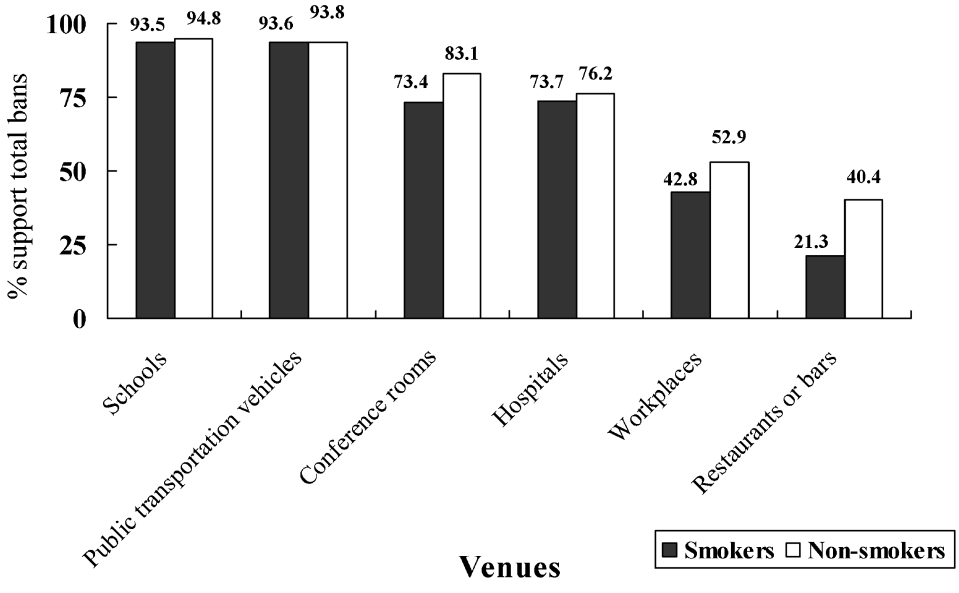

Figure 2 Support for total smoking bans in different venues among smokers and non-smokers in six cities in China. Notes: National level smoke-free laws are in place for schools, public transportation vehicles, conference rooms and hospitals. No national laws restrict smoking in workplaces, restaurants and bars. According to the local smoke-free laws in the six cities, smoking is allowed in workplaces, restaurants and bars except that Guangzhou bans smoking in workplaces and restaurants with air conditioning.

Table 3 Results of multivariate logistic regression models predicting support for total smoking ban at workplaces

	Smokers		Non-smokers	
	% support total ban	OR (95% CI)	% support total ban	OR (95% CI)
City				
Beijing	44.3	Referent	52.0	Referent
Shenyang	45.7	1.11 (0.73 to 1.71)	52.4	1.05 (0.58 to 1.92)
Shanghai	35.0	0.65 (0.48 to 0.88)	49.5	0.82 (0.47 to 1.43)
Changsha	36.5	0.78 (0.52 to 1.18)	44.9	0.69 (0.41 to 1.16)
Guangzhou	40.2	0.81 (0.59 to 1.10)	53.8	1.08 (0.61 to 1.91)
Yinchuan	55.4	1.90 (1.32 to 2.74)	64.3	1.78 (1.00 to 3.18)
Gender				
Male	42.0	Referent	51.2	Referent
Female	62.6	2.20 (1.34 to 3.60)	54.3	1.22 (0.93 to 1.62)
Age (years)				
18–34	36.0	Referent	50.6	Referent
35–44	39.1	1.23 (0.93 to 1.64)	56.5	1.06 (0.67 to 1.69)
45–54	44.0	1.64 (1.20 to 2.26)	47.8	0.82 (0.49 to 1.37)
55 or older	46.8	1.88 (1.42 to 2.50)	55.7	1.13 (0.67 to 1.91)
Ethnic group				
Han	42.9	Referent	52.7	Referent
Others	40.2	0.61 (0.41 to 0.92)	55.6	0.77 (0.41 to 1.46)
Highest education				
Low	47.4	Referent	59.3	Referent
Medium	42.6	1.01 (0.77 to 1.32)	52.0	0.86 (0.54 to 1.37)
High	40.5	0.91 (0.65 to 1.28)	52.2	0.85 (0.50 to 1.46)
Household income				
Low	45.4	Referent	54.3	Referent
Medium	42.5	0.92 (0.74 to 1.15)	52.9	0.92 (0.61 to 1.39)
High	41.5	1.03 (0.78 to 1.34)	52.1	0.94 (0.57 to 1.57)
Don't know	43.6	1.11 (0.78 to 1.58)	55.1	0.94 (0.42 to 2.11)
Believe smoking causes lung cancer in non-smokers from SHS				
No/don't know	39.9	Referent	53.0	Referent
Yes	45.2	1.27 (1.09 to 1.49)	52.8	0.93 (0.66 to 1.31)
Self-reported smoking rules at workplaces				
No rules or restrictions	36.2	Referent	39.4	Referent
Smoking is allowed only in some indoor areas	31.3	0.89 (0.65 to 1.22)	37.3	0.87 (0.45 to 1.70)
Smoking is not allowed in any indoor areas	61.1	3.10 (2.23 to 4.29)	69.3	3.60 (2.23 to 5.82)
Others	43.5	1.32 (1.03 to 1.70)	53.6	1.68 (1.01 to 2.79)
Number of cigarettes smoked per day				
1–10	46.1	Referent	Not included in the model	
11–20	42.0	0.95 (0.76 to 1.17)		
21–30	35.6	0.75 (0.56 to 0.99)		
31 or more	39.4	0.91 (0.65 to 1.28)		

SHS, secondhand smoke.

despite some initial scepticism among the public, once they experience the benefits of smoke-free places they grow to adapt and support these policies. Two findings of the current study add evidence to this. First, we found that support for total smoking ban was high for venues covered by smoke-free policies in most cities, such as schools, public transportation vehicles, hospitals and conference rooms; in comparison, for workplaces, restaurants and bars where most cities had no restrictions on smoking, support for total ban was lower. Second, we found that if respondents' workplaces or the indoor entertainment places that the respondents go most often had total smoking bans in place, they would be more likely to support total ban in these venues. These findings, combined with previous study results, suggest that comprehensive smoke-free policies grow in their popularity over time. Once implemented, smoke-free policies are likely to get extensive support from the public, even if the policy didn't get high levels of public support before it was implemented. For example, before Ireland made the national level comprehensive smoke-free law in 2004, support for total smoking ban in bars among Irish smokers was only 13%; while one year after the law was enforced, the number increased to 46%.[13] In this study, 21.3% of the smokers in the six cities support total smoking ban in restaurants or bars (much higher than support among Irish smokers before the Ireland smoke-free policy). Therefore, although this study shows that support for total smoking ban in workplaces, restaurants and

Table 4 Results of multivariate logistic regression models predicting support for total smoking ban in restaurants or bars

	Smokers		Non-smokers	
	% support total ban	OR (95% CI)	% support total ban	OR (95% CI)
City				
Beijing	24.5	Referent	33.8	Referent
Shenyang	27.6	1.37 (1.01 to 1.86)	32.6	1.09 (0.65 to 1.83)
Shanghai	15.7	0.73 (0.50 to 1.06)	48.5	1.88 (0.94 to 3.76)
Changsha	20.6	0.99 (0.67 to 1.46)	37.0	1.47 (0.90 to 2.42)
Guangzhou	20.2	0.94 (0.67 to 1.32)	49.0	2.20 (1.23 to 3.96)
Yinchuan	19.3	0.93 (0.66 to 1.32)	41.3	1.52 (0.86 to 2.67)
Gender				
Male	20.7	Referent	42.2	Referent
Female	37.6	1.61 (0.99 to 2.59)	38.9	0.90 (0.68 to 1.18)
Age (years)				
18–34	14.6	Referent	27.2	Referent
35–44	20.0	1.46 (0.95 to 2.25)	36.5	1.62 (0.93 to 2.81)
45–54	20.5	1.55 (1.06 to 2.26)	39.5	1.83 (1.08 to 3.09)
55 or older	25.8	1.85 (1.19 to 2.90)	48.4	2.33 (1.41 to 3.86)
Ethnic group				
Han	21.2	Referent	40.8	Referent
Others	23.2	1.05 (0.62 to 1.78)	32.9	0.63 (0.33 to 1.24)
Highest education				
Low	27.4	Referent	43.5	Referent
Medium	21.2	0.85 (0.61 to 1.18)	41.2	1.11 (0.67 to 1.86)
High	18.5	0.70 (0.44 to 1.13)	38.0	1.15 (0.62 to 2.14)
Household income				
Low	22.7	Referent	41.7	Referent
Medium	22.5	0.99 (0.77 to 1.29)	39.2	0.89 (0.58 to 1.36)
High	18.8	0.94 (0.63 to 1.39)	44.4	1.03 (0.62 to 1.69)
Don't know	20.2	1.01 (0.69 to 1.49)	34.9	0.65 (0.31 to 1.36)
Believe smoking causes lung cancer in non-smokers from SHS				
No/don't know	17.3	Referent	32.8	Referent
Yes	24.6	1.56 (1.18 to 2.06)	42.0	1.60 (1.11 to 2.31)
Self-reported smoking rules in indoor entertainment places that the respondents go most often				
No rules or restrictions	15.5	Referent	32.2	Referent
Smoking is allowed only in some indoor areas	21.9	1.56 (1.18 to 2.07)	33.0	1.05 (0.68 to 1.62)
Smoking is not allowed in any indoor areas	39.6	3.23 (2.25 to 4.64)	61.6	3.05 (2.04 to 4.57)
Others	27.4	1.82 (1.43 to 2.30)	47.8	1.98 (1.31 to 3.00)
Number of cigarettes smoked per day				
1–10	25.6	Referent	Not included in the model	
11–20	19.7	0.76 (0.63 to 0.92)		
21–30	15.7	0.56 (0.38 to 0.84)		
31 or more	19.4	0.80 (0.54 to 1.17)		

SHS, secondhand smoke.

bars was relatively low among urban residents in China, it does not necessarily mean that China cannot enforce comprehensive smoke-free policies in these venues. On the contrary, the results of this study suggest that, like smokers in other countries, Chinese smokers are likely to adapt to and even eventually support smoking bans.

Knowledge about the adverse health effects of SHS is associated with support for total smoking ban in workplaces, restaurants or bars. This is consistent with previous studies.[11] In the present study, only 53% of the smokers knew that SHS causes lung cancer, which is lower than in Western countries. For example, in the ITC four-country survey conducted in 2002, this statistics was 76.9% in Canada, 82.6% in the United States, 82.2% in United Kingdom and 72.1% in Australia. There is still room to increase Chinese urban smokers' knowledge level about the health harm of SHS. We should educate the public knowledge about SHS as this may increase public support for smoke-free policies.

Differences between cities do not show a consistent pattern. One might have predicted that the highest levels of support for smoke-free bars and restaurants to be found in Guangzhou, where partial smoking restrictions were in place at the time the survey was conducted; however, this association was only observed among non-smokers. This may be attributed to the

weak nature of the Guangzhou smoke-free policy. The Guangzhou smoke-free law is not comprehensive and exceptions are allowed in restaurants, and the enforcement of the law is also limited.[9] Such a policy may only have very limited effects. Therefore, the Guangzhou public doesn't truly experience a complete smoke-free environment. This finding indicates that a partial smoking ban may be ineffective and not as popular as comprehensive smoke-free laws in other countries.

We found some age and gender differences in this study. Generally, older people were more likely to support smoke-free policies in workplaces, restaurants or bars, a finding consistent with previous studies. Female smokers were more likely to support total smoking ban in workplaces, restaurants or bars, which is inconsistent with findings by Borland *et al*.[11] One possible interpretation is the cultural differences between China and Western countries. However, because the number of female smokers is very small in this study, further studies with larger sample size of female smokers are needed to verify this finding. Heavier smokers are less likely to support comprehensive smoke-free policies. Future research is needed from longitudinal samples to determine whether the support for smoke-free policies in these population changes over time and what factors drive those changes.

The strengths of the current study include a large sample size, a representative sample of smokers and non-smokers in each city, and the multi-city design which allows us to do comparisons among cities. There are several limitations in the study. First, the study was conducted in only six Chinese cities. The study sample is not representative of the whole Chinese population, and the results cannot be generalised to the national level. The rural population, which represents 54.3% of the total population in China, was not examined in this study. Perhaps a similar study conducted in rural areas of China can help address this limitation. Second, because older people were more likely to be at home and to cooperate with the investigation, this study slightly oversampled older respondents, which may result in biased estimates. However, the weighting procedure used in the analyses may help reduce the bias. Third, because of the cross sectional feature of the baseline data, this study is not able to make causal links. Fourth, the cooperation rate and the response rate vary among cities. The reason might be the differences in culture and economic levels. It is not clear whether and how those who refused to participate in the study differ from those who completed the survey, and this may generate bias in the results. Lastly, there are minor differences among surveys in different countries, which made some comparison among countries hard to do. For example, the ITC China Survey asked for respondents' attitudes towards smoking ban in ''restaurants or bars'', while the ITC surveys in other countries asked about restaurants and bars separately.

CONCLUSION

Considerable support for smoke-free policies was observed in six cities in China. The current study suggests that smoke-free policies are popular. Once smoke-free policies are implemented, both smokers and non-smokers adapt and support these policies. The level of public knowledge about the adverse health effects of SHS was associated with support for smoke-free policies. The opportunity is ripe for public education to further boost awareness of SHS and support for smoke-free policies in China.

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Cigarettes sold in China: design, emissions and metals

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ABSTRACT

Background China is the home to the world's largest cigarette maker, China National Tobacco Company (CNTC), yet little is known publicly about the design and emissions of Chinese cigarettes. CNTC is currently in the process of consolidating its brands and has ambitions to export its cigarettes. Machine-measured tar yields of many of its cigarette brands have also been reduced, similar to what occurred in Western countries from the 1970s through the 1990s with so-called 'low-tar' cigarettes introduced to address consumer concerns about health risks from smoking.

Method The current study examines the design and physical characteristics, labelled smoke emissions and tobacco metals content of leading brands of Chinese cigarettes from seven cities purchased in 2005—6 and in 2007.

Results Findings suggest that similar to most countries, tar levels of Chinese cigarettes are predicted primarily by tobacco weight and filter ventilation. Ventilation explained approximately 50% of variation observed in tar and 60% variation in carbon monoxide yields. We found little significant change in key design features of cigarettes purchased in both rounds. We observed significant levels of various metals, averaging 0.82 μg/g arsenic (range 0.3—3.3), 3.21 μg/g cadmium (range 2.0—5.4) and 2.65 μg/g lead (range 1.2—6.5) in a subsample of 13 brands in 2005—6, substantially higher than contemporary Canadian products.

Conclusion Results suggest that cigarettes in China increasingly resemble those sold in Western countries, but with tobacco containing higher levels of heavy metals. As CNTC looks to export its product around the world, independent surveillance of tobacco product characteristics, including tobacco blend characteristics, will become increasingly important.

INTRODUCTION

Approximately 57% of adult males and 3% of adult females in China smoke.[1] The WHO estimates tobacco-related diseases currently kill one million Chinese smokers each year,[2] with substantial increases expected in the coming years. China is increasingly a target market for multinational tobacco companies given its large population and high smoking rates.[3] *Tobacco Journal International* recently pointed to China as '… the only area of the world that the industry can look on with any degree of optimism.'[4] However, multinational brands have yet to gain substantial market share within China. China's domestic market is instead dominated by a state monopoly, and the world's largest tobacco company (by sales volume), the China National Tobacco Company (CNTC), which is overseen by the State Tobacco Monopoly Administration (STMA). Thirty-one independent cigarette factories operate in China under the direction of CNTC and STMA.[5] STMA has undertaken a plan of modernisation, which includes brand and manufacturing consolidation, aiming to create about 10 large tobacco manufacturing enterprises under CNTC. As part of this modernisation, the number of cigarette brands in China has dropped from 1181 in 2000 to 173 in 2007,[4] further dropping to 154 as of October 2008.[6] The goal is to create larger brand families with national and potentially international markets as opposed to locally popular varieties.[4 5]

As part of the CNTC modernisation strategy, efforts are under way to reduce tar levels under machine testing. In April 2006, a cap of 15 mg of tar was implemented, with a reported national average machine yield of 13.2 mg, as measured by the ISO method.[4] Lower tar (<10 mg) varieties account for about 2% of the market,[4] probably due to a lack of demand and limited competition from foreign brands.[7] However, the publicly stated goal of the tar level reduction is to reduce harm caused by smoking,[8 9] which raises the spectre of the low-tar cigarette debacle experienced by Western countries from the 1970s to the 1990s.

Reductions in tar levels to meet the newly adopted 15 mg tar yield ceiling have primarily been achieved through design modification, most prominently increasing filter ventilation, which has the effect of reducing the amount of smoke collected using the ISO machine smoking protocol. It is well established that the ISO regimen is not representative of human smoking patterns and that values obtained from smoking machines cannot be used to distinguish health risks associated with different brands.[10–14] Nevertheless, tar, nicotine and carbon monoxide emission from the ISO test are required by law to be printed on packs in China. It is increasingly recognised that these numbers are not valid indicators of health risk and can actively mislead consumers.[11–13] Indeed, Article 11 of the WHO Framework Convention on Tobacco Control (FCTC) has recommended the removal of tar and nicotine numbers from packages.[15]

There are few published reports on the design characteristics of cigarettes sold in China. Chen and colleagues reviewed news reports about herbal-tobacco cigarettes in China, which claimed health benefits but for which supporting data were difficult to locate.[16] Akpan and colleagues[17] reported the levels of polycyclic aromatic hydrocarbon levels

in Chinese cigarettes purchased in 2003–4 when smoked under the ISO regimen. Tar yields ranged from 6.3 mg/cigarette to 17.4 mg/cigarette, and benzo[a]pyrene (BaP) levels from 5.8 mg/cigarette to 14.2 ng/cigarette. The reported BaP levels were 2–7 times higher than contemporary cigarettes from the European Union. But the authors did not report physical characteristics or design features of the tested cigarettes, such as tobacco weight or filter ventilation, which would have a strong influence on observed BaP levels. Such measurements are critically important for understanding variability in TNCO yields across brands; in particular, filter ventilation can explain virtually all of the inter-brand variability in tar levels.[18 19]

In order to better understand the emerging epidemic of tobacco-caused illness in China and globally, given CNTC's role as the largest producer of cigarettes in the world, data on the changing design and emission characteristics of Chinese cigarettes are needed (eg, Geoffrey T, Fong, Yuan Jiang, *et al*. Introduction to the International Tobacco Control Policy Evaluation Project in China (ITC China Project). Tobacco Control, unpublished). This paper presents data on the physical characteristics, tobacco contents and selected smoke emissions of popular cigarette brands manufactured and sold in seven cities in China during 2005–6 and 2007. We addressed two main research questions: (1) how do the design and emission characteristics of Chinese cigarettes compare to those of established international brands; and (2) to what extent did the design and emission characteristics of Chinese cigarettes change between 2005–6 and 2007, if at all?

METHODS

Data for this study come from cigarettes purchased in China initially from December 2005 to March 2006 (2005–6), and again in October–December 2007 (2007). Cigarettes were purchased at typical retail locations in seven cities in China (Beijing, Changsha, Guangzhou, Shanghai, Shenyang, Yinchuan, Zhengzhou). In each city, a list of target brands was created and one carton of each brand was purchased at each of three distinct retail locations. In 2006, 65 target domestic brands were identified from local investigator knowledge of popular brands available at retail. In 2007, 28 leading domestic brands were identified by self-report data obtained from Wave 1 of the ITC China Survey.[20] While some imported varieties were also purchased (eg, Marlboro, State Express 555, Mild Seven), the current discussion focuses on domestic cigarette varieties. The tested brand varieties are listed in table 1. All cigarettes were shipped to the Tobacco Research Laboratory at Roswell Park Cancer Institute (RPCI) via overnight courier and stored unopened at −20°C until analysis.

Characteristics

Cigarette physical and design characteristics were assessed on all products using methods described previously.[18 19] Prior to analysis, the cigarettes tested were stored in a freezer at −20°C. The packs were conditioned for a minimum of 48 hours at 22°C±2.0°C and 60%±2.0% relative humidity in an environmental chamber per ISO. For a single brand, five cigarettes were randomly selected for each assay and the data averaged together. Physical measures were taken using digital callipers, including cigarette length and diameter, filter length, length of the tipping paper, distance to any areas of filter ventilation and the length of the tobacco rod. Filter weight measurements were made using a Mettler-Toledo analytical balance. The moisture and weight of tobacco was then analysed using an HR83 Moisture Analyser (Mettler-Toledo, Ohio, USA). The moisture content was determined as the percentage change in weight after heating the tobacco from five cigarettes with a halogen bulb at 125°C until an asymptote was reached. Weight is reported as the average of tobacco from five cigarettes prior to drying. The level of permeability of each cigarette paper was also examined using a PPM1000M paper porosity device (Cerulean, Milton-Keynes, UK) using the vacuum method. Lastly, the measurements of the cigarette filter ventilation and pressure drop were taken using a KC3 combined dilution/pressure drop instrument (Borgwaldt-KC, Richmond, Virginia, USA). For consistency, all products were tested contemporaneously and laboratory analysis was completed in April 2009.

Emissions

Values of tar, nicotine and CO (where available) as reported on packs were recorded for all products. These are ostensibly measured using the ISO testing regimen (ISO 3308),[i] in which 35 ml puffs of 2-second duration are drawn from the cigarette every 60 seconds until a fixed butt length is reached.

Metals concentration

A randomly selected subsample of 2006 brands (n=13) was tested for trace metals in unburned tobacco using polarised energy dispersive x-ray fluorescence[21] at St Andrews University in October–November 2007. In brief, tobacco extracted from about 20 cigarettes was dried and powdered. Two pressed pellets, each of about 6 g, were analysed quantitatively for several heavy metals and other trace elements on a Spectro XLAB using calibrations based on a wide range of reference standards including foliage materials. A more complete description with data on detection limits, etc, is published elsewhere.[22]

Statistical analysis

Analysis of data was conducted using SPSS 14.0. Brands that were not repeatedly sampled in each year were compared by Mann-Whitney U tests to account for differences in variance between samples. Repeatedly sampled brands (n=15) were compared via Wilcoxon signed rank tests. Averages of tested Chinese brands were compared to previously published data using t tests based on means and standard deviations. Relations between measured physical and design parameters and TNCO emissions were examined via stepwise linear regression, with an indicator variable for year of purchase was forced first into the model. Stepwise entry of other potential predictors used p value criteria of 0.10 and 0.15 for entry and removal, respectively, to be inclusive of features that might have small overall roles.

RESULTS

Product characteristics

Table 1 presents the per-brand values for ventilation, paper permeability, tobacco weight and rod and filter densities. Mean values for the products purchased in each year are presented in table 2. Comparing those brands purchased at both rounds (n=15) very few significant differences are evident. The 2007 versions of these products were slightly longer (apparently mostly attributed to longer tobacco rods), and had slightly higher packing density, but slightly lower moisture content.

Table 3 presents comparisons of the Chinese market cigarettes (combining both sets, but including only the 2007 purchase of repeated brands) to two published sources of cigarette characteristics data. The study by O'Connor and colleagues[19]

[i] http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=28325.

Table 1 Chinese brands examined in the current study with selected physical and design characteristics reported, 2005–7

Brand	Descriptor	UPC	Tobacco weight (mg)	Filter density (mg/ml)	Rod density (mg/ml)	Paper permeability (CORESTA)	Ventilation (%)
Baisha	Blue	191098	660.4	109.2	251.5	53.6	0.0
Baisha	Combination	191838	693.4	116.9	258.5	52.0	0.0
Baisha	Environmental protection	191432	681.4	114.3	258.2	49.0	0.3
Baisha	Red, soft, treasure	192545	693.4	116.7	263.3	50.8	0.0
Baisha	Silver lid	191500	690.6	111.8	240.2	52.0	0.0
Baisha	White lid	191029	714.2	113.8	244.9	34.9	0.0
Changzheng	Red hard pack	038638	678.2	115.7	241.6	53.9	2.5
Chunghwa	Lights red	075794	751.2	114.0	246.7	52.0	20.9
Cocopalm	Blue	002097	693.2	114.9	235.6	47.9	2.0
Cocopalm	Green	002752	676.4	116.4	229.7	47.1	0.1
Cocopalm	Red	002233	715.0	114.0	255.4	78.5	2.5
Daqianmen	Soft pack	075916	728.6	117.2	248.0	55.8	3.9
Derby	King size, tan	132268	676.8	118.9	236.5	57.2	22.1
Derby	White, soft pack	126021	669.2	117.8	256.7	45.9	0.0
Diaoyutai	Soft	326391	681.2	114.5	246.1	26.5	11.9
Dihao	Golden hard	170765	687.2	120.4	240.2	46.8	0.5
Double happiness	Elite	075602	752.8	113.3	255.9	27.4	21.9
Double happiness	Lights green	075978	703.2	106.3	246.2	54.9	17.0
Double happiness	Low tar	075824	726.8	107.1	250.1	52.8	20.7
Double happiness	Regular	075800	737.8	117.9	243.1	51.6	2.8
Double happiness	Soft	075817	730.4	113.1	237.9	57.3	3.6
Double happiness	Super aromatic	75831	633.0	114.3	230.4	57.4	23.5
Furong Xiangyan	Soft, gold	199414	699.6	121.0	244.9	38.1	2.2
Furongwang	Masterwork	193856	660.4	84.3	255.6	52.2	0.1
Furongwang	Yellow, lid	193498	729.0	122.3	248.8	52.6	0.9
Golden leaf	Light of the century	161145	693.8	112.2	239.8	43.2	0.1
Good fortune	Light red	050371	634.2	112.8	237.1	51.5	0.3
Happiness	King size, red	050678	698.6	119.5	246.9	54.5	1.7
Hatamen	Aromatic	149358	666.8	106.9	244.8	68.6	3.4
Honghe	Lid	055048	637.4	114.9	240.8	52.6	0.2
Honghe	Soft	055024	640.0	115.0	252.0	57.9	0.6
Hongjinlong	Dance of the fire	180177	657.4	112.7	239.3	58.5	0.7
Hongjinlong	Hard	179416	695.6	113.9	237.9	57.2	0.9
Hongmei	Red super aromatic	317610	679.8	114.2	248.5	38.8	19.5
Hongmei	White	315098	640.6	119.4	241.5	61.0	0.4
Hongmei	Yellow lid	314145	690.2	111.4	256.6	57.0	0.1
Hongmei	Yellow soft	048125	689.2	111.9	254.0	52.7	0.2
Hongqiqu	Gold elite	164511	661.4	109.5	248.4	64.8	0.8
Hongqiqu	Light of the milkyway	164542	645.4	118.2	246.4	55.1	14.2
Hongqiqu	Silver, special 1st class	164375	639.8	111.8	239.2	64.3	0.9
Hongtashan	Gold	314015	676.6	117.1	246.7	37.5	32.6
Hongtashan	Red platinum	317450	688.2	111.9	247.4	59.6	18.5
Hongtashan	Regular, red	316156	666.8	110.9	242.7	38.3	13.3
Hongtashan	Yellow	048231	687.2	113.8	253.6	37.2	29.3
Houwang	Hard	058032	668.4	114.1	252.3	57.1	1.0
Jinmanggou	Green	166041	661.6	116.9	252.3	67.5	0.0
Jinxuchang	Yellow soft	162012	685.4	110.3	227.4	46.5	1.2
LanLing	Green	091794	670.8	118.4	257.7	40.5	0.2
LanLing	Yellow	091176	691.8	112.8	248.2	54.1	1.5
Lesser Panda	Black soft	337168	720.6	112.4	245.7	53.5	16.6
Liqun	Hard	118170	711.4	119.2	252.9	56.4	2.8
Liqun	Long filter	118811	583.4	111.1	225.9	45.8	0.0
Mellow Furong	Yellow	193818	684.2	113.6	233.3	39.1	0.0
Peony	Filter kings- red	075855	665.6	112.2	225.5	56.7	5.8
Peony	Red	075589	698.6	115.6	229.1	61.7	0.4
Peony	Red, soft pack	075862	710.2	119.2	261.8	61.1	4.0
Peony	White	076012	714.6	117.9	242.2	58.0	4.3
Pingtan	Red	069427	655.2	113.1	238.7	53.7	0.1
Pingtanxian Gyan	White	069205	700.2	120.2	259.7	62.0	0.5
Pride	Black, multi-coloured print	025577	729.4	104.9	258.2	56.9	0.4
Sanhua	Blue	160018	668.6	111.0	218.2	39.9	1.0
Shanghai		075848	748.6	116.7	247.3	57.4	4.6

Continued

Table 1 Continued

Brand	Descriptor	UPC	Tobacco weight (mg)	Filter density (mg/ml)	Rod density (mg/ml)	Paper permeability (CORESTA)	Ventilation (%)
Shuangxi	Classic hard pack	000642	690.6	117.9	239.3	41.9	0.5
Shuangxi	Soft pack	001489	698.2	114.9	228.2	48.7	1.1
State Guests	Black, lights	052504	719.2	113.0	250.3	55.3	0.3
Stone Forest	White	050883	656.2	120.3	235.1	48.8	1.3
The Scarlet Camellia	Purple	310192	738.0	122.3	257.3	74.6	0.3
The Scarlet Camellia	Red	045605	728.6	125.3	256.0	63.0	0.7
Yizhibi	Hard	149396	688.0	102.6	248.0	62.5	0.9
Yun Yan	Regular (purple)	046886	647.6	119.2	243.2	58.4	0.6
Yun Yan	Regular (white)	045636	649.2	117.2	236.5	68.4	1.1
Yun Yan	Regular, red	045575	705.8	113.7	239.0	67.4	1.6
Yun Yan	Treasure	045902	713.6	114.6	238.1	61.1	0.2
Zhongnanhai	Herb Blend Regular[10]	071284	648.4	109.9	210.8	60.0	27.8
Zhongnanhai	Herb Blend- Regular[8]	071499	600.0	114.9	218.8	56.4	26.5
Zhongnanhai	Red, regular, hard	072038	722.0	114.2	238.9	52.2	11.8
Zhongnanhai	White, hard[3]	071673	591.2	117.8	216.8	58.3	59.2
Zhongnanhai	White, hard, colourful[8]	071765	577.2	109.9	208.5	57.0	25.0

examined characteristics of cigarettes sold in the USA, UK, Canada and Australia in 2005, while the study by Counts and colleagues[23] reported limited design information on Philip Morris international brands in 2004. As one can see the Chinese cigarettes are substantially different on a number of parameters, most notably filter ventilation, but also rod length, tobacco weight, rod and filter density, and paper permeability.

TNCO emissions and design

We examined the relation of the measured design features to labelled emissions of tar, nicotine and CO in the 78 unique varieties of Chinese cigarettes using stepwise linear regression. Results are shown in table 4. Prediction of tar yields involved a number of parameters, with ventilation making the largest single contribution to variation in yields (over 57% of variance), and parameters such as filter weight and paper permeability making minor contributions. The total model had an adjusted R^2 of 0.721, suggesting that the majority of variation in tar could be explained by the included parameters. Nicotine yielded a less complex model, with ventilation again serving as the largest predictor (40% of variance), with tobacco weight and filter length serving as significant contributors. However, the overall adjusted R^2 for this model was 0.472, suggesting that half the variation in nicotine yields could be explained by unmeasured parameters. Finally, for CO, the major contributors were ventilation and paper permeability, together explaining 49.3% of variation in CO yields. Design features not listed did not contribute significantly to the respective prediction model (p values >0.20).

Metals in unburned tobacco

Overall, as depicted in figure 1, the levels of metals of health concern (Cr, As, Cd, Pb) varied considerably among brands. The tested Chinese brands averaged 0.55 μg/g Cr (range 0.0–1.0), 0.78 μg/g As (range 0.3–3.3), 3.24 μg/g Cd (range 2.0–5.4) and 2.54 μg/g Pb (range 1.2–6.5). figure 2 presents comparison data from the Canadian market in 2004 (see Hammond and O'Connor for more details[24]) indicating that levels of Cr are comparable to Canadian brands (though statistically significantly different, p values <0.02 by t test), but that levels of As, Cd and Pb are substantially (2–3-fold) higher (p values <0.0001).

Table 2 Mean physical characteristics of Chinese brands tested in both 2005–6 and 2007

	Independent samples		Repeat samples (n=15)	
	Mean (SE)		Mean (SE)	
	2005–6 (n=50)	2007 (n=13)	2005–6	2007
Labelled tar (mg/cigarette)	13.9 (0.31)	12.9* (0.57)	13.5 (0.5)	12.9‡ (0.5)
Labelled nicotine (mg/cigarette)	1.13 (0.02)	1.12 (0.04)	1.07 (0.04)	1.08 (0.04)
Labelled CO‡ (mg/cigarette)	13.4 (0.55)	13.8 (0.55)	12.9 (0.5)	12.9 (0.4)
Cigarette length (mm)	83.8 (0.02)	83.7 (0.04)	83.6 (0.06)	83.9‡ (0.03)
Rod diameter (mm)	7.6 (0.02)	7.6 (0.03)	7.6 (0.05)	7.6 (0.03)
Tipping paper length (mm)	29.4 (0.40)	28.5 (0.58)	28.2 (0.65)	28.4 (0.67)
Tobacco rod length (mm)	61.4 (0.40)	62.3 (0.62)	61.4 (0.66)	62.4‡ (0.63)
Filter length (mm)	22.0 (0.54)	20.2* (1.1)	22.0 (0.64)	21.8 (0.67)
Filter weight (mg)	115.8 (2.68)	107.3 (6.2)	114.6 (4.7)	114.6 (3.1)
Paper permeability (CORESTA units)	52.7 (1.40)	52.3 (1.88)	49.5 (0.70)	52.9 (0.90)
Pressure drop (mmwg)	107.0 (1.61)	115.9*(2.74)	119.0 (3.2)	112.9 (2.6)
Ventilation (%)	7.3 (1.67)	4.9 (2.74)	5.9 (2.0)	4.6 (1.8)
Tobacco weight (mg)	684.2 (5.57)	675.2 (9.19)	680.0 (7.9)	687.1 (8.4)
Filter density (mg/ml)	113.9 (0.84)	116.3 (1.01)	113.1 (1.19)	113.7 (1.10)
Rod density (mg/ml)	244.6 (1.62)	239.2 (4.03)	239.1 (2.14)	242.0†(2.32)
Moisture (%)	19.1 (0.16)	18.3 (0.45)	19.0 (0.21)	18.3‡ (0.30)

*p<0.05 by Mann-Whitney test.
†p<0.05 by Wilcoxon signed rank test.
‡p<0.01 by Wilcoxon signed rank test.

Table 3 Mean (SD) of physical characteristics of cigarettes from different studies

	China (current study)		O'Connor *et al* (2008)[18]		Counts *et al* (2005)[22]	
Parameter	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
No tested	78		172		48	
Pressure drop	109.6*	11.4	98.6	15.3	NR	
Ventilation	6.4* †	10.7	37.8	21.6	37.3	22.1
Tobacco rod length	61.7*	2.6	59.9	3.3	NR	
Tipping paper length	28.9	2.6	28.2	3.1	NR	
Tobacco weight	683.3*	36.9	640.0	79.1	679.0	86.8
Rod density	243.2*	11.7	229.1	23.7	NR	
Filter density	114.2*	5.3	122.2	10.9	NR	
Paper permeability	53.3†	9.6	NR		45.0	16.5

*significantly different from O'Connor *et al*[18] at $p<0.0001$ by t test.
†significantly different from Counts *et al*[22] at $p<0.001$ by t test.
NR, not reported.

DISCUSSION

The current paper examined the variation in design features in contemporary Chinese cigarettes and their relation to reported ISO emissions, as well as tobacco metal contents in a subsample of popular cigarette brands purchased in seven cities in China in 2005–6 and 2007. The physical and design characteristics of Chinese domestic cigarettes were broadly similar to manufactured cigarettes examined in international samples.[19 23 25] However, they did show significant differences in specific parameters such as ventilation, tobacco weight and paper permeability. Mass-manufactured cigarettes have relatively tight parameters for features such as overall length and diameter, such that there is little variation among brands or across countries within a product class (eg, king size filter tipped). Most observed brand-to-brand variation occurs in tobacco and filter weight, filter length, paper permeability and filter ventilation. Consistent with data from other countries, filter ventilation emerged as the most important predictor of labelled tar, nicotine and CO yields, though the relation was not as strong as observed in other studies, where R^2 values of 0.90 and greater are seen.[18 19] Differences in predicted yields from previous studies probably reflect the restricted range of yields examined in China since very few brands purchased had tar yields lower than 10 mg, in contrast to many Western markets where 50% or more of tar yields fall below 10 mg. The predictive model for nicotine was weakest, suggesting that engineering features may not be the primary drivers of nicotine yield in China, especially considering the very narrow range of yields observed. The findings overall underscore the influence of ventilation, even at relatively low levels, in manipulating the emission levels of products when tested under the standard ISO regimen, which remains the basis for reporting in much of the world. The fact that few brands on the Chinese market currently have yields below 10 mg suggests a potential marketing opportunity for CNTC as Chinese smokers become increasingly educated about the health risks of smoking. Indeed, evidence from the ITC Survey suggests that many Chinese smokers believe 'light'/'low tar' cigarettes are less harmful.[25]

We found relatively high levels of arsenic, lead and cadmium in the tobacco of domestic Chinese cigarettes, substantially higher than cigarettes from Canada.[26] This is consistent with existing literature on metals in counterfeit cigarettes, the majority of which appear to originate in China.[21] Metal content in tobacco leaf primarily is driven by the metal content of the soil in which it is grown, rather than resulting from processing.[27] Various investigations using different methodologies consistently indicate that cadmium (an IARC Type 1 carcinogen) transfers linearly from tobacco into smoke emissions.[24 28 29] Galazyn-Sidorczuk *et al*[28] have shown that this correlation extends to blood cadmium levels. Recent work also suggests that cadmium and lead levels are higher in lung tissues of current and former smoking lung cancer patients relative to non-smokers.[30] Furthermore, large increases in transference factors are observed using the Canadian intense smoking protocol compared with the ISO protocol (factors of 2.9 and 2.4 respectively for Cd and Pb; 25), meaning transfer increases with increasing smoking intensity. Thus cadmium and lead concentrations in tobacco can be taken as first order indicators of relative exposure to different products. While the relative health burden of metal exposure from tobacco is still unclear, some studies suggest that they might be at least as important in carcinogenesis as polycyclic aromatic hydrocarbons (PAHs) and N-nitrosamines.[31]

The higher yields of cadmium and lead in cigarettes manufactured in China are worrisome given current smoking prevalence in China and CNTC's export ambitions. Health and regulatory officials around the world should be concerned about the potential for export of cigarettes (or processed tobacco) with manifold higher contents of known toxicants from China into international markets. From a regulatory perspective, precluding import of tobacco and tobacco products with high arsenic, cadmium, and/or lead content, using relatively simple leaf and filler analysis as screening tools, could have substantial impacts on the international tobacco trade and, potentially, public health. Regulatory limits on metal contamination would not be unprecedented. Australia and New Zealand, for example, have maximal limits for arsenic (1 mg/kg[ii] in cereals), cadmium (0.1 mg/kg in leafy vegetables) and lead (0.1 mg/kg in

Table 4 Stepwise linear regression results for tar, nicotine, and carbon monoxide on cigarettes purchases in China, 2005–7 (n=78)

Variable	ΔR^2	B	Beta	t	p Value
Tar					
Intercept		−4.183		−0.796	0.429
Year	0.049	−1.274	−0.283	−4.455	<0.001
Ventilation	0.577	−0.118	−0.584	−7.675	<0.001
Tobacco weight	0.047	8.785	0.149	1.615	0.111
Filter weight	0.044	39.023	0.332	3.522	0.001
Paper permeability	0.016	−0.25	−0.112	−1.791	0.078
Rod length	0.010	0.160	0.192	1.683	0.097
Final model	0.721				
Nicotine					
Intercept		0.095		0.299	0.766
Year	0.008	−0.033	−0.098	−1.142	0.257
Ventilation	0.402	−0.007	−0.441	−4.351	<0.001
Tobacco weight	0.037	1.195	0.275	3.064	0.003
Filter length	0.053	0.012	0.277	2.778	0.007
Final model	0.472				
CO (N=40)					
Intercept		16.571		14.669	<0.001
Year	0.004	−0.183	−0.049	−0.429	0.67
Ventilation	0.477	−0.142	−0.713	−6.244	<0.001
Paper permeability	0.050	−0.040	−0.224	−1.988	0.054
Final model	0.493				

B, unstandardised regression weight.
Beta, standardised regression weight.

[ii] 1 mg/kg = 1 ug/g.

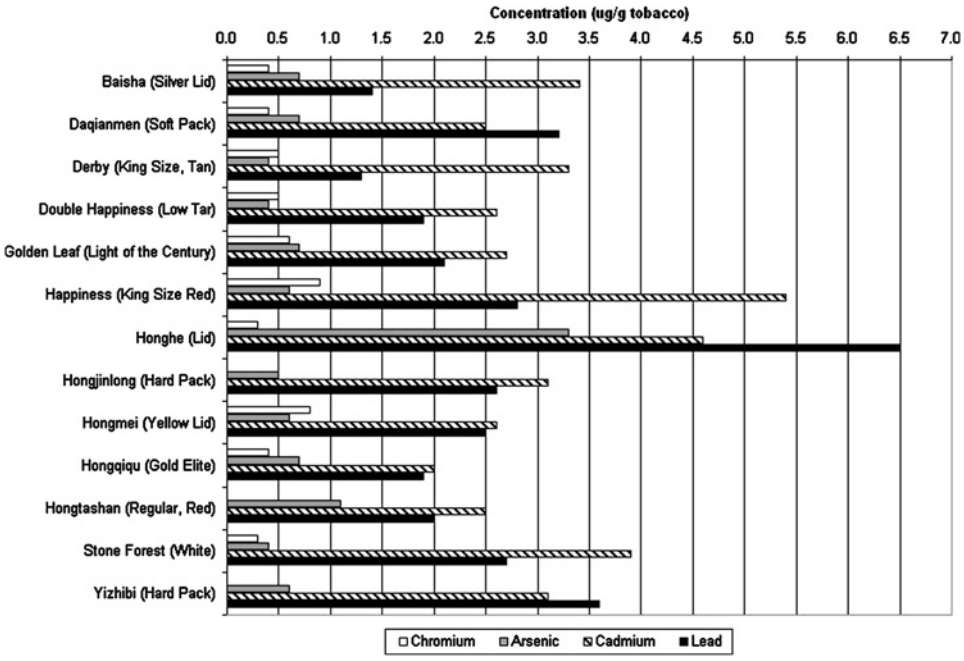

Figure 1 Distribution of metal content of unburned tobacco in 13 Chinese cigarette varieties, 2005–6.

vegetables) in plant products intended as foods.[32] Cigarette tobacco (even those in Canada) generally exceeds these levels.

A limitation of the current study is the reliance on labelled values for tar, nicotine and CO for regression analyses rather than direct testing of emissions. In addition, metals were only tested for a subset of brands. Another limitation is that brands for this study were not selected strictly on the basis of market share or to represent a broad range of tar yields, but rather were a convenience sample. Future research should replicate these findings across a market-based sample.

China is a party to the FCTC and is moving to implement regulations to meet its treaty obligations. Simultaneously, it owns the world's largest tobacco company. Chinese tobacco scientists appear to be active in research and development of new products and emission reduction technologies, which speaks to the growing sophistication of the Chinese industry.[33] These reports are consistent with STMA's moves to modernise factories and adopt manufacturing and quality control technologies from the major international companies. It is also possible, then, that product-level regulations such as chemical-specific emissions limits[12] could be implemented in China with emerging production technologies. Particular attention should be paid to eliminating heavy metals from tobacco.

Overall, the findings from this study suggest that Chinese cigarettes differ in substantive ways from cigarettes sold in Western markets, though they follow similar patterns in determining tar and nicotine yields under standard testing conditions. But the presence of high levels of heavy metals in Chinese cigarettes may constitute a potential global public health problem as exports of Chinese cigarettes continue to increase.

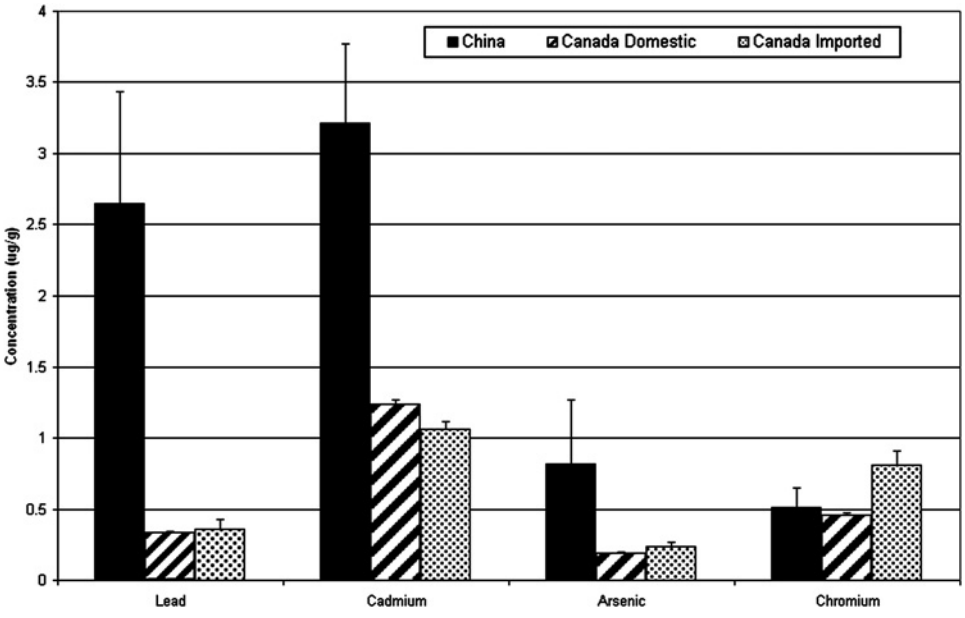

Figure 2 Comparisons of average metal contents for Chinese and Canadian cigarettes. Error bars represent 95% CIs.

What this paper adds

There is very limited public information about the design and emissions of Chinese cigarettes. In recent years the China National Tobacco Company (CNTC) has reduced the machine measured tar yields of many of its cigarette brands, similar to what occurred in Western countries from the 1970s through the 1990s with so-called 'low-tar' cigarettes introduced to address consumer concerns about health risks from smoking. Findings from this study suggest that, as in most countries, reported tar levels are predicted primarily by tobacco weight and filter ventilation. We found particularly high levels of cadmium and lead in Chinese cigarette tobacco, which is probably the result of soil conditions where tobacco is grown in China. The presence of high levels of these and other heavy metals may constitute a global health concern as China increases their cigarette exports.

Regulators should require disclosure of the source and growing conditions of tobacco used in all products and should consider product standards based on heavy metal content.

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Beliefs about the relative harm of "light" and "low tar" cigarettes: findings from the International Tobacco Control (ITC) China Survey

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ABSTRACT

Background: Many smokers in Western countries perceive "light" or "low tar" cigarettes as less harmful and less addictive than "regular" or "full flavoured" cigarettes. However, there is little research on whether similar perceptions exist among smokers in low and middle incomes, including China.

Objective: To characterise beliefs about "light" and "low tar" cigarettes among adult urban smokers in China.

Methods: We analysed data from Wave 1 of the ITC China Survey, a face-to-face household survey of 4732 adult Chinese smokers randomly selected from six cities in China in 2006. Households were sampled using a stratified multistage design.

Findings: Half (50.0%) of smokers in our sample reported having ever tried a cigarette described as "light," "mild" or "low tar". The majority of smokers in our sample (71%) believed that "light" and/or "low tar" cigarettes are less harmful compared to "full flavoured" cigarettes. By far the strongest predictor of the belief that "light" and/or "low tar" cigarettes are less harmful was the belief that "light" and/or "low tar" cigarettes feel smoother on the respiratory system ($p<0.001$, OR = 53.87, 95% CI 41.28 to 70.31).

Conclusion: Misperceptions about "light" and/or "low tar" cigarettes were strongly related to the belief that these cigarettes are smoother on the respiratory system. Future tobacco control policies should go beyond eliminating labelling and marketing that promotes "light" and "low tar" cigarettes by regulation of product characteristics (for example, additives, filter vents) that reinforce perceptions that "light" and "low tar" cigarettes are smoother on the respiratory system and therefore less harmful.

It is estimated that there are 320 million smokers in China.[1] Approximately 57% of adult males and 3% of adult females in China are current smokers.[2] Currently, about one million smokers in China will die from tobacco-related illnesses per year[1] but it is expected to rise to 2.2 million deaths by 2020.[3]

We can examine the experiences of Western countries to predict what might happen in China. In Western countries, "light" and "low tar" cigarettes were initially introduced in the 1960s and 1970s as smokers became aware of the health risks of smoking. These cigarettes have been marketed using advertising and packaging which suggests that these brands are less harmful alternatives to "full flavour" or "regular" brands[4 5] and therefore appeal to health concerned smokers.[6–9] Consequently, the availability of "low tar" cigarettes is likely to have discouraged some smokers from quitting,[10 11] although this evidence is not conclusive.[12] Brands that are described as "low tar" typically generate lower levels of tar and nicotine emissions under machine testing owing to higher levels of filter ventilation and filtration. However, smokers have been shown to compensate for the reduced deliveries of nicotine in order to achieve target nicotine doses, therefore increasing tar delivery and suggesting that the originally anticipated benefits of "low tar" cigarettes would not eventuate.[13–16] This is in accordance with the epidemiological evidence, which has shown that these brands are no less harmful to consumers.[17 18]

It is unclear to what extent similar marketing practices have been employed in China. Tobacco industry documents have demonstrated that Philip Morris launched Marlboro Lights in 1994 in major urban centres in the People's Republic of China. Philip Morris predicted that young adult smokers would follow the established trend in Hong Kong towards lower tar and nicotine products.[19] There is also evidence that "low tar" cigarettes were associated with "lower risk"—see figure 1 for an example. Tar yield numbers are also printed on the side of many Chinese cigarette packages, reinforcing the belief that they are less harmful. Anecdotal evidence, however, suggests that the use of terms such as "light" or "mild" to market "low tar" cigarettes has been less common in mainland China than in Western countries. These terms do appear on some cigarette packages (for example, Zhongnanhai Light), but typically appear only in English.

Brands with higher levels of filter ventilation and other design features that generate low tar under machine tests are less prevalent in China than in Western countries primarily because of a lack of domestic production technology and a limited presence of foreign brands in the Chinese market to stimulate interest in alternatives to the traditional higher tar cigarette.[20]

Although smokers in China are less aware and health concerned about the health risks of smoking compared to other countries,[21 22] this may soon be changing. As China implements more stringent tobacco control policies in accordance with the Framework Convention on Tobacco Control (FCTC), it is anticipated that there will be an increase in public education about the health risks of smoking. Chinese smokers are therefore more likely to become concerned about health, and it is anticipated that the market share of lower tar

Figure 1 An advertisement for Zhongnanhai Lights Cigarettes.

brands will increase in response to these rising concerns. Regulations that prohibit the sale of cigarettes above 15 mg tar/stick in 2004 are also expected to reduce the machine tar numbers, as is the increasing presence of multinational companies.[20]

Use of ''light'' and ''low tar'' cigarettes is likely to increase; however, to our knowledge no research has examined beliefs about the relative health risks of ''light'' and ''low tar'' cigarettes compared to full flavoured cigarettes among smokers in China. It will be important to know whether these cigarettes are also seen as ''less harmful'' and therefore could be appealing to health-concerned smokers in China. The International Tobacco Control (ITC) China Survey, conducted in six Chinese cities among representative samples of adult smokers included a number of survey questions designed to assess beliefs about ''light'' and/or ''low tar'' cigarettes (which we will refer to as ''LLT''). We also examined which factors are independently associated with a belief that LLT cigarettes are less harmful relative to full flavoured cigarettes.

We focused on beliefs about the sensory experience of LLT cigarettes as a potentially important factor that could lead smokers to believe that LLT cigarettes as less harmful. Previous research has demonstrated an association between the belief that LLT cigarettes are smoother and the belief that LLT cigarettes are less harmful.[7 8 23] This study will examine whether smokers in China who believe that LLT cigarettes are smoother on the respiratory system compared to regular cigarettes are more likely to believe that LLT cigarettes are less harmful. In countries where ''light'' and ''low tar'' descriptors were removed, smokers continued to believe that LLT cigarettes are less harmful particularly if they believed that these cigarettes are smoother on the throat and chest.[24] We therefore tested whether this association also existed in China.

This was a critical time to evaluate beliefs about the relative harm of ''light'' and ''low tar'' cigarettes because China introduced a ban on these descriptors in January 2006 (however, the tobacco industry was given a grace period until April 2006). Because our survey started in April 2006, we are not able to compare changes in smokers' perceptions about ''light'' and ''low tar'' cigarette labelling before and after the regulation took effect even though it is likely that some cigarettes with ''light'' and ''low tar'' labels were still on store shelves after the official policy took effect. However, future research waves can address the impact of this ban.

METHOD

Sample

Participants were from Wave 1 of the ITC China Survey conducted in April to August 2006. The ITC China Survey is a prospective, face-to-face, cohort survey of adult smokers and non-smokers 18 years of age or older. The current study examined smokers only (respondents who had smoked more than 100 cigarettes in their life and smoked at least weekly, n = 4732). Respondents were from six cities: Beijing (n = 785), Guangzhou (n = 791), Shenyang (n = 781), Shanghai (n = 784), Changsha (n = 800) and Yinchuan (n = 791). A seventh city, Zhengzhou, was initially included in the study. Wave 1 and 2 data were examined across both waves. A random sample of the survey data and MP3 recordings of survey interviews were examined in each city to ensure consistency in responses between waves. In Zhengzhou there was a significant level of inconsistencies between Wave 1 and Wave 2 (for example, different genders for the supposedly same respondents), the city was therefore removed from the study (there were virtually no such cases in the other six cities). Cooperation rates were 80.0% in Beijing (estimated), 80.0% in Guangzhou (estimated), 81.2% in Shenyang (exact), 84.2% in Shanghai (exact), 80.0% in Changsha (estimated) and 90.3% in Yinchuan (exact). Response rates were 50.0% in Beijing (estimated), 50.0% in Guangzhou (estimated), 50.0% in Shenyang (exact), 61.3% in Shanghai (exact), 50.0% in Changsha (estimated), and 39.4% in Yinchuan (exact). The cooperation rates were comparable to (and the response rates were generally higher than) those obtained in the ITC Four Country Survey (a telephone survey of smokers in Canada, United States, United Kingdom and Australia). Table 1 presents the sample characteristics of respondents included in these analyses.

Procedure

In each of the six cities, the survey team led by investigators at the Chinese Center for Disease Control and Prevention selected 10 Jie Dao (street districts), with the probability of selection proportional to size. Within each Jie Dao, two Ju Wei Hui (residential blocks) were selected, again with the probability of selection proportional to size. Within each Ju Wei Hui, the addresses of all households were listed and a sample of 300 addresses was randomly selected without replacement.

Among these 300 households, basic information was collected on every person over the age of 18 to determine eligibility for the survey. From these 300 households, 50 people were randomly selected to participate in the survey (40 adult smokers and 10 adult non-smokers). The ''next birthday method'' was used to select the respondent in households with more than one eligible respondent.[25]

The smoker survey was a 40-minute face-to-face survey conducted in Mandarin by experienced survey interviewers specially trained to conduct the ITC China survey. Further details about the team structure are available in the ITC China Wave 1 technical report.[26] Respondents were given a small gift (soap) worth 10–20 Yuan in appreciation for their participation. This compensation is typical for survey participation in China.

The ITC China Survey was constructed with reference to ITC surveys being conducted in 14 other countries. The survey and training manual were translated from English into Chinese and standardised across all cities. The survey fieldwork was

Table 1 Unweighted sample characteristics for the six Chinese cities in the ITC China Survey

	Beijing (n = 785)	Shenyang (n = 781)	Shanghai (n = 784)	Changsha (n = 800)	Yinchuan (n = 791)	Guangzhou (n = 791)	Overall (n = 4732)
Factor	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**	**No (%)**
Gender							
Male	743 (94.6)	741 (94.9)	765 (97.6)	732 (91.5)	772 (97.6)	746 (94.3)	4499 (95.1)
Female	42 (5.4)	40 (5.1)	19 (2.4)	68 (8.5)	19 (2.4)	45 (5.7)	233 (4.9)
Age (years)							
18–39	120 (15.3)	111 (14.2)	89 (11.3)	201 (25.1)	258 (32.6)	118 (14.9)	897 (19.0)
40–54	373 (47.5)	456 (58.4)	456 (58.2)	362 (45.3)	343 (43.4)	348 (44.0)	2338 (49.4)
55+	292 (37.2)	214 (27.4)	239 (30.5)	237 (29.6)	190 (24.0)	325 (41.1)	1497 (31.6)
Ethnicity							
Other	42 (5.4)	40 (5.1)	11 (1.4)	11 (1.4)	125 (15.8)	6 (0.8)	235 (5.0)
Han*	743 (94.6)	741 (94.9)	773 (98.6)	789 (98.6)	666 (84.2)	785 (99.2)	4497 (95.0)
Income							
Low	74 (9.4)	244 (31.2)	113 (14.4)	226 (28.3)	174 (22.0)	94 (11.9)	925 (19.6)
Medium	323 (41.2)	435 (55.7)	348 (44.4)	335 (41.9)	396 (50.1)	295 (37.3)	2132 (45.1)
High	322 (41.1)	79 (10.1)	291 (37.2)	198 (24.8)	156 (19.7)	286 (36.2)	1332 (28.2)
Don't know	65 (8.3)	23 (2.9)	31 (4.0)	41 (5.1)	64 (8.1)	116 (14.7)	340 (7.2)
Education							
Low	76 (9.7)	60 (7.7)	47 (6.0)	142 (17.8)	107 (13.5)	188 (23.9)	620 (13.1)
Medium	496 (63.2)	570 (73.1)	588 (75.0)	486 (60.8)	486 (61.5)	472 (59.9)	3098 (65.5)
High	213 (27.1)	150 (19.2)	149 (19.0)	172 (21.5)	197 (24.9)	128 (16.2)	1009 (21.3)
Daily/weekly smoking							
Daily smoker	730 (93.0)	733 (93.9)	742 (94.6)	749 (93.6)	721 (91.2)	747 (94.4)	4422 (93.4)
Weekly smoker	55 (7.0)	48 (6.1)	42 (5.4)	51 (6.4)	70 (8.8)	44 (5.6)	310 (6.6)
Cigarettes per day							
1–10	299 (38.4)	292 (37.5)	266 (34.0)	194 (24.4)	336 (42.7)	253 (32.2)	1640 (34.8)
11–20	374 (48.0)	372 (47.8)	389 (49.7)	407 (51.3)	356 (45.3)	409 (52.0)	2307 (49.0)
21–30	58 (7.4)	68 (8.7)	71 (9.1)	87 (11.0)	48 (6.1)	73 (9.3)	405 (8.6)
31+	48 (6.2)	46 (5.9)	57 (7.3)	106 (13.4)	46 (5.9)	51 (6.5)	354 (7.5)
Ever tried light, low tar							
Yes	443 (56.4)	329 (42.1)	467 (59.6)	303 (37.9)	407 (51.5)	417 (52.7)	2366 (50.0)
No	316 (40.3)	410 (52.5)	295 (37.6)	447 (55.9)	321 (40.6)	334 (42.2)	2123 (44.9)
Don't know	26 (3.3)	42 (5.4)	22 (2.8)	50 (6.3)	63 (8.0)	40 (5.1)	243 (5.1)
Tar level							
Don't know	282 (36.6)	284 (38.1)	246 (31.5)	400 (50.1)	230 (29.3)	321 (40.9)	1763 (37.8)
Invalid tar level	4 (0.5)	2 (0.3)	11 (1.4)	6 (0.8)	8 (1.0)	4 (0.5)	35 (0.8)
15 mg	202 (26.2)	204 (27.3)	310 (39.6)	38 (4.8)	208 (26.5)	335 (42.7)	1297 (27.8)
11–14 mg	169 (21.9)	235 (31.5)	103 (13.2)	349 (43.7)	326 (41.5)	107 (13.6)	1289 (27.6)
10 mg or less	113 (14.7)	21 (2.8)	112 (14.3)	5 (0.6)	14 (1.8)	17 (2.2)	282 (6.0)

*Han is the majority ethnicity in China; approximately 91.6% of the national population is Han.[27]

supervised by members of the local Centers for Disease Control and Prevention (CDC) in each of the six cities and was coordinated by the China National CDC and the ITC Project Data Management Centre at the University of Waterloo. Research ethics approval was obtained from the University of Waterloo, Roswell Park Cancer Institute, the Cancer Council Victoria, and the Chinese National CDC.

Sampling weights were constructed separately for male smokers, female smokers, and non-smokers. Wave 1 weight construction accounted for four levels of sample selection: Jie Dao, Ju Wei Hui, household, and individual. The final Wave 1 weight for a sampled individual was the number of people in the city population and the sampling category represented by that individual.

For additional information about the methods of the ITC China Survey see Wu *et al*[28] and the ITC China Survey Technical Report.[26]

Measures

Beliefs about "light" and/or "low tar" cigarettes

Respondents were asked whether they strongly agree, agree, neither agree or disagree, disagree, strongly disagree or don't know with each of two statements: "low tar cigarettes are less harmful than regular cigarettes" and "light cigarettes are less harmful than regular cigarettes." Although the terms "light" and "low tar" are often used synonymously, separate questions were asked in order to ensure that we captured all possible awareness of these types of cigarettes. The term "low tar" is used in China both in marketing the product as "low tar" and also because of the tar levels on cigarette packaging. "Light" descriptors are typically written in English only on cigarette packages. Thus only those who read English would understand the meaning. The terms were similar enough, however, that we collapsed responses across beliefs about "light" and "low tar" cigarettes.

Responses were recoded so that "strongly agree" and "agree" were coded as 1 and other responses coded as 0. Beliefs about "light" and "low tar" cigarettes were combined so that having one or both of these beliefs was coded 1 and having neither of these beliefs was coded 0. Before collapsing across beliefs about "light" and "low tar" cigarettes we tested each model separately. The results were similar to those we obtained when combining beliefs about "light" and "low tar" cigarettes.

Demographics and smoking behaviour

Standard demographic measures included sex, ethnicity (Han vs other ethnic groups), age (18–39, 40–54, 55+; there were few respondents (1.4%) in the 18–24 category and it was therefore collapsed with the 25–39 category), household income per month (low: $<$1000 yuan per month, medium: $\geqslant$1000 yuan and $\leqslant$2999 yuan per month, high: $\geqslant$3000 yuan, don't know), education (low: no education or elementary school, medium: junior high school or high school/technical high school, high: college, university or higher) and city. Daily cigarette smokers responded "every day" to the question: "Do you smoke every day, less than every day, or not at all?" and weekly smokers indicated that they smoked "less than every day". Cigarettes smoked per day was calculated by asking daily smokers: "On average, how many cigarettes do you smoke each day, including both factory-made and hand-rolled cigarettes?" and weekly smokers: "On average, how many cigarettes do you smoke each week?" (divided by 7). Impossible per day values (greater than 100) were treated as coding errors and recoded as 100. In the logistic regression equation, cigarettes per day was centred and treated as a continuous variable.

Knowledge of health effects of smoking

Respondents were asked whether smoking causes stroke, impotence, lung cancer in smokers, emphysema in smokers, stained teeth, premature ageing, lung cancer in non-smokers and cardiovascular heart disease. Responses were coded so that no and don't know/cannot say = 0 and yes = 1. The measure of health knowledge was the sum of all eight responses. The Cronbach α for this measure was 0.79, suggesting that the scale was reliable.

Self-reported use of "light" and "low tar" cigarettes

We asked respondents whether they had ever tried cigarettes described as "light," "mild" or "low tar" (yes, no or don't know). We also asked respondents to provide the tar level of the brand they currently smoked most often. Responses were coded as 1 = $\leqslant$10 mg of tar, 2 = $\geqslant$11 mg of tar to $\leqslant$14 mg of tar, 3 = 15 mg of tar, 4 = invalid tar level and 5 = don't know. Because China banned cigarettes above 15 mg of tar, any respondent who reported greater than 15 mg was given an invalid code and treated as a separate category.

Health concerns about smoking

To assess health concerns, respondents were asked: "to what extent, if at all, has smoking damaged your health?" and "how worried are you, if at all, that smoking will damage your health in the future?" (not at all/don't know, a little, very much). We also asked smokers to rate their health with response options from 1 = poor to 5 = excellent. Smokers were asked whether they considered themselves addicted to cigarettes (not at all, a little, somewhat, a lot).

Quitting related variables

We asked respondents whether they had ever tried to quit smoking (yes or no). Quit intentions were assessed by asking respondents: "are you planning to quit smoking?" (within the next month, within the next 6 months, sometime in the future, beyond 6 months, not planning to quit/don't know). To assess quitting efficacy respondents were asked: "if you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed?" (not at all sure, somewhat sure, very sure, extremely sure, don't know).

Smoothness beliefs

Respondents were asked whether they strongly agree, agree, neither agree nor disagree, disagree, strongly disagree or don't know with the statements: "low tar cigarettes are smoother on your respiratory system than regular cigarettes", and "light cigarettes are smoother on your respiratory system than regular cigarettes". (Surveys typically ask "Do light cigarettes feel smoother on the throat and chest?" However, in Chinese, this question was interpreted as referring to outside the throat and chest. To capture the sensation within the throat and chest, our Chinese translation team suggested the translation should be "on the respiratory system".)

Responses were recoded so that "strongly agree" and "agree" were coded as 1 and other responses coded as 0. Again, beliefs about "light" and "low tar" cigarettes were combined so that having one or both of these beliefs was coded as 1 and having neither of these beliefs was coded as 0.

Statistical analyses

SPSS (version 17) was used for all statistical analyses. A complex samples logistic regression model was used to test which variables were independently associated with the beliefs that LLT cigarettes are less harmful. All analyses were conducted on weighted data. These predictors were related to beliefs that "light" cigarettes confer health benefits among smokers in the ITC Four Country Survey.[15]

RESULTS

Half (50.0% unweighted; 48.5% weighted) of the respondents reported having ever tried a cigarette described as "light", "mild" or "low tar" (table 1). Approximately 28% of respondents reported their current brand had 15 mg of tar, 27.6% had a brand with 11–14 mg of tar, and 6% had a brand with 10 mg of tar or less. Reported use of "light" and "low tar" cigarettes varied by city with lower tar cigarette brands being more common in more Westernised cities (Beijing, Shanghai).

Beliefs about "light" and/or "low tar" cigarettes

Table 2 presents overall beliefs about "light" and "low tar" cigarettes. The majority of smokers (71.0%) believed that LLT cigarettes are less harmful and that LLT cigarettes are smoother on the respiratory system (73.3%).

Factors associated with the belief that "light" and/or "low tar" cigarettes are less harmful

Table 3 presents the results of a logistic regression analysis to determine what factors were independently associated with the belief that LLT cigarettes are less harmful. Smokers in the oldest age category were more likely than smokers in the youngest category to believe that LLT cigarettes are less harmful ($p<0.001$, OR = 1.97 CI 1.36 to 2.87). Compared to people with a high education, people who were low educated were significantly less likely to believe that LLT cigarettes are less harmful ($p = 0.007$, OR = 0.55 CI 0.34 to 0.89).

By far the strongest predictor of the misconception that LLT cigarettes are less harmful was the belief about the sensory perception of LLT cigarettes. Smokers who thought that LLT cigarettes are smoother on the respiratory system were significantly more likely to believe that LLT cigarettes are less harmful ($p<0.001$, OR = 53.87, CI 41.28 to 70.31). Of the smokers who believed that LLT cigarettes are smoother on the respiratory system, 90.9% said that these cigarettes are less harmful than regular cigarettes. In sharp contrast, among those who did *not* believe that LLT cigarettes are smoother on the respiratory system, only 16.4% believed that these cigarettes are less harmful.

Interactions with the belief that "light" and/or "low tar" cigarettes are smoother

We tested interactions between the smoother belief and each variable. It should be noted that the main effect for smoother belief was enormous, and so even if there exist statistically significant interactions, the effect of those interactions would be differences around a main effect corresponding to an odds ratio of 53.

Among smokers who ever used "light" or "low tar" cigarettes, those who believed that these types of cigarettes are smoother have significantly greater odds of believing that LLT cigarettes are less harmful than those who did not believe that these cigarettes are smoother ($p<0.001$, OR = 40.03, CI = 28.59 to 56.03). Those who never used "light" or "low tar" cigarettes and who believed that these types of cigarettes are smoother were more likely to believe that LLT cigarettes are less harmful than those who did not believe that these cigarettes are smoother ($p<0.001$, OR = 71.52, CI = 50.86 to 100.57). The relation between smoothness and less harm was therefore stronger for those who had never tried "light" or "low tar" cigarettes compared to those who had tried "light" or "low tar" cigarettes ($p = 0.004$, OR = 1.79, CI 1.22 to 2.62).

There was no significant interaction between the tar level of the respondent's current brand and the belief that LLT cigarettes are smoother predicting the belief that these cigarettes are less harmful. Few other predictors interacted with the perception that LLT cigarettes are smoother to predict the belief that they are less harmful. There was a significant overall interaction by city ($p = 0.02$) and education ($p = 0.006$). In every case, those who believed that LLT cigarettes are smoother were more likely to believe that LLT cigarettes are less harmful (the lowest odds ratio was 25.6 and the highest odds ratio was 85.5).

DISCUSSION

Over two-thirds of Chinese smokers surveyed held the false belief that LLT cigarettes are less harmful. This is a much higher level of belief than smokers in Canada (16%), the US (28%), the UK (43%) and Australia (27%).[15] This may be a reflection of marketing campaigns in China that continue to use explicit health claims. For example, a two-page spread magazine advertisement for one Chinese brand, "Zhongnanhai Light" cigarettes, claims "Every product fuses the world's most advanced low-harm cigarette technology, offering a guarantee of health for your smoking life." Another print ad claims: "A little lower is healthier! Low-harm tobacco, more technological components, greater loving care for your body!" (see fig 1). Since the Chinese government has allowed these companies to

Table 2 Weighted beliefs about the relative harm and sensory characteristics of "light" and "low tar" cigarettes and inter-item correlations

Belief	"Light" less harmful	"Low tar" less harmful	LLT less harmful	"Light" smoother	"Low tar" smoother	LLT smoother	% Agree or strongly agree with belief item	95% CI for belief item
"Light" cigarettes are less harmful than regular cigarettes	1						55.7	52.8% to 58.6%
"Low tar" cigarettes are less harmful than regular cigarettes	0.51	1					62.0	59.4% to 64.4%
LLT cigarettes are less harmful	0.72	0.83	1				71.0	68.4% to 73.5%
"Light" cigarettes are smoother on your respiratory system than regular cigarettes	0.76	0.49	0.63	1			60.4	57.5% to 63.2%
"Low tar" cigarettes are smoother on your respiratory system than regular cigarettes	0.46	0.68	0.60	0.48	1		61.4	58.9% to 63.9%
LLT cigarettes are smoother on your respiratory system than regular cigarettes	0.61	0.62	0.73	0.75	0.76	1	73.3	70.7% to 75.8%

Table 3 Weighted logistic regression of belief "light"/"low tar" cigarettes are less harmful

Factor	No	% of smokers believing LLT cigarettes are less harmful*	Adjusted odds ratio (95% CI)	p Value
Demographic variables				
Gender				
Male	4499	71.1	0.84 (0.60 to 1.18)	0.31
Female	233	70.5	1.00 (reference)	
Age (years)				
18–39	897	67.4	1.00 (reference)	<0.001
40–54	2338	70.3	1.17 (0.87 to 1.57)	
55+	1497	74.4	1.97 (1.36 to 2.87)	
Ethnicity				
Other	235	62.2	0.93 (0.55 to 1.56)	0.77
Han	4497	71.5	1.00 (reference)	
Income				
Don't know	340	61.5	1.05 (0.69 to 1.59)	0.20
Low	925	69.1	1.27 (0.90 to 1.80)	
Medium	2132	73.6	1.50 (1.01 to 2.23)	
High	1332	70.6	1.00 (reference)	
Education				
Low	620	64.2	0.55 (0.34 to 0.89)	0.007
Medium	3098	72.6	0.85 (0.55 to 1.31)	
High	1009	70.9	1.00 (reference)	
City				
Beijing	785	74.7	1.36 (0.85 to 2.18)	0.46
Shenyang	781	74.6	1.47 (1.00 to 2.17)	
Shanghai	784	66.5	1.19 (0.75 to 1.89)	
Changsha	800	72.3	1.33 (0.88 to 1.99)	
Yinchuan	791	67.3	1.27 (0.89 to 1.83)	
Guangzhou	791	70.9	1.00 (reference)	
Smoking behaviour				
Daily/weekly smoking				
Daily smoker	4422	70.7	0.81 (0.53 to 1.22)	0.30
Weekly smoker	310	75.3	1.00 (reference)	
Cigarettes per day				
0–10	1640	72.2	1.01 (0.99 to 1.03)†	0.53
11–20	2307	71.0		
21–30	405	65.5		
31+	354	73.6		
Health knowledge				
0	360	56.8	1.01 (0.94 to 1.08)†	0.84
1	570	59.4		
2	502	69.9		
3	610	74.5		
4	665	76.7		
5	760	76.8		
6	602	75.4		
7	375	71.4		
8	261	70.2		
Ever tried light, low tar				
No	2123	68.6	0.91 (0.68 to 1.22)	0.63
Don't know	243	68.6	1.11 (0.66 to 1.85)	
Yes	2366	73.6	1.00 (reference)	
Tar level				
Don't know	1763	71.4	0.72 (0.42 to 1.21)	0.19
Invalid tar level	35	61.4	0.38 (0.15 to 0.96)	
15 mg	1297	69.5	0.61 (0.37 to 1.01)	
11–14 mg	1289	72.0	0.71 (0.44 to 1.14)	
10 mg or less	282	76.5	1.00 (reference)	
Health concern				
Worried smoking has damaged health				
Very	770	76.1	1.08 (0.75 to 1.55)	0.48

Continued

Table 3 Continued

Factor	No	% of smokers believing LLT cigarettes are less harmful*	Adjusted odds ratio (95% CI)	p Value
A little	1973	75.9	1.17 (0.91 to 1.52)	
Not at all/don't know	1983	64.3	1.00 (reference)	
Worried smoking will damage health				
Very	855	77.0	1.22 (0.80 to 1.87)	0.30
A little	1984	75.7	1.23 (0.95 to 1.59)	
Not at all/don't know	1890	63.3	1.00 (reference)	
Describe your health				
1 Poor	131	72.7	1.04 (0.86 to 1.26)†	0.68
2	273	66.5		
3	2218	72.0		
4	1445	70.6		
5 Excellent	653	70.4		
Perceived addiction				
A little	2132	72.3	1.09 (0.69 to 1.72)	0.81
Somewhat	1359	71.9	1.22 (0.70 to 2.14)	
A lot	515	67.0	1.18 (0.49 to 2.82)	
Not at all	666	70.4	1.00 (reference)	
Quitting				
Past quit attempt				
No	2219	69.6	1.12 (0.78 to 1.61)	0.52
Yes	2512	72.3	1.00 (reference)	
Quit intention				
In the next month	377	73.8	0.74 (0.48 to 1.13)	0.53
In the next 6 months	297	77.0	0.80 (0.45 to 1.42)	
In the future beyond 6 months	437	77.3	0.92 (0.59 to 1.43)	
No intention/don't know	3602	69.6	1.00 (reference)	
Quit efficacy				
Don't know	334	61.3	1.20 (0.70 to 2.06)	0.68
Extremely sure	612	71.1	0.94 (0.61 to 1.44)	
Very sure	622	73.4	1.13 (0.71 to 1.80)	
Somewhat sure	1158	76.8	1.21 (0.91 to 1.61)	
Not at all sure	2004	68.5	1.00 (reference)	
Light/low tar smoother				
Agree/strongly Agree	3451	90.9	53.87 (41.28 to 70.31)	<0.001
Disagree/strongly disagree/neutral/DK	1280	16.4	1.00 (reference)	

*The belief prevalences presented for each response category of each factor are not adjusted for the other predictor variables in the model. †Continuous variable.

make explicit health claims, even after the ban, it is not surprising that a relatively high number of smokers in China believe that these cigarettes are less harmful compared to conventional high tar yield brands.

Consistent with previous research that has found that the sensory experience of smoking "low tar" cigarettes with higher levels of filter ventilation reinforces the belief in reduced harm,[14] we found that the factor most strongly associated with the belief that LLT cigarettes are less harmful was the belief that LLT cigarettes are smoother on the respiratory system. We also found a stronger association between the belief that LLT cigarettes are smoother on the airway and the belief that they are less harmful than regular cigarettes, among those who had never tried "light" or "low tar" cigarettes compared to those who had ever tried these cigarettes.

One might suspect that the experience of smoking LLT cigarettes would strengthen the belief that they are smoother because in most cases they would be smoother. However, the belief that LLT cigarettes are smoother is also communicated through package designs (that is, lighter colours), as well as descriptors that say "smooth", "mellow", etc. Perhaps the smoothness implied in marketing for these cigarettes differs from the actual smoking experience. Also, the fact that "light" and "low tar" cigarettes are only recently being introduced into the market is another factor that may account for the finding. In addition, there was no interaction between the tar level of the respondent's current brand and the belief that LLT cigarettes are less harmful. It should be pointed out that whatever the nature of the interaction, it was still the case for both groups that the relation between the smoother belief and the lower harm belief was very substantial.

Limitations

The findings reported in this article are from six cities in China. However, we can see no reason why they would not generalise to other urban Chinese cities as the cities in our study cover a broad range of economic and social conditions. There are plausible reasons why the findings might be somewhat different in rural China, where "light" cigarettes may be less likely to be promoted and there may be a smaller range of cigarette brands available. Still, with a starting point of an odds ratio of 53, we believe that it is extremely unlikely that the very strong relation

What this paper adds

This is the first study to examine beliefs about "light" and "low tar" cigarettes among smokers in China, the world's largest consumer of tobacco. There was a very strong relation between the belief that "light" and/or "low tar" cigarettes are smoother on the respiratory system and the belief that "light" and/or "low tar" cigarettes are less harmful. The findings suggest that future tobacco control policies should go beyond eliminating labelling and marketing that promotes "light" and "low tar" cigarettes (the focus of Article 11 of the Framework Convention on Tobacco Control (FCTC)), and address the tobacco product characteristics (for example, additives, filter vents) that reinforce the belief that "light" and "low tar" cigarettes are less harmful (Articles 9 and 10 of the FCTC).

would not hold across a very broad range of locations across all of China.

As with any survey research, there are always concerns about survey non-response and under-representation of certain groups. We addressed this issue by conducting weighted analyses for each city. Although we did have a low number of respondents in the youngest age category (18–24), this is consistent with samples from China's 1996 National Prevalence Study.[22]

Implications

In January 2006, China banned descriptors such as: "light", "ultra-light", "mild", "medium/low tar", "low tar", "low tar content" on cigarette packaging and inserts. However, the tobacco industry was given a period of grace until April 2006. In addition, sources in China have indicated that although the Chinese terms for "light", etc, have been removed, the English descriptors are not covered under this ban and remain on cigarette packages. Because our survey started in April 2006, we were unable to evaluate the initial impact of the ban, although we did not expect any immediate impact of the ban, rather we expected any changes in beliefs to take time. In follow-up surveys with this cohort of smokers we will be able to measure whether perceptions about these brands will change as time from the ban elapses. What is known is that the majority of adult smokers in China hold the erroneous belief that LLT cigarettes are less harmful than conventional high yield cigarettes. Smokers in China, like those throughout the world, need to be educated that all combustion tobacco products are harmful and that there is no compelling evidence to support a meaningful difference in health risk between products no matter what the marketing claims might suggest.

These findings demonstrate the need for China to also consider banning advertising that supports the idea that certain cigarettes are less harmful than others, as well as the need to remove tar numbers from cigarette packages. China has joined other countries (for example, Thailand, Australia and the United Kingdom) to ban "light" and "mild" descriptors on cigarette packages. However, research suggests banning these terms may not be sufficient to change beliefs about the relative harm of "light" cigarettes at least in the short term.[25] Our findings highlight the importance of the association between the belief that these cigarettes are smoother on the respiratory system and the relative harmfulness of "light" and "low tar" cigarettes. Banning "light" or "low tar" descriptors does nothing to break the link between the lighter and smoother physical sensations associated with "light" and "low tar" cigarettes and their presumed harmfulness. The association between the physical aspects of these cigarettes and their relative harm can certainly be created from package designs, advertising, descriptors, but our findings point to the powerful association created by the product itself that may provide illusory messages directly to the smoker that some brands are less harmful than others.

In addition, Articles 9 and 10 of the Framework Convention on Tobacco Control (FCTC)[29] relate to the regulation of tobacco products and these results point to the need to regulate the product to ban design features that would make a product smoother and lighter in sensation. Doing so could reduce perceptions of lower harm, which may be a key factor in increasing motivation to quit smoking.

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Use of less expensive cigarettes in six cities in China: findings from the International Tobacco Control (ITC) China Survey

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ABSTRACT

Objective The existence of less expensive cigarettes in China may undermine public health. The aim of the current study is to examine the use of less expensive cigarettes in six cities in China.

Methods Data was from the baseline wave of the International Tobacco Control (ITC) China Survey of 4815 adult urban smokers in 6 cities, conducted between April and August 2006. The percentage of smokers who reported buying less expensive cigarettes (the lowest pricing tertile within each city) at last purchase was computed. Complex sample multivariate logistic regression models were used to identify factors associated with use of less expensive cigarettes. The association between the use of less expensive cigarettes and intention to quit smoking was also examined.

Results Smokers who reported buying less expensive cigarettes at last purchase tended to be older, heavier smokers, to have lower education and income, and to think more about the money spent on smoking in the last month. Smokers who bought less expensive cigarettes at the last purchase and who were less knowledgeable about the health harm of smoking were less likely to intend to quit smoking.

Conclusions Measures need to be taken to minimise the price differential among cigarette brands and to increase smokers' health knowledge, which may in turn increase their intentions to quit.

INTRODUCTION

It is well accepted that the most effective way to reduce cigarette consumption is to raise the price of cigarettes.[1 2] Most econometric studies conducted in Western countries yielded price elasticity for cigarette demand estimates between −0.3 and −0.5,[1 3 4–7] which implies that a 10% increase in cigarette price may result in 3% to 5% decrease in cigarette consumption. Article 6 of the World Health Organization Framework Convention on Tobacco Control (WHO FCTC), the first ever global public health treaty, asks party countries to raise the price of and tax on tobacco products.

Economists used to believe that cigarette price elasticity was higher in developing countries compared to developed countries.[1 8] However, several studies suggest that China may have lower price elasticity than Western countries. For example, Lance *et al* estimated that the price elasticity in China was −0.082[9]; and Mao *et al* concluded that price elasticity in China was −0.15.[10] One possible interpretation proposed by Mao *et al* is that smokers' brand switching behaviours from expensive cigarettes to cheaper cigarettes lowered price elasticity.[10]

As shown in figure 1, when cigarette price goes up, smokers have different responses. Besides quitting and consumption reduction, some smokers may switch to less expensive brands or engage in tax avoidance behaviours[11 12]; some smokers may purchase cigarettes from different retail outlets such as tobacco discount stores[11]; there are also smokers engage in compensating behaviours, for example, switching to cigarettes higher in tar and nicotine.[13] The current study focuses on the use of less expensive cigarettes in China.

Like most goods, the price of cigarettes differs among brands. Examples include the three-tier cigarette pricing structure in the US (premium, discount and generic)[14] and Australia (premium, mainstream and supervalue).[15] China is the largest cigarette-producing country in the world, and cigarette prices vary considerably among brands. In 2006, there were 40 tobacco companies producing more than 200 domestic cigarette brands in China,[16] and within brand families there were multiple brand varieties. Chinese cigarettes are classified into different grades according to the quality of tobacco leaves and the price of cigarettes. As shown in table 1, according to the classification criteria of the China National Tobacco Company, there are five grades of cigarettes in China. The factory price of grade 1 cigarettes is at least six times higher than grade 5 cigarettes. In addition, China has a two-tier taxing system for cigarettes. Namely, the tax rate for higher grades of cigarettes is higher than lower grades of cigarettes, which further widens the price differential among different grades of cigarettes.

The tobacco monopoly system in China has policies that guarantee the supply of low-level (grades 4 and 5) cigarettes. China National Tobacco Company requires local tobacco companies produce certain amounts of low-level cigarettes each year and subsidises them to compensate for the relatively low profit margin. Thus, the production and the sale of low-level cigarettes in China are maintained according to objectives set by the China National Tobacco Company. For example, in 2006, 24.9% (503.9 billion sticks) of the cigarette production and 24.7% (500.6 billion sticks) of the cigarette sales in China were low-level cigarettes.[16] The China National Tobacco Company claimed that low-level cigarettes may help satisfy low-income populations' needs.

Cummings *et al* reported that in the US, smokers of discount or generic cigarette brands tend to be Caucasian, more addicted to smoking and to have

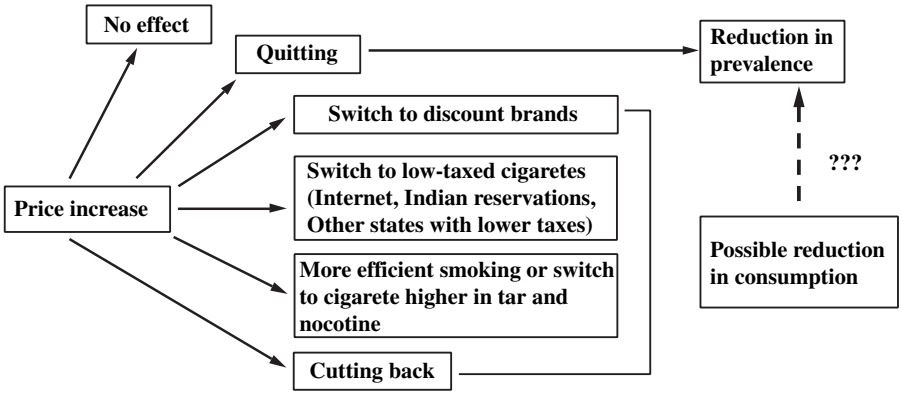

Figure 1 Compensatory model of cigarette price effects.

Adapted from: Fong GT. The International Tobacco Control Policy Evaluation Project (ITC Project): Evaluating the Impact of Policies of the WHO Framework Convention on Tobacco Control. Presentation given at the 8th Asia Pacific Conference on Tobacco or Health, Taipei, Taiwan. October 2007.

a lower income.[14] Studies also suggest that poorer and heavier smokers are sensitive to changes in cigarette prices and more likely to engage in tax avoidant behaviours.[12] Researchers proposed that less expensive cigarettes may undermine the public health effects of price and tax policies.[14 17] Theoretically, when cigarette prices increase, smokers may switch to less expensive cigarettes to minimise the financial burden and to maintain their smoking habit. As shown in figure 1, after a price increase, smokers who switch to less expensive cigarettes may not perceive much additional financial burden and may not choose to quit or reduce consumption. Given the enormous price differential among cigarette grades in China, it is particularly important to examine the use of less expensive cigarettes because of the increased potential for smokers to choose lower priced cigarettes. The aim of the current study is to determine the major characteristics of smokers of less expensive cigarettes, and whether the use of less expensive cigarettes are associated with decreased intentions to quit smoking.

METHODS

The International Tobacco Control (ITC) China Survey

The ITC China Survey is a prospective cohort survey in six cities in China: Beijing, Shanghai, Guangzhou, Shenyang, Changsha and Yinchuan. The six cities were selected based on their size, diverse geographic location and level of economic development. table 2 shows the registered population, gross domestic product (GDP), per capita annual disposable income and consumption expenses in 2006 in each of the six cities. The wave 1 survey was conducted between April and August 2006. In each wave, about 800 smokers and 200 non-smokers were interviewed in each city. Participants included in this study come from 4815 smokers who completed the wave 1 survey. A more detailed description of the study design can be found in Wu *et al*.[18] Briefly, in each city the ITC China Survey employed a multistage cluster sampling design to select representative adult urban smokers and non-smokers. The ITC China Survey was conducted using face-to-face interviews. The wave 1 cooperation rates range from approximately 80.0% in Beijing and Guangzhou to 95.0% in Changsha. The response rates range from 39.4% in Yinchuan to 66.0% in Guangzhou. All materials and procedures used in the ITC China Survey were reviewed and cleared with regard to ethics by the Office of Research at the University of Waterloo (Waterloo, Canada) and the Institutional Review Boards at: Roswell Park Cancer Institute (Buffalo, USA), the Cancer Council Victoria (Victoria, Australia) and the China National Centres for Disease Control and Prevention (Beijing, China). This study only used the data of current smokers.

Table 1 Factory price of different grades of cigarettes in 2006 in China

Grades of cigarettes	Price per carton before VAT (¥)	Ad valorem tax rate
1	50>	45%
2	30–49	30%
3	15–30	30%
4	10–14	30%
5	<10	30%

Grades 4 and 5 are defined as 'low-level cigarettes', grades 1 and 2 are defined as 'high-level cigarettes' and grade 3 is defined as 'medium-level cigarettes'.
VAT, value added tax.

Measures

Dependent variables

Purchase of less expensive cigarettes

We asked smokers to provide information on the cost of their cigarettes: 'The last time you bought cigarettes for yourself, how much did you pay for each pack of the cigarettes?' For smokers who didn't remember price paid per pack, the price was calculated from the smokers' response to the following two questions: (1) 'The last time you bought cigarettes for yourself, how many packs of cigarettes did you purchase?' and (2) 'How much did you pay for all the cigarettes you bought last time?' In this study, less expensive cigarettes were defined as cigarettes with reported price paid in the lowest tertile within each city (coded as 1), whereas cigarettes with reported prices paid in the middle or the highest tertile were defined as regular cigarettes (coded as 0).

Intention to quit smoking

We asked current smokers: 'Are you planning to quit smoking?' Smokers who responded 'within the next month', 'within the next 6 months', or 'sometime in the future, beyond 6 months'

Table 2 City population, gross domestic product (GDP), per capita annual disposable income and consumption expenses in 2006*

City	Number of registered residents	GDP	Per capita annual disposable income (¥)	Per capita annual consumption expense (¥)
Beijing	11	7720	19978	†
Guangzhou	5	6068	19851	15445
Shanghai	13	10297	20668	14762
Changsha	2	1791	13924	10680
Shenyang	6	2483	11651	8670
Yinchuan	1	335	10068	8288

*Data were from Statistical Report on the 2006 Economic and Social Development of each city.
†Data were not available for 2006 in Beijing.

were defined as having any intention to quit smoking (coded as 1), whereas smokers who responded 'not planning to quit' or 'don't know/cannot say' were defined as 'having no intention to quit or others' (coded as 0).

Independent variables

The major independent variables in this study included:

- City (Beijing, Shenyang, Shanghai, Changsha, Guangzhou, Yinchuan)
- Gender (male, female)
- Age (18–34 years, 35–44 years, 45–54 years, 55 years or older)
- Highest level of education (low=no education or elementary school, medium=junior high school or high school/technical high school, high=college, university or higher)
- Household income per month (low: <1000¥ per month, medium: 1000¥ to 2999¥, high: >3000¥, don't know/cannot say)
- Ethnicity (Han, others)
- Number of cigarettes smoked per day (1–10, 11–20, 21–30, 31+)
- How often did you think about the money spent on smoking in the last month? (never, occasionally, often, don't know/cannot say)

Knowledge about the adverse health effects of smoking: This index was based on smokers' responses to the following questions: 'Based on what you know or believe, does smoking cause the following: (1) stroke; (2) impotence in male smokers; (3) lung cancer in smokers; (4) emphysema; (5) stained teeth in smokers; (6) premature ageing; (7) lung cancer in non-smokers from secondhand smoke; and (8) CHD (coronary heart disease). Response options were: 'yes' (coded as 1), 'no' (coded as 0), 'don't know/cannot say' (coded as 0). The index was computed by summing the scores for the eight questions.

Weighting procedures

Sampling weights were constructed to provide the best possible prevalence estimates. The weights were constructed separately for male adult smokers and female adult smokers. Wave 1 weights were constructed by accounting for the four levels of sample selection: Jie Dao, Ju Wei Hui, household and individual. The final weight for a sampled individual was the number of people in the city population and the sampling category represented by that individual. A full description of the weighting methodology is available at http://www.itcproject.org.

Statistical analyses

Descriptive analysis

SPSS for Windows, V.17.0 (SPSS, Chicago, Illinois, USA), was used for all analyses. For each of the six cities, the median and the interquartile range for cigarette price paid were calculated.

Factors associated with purchasing less expensive cigarettes

Complex samples multivariate logistic regression models were constructed to examine factors associated with purchasing less expensive cigarettes. The dependent variable was purchase of less expensive cigarettes and the independent variables were forced to enter the model. All categorical variables were changed to dummy variables before entering the model.

Factors associated with intentions to quit smoking

Complex samples multivariate logistic regression models were constructed to examine whether use of less expensive cigarettes was associated with decreased intentions to quit. The dependent variable was intention to quit smoking, the major independent variable of interest was purchase of less expensive cigarettes. All categorical variables were changed to dummy variables before entering the model.

Table 3 Median, IQR and lowest tertile of cigarette price paid (per pack) in the six cities

City	Valid N	Median	IQR	The lowest tertile of cigarette price paid (Yuan RMB)
Beijing	761	4.00	2.20	3.00 (US$ 0.44)
Shenyang	740	3.70	2.50	2.80 (US$ 0.41)
Shanghai	783	7.50	1.50	7.33 (US$ 1.08)
Changsha	793	4.40	1.00	4.00 (US$ 0.59)
Guangzhou	777	4.00	3.70	3.50 (US$ 0.51)
Yinchuan	784	5.00	3.50	4.00 (US$ 0.59)

RESULTS

The demographics of the study participants can be found in Wu *et al*.[18]

Cigarette price in each city

Table 3 presents the median, interquartile range and the lowest tertile of cigarette price paid (per pack) of the last purchase by city. Overall, the self-reported price of cigarettes ranges from 0.70¥ RMB per pack to 100¥ RMB per pack. The median price paid per pack was highest in Shanghai (7.50¥), followed by Yinchuan (5.00¥), Changsha (4.40¥), Guangzhou (4.00¥), Beijing (4.00¥) and Shenyang (3.70¥). The lowest tertile of cigarette price paid (per pack) of the last purchase was 3.00 in Beijing, 2.80 in Shenyang, 7.33 in Shanghai, 4.00 in Changsha, 3.50 in Guangzhou and 4.00 in Yinchua.

Factors associated with purchasing less expensive cigarettes

Table 4 shows the results of a complex samples multivariate logistic regression examining factors associated with purchasing less expensive cigarettes. Smokers who bought less expensive cigarettes at the last purchase tended to be older, heavier smokers, to have lower education and income, to smoke more cigarettes per day and to think more about the money spent on smoking in the last month.

Factors associated with intentions to quit smoking

Table 5 shows the results of a complex samples multivariate logistic regression model examining factors associated with intentions to quit smoking. Smokers who reported buying less expensive cigarettes at the last purchase were less likely to have intention to quit (OR=0.75, 95% CI 0.58 to 0.96). Compared to Beijing smokers, smokers in Shanghai (OR=0.50, 95% CI 0.27 to 0.92) and Guangzhou (OR=0.54, 95% CI 0.31 to 0.96) were less likely to have intention to quit. Other factors associated with decreased intention to quit included heavier smokers, smokers less knowledgeable about the harms of smoking and smokers who thought more about the money spent on smoking in the last month.

DISCUSSION

In this study, the median cigarette price paid ranged from 3.70¥ (about US$ 0.54) per pack in Shenyang to 7.50¥ (about US$ 1.10) per pack in Shanghai. The lowest tertile of cigarette price paid ranged from 2.80¥ (about US$ 0.41) per pack in Shenyang to 7.33¥ (about US$ 1.08) per pack in Shanghai. There are several possible interpretations for the huge differences among cities. The first one is the differences in city economy. As shown in table 2, the residents in the six cities differed in disposable

Table 4 Results of multivariate logistic regression examining factors associated with purchasing less expensive cigarettes

	N	Percentage who bought less expensive cigarettes*	OR	95% CI
Gender				
Male	4487	35.4	Reference	
Female	232	57.1	1.37	0.80 to 2.34
Age in years				
18–34	470	23.0	Reference	
35–44	1153	25.2	0.82	0.58 to 1.16
45–54	1624	32.4	1.08	0.79 to 1.48
55 or older	1463	53.1	2.61	1.90 to 3.59
Ethnic group				
Han	4484	33.3	Reference	
Others	235	36.4	1.01	0.66 to 1.56
Highest level of education				
Low	607	64.1	Reference	
Medium	3092	36.7	0.58	0.44 to 0.78
High	1014	16.3	0.28	0.20 to 0.39
Household income per month				
Low	911	57.4	Reference	
Medium	2120	39.6	0.50	0.39 to 0.64
High	1344	18.2	0.21	0.16 to 0.28
Don't know/cannot say	340	29.9	0.34	0.22 to 0.51
Number of cigarettes smoked per day				
1–10	1631	32.8	Reference	
11–20	2316	36.3	1.23	1.03 to 1.46
21–30	400	45.9	1.74	1.28 to 2.35
31 or more	344	40.7	1.32	0.95 to 1.83
Think about the money spent on smoking in the last month				
Never	3130	32.7	Reference	
Occasionally	961	36.8	1.18	0.95 to 1.45
Often	571	54.9	2.10	1.62 to 2.71
Don't know/cannot say	53	34.5	0.90	0.42 to 1.94
Index of knowledge about the adverse health effects of smoking				
0–1	928	44.2	Reference	
2–3	1110	37.5	0.92	0.68 to 1.24
4–5	1419	33.7	0.89	0.70 to 1.12
6–8	1234	31.3	0.77	0.59 to 1.01

City was not included in this model because we used the lowest tertile of cigarette price paid in each city as the cut-off for less expensive cigarettes, thus the percentage of smokers who bought less expensive cigarettes is the same across cities (1/3).
*Refers to the last purchase.

Table 5 Results of multivariate logistic regression examining factors associated with any intention to quit smoking

	Percentage intending to quit	OR	95% CI
City			
Beijing	29.1	Reference	
Shenyang	32.4	1.13	0.61 to 2.09
Shanghai	16.5	0.50	0.27 to 0.92
Changsha	25.2	0.99	0.58 to 1.69
Guangzhou	14.8	0.54	0.31 to 0.96
Yinchuan	28.3	0.88	0.50 to 1.55
Gender			
Male	24.3	Reference	
Female	25.3	0.92	0.53 to 1.61
Age in years			
18–34	25.3	Reference	
35–44	25.4	1.13	0.79 to 1.61
45–54	24.5	1.19	0.80 to 1.76
55 or older	23.2	1.21	0.83 to 1.77
Ethnic group			
Han	26.9	Reference	
Others	24.3	0.92	0.59 to 1.43
Highest education			
Low	19.1	Reference	
Medium	24.7	1.16	0.85 to 1.58
High	27.3	1.10	0.72 to 1.67
Household income per month			
Low	22.8	Reference	
Medium	25.6	1.13	0.85 to 1.51
High	25.5	1.27	0.91 to 1.77
Don't know/cannot say	16.6	0.85	0.52 to 1.39
Number of cigarettes smoked per day			
1–10	30.5	Reference	
11–20	22.6	0.71	0.60 to 0.84
21–30	15.7	0.50	0.36 to 0.70
31 or more	15.6	0.49	0.33 to 0.72
Think about the money spent on smoking in the last month			
Never	19.6	Reference	
Occasionally	29.6	1.61	1.26 to 2.05
Often	42.2	2.78	2.17 to 3.57
Don't know/cannot say	12.4	0.85	0.35 to 2.02
Buy less expensive cigarettes at the last purchase			
No	26.2	Reference	
Yes	21.0	0.75	0.58 to 0.96
Index of knowledge about the adverse health effects of smoking			
0–1	11.8	Reference	
2–3	17.1	1.49	1.09 to 2.04
4–5	27.5	2.56	1.95 to 3.35
6–8	37.8	3.69	2.59 to 5.23

income and consumption expenditure in 2006. Shanghai was the most affluent city, and this may partly interpret the high cigarette price and low use rate of less expensive cigarettes. However, the city economies cannot explain all the huge differences between cities. For example, Beijing and Shanghai residents had similar income and expenditure in 2006, but Beijing had 6 times higher less expensive cigarette use rates than Shanghai. The second possible interpretation is the difference in the supply of less expensive cigarettes. Because the profit margin of low-level cigarettes is very low, local tobacco companies are inactive in producing these cigarettes, which results in shortages in less expensive cigarette supply.[19] One article from Guangzhou Tobacco Company clearly stated, '…the major reason for the decrease in low-level cigarette sales is the shortage in supply'.[20] If the supply of low-level cigarettes in some cities is not enough, it's possible that less expensive cigarette smokers in these cities cannot find their usual brands and have to switch to more expensive cigarettes. The third possible interpretation might be the cultural differences among cities, which is unclear and needs further research.

In this study, the price differential among brands is large. The self-reported cigarette price ranged from 0.70¥/pack to 100¥/pack, which gives smokers more choices in the price of cigarettes. In other words, Chinese smokers have more flexibility in choosing different prices of cigarettes than most Western smokers.

Older, heavier smokers and smokers with lower SES were more likely to buy less expensive cigarettes. These findings are consistent with previous studies.[12 14] Poorer smokers bear more financial burden from smoking.[2 21] In this study, about 20% of smokers reported that their household income was less than 1000¥ per month. Even if these smokers smoked cigarettes priced at 2.5¥ per pack, a one pack per day smoker would spend 75¥ per month on smoking, which is about 7.5% of their household income. Thus, although tobacco companies have claimed that low-level cigarettes may decrease the

financial burden on low-income smokers, poorer smokers still spend a fair amount of their income on smoking. In comparison, raising cigarette prices may help poor smokers to quit smoking, which would decrease their smoking expenditure to 0 and also would help them lower the risk of getting smoking-related diseases.

Smokers who reported buying less expensive cigarettes at the last purchase were less likely to intend to quit, which is consistent with Cummings *et al*'s study conducted in the US. This suggests that the existence of less expensive cigarettes may deter smoking cessation. In the 1980s and 1990s, US tobacco companies used discount and generic cigarettes to retain price sensitive smokers and to slow the decline of tobacco use rates among US adults.[14] The China National Tobacco Company seems to be doing the same thing. In a paper published in the journal of China Tobacco in 2006, the authors from the China National Tobacco Company stated, 'if we abandon the market of low-level cigarettes, we will lose consumers as well as the basis for the continuing development of the tobacco industry…'.[22] This finding has important policy relevance. The WHO FCTC requires party countries adopt price and tax policies to reduce tobacco consumption. However, when cigarette prices are increased in China, some smokers may easily find a less expensive cigarette brand to substitute for their old brand, which may damage the effects of price and tax policies. Therefore, if China is to adopt price and tax policies as suggested in WHO FCTC, accompanying measures should be taken to reduce the price differential among brands. One option is to set a minimum price for cigarettes, another possible option is to change the current two-tier tax structure and apply the same amount of specific tax to each pack of cigarettes and eliminate the two-tier ad valorem tax, as suggested by Hu *et al*.[23]

Another interesting finding is that smokers who were more knowledgeable about the adverse health effects of smoking had more intent to quit smoking. The clear policy implication is that raising smokers' health knowledge may be an effective way to increase cessation in China. Health education or other interventions are needed to educate Chinese smokers about the specific effects on health of smoking.

The advantages of this study included the large sample size, rigorous study design and the ability to do comparisons among cities. However, there were some limitations in this study. The first limitation is the use of self-reported price. Smokers may not be willing to report buying less expensive cigarettes in a face-to-face survey. However, for most respondents, we asked them to show the interviewers their cigarette pack, which may have lowered such possibility. The second limitation is that we used the lowest tertile of cigarette price paid at the last purchase to classify cigarettes as less expensive in each city. As shown in table 1, the cut-off of the lowest tertile was different across cities. However, this method may reflect the relative price within each city. The third limitation is the use of cross-sectional data, which restricts our ability to explore causal relationships. This issue will be addressed when the next wave of data is available. Fourth, we measured the price of the last brand of cigarettes purchased. However, the last brand purchased may not be smokers' primary brand of cigarettes. Fifth, this study used self-reported data and may be subject to social desirability bias, namely respondents might tell the interviewer what they think he/she wants to hear. To minimise the social desirability bias, all the field interviewers were trained to be objective when administrating the survey, although this may not have completely solved the problem.

In summary, there is a wide variation in the price of cigarettes in China. Smokers of less expensive cigarettes tend to be older, heavier smokers, to have lower education and income, and to think more about the money spent on smoking in the last month. Smokers who bought less expensive cigarettes who were less knowledgeable about the health harms of smoking at the last purchase were less likely to intend to quit smoking. Measures need to be taken to minimise the price differential among cigarette brands and to increase smokers' health knowledge, which may in turn increase their intentions to quit.

What this paper adds

- China is home to one-third of the world's smokers. The prices of Chinese cigarettes differ dramatically. Studies from Western countries suggest that use of less expensive cigarettes may deter smoking cessation. However, little is known about the effects of less expensive cigarettes on smoking cessation in China.
- This paper suggests that Chinese smokers who use less expensive cigarettes and who are less knowledgeable about the health harms of smoking have weaker intention to quit smoking.
- Measures need to be taken to minimise the price differential among cigarette brands and to increase smokers' health knowledge, which may in turn increase their intentions to quit.

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Competing interests None.

Patient consent Obtained.

Ethics approval This study was conducted with the approval of the All materials and procedures used in the ITC China Survey were reviewed and cleared for ethics by the Office of Research at the University of Waterloo (Waterloo, Canada) and the Institutional Review Boards at: Roswell Park Cancer Institute (Buffalo, USA), the Cancer Council Victoria (Victoria, Australia) and the China National Centers for Disease Control and Prevention (Beijing, China).

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Perceptions of tobacco health warnings in China compared with picture and text-only health warnings from other countries: an experimental study

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ABSTRACT

Objective To assess the perceived effectiveness of cigarette health warnings in China, compared with picture and text-only warnings from other countries.

Method 1169 individuals (adult smokers, adult nonsmokers and youth) from four Chinese cities (Beijing, Shanghai, Kunming and Yinchuan) viewed 10 health warnings on cigarette packages, which included (a) the current Chinese text warnings covering 30% of the front/back of the pack (introduced October 2008); (b) the former Chinese text warning located on the side of the pack; (c) four picture warnings covering 50% of the front/back of the pack from Canada (lung cancer), Singapore (mouth disease), Hong Kong (gangrene) and European Union (clogged arteries); and (d) the same four warnings without the picture. Participants rated and ranked the 10 warnings on dimensions including how effective each would be in motivating smokers to quit and in convincing youth not to start smoking.

Results Both Chinese warnings were consistently rated as least effective, with the new Chinese warning rated only slightly higher than the old warning. The picture warnings were consistently ranked or rated as most effective, with the text-only versions in the middle. Results were consistent across subject group, city and sex.

Conclusions (1) Picture warnings are rated as much more effective than the same warnings without pictures. (2) The revised health warnings in China, introduced in October 2008, are only marginally more effective than the previous warning and far less effective than even text warnings from other countries. These results, coupled with population-based evaluation studies, suggest that pictorial warnings would significantly increase the impact of health warnings in China.

Health warnings on tobacco packages constitute an important method to inform and educate the public about the harms of tobacco use.[1] Health warnings are the focus of Article 11 of the World Health Organization's Framework Convention on Tobacco Control (FCTC), the world's first health treaty, which, as of August 2010, has been ratified by 171 countries inhabited by more than 85% of the world's population. Article 11 states that warnings shall be no less than 30% of the front and back of the package. There must be multiple versions of the warnings, which must be rotated, and packs must display information about product constituents. In addition to the minimum requirements, the FCTC recommends that health warnings cover at least 50% of the package, include pictures and a distinctive border to make the warning more prominent, and that they appear at the top of the package; these recommendations were incorporated in the Article 11 Guidelines, which were adopted at the Third Conference of the Parties in November 2008.[2]

China ratified the FCTC in October 2005 and has slowly begun to take steps towards implementing the FCTC in this country of over 300 million smokers. Until October 2008, China's text-only health warning was very small and located on the side of the pack, rather than on the front or back. There was just one message: "smoking may harm your health".

In October 2008, China implemented an enhancement of its health warning. The old and new health warnings are shown in figure 1. The new health warning had the following characteristics: (1) The health warning occupied 30% of both the front and back, although there were no design elements that set apart the health warning from the rest of the package design; (2) the warning appeared at the bottom rather than at the top of the package; (3) the health warning consists of two very general messages, rather than including information about the specific harms of smoking: "smoking is harmful to your health" and "quit[ting] smoking reduces health risk"; (4) the rotation consists only of a slight change in the second message: "quit[ting] smoking early is good for your health"; the first message remains identical on all packages; and (5) the two-message health warning on the back of all packages is identical to the front but is printed entirely in English (the English warnings included a grammatical error; the verbatim text is corrected above).

Although evaluation studies from the International Tobacco Control Policy Evaluation Project (the ITC Project) have demonstrated the effectiveness of picture warnings relative to text warnings at the population level,[1 3–8] the survey methods used in those evaluation studies have not allowed a more fine-grained and comparative evaluation at the level of the individual warning. Different methods — in particular, experimental studies — are best suited to determine the relative effectiveness of specific and individual warnings. In one such example by Peters *et al*,[9] smokers and nonsmokers in the USA were exposed to either Canadian pictorial health warnings or the U.S. text-only health warnings. Peters *et al* found that the Canadian pictorial warnings elicited significantly greater negative affect and were viewed for

Figure 1 The old (before October 2008) health warning and the new (October 2008) health warning on cigarette packages in China.

a significantly longer time than were the U.S. warnings. Such experimental studies are necessary to examine the impact of specific features of warnings, which would be beneficial for the design of warnings in countries that are in the planning stages.

The objective of this study was to compare the perceptions of Chinese individuals among three groups — adult smokers, adult nonsmokers and youth — of both the new and the old Chinese health warnings as contrasted with four health warnings from other countries/jurisdictions: Hong Kong, Singapore, Canada and the European Union (EU) — in their original form with pictures and in a revised form in which the text of the warning was identical but with the picture removed. Participants rated and ranked the 10 health warnings on a number of important dimensions directly related to public health goals, including perceived effectiveness in motivating smokers to quit and in convincing youth not to start smoking. To test for regional differences, the study was conducted in four cities: Beijing, Shanghai, Kunming and Yinchuan. The study was conducted in January–February 2009. Reports from all four cities indicated that at the time of the study the new warnings had totally or nearly totally replaced the old warnings.

METHOD

Participants and study design

The participants were 1169 individuals, who participated in the study during January–February 2009. The study design was a city (four: Beijing, Shanghai, Kunming, Yinchuan)×sex (two)× participant group (three: adult smokers, adult nonsmokers, youth (13–17 years old)). Table 1 presents the study design and the number of participants in each of the cells. Table 2 presents descriptive statistics of two participant groups: adult smokers and youth. Reactions to the current health warnings by adult smokers point to their lack of impact: only 28% to 46% reported noticing the warnings "often" or "very often" and only 9% to 13% reported that the warnings made them think about the health risks of smoking "often" or "very often".

The participants were recruited by local neighbourhood leaders and/or by staff at the local Center for Disease Control (CDC) in each city, who conducted the recruitment at neighbourhood association offices (Ju Wei Hui) and at local schools across a broad number of street districts (Jie Dao) throughout each city.

Table 1 Study design and number of participants

	Adult smoker		Adult nonsmoker		Youth (13–17 years)		
City	Male	Female	Male	Female	Male	Female	Total
Beijing	55	40	39	47	51	45	277
Kunming	50	50	46	50	50	50	296
Shanghai	51	52	47	50	50	50	300
Yinchuan	50	48	48	50	50	50	296
Totals	206	190	180	197	201	195	1169

Stimulus materials

Ten images of Chinese health warnings were created, including the old Chinese health warning (located on the side of the pack) and the new Chinese health warning (30% on the front of the pack). We created high-quality images of one health warning from each of four countries with picture warnings (Canada, lung cancer; Singapore, mouth disease; Hong Kong, gangrene; EU, clogged arteries). We translated the text into Chinese. For each of the four picture warnings, we created text-only versions by removing the picture.

Using digital image software, each constructed warning was placed on the image of a cigarette pack so that the resulting image was consistent with the Article 11 Guidelines: they occupied 50% of the top part of the package and each was set apart by a thick black box surrounding the warning. Each of the 10 images (old and new Chinese warnings and the eight constructed warnings) was placed on the cigarette pack of the same brand (Chunghwa) to maintain consistency.

The 10 images were assigned a random number from 1 to 10 to identify each warning to the respondent for the rating and ranking tasks. An image of each pack with that identifying number was printed on photographic paper, so that the size of the pack image was about 57×90 mm, nearly identical to the real pack size of about 55×88 mm.

The full set of 10 images is presented in figure 2.

Measures

Prelabel task questionnaire

Each respondent completed a short questionnaire that asked about demographic characteristics (eg, age, sex) and about various attitudes and opinions about smoking. Respondents who were smokers completed additional items that asked about their smoking history and current smoking (eg, cigarettes per day), using standard wording from the ITC surveys in China (see http://www.itcproject.org/research/surveys/itcchina).

Translation task

The translation task was designed to assess whether the Chinese respondents could understand the back warnings, which, as indicated above, appeared entirely in English. The first sentence was the top message of the new Chinese health warning: "Smoking is harmful to your health". The second sentence was one of the two variations of the bottom message: "Quit smoking early is good for your health" (this ungrammatical English sentence was reproduced verbatim from the text of the warning). The translation task was presented before exposure to any of the health warnings described below, so there was no previous exposure that could have prompted the answers to this translation task.

Label rating task

Each participant rated each of the 10 health warnings on two dimensions: (a) how effective each label would be in motivating smokers to quit and how effective each label would be in convincing youth not to start smoking. They did so on a five-point scale, where 5=" extremely effective", 4="very effective", 3="somewhat effective", 2="a little bit effective", and 1="not at all effective" (there were additional rating tasks, eg, emotional reactions and ratings of realism, but the analyses involving those variables are not reported in this paper).

Table 2 Descriptive statistics for adult smokers and for youth

Adult smokers					
Characteristic	**Beijing (n=95)**	**Shanghai (n=103)**	**Kunming (n=100)**	**Yinchuan (n=98)**	**Statistical test**
Age					
18–29	63%	60%	49%	48%	$\chi^2(9)=11.6$ p=0.24
30–39	13%	13%	22%	20%	
40–49	12%	17%	14%	20%	
50+	13%	10%	15%	11%	
Household income/month					
<3000 yuan	44%	36%	48%	43%	$\chi^2(9)=17.8$ p=0.038
3000–6999 yuan	35%	29%	29%	28%	
7000+ yuan	12%	15%	6%	4%	
No Answer	9%	20%	17%	25%	
Daily smokers	83%	79%	79%	78%	$\chi^2(3)=1.1$ p=0.78
Cigarettes per day, mean (SD)	12.5 (7.9)	12.1 (8.1)	11.1 (8.3)	10.4 (8.2)	F(3,387)=1.3 p=0.29
Ever tried to quit	61%	52%	61%	63%	$\chi^2(3)=2.9$ p=0.41
Time to first cigarette					
<5 min	26%	22%	22%	18%	$\chi^2(9)=4.6$ p=0.87
5–30 min	33%	27%	35%	30%	
31–60 min	15%	21%	18%	21%	
>60 min	25%	30%	25%	31%	
Self-rating of addiction to cigarettes: % somewhat or very addicted	87%	77%	86%	84%	$\chi^2(3)=4.9$ p=0.18
How often noticed warning labels: % often or very often	32%	46%	38%	28%	$\chi^2(3)=8.2$ p=0.04
How often warning labels make you think about the health risks of smoking: % a lot	9%	11%	12%	13%	$\chi^2(3)=0.8$ p=0.86

Youth					
Characteristic	**Beijing (N=96)**	**Shanghai (N=100)**	**Kunming (N=100)**	**Yinchuan (N=100)**	**Statistical test**
Age, mean (SD)	15.4 (0.6)	14.5 (1.3)	14.9 (1.9)	15.7 (1.0)	F(3,392)=17.4 p<0.0001
Smoking status					
Never smoked	98%	90%	79%	85%	Nondaily versus daily: $\chi^2(3)=5.9$ p=0.12
Former smoker	2%	9%	11%	10%	
Nondaily smoker	0%	1%	5%	4%	
Daily smoker	0%	0%	5%	1%	

Label ranking task

Each participant rank ordered each of the 10 health warnings on effectiveness on four dimensions: (a) motivating smokers to quit, (b) convincing youth not to start smoking, (c) informing the public about the harms of smoking, and (d) showing that the Chinese government is serious about reducing smoking.

Postlabel task questionnaire

All respondents answered two questions. The first was: "Do you think that cigarette packages should have more health information than they do now, less information, or about the same amount as they do now?" The response categories were "less health information", "about the same" and "more health

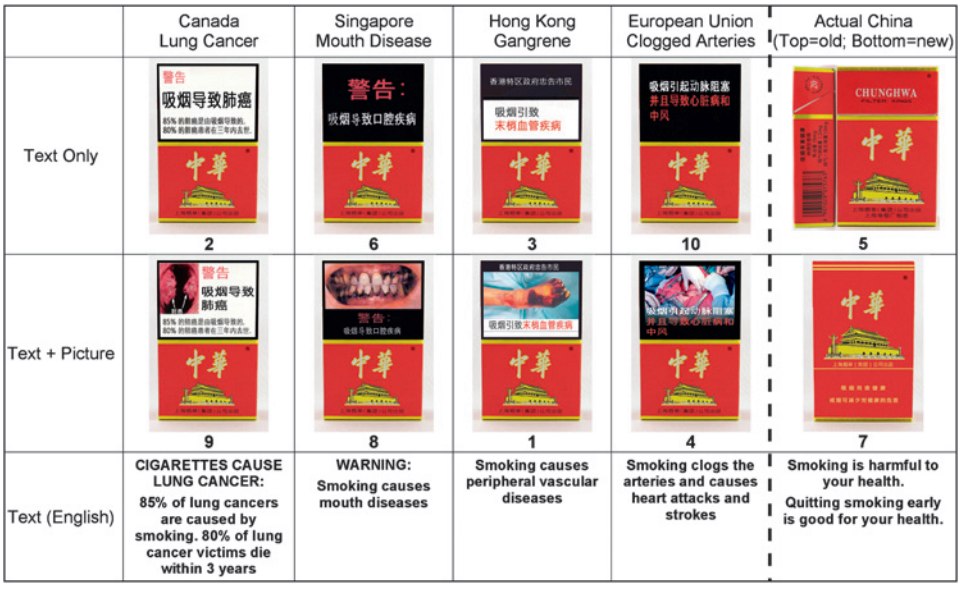

Figure 2 Images of health warnings used in the study, including Old and New Chinese health warnings. Note: numbers below each image are the random order numbers assigned to each of the images.

information". The second was "Do you think that the government should include pictures as part of the health warning on cigarette packs?" The response categories were "yes" or "no".

Procedure

Participants were recruited by local CDC staff in each of the four cities. They participated in small groups at locations such as conference rooms and neighbourhood schools. Upon arrival at the experimental session, participants were placed at a desk or table at sufficient distance from other participants so that their responses could remain confidential. The experimenter (a trained staff member of the local CDC) read the instructions from a written script for each part of the experiment. All experimental sessions across all four cities used the same script.

After the prelabel task questionnaire and translation task were completed, the experimenter called attention to the envelope on each participant's desk or table position. Inside the envelope were the 10 photo cards of the health warnings, randomly numbered 1 to 10 as shown above in figure 2. The experimenter conducted the label ranking task, the label rating task, and the postlabel task questionnaire. The experimenter then verbally debriefed the respondents and gave them a written feedback sheet. Finally, each participant was given 20 yuan in compensation for their participation.

The study protocol and all experimental materials, including the photo images and the questionnaires, were cleared for ethics by the Institutional Review Board of the China National CDC and by the Human Research Ethics Committee at the University of Waterloo.

Data analysis

Descriptive statistics were conducted on the demographic variables, and differences were tested via χ^2 analyses. The rating data were analysed by a mixed-model analysis of variance, with post hoc contrasts conducted to test for differences between individual warnings. Pearson correlation coefficients were computed to examine the degree of consistency between the rating and ranking tasks. All analyses were conducted using SAS V.9.1.

RESULTS

Ratings of warning effectiveness

Figure 3 presents the mean effectiveness ratings across all respondents for each of 10 health warnings on the dimension of motivating smokers to quit. The four picture warnings are presented in upward diagonal striped bars; the four text warnings from non-Chinese countries are in solid bars; the two China warnings (the old warning and the new warning) are in downward diagonal striped bars.

There was a substantial difference across the 10 warnings in mean effectiveness, $F(9,10\,278)=785.32$, $p<0.0001$. A difference between the means of any two labels of 0.10 scale point is significant at the 0.05 level, a difference between the means of any two labels of 0.13 scale points is significant at the 0.01 level, and a difference of 0.17 scale points is significant at the 0.001 level.

Looking first at the broad categories of warnings, all four of the picture warnings were rated highest on effectiveness in motivating smokers to quit, followed by a large gap of about 0.5 scale point by the four non-Chinese text warnings ($p<0.0001$), followed by another large gap of 0.6 scale point between the text warnings and the two Chinese warnings ($p<0.0001$).

Looking within the picture warnings, the Canadian lung cancer warning received the highest rating, followed by the Singapore mouth disease warning, the Hong Kong gangrene warning and the EU clogged arteries warning. All differences between adjacent warnings were significant at the 0.05 level. Among the text warnings, the Canadian lung cancer warning had the highest rating, followed by the EU clogged arteries warning, the Hong Kong gangrene warning and the Singapore mouth disease warning. Finally, the new Chinese warning was significantly more highly rated than the old warning ($p<0.05$), but much lower in ratings than the lowest-rated text-only warning from the other countries ($p<0.0001$).

Figure 4 presents the mean effectiveness ratings on the dimension of convincing youth not to start smoking. The identical pattern of results was found. The exact ordinality of the 10 warnings was replicated with the only exception that the

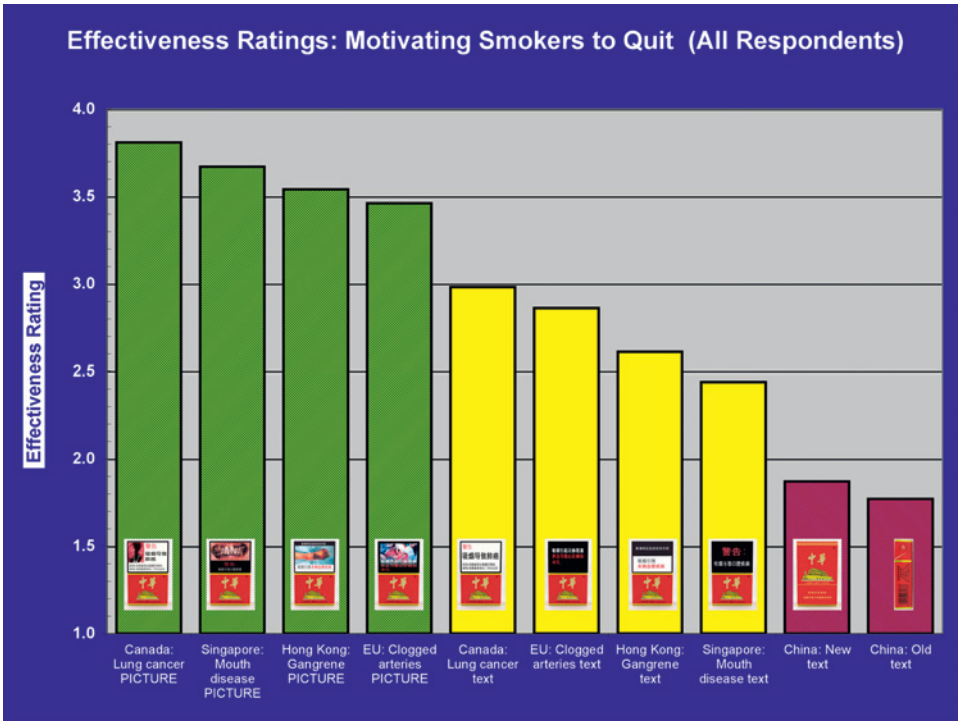

Figure 3 Mean effectiveness ratings of each health warning: "How effective would each label be in motivating smokers to quit?" (All Respondents).

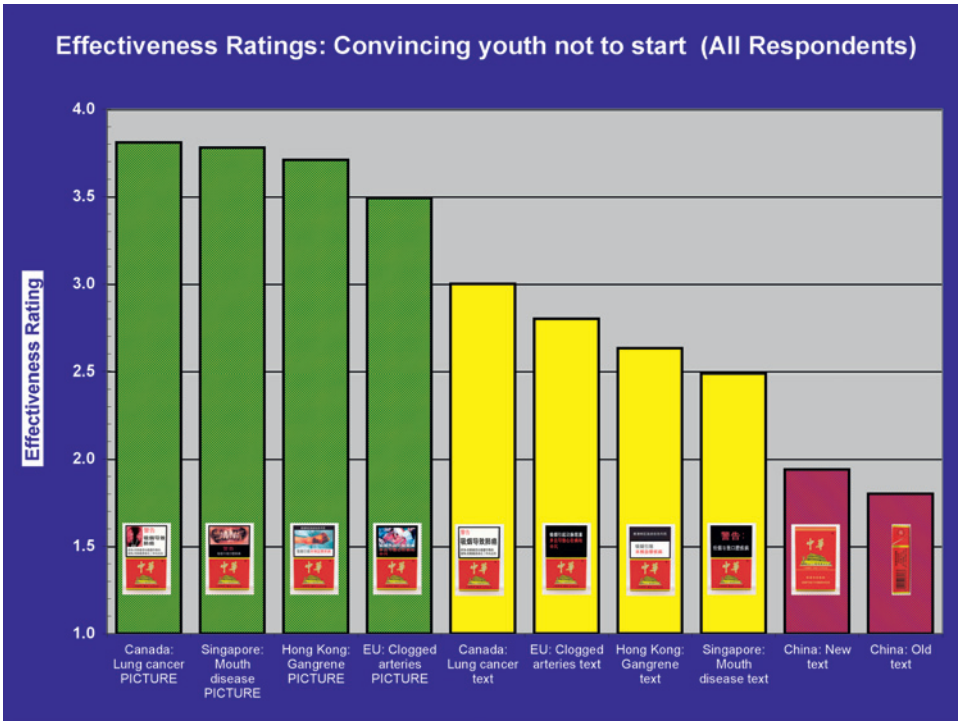

Figure 4 Mean effectiveness ratings of each health warning: "How effective would each label be in convincing youth not to start smoking?" (All respondents).

Canadian lung cancer and Singapore mouth disease picture warnings did not differ significantly at the 0.05 level.

We conducted mixed model ANOVAs to determine whether these ratings varied as a function of the factors in the study design. The results were essentially the same for the ratings for motivating smokers to quit and for convincing youth not to start: (a) there was no difference by city, subject group (smokers, nonsmokers, youth) or sex; (b) there was an enormous effect of warning ($p<0.0001$) and (c) there were significant interactions for warning×city ($p<0.0001$) and for warning×participant group ($p<0.0001$) and warning×sex ($p=0.017$). The interactions were due almost entirely to variations in the effectiveness ratings among the four pictorial warnings or among the four non-Chinese text warnings rather than due to variation in city, participant group, and sex across the broader categories of pictorial warnings versus text-only warnings. In no subgroup (sex, city, or participant group) did the basic ordering change: the four pictorial warnings were always rated as much more effective than the four non-Chinese text warnings, which in turn were always rated as much more effective than the two Chinese warnings. The two China warnings were always the lowest rated of the 10 warnings.

Because the sample sizes were high, small mean differences can yield statistical significance. To provide some indication of the effect sizes — which are independent of sample size — associated with key comparisons of the new Chinese warning and the other warnings, we computed the Cohen's d for the difference between the new Chinese warning and (a) the lowest-rated foreign text warning and (b) between the new Chinese warning and the lowest-rated foreign picture+text warning. For ratings of effectiveness for whether the warning motivated smokers to quit, the difference between the new Chinese warning and the lowest rated foreign text warning (Singapore mouth disease) was associated with $d=0.47$, close to the benchmark of 0.5, for a "moderate" effect size and the difference between the new Chinese warning and the lowest rated foreign text+picture warning (EU clogged arteries) was associated with $d=1.36$, way above the benchmark of 0.8 for a "high" effect size. The Cohen's d for the same two differences on convincing youth not to start smoking were very similar: 0.45 and 1.27, respectively. All other comparisons between the new Chinese warning and any other text or text+picture warning would yield an even higher effect size. These effect size computations demonstrate the pronounced differences in perceived effectiveness between the new Chinese warnings and any of the foreign alternatives, especially those with graphic images.

Ranking of label effectiveness

The ranking task replicated the findings of the rating task. There were two dimensions on which participants both ranked and rated the 10 labels. Figure 5 presents the mean rankings for effectiveness in motivating smokers to quit, which shows the near identical pattern of results presented in figure 3 for mean ratings.

The chart of mean rankings for effectiveness in convincing youth not to start smoking is presented in figure 6. Although there were some differences in ordering within the four picture warnings (eg, the Singapore mouth disease warning was the highest ranked warning), compared with the mean ratings presented in figure 4, the strong three-level ordering of the warnings was found again. For the mean rankings, the gap between the China warnings and the other text-only warnings was more pronounced than it was for the mean ratings.

The similarity of the ranking and rating tasks was quantified by computing the within-subject correlation between ranking and rating for each respondent. For motivating smokers to quit, the mean correlation between ranking and rating was 0.732; for convincing youth not to start smoking, it was 0.704.

As an illustration of the uniformity of the difference between the picture warnings and the new China warnings, 59% of all participants ranked the Singapore picture warning as the most effective or the second most effective warning for convincing youth not to start smoking. In contrast, 81% of all participants ranked the new China warning as either the least effective or the second least effective warning.

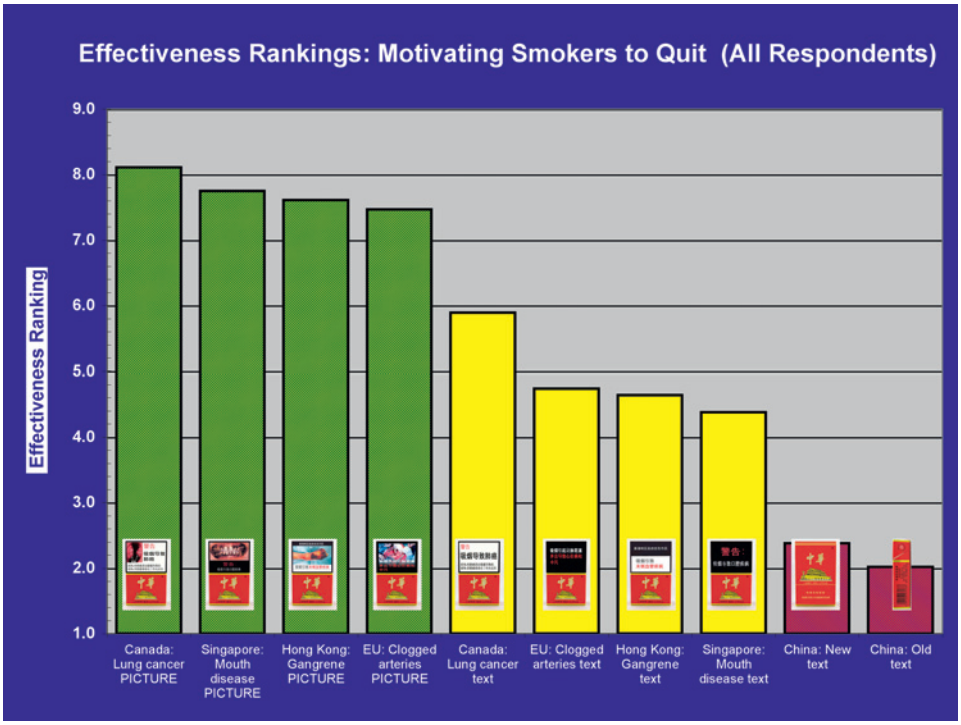

Figure 5 Mean ranking of health warnings on "How effective would each label be in motivating smokers to quit?" (All Respondents).

Figure 7 presents the mean rankings of the warnings on how effective the labels were for informing the public of the dangers of smoking. Figure 8 presents the mean rankings of the warnings on effectiveness for showing that the Chinese government is serious about reducing smoking. For both of these measures, the same three-level findings were replicated, although there was a very slight difference in ranking within the levels.

Opinions about what the Chinese warnings should include

At the end of the study session, participants were asked for their opinions about what the Chinese warnings should include. Nearly three-quarters of participants (74.4%) stated that cigarette packages should have more health information. Only 6.0% said that cigarette packages should have less health information, and 19.6% said that cigarette packages should have "about the same". The opinion that cigarette packages should have more health information was higher in Kunming (77.7%), Yinchuan (76.0%), and Shanghai (75.5%), than it was in Beijing (67.6%) (each comparison with Beijing: $p<0.035$). It was highest among youth (81.5%), followed by adult nonsmokers (77.5%) and lowest among adult smokers (64.2%). Youth and nonsmokers did not differ from each other, but both were, as expected,

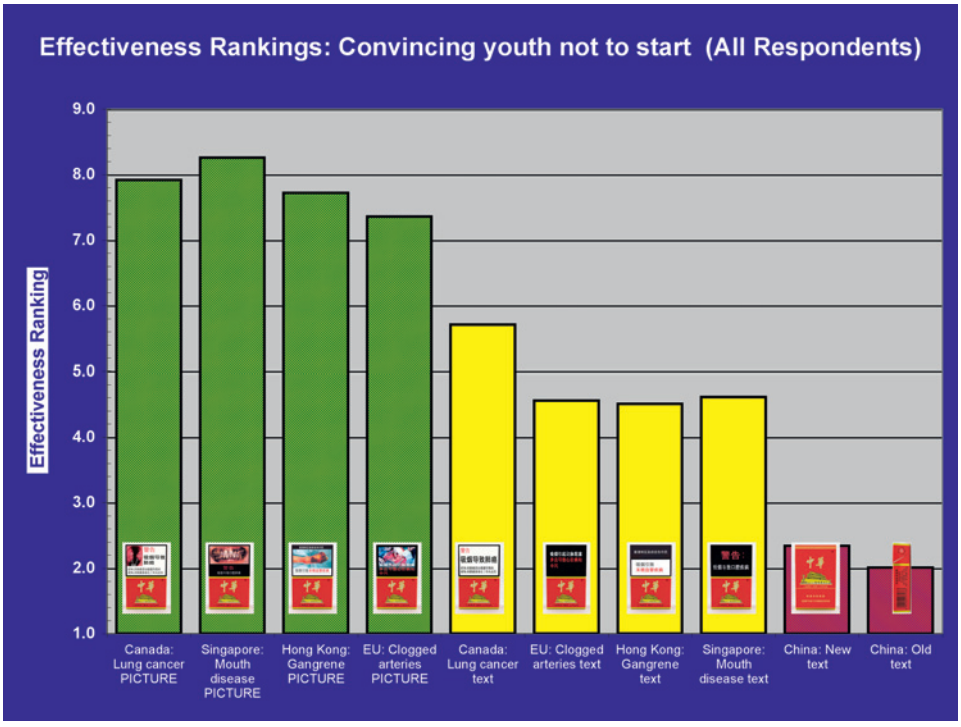

Figure 6 Mean ranking of health warnings on "How effective would each label be in convincing youth not to start smoking?" (All Respondents).

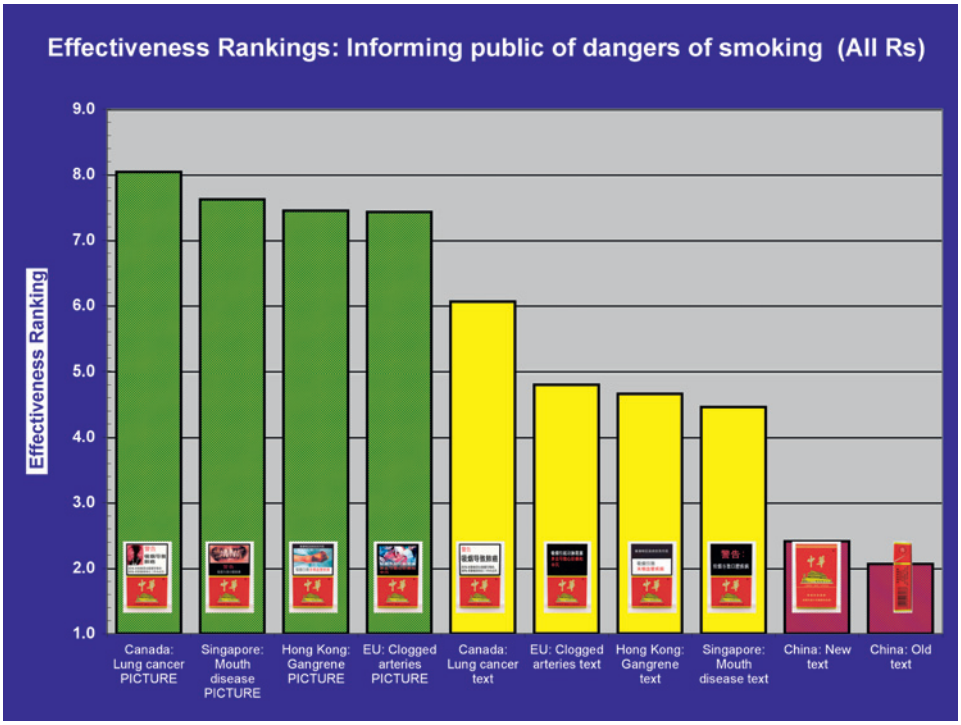

Figure 7 Mean ranking of health warnings on "How effective would each label be in informing the public about the harms of smoking?" (All Respondents).

significantly higher than adult smokers ($p<0.001$). However, it should be noted that even the majority of adult smokers wanted more health information on cigarette packages.

In addition, 80.7% of participants stated that warning labels should include pictures. This proportion was significantly higher among adult nonsmokers (86.1%) than it was among youth (78.9%) and adult smokers (77.4%); both comparisons with nonsmokers: $p<0.025$. It was higher in Kunming (87.2%) and Yinchuan (86.1%) than it was in Beijing (77.6%) and Shanghai (71.8%); Beijing and Shanghai did not differ significantly from each other, but both were significantly lower than Yinchuan and Kunming ($p<0.007$ for each comparison).

Prevalence of understanding the English warning messages

Table 3 presents the percentage of participants who correctly translated each of the two English phrases on the back of the cigarette pack. Of all adult smokers — the group that would be more likely to encounter these warnings — only 26.8% were able to correctly translate "smoking is harmful to your health" and only 10.1% could correctly translate "quit smoking early is

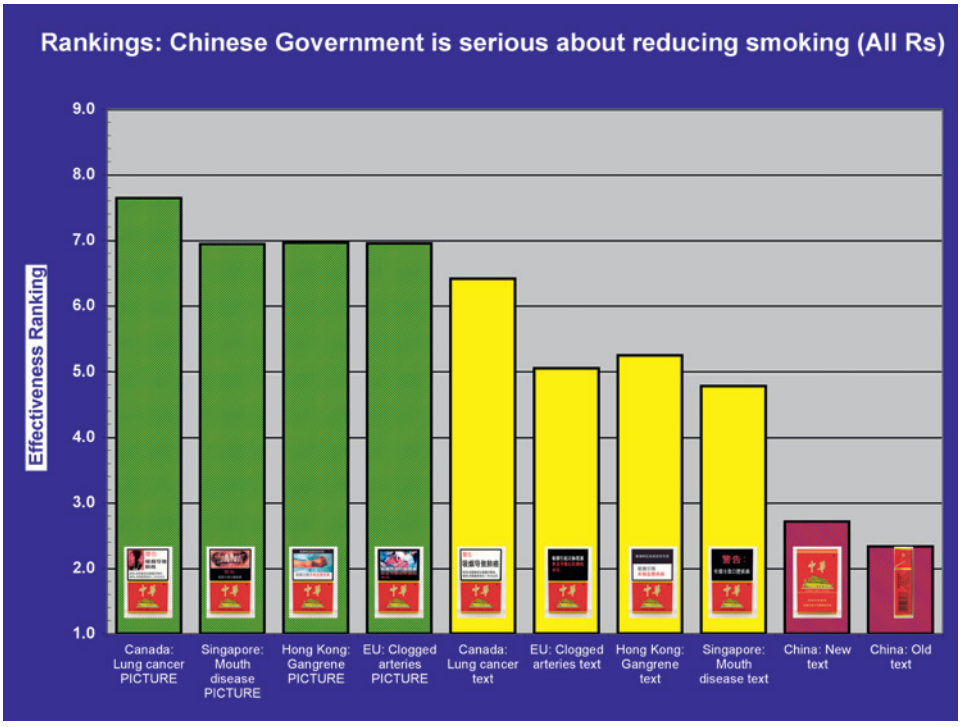

Figure 8 Mean ranking of health warnings on "How effective would each label be in showing that the Chinese Government is serious about reducing smoking?" (All Respondents).

Table 3 Percentage of participants who correctly translated each of the two English warnings by type of participant

Translation phrase	Adult smoker (n=396)	Adult nonsmoker (n=377)	Youth (n=396)	Total (n=1169)
"Smoking is harmful to your health".	26.8%	51.5%	90.4%	56.3%
"Quit smoking early is good for your health".	10.1%	24.7%	47.7%	27.5%

good for your health". As expected, youth were more likely to be able to translate these English phrases ($p<0.0001$), but fewer than half of youth (47.7%) were able to translate the second phrase.

DISCUSSION

The results of this experimental study across a diverse set of people in four Chinese cities strongly support two conclusions: that picture warnings are judged as being more effective than text-only warnings and that the new China health warnings are judged as less effective than text-only warnings being used by other countries. These strong findings were highly consistent across the three participant groups (adult smokers, adult nonsmokers and youth), city and sex, as well as across all dimensions on which the effectiveness was being judged.

The two conclusions were supported on dimensions that are at the heart of the main objective of health warnings: to communicate effectively about the dangers of smoking. Much work in health communication has demonstrated that messages are stronger to the extent that they can provide specific information about harm and that they do so in a vivid and engaging manner.[10 11] As of February 2010, 35 countries now employ pictorial warnings,[12] which depict a broad range of specific harms that are caused by smoking, including lung cancer, heart disease, stroke, mouth disease, chronic obstructive pulmonary diseases (COPD, such as emphysema) and impotence.[13] All of these adverse effects are well-documented by research, and some have been well-established for decades. As such, their inclusion on health warnings would be noncontroversial and important. Because knowledge of specific harms of smoking is low in China,[14] findings from the ITC Four Country Survey (Canada, USA, UK and Australia) showing that health warnings have a beneficial impact on increasing knowledge about the risks of smoking[3] and of smoke constituents[4 15] lead to the strong prediction that inclusion of such specific harms on health warnings would be an effective and low-cost method for increasing the knowledge of the Chinese public.

The findings make a compelling case that the Chinese health warnings introduced in October 2008 do not represent a significant enhancement. Both the old and the new warnings were consistently the lowest rated or ranked of the set of 10 warnings, and the new warning was only slightly stronger than the old warning, which had appeared on the side of the pack. The use of English for the warning on the back of the pack was shown to be ineffective at best: close to three-quarters of adult smokers could not translate one of the two sentences on the text-only warning, and close to 90% of them could not translate the other sentence. These findings support the principle that countries should not be presenting important health messages to their people in a foreign language.

The findings also indicate that the Chinese public wants their government to implement stronger health warnings. The vast majority wants more health information on cigarette packages, and an even greater proportion wants the health warnings to include pictures. This was true even among smokers. It should be noted that participants gave their responses to these two questions after seeing the picture warnings we had created for this study, so their opinions were shaped by having been exposed to concrete examples rather than by mere abstract concepts. It is also notable that participants in Kunming, located in the heart of the tobacco industry in China, were the highest among the four cities in their desire for the government to implement stronger health warnings.

Limitations

The experiment asked participants to give their opinions on the warnings after limited exposures, and thus the actual impact of the warnings if they were to appear on packs is not certain. Similar to this, the dependent measures were not actual risk perceptions, personal beliefs about smoking-related disease, quit intentions or smoking/quitting behaviour after having been exposed to real-world graphic warnings. Such a real-world experiment would be difficult or impossible to conduct. However, these findings of the superiority of pictorial warnings are convergent with findings from other experimental studies (eg, Peters *et al*[9]) and with population-based evaluations of warning labels from the ITC Project across a number of countries.[1 3–8]

This experiment was conducted in only urban areas and thus may not represent responses that would be obtained in rural areas. However, if literacy rate and knowledge of English are lower in rural China, then it is reasonable to expect that the main findings of the superiority of pictorial warnings and the low rates of comprehension of the English text would, if anything, be enhanced.

Conclusions

In response to the tobacco epidemic in China, which caused an estimated 673 000 deaths in 2005,[16] China has made

What this paper adds

- Recent survey research and some experimental studies have demonstrated that including graphic pictures on health warnings on tobacco packaging is more effective in increasing thinking about the health risks of smoking and of motivating intentions to quit and actual quit attempts. These studies have almost exclusively been conducted in high-income countries.
- This is the first study to examine the potential impact of pictorial health warnings in China. Using an experimental design allowing the specific comparison of the same health warning with and without a graphic warning, the results demonstrated the superiority of pictorial health warnings; these results did not differ substantially across different cities, sex, smoking status and age group. Moreover, the inclusion of the old and new (October 2008) Chinese warnings allowed for an explicit comparison of the actual Chinese warnings against warnings from other countries. Both Chinese warnings were rated as lowest in effectiveness and the new warning was barely higher than the old warning in effectiveness. In all, the findings support the conclusion that the Chinese government's October 2008 enhancement of the warnings represents a minimal improvement over the old warnings and that pictorial warnings, such as those already introduced in 35 other countries, would represent a considerable improvement.

a commitment towards tobacco control in its ratification of the FCTC. Strong health warnings are the foundation of a comprehensive approach to tobacco control because the objective of health warnings is to inform the public about the harms of tobacco products, using methods that will increase the likelihood that smokers will be motivated to quit and youth will be less likely to take up smoking.

The findings of this experimental study add to the growing evidence on the superiority of picture warnings and highlight the importance of strong, pictorial warnings in a comprehensive tobacco control program. But this study also demonstrates how little progress has been made so far in China on health warnings.

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Competing interests None.

Ethics approval This study was conducted with the approval of the Institutional Review Board of the China National CDC and by the Human Research Ethics Committee at the University of Waterloo.

Contributors GTF led the conception and design of the study, the interpretation of the data analysis and drafted the article and its revisions. DH contributed to the conception and design, the interpretation of the data and revised drafts of the article. YJ contributed to the conception and design, the acquisition of data and reviewed drafts. QL contributed to the conception and design, to the acquisition of data and reviewed drafts. ACKQ contributed to the conception and design and reviewed drafts. PD led the analyses of the data and reviewed drafts. MY contributed to the analyses of the data and reviewed drafts. All authors reviewed and approved the final version of the article.

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