Cross-sectional survey on cigarette smoking in Chinese high-income areas

Lei Yuan, Pei Liu, Zhe Zhao, Zhenbang Wei, Lijuan Liu, Jinhai Sun

ABSTRACT

Objective To evaluate smoking status and its influencing factors in high-income areas of China.

Design Cross-sectional.

Setting High-income areas in China.

Participants 4064 persons aged 15 years or older from the survey results in Global Adult Tobacco Survey-China 2018.

Methods Gross national income data were used to determine China’s high-income economic regions, and the results of the survey in Global Adult Tobacco Survey-China 2018 were used for statistical analysis.

Results A total of 4064 people were included in our study, including 881 current smokers, 2884 who had never smoked and 299 who had quit smoking. Using the standardised rate method, the standardised smoking rates in high-income and non-high-income areas in China were calculated to be 23.56% and 27.77%, respectively. Men, high school education or below, knowledge of e-cigarette information, permission to smoke at home and people with poor smoking health literacy are the main influencing factors of smokers in high-income areas of China.

Conclusion The smoking rate of people in China’s high-income areas is lower than the overall smoking rate in China, and we should increase the public awareness that smoking is harmful to health, encourage the prohibition of smoking at home, increase investment in higher education and improve residents’ smoking health literacy level. The purpose of this study was to encourage reduction in the rate of smoking and better control the prevalence of smoking.

INTRODUCTION

Smoking is the main cause of chronic non-communicable diseases worldwide, and it is also an important risk factor for cardiovascular diseases and lung diseases. In 2019, as the second largest health risk factor in the world, smoking caused 8.71 million deaths, accounting for 15.4% of the annual deaths. As a major tobacco producer and consumer in the world, China is at the centre of this health crisis. The results of the 2018 Chinese Adult Tobacco Survey released by the Chinese Center for Disease Control and Prevention (CCDC) show that the smoking rate of people aged 15 and over in China is 26.6%, including 50.5% for men and 2.1% for women. Although the overall rate is lower than in the previous survey (28.1% in 2010), the number of people who smoke is still high compared with the global smoking rate of 19.2%.

Previous studies have shown that exposure and use of tobacco products are related to regional income levels. Compared with developed countries, the smoking rate of people in developing countries is often higher, and national economic development is one of the main factors influencing smoking prevalence. Several studies on smoking prevalence have found that people with low income have a stronger response to tobacco prices than people with high income. Other studies found no evidence of this difference. In the past three decades, China’s economy has developed rapidly, and the national income of some regions has reached the standard of developed regions worldwide and has entered the ranks of high-income areas. Control of the tobacco epidemic is a long-term process, which is strongly related to the residents’ education, culture, health literacy, behaviour, cognition, family income and mental health. In recent decades, some cities in China have seen rapid growth in industrialisation and modernisation and have become areas of higher economic levels. However, there is a lag in changes related to smoking intensity pattern, social and economic group composition, the tobacco epidemic trend and other factors that are different from those in developed countries.
of controlling the tobacco epidemic needs to be different from that used in developed countries; however, there are no studies on this yet. Therefore, it is necessary to analyse the characteristics of smoking behaviour in high-income areas of China to provide suggestions for developing countries to control the tobacco epidemic while undergoing rapid economic growth.

**METHODS**  
**Definition and selection of high-income regions in China**  
According to the per-capita gross domestic product (GDP) of China’s provinces in 2018 published in the 2019 *China Statistical Yearbook*, and according to the economic division standard of high-income countries by the World Bank (gross national income (GNI) >$12,055, on average $1 equalled ¥6.6118 in 2018). Since only the GDP, and not the GNI value, is mentioned for each region of China, the regional GDP value is used to calculate the regional GNI value. The formula used for conversion is:

\[
\text{Regional GNI} = \frac{\text{Regional GDP}}{\left(\frac{\text{National GDP}}{\text{National GNI}}\right)}
\]

According to the formula, the provinces with regional GNI that meet high-income regional standards are Beijing ($23,125), Tianjin ($18,188), Shanghai ($20,338), Jiangsu ($17,353), Zhejiang ($14,863), Fujian ($13,741) and Guangdong ($13,020).

**Data sources**  
The research data come from the Global Adult Tobacco Survey (GATS)-China 2018, which was a multistage stratified cluster sample survey conducted by the CCDC in 2018, and 19,376 people were selected for interview survey. The detailed design report is available here: https://ncdc.cdc.gov/GTSSDataSurveyResources/Ancillary/Publications.aspx (accessed 5 Jan 2022). The inclusion criteria included living in China’s high-income provinces and age above 15. The data of 4,851 respondents belonged to high-income areas. The exclusion criteria included no response to any item in the survey and/or no response to smoking knowledge and/or no response to smoking attitude. A total of 4,064 respondents were selected for this study.

**Smoking classification**  
This study divided participants into three categories: 881 current smokers (smokers at the time of the survey), 2,884 people who had smoked (never smokers) and 299 people who had quit smoking (quit smokers).

**Analytical index**  
**Demographic data**  
All participants provided the following demographic data: sex, age, province, residence attributes (urban and rural), education level (no formal education, below primary school, below junior high school, junior high school, high school, university, postgraduate, above), annual family income, occupation (agriculture, forestry, animal husbandry, government civil servants, business administration, factory workers, teachers, health workers, students, soldier, no job, retired, other employment statuses), number of family members, number of family members 15 years and older, workplace (indoor and outdoor), family smoking regulations (allowed, generally not allowed but with exceptions, never allowed, no regulations) and knowledge about electronic cigarettes.

**Smoking cessation**  
The smoking cessation of current 881 smokers was investigated through seven questions, including:

1. Have you ever tried to stop smoking? (‘Yes’ or ‘No’).
2. Which of the following best describes your thinking about quitting smoking? (‘Quit within the next month’, ‘Thinking within the next 12 months’, ‘Quit someday, but not in 12 months’, ‘Not interested in quitting’, ‘Don’t Know’, ‘Refuse/Missing’).
3. What was the most important reason for you to try to stop smoking last time? (‘Got illness’, ‘Worried about self-health’, ‘Heavy economic burden’, ‘Family’s disapproval’, ‘Other’).
4. Thinking about the last time you tried to quit, how long did you stop smoking? (‘Months’, ‘Weeks’, ‘Days’, ‘Less than one day 24 hours’).
5. During any visit to a doctor or healthcare provider in the past 12 months, were you asked if you smoke tobacco? (‘Yes’ or ‘No’).
6. During any visit to a doctor or healthcare provider in the past 12 months, were you advised to quit smoking tobacco? (‘Yes’ or ‘No’).
7. Have the warnings on cigarette packs made you think about quitting? (‘Yes’, ‘No’ or ‘No attention paid’).

**Knowledge of smoking**  
All participants were provided a 12-item questionnaire to evaluate smoking knowledge, including statements on smoking and the relationship between smoking and the consequences such as specific diseases. The specific questions have been shown in online supplemental table S1. Each question was scored 1 point for correct answers and 0 point for incorrect answers. The score was calculated according to ref 18.

Questions for knowledge judgement evaluated the knowledge of smoking in the survey population. The scores of 1–4 indicated ‘poor smoking knowledge’, 5–8 indicated ‘fair’ and 9–12 demonstrated ‘good’.

**Attitude towards smoking**  
The attitude towards smoking was evaluated through five questions, including:

1. Do you pay attention to health warnings on the cigarette case? (‘Yes’, ‘No’ or ‘Uncertain’).
2. Do you agree with having health warning pictures printed on cigarette packs? (‘Yes’, ‘No’ or ‘Uncertain’).
3. Do you agree with increasing the tobacco tax and retail price of cigarettes? (‘Yes’, ‘No’ or ‘Uncertain’).
4. If the tobacco tax increases, should part of the funds be used for tobacco control? (‘Yes’, ‘No’ or ‘Uncertain’).
5. If the tobacco tax is increased, do you think that part of the funds should be used for health insurance? (‘Yes’, ‘No’ or ‘Uncertain’).

Statistical method
The SPSS Statistics V.21.0 (IBM) software was used for statistical analysis. Descriptive statistical method was used to describe demographic data and the proportion of answers that varied in the questionnaires, among different groups; we used the standardised rate method to calculate smoking prevalence in high-income areas based on population adjustments; \( \chi^2 \) test was used to analyse the univariate analyses of smokers and quit smokers, the test standard was \( \alpha = 0.05 \).

We selected current smokers and never smokers as evaluation variables using stepwise regression analysis established to evaluate the influence of different variables on smoking and quitting status (including \( \alpha = 0.05 \), excluding \( \alpha < 0.10 \)), the bilateral test (\( p < 0.05 \)) was considered statistically significant.

Patient and public involvement
No participants were involved in deciding the research question, study design, outcome measures or interpretation of results. This study uses data provided through a survey by the participants and were securely accessed and stored. There are no plans to disseminate the results of the research to the study participants. No permission was required for accessing and using these data.

RESULTS

Demographic data
The demographic data of the survey respondents are shown in table 1. The results of the study were based on 881 smokers, 2884 never smokers and 299 quit smokers.

The population aged 15 years and over in China’s high-income areas was calculated according to the sampling results of China’s population in 2018 surveyed by the China Statistical Yearbook in 2019. According to the results of the smoking sampling survey, the total smoking rate in the survey area was 30.75%, of which 44.52% were men and 1.62% were women (online supplemental table S2). Using the standardised rate method and based on the total population of China and officially announced smoking rate in 2018, the standardised smoking rate in high-income areas was 23.56% while that in non-high-income areas was 27.77%.

Current smokers
The current tobacco usage activities of smokers are shown in table 2. According to the survey, current smokers often smoked their first cigarette 6–30 min after waking up in the morning and like to buy packaged cigarettes. The cost of buying cigarettes every time was mostly below ¥100, they often bought cigarettes in supermarkets and did not use smokeless tobacco.

Smoking cessation
Among the current smokers, 364 people (41.32%) had tried to quit smoking, and more than half of the smokers (65.22%) were unwilling to quit smoking (table 3). Among the people who tried to quit smoking, the main reason for quitting was health (either they got ill or worried about their health). Most of the people who answered the last smoking cessation situation persisted on quitting smoking for several months. The data were got by question D02A in the GATS. The investigation which was carried out by questions B16 and B17 in the GATS showed that 54.57% of people were asked about their treatment by doctors and 73.60% of patients who had asked about smoking had been advised to quit (D02A, B16 and B17 in online supplemental table S3). Only a small number of people (24.08%) thought that the warnings on the cigarette packs were useful, while most thought they were useless or paid no attention to them.

Knowledge of and attitude on smoking
Questions 1–12 are based on knowledge of smoking (table 4). There are seven questions with the correct answer rate exceeding 50%. Many people do not have the knowledge of the harm caused by smoking or by second-hand smoke in relation to stroke, heart disease, erectile dysfunction and heart disease in adults.

Smoking knowledge scores
The scores based on knowledge of smoking for 918 people (22.59%) were evaluated as poor and for 1445 people (36.48%) as good (table 5). After analysis, there were significant differences in smoking scores among current smokers, never smokers and quit smokers (\( p < 0.001 \)).

Factors associated with smoking
There are 12 input variables: the factors with \( p < 0.05 \), as shown in table 1, and smoking knowledge scores were selected as input variables, the current smoking status was taken as the output variable and a binary logistic model was established (table 6). The results of stepwise regression analysis show that five variables are the influencing factors of smoking in high-income areas: sex, education level, e-cigarette knowledge, smoking rules at home and smoking knowledge.

DISCUSSION
To the best of our knowledge, this study is the first to examine the prevalence of smoking among people in high-income areas in China. It evaluates smoking knowledge and attitudes towards smoking, and analyses the main influencing factors of smoking among people in high-income areas. The regional formulation of tobacco control policies provides good theoretical support.
However, the smoking rate in China is still higher than the global average. The results of our analysis show that
**Table 1**  Basic information

| Characteristics          | Current smoker | Never smoker | Former smoker | $X^2$ | P value |
|--------------------------|----------------|--------------|---------------|-------|---------|
| **Province**             |                |              |               |       |         |
| Beijing                  | 33             | 144          | 14            | 48.55 | <0.001  |
| Tianjin                  | 20             | 50           | 8             |       |         |
| Shanghai                 | 109            | 336          | 44            |       |         |
| Jiangsu                  | 260            | 582          | 80            |       |         |
| Zhejiang                 | 130            | 582          | 80            |       |         |
| Fujian                   | 22             | 42           | 2             |       |         |
| Guangdong                | 307            | 1003         | 68            |       |         |
| **Gender**               |                |              |               |       |         |
| Male                     | 859            | 736          | 279           | 1696.55 | <0.001 |
| Female                   | 22             | 2148         | 20            |       |         |
| **Age**                  |                |              |               |       |         |
| 15–19                    | 6              | 63           | 2             | 181.74 | <0.001 |
| 20–29                    | 95             | 359          | 6             |       |         |
| 30–39                    | 95             | 306          | 15            |       |         |
| 40–49                    | 156            | 498          | 28            |       |         |
| 50–59                    | 198            | 504          | 50            |       |         |
| ≥60                      | 331            | 954          | 198           |       |         |
| **Urban-rural indicator**|                |              |               |       |         |
| Urban                    | 636            | 2195         | 203           | 13.28 | 0.001   |
| Rural                    | 245            | 689          | 96            |       |         |
| **Education level**      |                |              |               |       |         |
| No formal schooling      | 28             | 321          | 17            | 168.44 | <0.001 |
| Less than primary school completed | 99 | 259 | 42 |
| Primary school completed | 116            | 304          | 20            |       |         |
| Less than secondary school completed | 45 | 98 | 22 |
| Secondary school completed | 286           | 640          | 70            |       |         |
| High school completed    | 178            | 484          | 59            |       |         |
| College/university completed | 125           | 719          | 48            |       |         |
| Postgraduate degree completed | 4             | 59           | 1             |       |         |
| **Profession**           |                |              |               |       |         |
| Agriculture, forestry, animal husbandry | 147 | 378 | 46 |
| Government employee      | 33             | 118          | 5             |       |         |
| Factory, business, service industry employee | 296 | 857 | 65 |
| Teacher                  | 5              | 62           | 1             |       |         |
| Healthcare provider      | 3              | 56           | 2             |       |         |
| Student                  | 1              | 64           | 1             |       |         |
| Soldier                  | 1              | 2            | 1             |       |         |
| No job                   | 39             | 278          | 23            |       |         |
| Retired                  | 168            | 649          | 119           |       |         |
| Other                    | 188            | 420          | 36            |       |         |
| **Number of persons who live in this household** | | | | 33.42 | <0.001 |
| 1                        | 164            | 463          | 56            |       |         |
| 2                        | 290            | 927          | 128           |       |         |
| 3                        | 178            | 662          | 46            |       |         |
| 4                        | 93             | 395          | 27            |       |         |
| 5                        | 87             | 254          | 25            |       |         |
| 6~                       | 69             | 183          | 17            |       |         |

Continued
the smoking rate of residents 15 years and older in high-income areas in China is 23.56%, which is lower than the smoking rate of 26.6% of the general population in China surveyed in the same year. Studies have shown that the government in high-income areas of China has implemented a series of tobacco control policies, such as taking hospitals, transportation, shopping malls and other public places as key monitoring areas, forcing smoke-free measures and posting 'no smoking' warning signs, all of which have led to some success.

The current characteristics of smokers in high-income areas in China are that they buy cigarettes for no more than ¥100 each time, they like to buy packaged cigarettes and they often smoke within 6–30 min after waking up in the morning; more than 40% of smokers have tried to quit smoking, and the main reason for quitting is worried about their health. Therefore, there are strong recommendations for smokers. First, through family education, our research shows that family regulations can reduce the likelihood of smoking; the second is to print health warning slogans on cigarette packs. Our research finds that people who quit smoking pay more attention to their own health, but the warnings on cigarette packs are often ignored. Therefore, we recommend that smokers pay attention to the harmful effects of tobacco use. The third is that doctors can strengthen the smoking-related education in patients. We found that only 54.57% of Chinese patients were asked about smoking history and their treatment by doctors, 73.60% of patients were advised to quit smoking and some patients failed to get a doctor’s advice to quit smoking.

Sex, education level and tobacco health literacy are the main factors influencing smoking among residents in high-income areas of China. The multivariate logistic regression analysis of smoking in high-income areas of China showed that sex, education level, e-cigarette knowledge, family smoking regulations and tobacco health literacy are the main influencing factors of smoking among residents over 15 years old in high-income areas of China. Being a man is a risk factor for smoking, which is consistent with other related research results in China. The smoking rate of men is 45.84%, that of women is 1.00% and the smoking probability of men is 129.92 times that of women (OR=129.92), which indicates that the smoking rate of women in high-income areas in China is not high, suggesting that the key population of tobacco control is still men.

Undergraduate/college education or above is a protective factor for smoking; a possible reason for this is that residents with higher education have more knowledge about health and are inclined to adopt to a healthy lifestyle. The survey results show that consistent cigarette publicity is a risk factor for smoking, and some studies have shown that residents who have heard of e-cigarettes are more likely to try smoking out of curiosity. Regulations disallowing smoking, but with exceptions or no restrictions at home, are currently the protective factors of smoking, which may be because there are no explicit

| Characteristics | Current smoker | Never smoker | Former smoker | χ² | P value |
|-----------------|----------------|--------------|---------------|----|---------|
| Number of family members over 15 years old |                 |              |               |    |         |
| 1               | 172            | 562          | 59            | 13.02 | 0.223  |
| 2               | 381            | 1253         | 149           |     |        |
| 3               | 165            | 607          | 44            |     |        |
| 4               | 120            | 355          | 38            |     |        |
| 5               | 33             | 82           | 7             |     |        |
| 6~              | 10             | 25           | 2             |     |        |
| Household income (¥) |          |              |               |    |         |
| <10 000         | 75             | 232          | 36            | 39.75 | <0.001 |
| 10 000–29 999   | 150            | 400          | 30            |     |        |
| 30 000–49 999   | 185            | 535          | 57            |     |        |
| 50 000–99 999   | 253            | 739          | 89            |     |        |
| 100 000–199 999 | 125            | 536          | 52            |     |        |
| 200 000–299 999 | 29             | 147          | 13            |     |        |
| ≥300 000        | 13             | 63           | 4             |     |        |
| Don't know/refused | 51            | 232          | 18            |     |        |
| Workplace       |                |              |               |    |         |
| Indoors         | 516            | 1424         | 104           | 53.89 | <0.001 |
| Outdoors        | 365            | 1460         | 195           |     |        |
| Smoking rules at home |        |              |               |    |         |
| Allowed         | 425            | 635          | 81            | 274.08 | <0.001 |
| Not allowed, but exceptions | 153          | 628          | 77            |     |        |
| Never allowed   | 173            | 1226         | 95            |     |        |
| No rules        | 130            | 395          | 46            |     |        |
| Approaches to hear about e-cigarettes |        |              |               |    |         |
| Yes             | 463            | 1162         | 142           | 43.41 | <0.001 |
| No              | 418            | 1722         | 157           |     |        |
regulations about smoking at home, and family members will consider the feelings of other members, thus reducing the possibility of smoking. The higher the score of smoking health knowledge, the lower the possibility of smoking, probably because people with certain smoking health literacy can recognise the harm caused, and try to have some self-restraint to refuse smoking.

Given the need, this study provides strong policy recommendations. In China’s high-income economic regions, men with high school education or below, who know about electronic cigarettes, are allowed to smoke at home. People with poor health literacy are those with a high smoking rate, and need professional smoking cessation advice to help them quit smoking and should be listed as key targets to provide professional smoking cessation help in China’s high-income regions.

In addition, it is suggested that government departments in low and middle-income areas refer to the practices in high-income areas, such as setting up special smoking areas in some hospitals resulting in better conditions. At the same time, in order to achieve better tobacco control and become comparable with the global average level, the implementation of national smoke-free legislation should

### Table 2 Recent tobacco activities of current smokers

| Questions | Valid case (%) |
|-----------|---------------|
| How soon after you wake up in the morning do you usually have your first smoke? | 747 |
| Within 5 min | 152 (20.35) |
| 6–30 min | 242 (32.40) |
| 31–60 min | 124 (16.60) |
| More than 60 min | 225 (30.12) |
| Refused to reply | 4 (0.54) |
| The last time you bought cigarettes for yourself, did you buy loose cigarettes, packs, cartons or something else? | 839 |
| Cigarettes | 8 (0.95) |
| Packs | 458 (54.59) |
| Cartons | 353 (42.07) |
| Never bought cigarettes/refused | 20 (2.38) |
| How much money did you pay for the last time you purchased cigarettes? (¥) | 809 |
| <20 | 274 (33.87) |
| 20–49 | 170 (21.01) |
| 50–99 | 87 (10.75) |
| 100–199 | 128 (15.82) |
| 200–499 | 120 (14.83) |
| >500 | 30 (3.71) |
| The last time you purchased cigarettes for yourself, where did you buy them? | 816 |
| Kiosks/gas station/convenience store | 186 (22.79) |
| Tobacco store/liquor store | 171 (20.96) |
| Store/supermarket | 430 (52.70) |
| Other | 29 (3.55) |
| Do you currently use smokeless tobacco daily, less than daily or not at all? | 881 |
| Daily | 17 (1.93) |
| Less than daily | 6 (0.68) |
| Not at all | 858 (97.39) |

### Table 3 Cessation attempts and history

| Question | Valid case (%) |
|----------|---------------|
| Have you ever tried to stop smoking? | 881 |
| Yes | 364 (41.32) |
| No | 517 (58.68) |
| Which of the following best describes your thinking about quitting smoking? | 881 |
| Quit within the next month | 29 (3.29) |
| Thinking within the next 12 months | 62 (7.04) |
| Quit someday, but not in 12 months | 143 (16.23) |
| Not interested in quitting | 557 (63.22) |
| Don’t know/refuse/missing | 90 (10.22) |
| What was the most important reason for you to try to stop smoking last time? | 364 |
| Got illness | 109 (29.95) |
| Worried about self-health | 106 (29.12) |
| Heavy economic burden | 25 (6.87) |
| Family’s disapproval | 61 (16.76) |
| Other | 63 (17.31) |
| Thinking about the last time you tried to quit, how long did you stop smoking? | 123 |
| Months | 70 (56.91) |
| Weeks | 26 (21.14) |
| Days | 24 (19.51) |
| Less than 1 day 24 hours | 3 (2.44) |
| During any visit to a doctor or healthcare provider in the past 12 months, were you asked if you smoke tobacco? | 361 |
| Yes | 197 (54.57) |
| No | 164 (45.43) |
| During any visit to a doctor or healthcare provider in the past 12 months, were you advised to quit smoking tobacco? | 197 |
| Yes | 145 (73.60) |
| No | 52 (26.40) |
| Have the warnings on cigarette packs made you think about quitting? | 818 |
| Yes | 197 (24.08) |
| No | 597 (72.98) |
| No attention paid | 24 (2.93) |
be promoted as soon as possible to protect people from the harm of secondhand smoke. Second, increasing the tobacco tax, making tobacco more expensive, reducing its availability and making it less economically viable could reduce the number of smokers. Third, we should increase the awareness of the harm smoking causes to health, encourage the prohibition of smoking at home, increase investment in higher education, improve the residents’ smoking health literacy level and achieve the goal of reducing people’s smoking rate. Fourth, reduce the allure of tobacco use and prevent teenagers from smoking their first cigarette to control the number of new smokers.

**Limitations**
This study has some limitations. First, China has a large population, the sample size of our study was relatively small and did not cover the entire population. Second, there are many influencing factors of smoking, and we only measured some of them. Despite the limitations of the study, our research results are helpful for the classification and formulation of China’s tobacco control policies. In the follow-up, we will continue to increase the number of relevant studies to improve our existing shortcomings.

**CONCLUSION**
This study reveals the prevalence and main factors of smoking in high-income areas in China. The prevalence of smoking in high-income areas in China is lower than that in China as a whole; sex, education level and tobacco health literacy are the main factors influencing smoking among residents in high-income areas of China. Our research results can provide a good reference for China to formulate tobacco control policies in high-income areas.

**Table 4** Knowledge and attitude on smoking

| Code | Statement about smoking                                      | Yes     | No      | Uncertain |
|------|-------------------------------------------------------------|---------|---------|-----------|
| 1    | Smoking can cause serious illness.                          | 3405    | 189     | 470       |
| 2    | Smoking can cause stroke (blood clots in the brain that may cause paralysis). | 1632    | 615     | 1817      |
| 3    | Smoking can cause heart disease.                            | 1964    | 528     | 1572      |
| 4    | Smoking can cause lung cancer.                              | 3232    | 142     | 670       |
| 5    | Smoking can cause erectile dysfunction.                     | 1065    | 425     | 2574      |
| 6    | Secondhand smoke can cause serious illness among non-smokers. | 2751    | 384     | 929       |
| 7    | Secondhand smoke can cause heart disease in adults.         | 1538    | 698     | 1828      |
| 8    | Secondhand smoke can cause lung illness in children.        | 2647    | 271     | 1146      |
| 9    | Secondhand smoke can cause lung cancer in adults.           | 2569    | 302     | 1193      |
| 10   | Do you think low-tar cigarettes are less harmful than regular cigarettes? | 1270    | 819     | 1975      |
| 11   | Do you think smoking should be allowed in hospital?          | 31      | 3927    | 106      |
| 12   | Do you think smoking should be allowed in public transportation vehicles? | 19      | 3929    | 116      |
| 13   | Did you notice any health warnings on cigarette packages?   | 2275    | 921     | 868       |
| 14   | Do you support printing health warning picture on cigarette packages? | 2757    | 869     | 438       |
| 15   | Do you support the increase in tax on cigarettes to increase their retail price? | 1750    | 1233    | 1081      |
| 16   | If there was an increase in the tax on cigarettes, do you think part of the money should be spent on tobacco control? | 2854    | 426     | 784       |
| 17   | If there was an increase in the tax on cigarettes, do you think part of the money should be spent on paying some of the costs of health insurance? | 3296    | 245     | 523       |

**Table 5** Distribution of smoking knowledge scores

| Scores | Current smoker | Never smoker | Former smoker | Total | \(X^2\) | P value |
|--------|----------------|--------------|---------------|-------|---------|---------|
| 1–4    | 271            | 585          | 62            | 918   | 49.68   | <0.001  |
| 5–8    | 319            | 1065         | 117           | 1501  |         |         |
| 9–12   | 291            | 1234         | 120           | 1645  |         |         |
| Independent variables                  | P value | OR    | CI          |
|---------------------------------------|---------|-------|-------------|
| Sex                                   |         |       |             |
| Women                                 | 1.00    |       |             |
| Men                                   | <0.001  | 129.92| 59.69 to 282.75 |
| Education                             |         |       |             |
| No formal schooling                   | 1.00    |       |             |
| Less than primary school completed    | 0.556   | 0.68  | 0.19 to 2.45 |
| Primary school completed              | 0.231   | 0.47  | 0.13 to 1.63 |
| Less than secondary school completed  | 0.257   | 0.46  | 0.12 to 1.76 |
| Secondary school completed            | 0.105   | 0.37  | 0.11 to 1.23 |
| High school completed                 | 0.059   | 0.30  | 0.09 to 1.05 |
| College/ university completed         | 0.002   | 0.14  | 0.04 to 0.51 |
| Postgraduate degree completed         | 0.001   | 0.06  | 0.01 to 0.33 |
| Know e-cigarettes                     |         |       |             |
| No                                    | 1.00    |       |             |
| Yes                                   | <0.001  | 2.01  | 1.48 to 2.73 |
| Smoking rules at home                 |         |       |             |
| Allowed                               | 1.00    |       |             |
| Not allowed, but exceptions           | <0.001  | 0.48  | 0.33 to 0.69 |
| Never allowed                         | <0.001  | 0.24  | 0.17 to 0.35 |
| No rules                              | 0.002   | 0.52  | 0.34 to 0.78 |
| Knowledge of smoking                  |         |       |             |
| 1–4                                   | 1.00    |       |             |
| 5–8                                   | 0.001   | 0.49  | 0.33 to 0.73 |
| 9–12                                  | 0.003   | 0.53  | 0.35 to 0.81 |

**Correction notice** This article has been corrected since it was published. In the supplemental table S2, the labels male and female have been corrected.

**Contributors** Concept and design: LY and JS designed the study. PL and LL controlled the quality of the data and performed statistical analysis. LY, ZZ, ZW and LL managed and checked all the data. JS, ZZ and LY contributed to manuscript preparation, editing and review. All authors read, checked and approved the final manuscript. LY is responsible for the overall content as guarantor.

**Funding** This work was supported by the National Social Science Foundation of China (No 14BGL142).

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**REFERENCES**

1. Münzel T, Hadah O, Kuntic M, et al. Effects of tobacco cigarettes, e-cigarettes, and waterpipe smoking on endothelial function and clinical outcomes. *Eur Heart J* 2020;41:4057–70.
2. Murray CJL, Aravkin AY, Zheng P, et al. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the global burden of disease study 2019. *The Lancet* 2020;396:1223–49.
3. Chen S, Kuhn M, Prettner K, et al. Noncommunicable diseases attributable to tobacco use in China: Macroeconomic burden and tobacco control policies. *Health Aff* 2019;38:1832–9.
4. Chinese Center for Disease Control and Prevention. Data from: Chinese adult tobacco survey fact sheet, 2018. January 5, 2022. Available: https://www.cdc.gov/ncctd/mmwr/preview/mmwrhtml/mm6306a1.htm
5. World Health Organization. Data from: WHO report on the global tobacco epidemic. 2019; offer help to quit tobacco use 2022 https://apps.who.int/iris/handle/10665/326043
6. Vijayaraghavan M, Pierce JP, White M, et al. Differential use of other tobacco products among current and former cigarette smokers by income level. *Addict Behav* 2014;39:1452–8.
7. Samet JM. Tobacco products: the leading cause of preventable disease worldwide. *Thorac Surg Clin* 2013;23:103–12.
8. Kostova D, Andes L, Erguder T, et al. Cigarette prices and smoking prevalence after a tobacco tax increase--Turkey, 2008 and 2012. *MMWR Morb Mortal Wkly Rep* 2014;63:457–61.
9. Centers for Disease Control and Prevention (CDC). Response to increases in cigarette prices by race/ethnicity, income, and age groups--United States, 1976-1993. *MMWR Morb Mortal Wkly Rep* 1998;47:605–9.
10. Farrelly MC, Nonnemaker JM, Watson KA. The consequences of high cigarette excise taxes for low-income smokers. *PLoS One* 2012;7:e43838.
11. Borren P, Sutton M. Are increases in cigarette taxation regressive? *Health Econ* 1992;1:245–53.
12. Franks P, Jerant AF, Leigh JP, et al. Cigarette prices, smoking, and the poor: implications of recent trends. *Am J Public Health* 2007;97:1873–7.
13. Mbulo L, Palipudi KM, Smith T, et al. Patterns and related factors of bidi smoking in India. *Tob Prev Cessat* 2020;6:28.
14. Creamer MR, Wang TW, Babb S, et al. Tobacco Product Use and Cessation Indicators Among Adults - United States, 2018. *MMWR Morb Mortal Wkly Rep* 2019;68:1013–9.
15 Islami F, Stoklosa M, Drope J, et al. Global and regional patterns of tobacco smoking and tobacco control policies. *Eur Urol Focus* 2015;1:3–16.
16 World Bank. Data from: new country classifications by income level: 2018-2019. January 5, 2022. Available: https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2018-2019
17 Chinese Center for Disease Control and Prevention. Data from: China global adult tobacco survey 2018. January 5, 2022. Available: http://ghdx.healthdata.org/record/china-global-adult-tobacco-survey-2018
18 Chen F, Hu P, Chang W, et al. A cross-sectional survey on cigarette smoking in the Chinese navy. *Mil Med* 2019;184:e211–7.
19 Qian X, Gu H, Wang L, et al. Changes in smoking prevalence after the enforcement of smoking control regulations in urban Shanghai, China: findings from two cross-sectional surveys. *Tob Induc Dis* 2018;16:27.
20 Wu Y, Wang Z, Zheng Y, et al. The impact of comprehensive tobacco control policies on cardiovascular diseases in Beijing, China. *Addiction* 2021;116:2175–84.
21 Zhao M. The public health implications of China’s travel ban for smoking on trains. *Iran J Public Health* 2020;49:2009–10.
22 Au WW, Ma W, Zhu Q, Chen H, et al. Problems with cigarette smoking and attitudes towards the ban of smoking in Shantou, China. *Public Health* 2016;134:46–53.
23 Lin H, Chang C, Liu Z, et al. Subnational smoke-free laws in China. *Tob Induc Dis* 2019;17:78.
24 Yanjun X, Wenjun M, Haocheng X. Analysis on smoking pattern and relative risk factors in inhabitants aged 15 or elder in Guangdong Province. Zhongguo Gong Gong Wei Sheng 2005;21:899–901.
25 Hong P, Meng W, Xiaoyan H, et al. Investigation on smoking status of residents aged 15 years and over in Hangzhou. *Yu fang yi xue* 2020;32:253–7.
26 Haonan K, Xiaozhuo Z, Qin X. Prevalence of tobacco use and its influencing factors among residents aged 15 years and above in Chaoyang district. *Yu fang yi xue* 2021;33:94–6.
27 Yali D, Xiaofen L, Ying H. Investigation on smoking status of residents in Fangshan district of Beijing. Zhongguo man xing bing yu fang yu kong zhi 2019;27:528–32.