Knowledge about and sources of smoking-related knowledge, and influencing factors among male urban secondary school students in Chongqing, China

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Abstract
Objectives: This study examined smoking-related knowledge, sources of smoking-related knowledge and its influencing factor among male urban secondary school students.

Methods: We conducted a cross-sectional survey, using a self-administered questionnaire, among 1297 male secondary school students in municipal areas of Chongqing, China.

Results: Non-smokers had a better knowledge of smoking hazards than smokers. Less than 20% of students knew that smoking can cause heart disease, peptic ulcer, and cerebral stroke. Sources of smoking-related knowledge differed between smokers and non-smokers, respectively: TV (76.5 vs. 76.7%), teacher (70.1 vs. 62.4%), social network (66.6 vs. 73.1%), parents (57.0 vs. 59.2%), newspaper (55.4 vs. 61.6%), and friends (37.7 vs. 33.9%). Non-smokers' hobbies of reading were significantly higher than smokers' ($\chi^2 = 11.5845, p = 0.0007$). Smokers' hobbies of online games ($\chi^2 = 14.9106, p = 0.0001$), and sports ($\chi^2 = 4.8609, p = 0.0275$) were significantly higher than non-smokers'. Generalized estimating equations (GEE) found that students whose both father and mother smoke were unable to receive tobacco-related knowledge. GEE also found that students in high school, with affluent family economic condition and with an opposing attitude towards father smoking possessed a better smoking-related knowledge. However, male students with disagreement or neutral attitude towards friends smoking were negatively associated with the knowledge of smoking hazards.

Conclusions: The findings of the present study suggest that a significant proportion of male secondary school students in urban Chongqing lack specific knowledge about smoking-related diseases. Targeted educational programs for secondary school students in China are needed to promote tobacco control and tobacco use reduction and cessation among students.

Keywords: Smoking-related knowledge, Sources, Influencing factors, Hobby, Male, Secondary school students, China

Background
Smoking causes five million annual deaths globally and 80% of smoking-related deaths occur in low- and middle-income countries (LMICs) every year (World Health Organization 2012). Smoking has been recognized as an independent risk factor for several common chronic diseases such as cardiovascular disease and cancer (Windham et al. 2005; Belchamber et al. 2014). Tobacco use among the youth has become a serious public health problem. According to 2014 China Youth Tobacco Report, about 8000–9000 teenagers become smokers every day in China, about 1.2 million teenagers were exposed to secondhand smoke, and nearly 7% of middle school students were using tobacco products, and another 19.9% of middle school students tried tobacco.
products (China CDC 2015). Male smoking prevalence has been high in China. In 2013, 52.9% of adult males and 2.4% of females were tobacco smokers in China (World Health Organization 2013). Furthermore, worldwide it was estimated that males smoked nearly five times as much as females (Guindon and Boisclair 2003), and males smoking rate was higher than females (World Health Organization 2009, 2015; Xu et al. 2015a). Although smoking rate among the adults is decreasing worldwide, the rates are on the rise among male secondary school students. Among middle school students in China, the percent of male students who have tried tobacco products was 30.1% in 2013 (China CDC 2015).

The perception of health risk may not only have a major influence on students’ smoking-related health behavior, but also is an important consideration in health-prevention and programs. In 2014, about 68.4% of students lacked a correct understanding of nicotine addiction (China CDC 2015). In China, approximately 31.6% of students think quitting smoking must be difficult; however, only 18.5% of current smokers among students think that smoking cessation is difficult (China CDC 2015). In the 2010 Global Adult Tobacco China Survey, nonsmokers had a better knowledge about the harms of smoking than smokers (Cheng et al. 2015). Improving knowledge and self-efficacy are essential strategies for reducing the high rate of smoking among teenagers, and previous study found that knowledge of tobacco cessation was significantly positively related with the implementation of tobacco cessation behavioral treatments (Muilenburg et al. 2015). About 13.0% of students believed that smoking makes people look more attractive, and 81% of students had never been taught about smoking or tobacco prevention at school in China (Xu et al. 2015b). Previous studies have also proved that cognition indeed affect behavior (Parasuraman and Jiang 2012; Richardson et al. 2012), and another study among adults found that smoking-related knowledge effectively encouraged smoking cessation, which was showed on the radio, outdoor advertisements or posters, newspapers or magazines/journals, indoor LED screens, mobile TV and television (World Health Organization 2015). Therefore, to prevent smoking and reduce tobacco consumption, it’s more important to pay attention to the smoking-related knowledge and strengthen students’ awareness of smoking-related knowledge (The Ministry of Health of the People’s Republic of China 2012).

A hobby is a regular activity that is done for enjoyment, typically during one’s leisure time. By continually participating in a particular hobby, one can acquire substantial skill and knowledge in that area. A previous study in Japan found the association between smoking behaviors and hobbies (Hu et al. 2007), and another case–control study in Spain found that leisure time activities were associated with the risk of having lung cancer (Ruano-Ravina et al. 2014). In addition, a qualitative analysis found that hobbies were associated with tobacco using and its treatment among young people (Prochaska et al. 2013). Hobbies among students mainly included reading, painting, music; sports, tourism and online games, and different kinds of hobbies might bring different health effects. Computer games have a relationship with teenagers physical health, such as overweight and obesity (Martinovic et al. 2015; Ustinavičienė et al. 2016), but the association with tobacco use still lacks of investigation.

Knowledge, attitudes and practices (KAP) studies have been widely used to investigate health problems in the medical and public health disciplines, which were based on the principle that increasing knowledge, will result in changing attitudes and practices to minimize disease burden (Goh and Chua 2016). Previous studies have found that increased knowledge would help tobacco control, but it still lacks methods to improve smoking-related knowledge. At the same time, the perception of smoking-related health risk among the Chinese has seldom been studied. Currently, more than three quarters of the Chinese did not fully recognize the dangers of smoking (Moore et al. 2014).

The determinants of smoking-related health risk perceptions among secondary school students have not been studied thoroughly in China. Cultural and social context may influence public health risk perceptions (Zhang and Fan 2013). Clarifying the factors that affect smoking-related health risk perceptions is necessary to develop tobacco control strategies among secondary school students in China. In this study we examined smoking-related knowledge, sources of smoking-related knowledge and its influencing factor among male urban secondary school students in a major municipal city in China.

Methods

Participants

The inclusion criteria for participation in the study were (1) student in grades 7–12 in the selected school district; (2) obtaining parental permission and providing assent; (3) male; and (4) being resident of Chongqing. The exclusion criteria were: (1) students with mental illness and (2) writing difficulties. Chinese secondary education included junior middle school and high school. Grades 7–9 comprise junior middle school, and grades 10–12 are high school. Considering the low smoking prevalence in female students in China, this study only focused on male students to investigate typical smoking-related characteristics.
Ethical approval
We obtained written informed consents from all parents or main caregivers of the enrolled students through parent–teacher conferences. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Chongqing Medical University.

Methods
Stratified cluster sampling method was used. Chongqing is one of the municipalities directly under the central government, and it is located in the southwest region of China. After contacting 10 schools in Chongqing, three schools agreed to participate in the study: one school in Bishan County, one in Banan District, and one in Yubei District. Each class from grades 7–12 was randomly selected for data collection. After obtaining the parental informed consents, data were collected through self-administered anonymous questionnaires survey completed by the students.

Questionnaire
The questionnaire was derived with reference to the China Youth Tobacco Survey (China CDC 2015). We modified the questionnaire according to the results of the pilot study among the target subjects, especially on the presentation of questions and further improved the response options of the questions. Questionnaire domains included demographic characteristics, smoking status, smoking-related knowledge, and parental smoking status.

Demographic characteristics
Demographic data included age, school status (middle/high school students), smoking status of parents (non-smoker/smoker), family structure (non-parent families/Single-parent families), per capita household income [high (>5000 ¥), average (1500–5000 ¥), and low (<1500 ¥)] (1 USD = 6.65 ¥).

Smoking-related knowledge
Smoking-related knowledge included nine items: (1) whether smoking causes lung cancer (yes/no), whether smoking causes chronic bronchitis (yes/no), whether smoking causes Laryngeal cancer (yes/no), whether smoking causes heart disease (yes/no), whether smoking causes peptic ulcer (yes/no), whether smoking causes cerebral stroke (yes/no); (2) the way that you get smoking-related knowledge [Television (yes/no)/Teachers (yes/no)/Internet (yes/no)/School (yes/no)/Parents (yes/no)/Newspaper (yes/no)/Friends (yes/no)]; (3) nicotine is a kind of addictive substances (yes/no); (4) smoking has a direct effect on the health (yes/no); (5) pregnant women smoking are harmful to fetus (yes/no); (6) smoke-free environment is helpful to health (yes/no); (7) second-hand smoking is harmful to health (yes/no); (8) smoking whether has effects on physiologic, appearance, social and economy (yes/no); (9) your attitude towards family member smoking (Agree/Neutral/Disagree); your attitude towards family smoking (Agree/Neutral/Disagree); and your attitude towards friends smoking (Agree/Neutral/Disagree).

Hobbies
To assess hobbies, we asked: “Do you have the following hobbies? Reading (yes/no), music (yes/no), Painting (yes/no), online games (yes/no), sports (yes/no), tourism (yes/no”).

Smoking status
Smoking status was determined by asking respondents whether they were smokers. Current smoker was defined as a person who smoked tobacco at the time of the interview. Assessing the smoking status of parents was conducted the same way. Participants were asked the following questions: “Does your father smoke? (yes/no)” and “Does your mother smoke? (yes/no)”.

Methods of data collection
In June 2014, a formal survey was conducted in main urban areas of Chongqing. At each survey location, participants who had met the inclusion criteria completed the questionnaires. The investigating team members audited the questionnaire on the spot for completeness and corrected the error before collecting the questionnaires. A total of 1297 completed questionnaires were collected after distributing 1370 questionnaires in the three schools of Bishan Country (300/320), Banan District (526/550) and Yubei District (481/500), with overall response rate of 94.7%.

Pilot test
The pilot test was conducted with 50 students in a middle school that did not participate in the current study. We modified the questionnaire according to results of the pilot test, especially on the presentation of questions.

Data collector and training
Nine medical students of Chongqing Medical University were recruited to collect data. The data collectors were trained. Investigation site was coordinated by the investigator. Data collection process entailed explaining to the students that the questionnaire was anonymous and steps were taken to ensure the authenticity and reliability of the questionnaire.
Data processing and analyses
Frequencies were calculated for all categorical variables and means and standard deviations were computed for all metric variables. Comparison between groups was conducted using $\chi^2$ test, and generalized estimating equation for statistical analysis. Generalized estimating equation (GEE) (Liang and Zeger 1986; Liu and Zhang 2006) was used to probe factors that affect sources of smoking-related knowledge, which including television, teachers, internet, school, parents, newspaper, and friends. Generalized estimating equation to probe factors affects smoking-related diseases, which including lung cancer, chronic bronchitis, laryngeal cancer, heart disease, peptic ulcer, and cerebral stroke. Statistical tests included a two-sided test, and statistical significance was considered at $p < 0.05$. All data were analyzed the Statistical Package for Social Sciences (IBM-SPSS), Version 22.0.

Results
Characteristics of the sample
Among the participants, 395 (30.5%) were smokers, and the average age of smokers was 16.52 years old. Smoking rates of high school students were higher than middle school students ($p < 0.05$). Smokers’ father’s smoking rates were statistically significantly higher than non-smokers’ (smoker vs. non-smoker = 6.3 vs. 3.1%, $p < 0.05$). Smokers’ mother’s smoking rates were higher than non-smokers’ (smoker vs. non-smoker = 50.2 vs. 64.6%, $p < 0.05$). Statistically significant differences were observed on “per capita household income ($p = 0.003$), “the number of smokers in family ($p < 0.0001$)”, “the number of smokers among friends ($p < 0.001$)” between smokers and non-smokers. Non-smokers showed more unfavorable attitude towards both family members and friends smoking than smokers ($p < 0.001$). Among smokers, only 25.8% students disagreed with friends smoking and 50.1% students disagreed with family member smoking, with more concern for family members’ health (see Table 1).

Hobbies and smoking
Non-smokers’ hobbies of reading were significantly higher than smokers’ ($\chi^2 = 11.5845, p = 0.0007$). Smokers’ hobbies of online games ($\chi^2 = 14.9106, p = 0.0001$), and sports ($\chi^2 = 4.8609, p = 0.0275$) were significantly higher than non-smokers’ (see Table 2).

Smoking-related knowledge
Less than twenty percent of students knew that smoking can cause Heart disease (Smokers vs. Non-smokers = 19.5 vs. 19.7%), Peptic ulcer (Smokers vs. Non-smokers = 16.7 vs. 12.5%), and cerebral stroke (Smokers vs. Non-smokers = 11.1 vs. 12.2%). The perception among smokers of “Smoke-free environment is helpful to health ($p = 0.013$)”, “Second-hand smoke is harmful to health ($p = 0.007$)”, “Smoking on physiology, appearance, short-term and long-term impact on society and economy ($p = 0.002$)” “Personal, family, peers and the media can affect people decide whether or not to smoke ($p = 0.041$) is statistically significantly lower than the non-smokers (see Table 3).

Sources of smoking-related knowledge
Sources of smoking-related knowledge among smokers were 302 (76.46%) TV, 277 (70.13%) teachers and 263 (66.58%) network. Sources of smoking-related knowledge among non-smokers were 692 (76.72%) TV, 659 (73.06%) network and 574 (63.64%) school, 563 (62.42%) teachers, 556 (61.64%) newspaper, 534 (59.2%) parents and 306 (33.92%) friends. Smokers’ smoking-related knowledge was obtained from the teacher, were significantly higher than non-smokers ($p < 0.05$). Non-smokers were statistically significantly higher on “smoking-related knowledge was obtained from the network” than smokers ($p < 0.05$) (see Table 4).

Generalized estimating equation to probe factors that affect sources of smoking-related knowledge
Generalized estimating equations found that students whose father smoked has less way to get tobacco-related knowledge (odds ratio, OR = $e^{-0.202} = 0.82$, $p < 0.05$). Students whose mother smoked has less way to get tobacco-related knowledge (OR = $e^{-0.334} = 0.70$, $p < 0.05$) (see Table 5).

Generalized estimating equation to probe factors affect knowledge of smoking-related diseases
Generalized estimating equations found that male students who were high school were 1.13 times more to acquire knowledge of smoking-related diseases (OR = $e^{0.123} = 1.13$, $p < 0.05$). Students who come from economically rich family condition (OR = 1.25) and disagree with family member smoking (OR = 1.80) were more likely to acquire higher knowledge of smoking-related diseases. Students who disagreed or were neutral towards friends smoking were less likely to acquire higher knowledge of smoking-related disease (OR = 0.69) (see Table 6).

Discussion
The findings of this study show that many middle school students have cognitive limitations on the specific knowledge of smoking-related diseases. About 95% of high school students knew that smoking was harmful to health, which was a little higher than the awareness rate in Bangalore, India, where 90.2% students knew the
### Table 1 Characteristics of the study participants stratified by smoking status in Chongqing, China [%/mean (SD)]

| Variable                  | Smokers (n = 395) | Non-smokers (n = 902) | Statistical test |
|---------------------------|-------------------|-----------------------|------------------|
| Age (mean ± SD)           | 16.52 ± 1.40      | 15.35 ± 1.89          | t = 1.83, p < 0.001* |
| School category           |                   |                       | χ² = 42.4823, p < 0.001* |
| Middle school             | 61 (15.4)         | 298 (33.0)            |                 |
| High school               | 334 (84.6)        | 604 (67.0)            |                 |
| Marital status of parents |                   |                       | χ² = 2.011, p < 0.366  |
| Non-single parent families| 323 (81.8)        | 760 (84.3)            |                 |
| Single parent families    | 69 (17.5)         | 139 (15.4)            |                 |
| Missing                   | 3 (0.8)           | 3 (0.3)               |                 |
| Family economic situation |                   |                       | χ² = 11.5954, p = 0.003* |
| Rich                      | 57 (14.4)         | 171 (19.0)            |                 |
| Average                   | 244 (61.8)        | 583 (64.6)            |                 |
| Impoverished              | 94 (23.8)         | 148 (16.4)            |                 |
| Father smoking status     |                   |                       | χ² = 22.7722, p < 0.001* |
| Non-smoker                | 140 (35.4)        | 449 (49.8)            |                 |
| Smoker                    | 255 (64.6)        | 453 (50.2)            |                 |
| Mother smoking status     |                   |                       | χ² = 7.2892, p = 0.007* |
| Non-smoker                | 370 (93.7)        | 874 (96.9)            |                 |
| Smoker                    | 25 (6.3)          | 28 (3.1)              |                 |
| Number of family member smoking |            |                       | χ² = 33.0289, p < 0.001* |
| None                      | 80 (20.3)         | 310 (34.4)            |                 |
| One to two                | 257 (65.1)        | 520 (57.7)            |                 |
| Three and above           | 58 (14.7)         | 72 (8.0)              |                 |
| Number of friends smoking |                   |                       | χ² = 236.0684, p < 0.001* |
| None                      | 82 (20.8)         | 582 (64.5)            |                 |
| One to two                | 48 (12.2)         | 99 (11.0)             |                 |
| Three and above           | 265 (67.1)        | 221 (24.5)            |                 |
| Attitude towards friends smoking |              |                       | χ² = 155.8387, p < 0.001* |
| Agree                     | 47 (11.9)         | 24 (2.7)              |                 |
| Neutral                   | 246 (62.3)        | 323 (35.8)            |                 |
| Disagree                  | 102 (25.8)        | 555 (61.5)            |                 |
| Attitude towards family member smoking |          |                       | χ² = 70.4818, p < 0.001* |
| Agree                     | 29 (7.3)          | 20 (2.2)              |                 |
| Neutral                   | 168 (42.5)        | 222 (24.6)            |                 |
| Disagree                  | 198 (50.1)        | 660 (73.2)            |                 |

* Statistically significant (p < 0.05)

### Table 2 Hobbies stratified by smoking status in Chongqing, China (n, %)

| Hobbies            | Smokers (n = 395) | Non-smokers (n = 902) | Statistical test |
|--------------------|-------------------|-----------------------|------------------|
| Reading            | 154 (39.0)        | 444 (49.2)            | χ² = 11.5845, p = 0.001* |
| Music              | 268 (67.9)        | 588 (65.2)            | χ² = 0.8659, p = 0.352  |
| Painting           | 83 (21.0)         | 209 (23.2)            | χ² = 0.7334, p = 0.392  |
| Online games       | 268 (67.9)        | 509 (56.4)            | χ² = 14.9106, p < 0.001* |
| Sports             | 262 (66.3)        | 540 (59.9)            | χ² = 4.8609, p = 0.028*  |
| Tourism            | 180 (45.6)        | 424 (47.0)            | χ² = 0.228, p = 0.633  |

* Statistically significant (p < 0.05)
harmful effects of tobacco in 2015 (Singh et al. 2015). Although more than 90% students knew smoking can cause lung cancer, <20% know other diseases (heart disease, peptic ulcer, cerebral stroke) caused by smoking. Students in the specific understanding of the dangers of smoking are not enough, especially in smokers. Most people know that smoking is harmful to health but they did not know what it exactly harms. Therefore, it is necessary to promote the knowledge of smoking in many ways, especially in smokers.

Main sources to receive tobacco-related knowledge are TV and the Internet. However, still 23.36% of the students indicate that they did not get smoking-related knowledge from these sources. It is still very necessary for the improvement of the coverage of smoking-related knowledge. This study further confirms that smoking-related knowledge was more likely to be noticed on TV than on other media among the urban secondary school students (World Health Organization 2015). This suggests that tobacco control has a certain effect, but there is still room for improvement of the coverage. Tobacco-control mass media campaigns could encourage people to refrain from smoking (Farrelly et al. 2007). This survey showed that <40% of high school students get smoking-related knowledge from friends. In this case, when nonsmoking youth are friends with smokers and have weak relationships with family and school faculty, they are more likely to become smokers themselves than are youth who do not associate with smokers (Jordan et al. 2014). This study found that students whose father smoke and mother smoke received less tobacco-related knowledge.

| Table 3 | Smoking-related disease stratified by smoking status in Chongqing, China (n, %) |
|---------|--------------------------------------------------------------------------------|
| Variable | Smokers (n = 395) | Non-smokers (n = 902) | Statistical test |
| Smoking-related diseases | – | – | – |
| Lung cancer | 383 (97.0) | 877 (97.2) | χ² = 0.070, p = 0.790 |
| Chronic bronchitis | 227 (57.5) | 499 (55.3) | χ² = 0.5138, p = 0.474 |
| Laryngeal cancer | 223 (56.5) | 457 (50.7) | χ² = 3.693, p = 0.055 |
| Heart disease | 77 (19.5) | 178 (19.7) | χ² = 0.01, p = 0.920 |
| Peptic ulcer | 66 (16.7) | 113 (12.5) | χ² = 4.036, p = 0.045* |
| Cerebral stroke | 44 (11.1) | 110 (12.2) | χ² = 0.2927, p = 0.589 |
| Smoking-related perceptions | – | – | – |
| Nicotine is a kind of addictive substances | 316 (80.0) | 744 (82.5) | χ² = 1.1344, p = 0.287 |
| Smoking has a direct effect on the health | 348 (88.1) | 812 (90.0) | χ² = 1.0729, p = 0.300 |
| Pregnant women smoking is harmful to fetus | 371 (93.9) | 861 (95.5) | χ² = 1.3517, p = 0.245 |
| Smoke-free environment is helpful to health | 356 (90.1) | 848 (94.0) | χ² = 6.2435, p = 0.013* |
| Second-hand smoking is harmful to health | 357 (90.4) | 852 (94.5) | χ² = 7.2197, p = 0.007* |
| Smoking has effects on physiologic, appearance, social and economy | 276 (69.9) | 702 (77.8) | χ² = 9.3701, p = 0.002* |
| Whether a person smoke depends on the feeling of individual, family, peers and the media | 274 (69.4) | 675 (74.8) | χ² = 4.1815, p = 0.041* |

* Statistically significant (p < 0.05)

| Table 4 | Sources of getting smoking-related knowledge stratified by smoking status in Chongqing, China (n, %) |
|---------|--------------------------------------------------------------------------------|
| The way you get smoking-related knowledge | Smokers (n = 395) | Non-smokers (n = 902) | Statistical tests |
| | Yes | Rank | Yes | Rank | |
| Television | 302 (76.5) | 1 | 692 (76.7) | 1 | χ² = 0.0106, p = 0.918 |
| Teachers | 277 (70.1) | 2 | 563 (62.4) | 4 | χ² = 7.1553, p = 0.008* |
| Internet | 263 (66.6) | 3 | 659 (73.1) | 2 | χ² = 5.608, p = 0.018* |
| School | 250 (63.3) | 4 | 574 (63.6) | 3 | χ² = 0.0141, p = 0.905 |
| Parents | 225 (57.0) | 5 | 534 (59.2) | 6 | χ² = 0.5677, p = 0.451 |
| Newspaper | 219 (55.4) | 6 | 556 (61.6) | 5 | χ² = 4.3877, p = 0.018 |
| Friends | 149 (37.7) | 7 | 306 (33.9) | 7 | χ² = 1.7389, p = 0.187 |

* Statistically significant (p < 0.05)
Previous research has shown that father smoking or mother smoking is a factor affecting teenagers smoking (Jordan et al. 2014); besides, with father or mother smoked, teenagers get less knowledge about tobacco which might be one of the causes of tobacco initiation. To improve the coverage of tobacco control, governments should make full use of the TV, Internet and other media for tobacco control propaganda. In addition, the way to improve the awareness rate of the hazards of smoking ought to be taken into consideration.

This study found that students were from high school, with rich family economic condition and with an opposing attitude toward smoking have a better understanding of the smoking-related knowledge. This survey also showed that 63% of students got smoking-related knowledge from school. Previous studies show that school intervention activities about tobacco control played a positive role in improving middle school students’ awareness of knowledge about tobacco control; the right beliefs hold rate and health behavior formation rate of tobacco (Zawahir et al. 2013). Previous study also showed that 81% of students had never been taught throughout school for smoking or tobacco prevention (Muilenburg et al. 2015). Considering this, the schools should systematically offer tobacco control education within the regular curriculum. Community programs, school and college policies and interventions that encourage tobacco-free environments and lifestyles can reduce smoking rates (U.S. Department of Health and Human Services 2012). Compared with students from low socioeconomic status background, male students with rich family economic background would receive more knowledge about the harm of tobacco using from parents (Bird et al. 2016), and those supported measures would prevent their smoking initiation. Previous study found that parents who believed that quitting would benefit their child were more likely to quit smoking (Mahabee-Gittens et al. 2014). Similarly, out of the strongly concern for family members health, male students who disagreed with family members smoking were associated with more knowledge of smoking hazards. A systematic review and meta-analysis found that family-based interventions prevent children and adolescents from starting to smoke (Thomas et al. 2016a). Also, good family relationships may help to reduce tobacco use among parents and children. However, the situation is different in the attitude

| Parameter                              | Category              | B     | SE    | 95% CI          | p value |
|----------------------------------------|-----------------------|-------|-------|-----------------|---------|
| Intercept                              |                       | 0.15  | 0.136 | −0.117 to 0.416 | 0.270   |
| School category                        | High school           | 0.05  | 0.053 | −0.054 to 0.154 | 0.346   |
|                                        | Middle school         | 0     |       |                 |         |
| Family financial circumstances         | Rich                  | −0.005| 0.074 | −0.151 to 0.14  | 0.944   |
|                                        | Average               | −0.096| 0.059 | −0.211 to 0.019 | 0.102   |
|                                        | Impoverished          | 0     |       |                 |         |
| Father’s smoking status                | Smoker                | −0.202| 0.061 | −0.321 to −0.083| 0.001*  |
|                                        | Non-smoker            | 0     |       |                 |         |
| Mother’s smoking status                | Smoker                | −0.354| 0.114 | −0.578 to −0.131| 0.002*  |
|                                        | Non-smoker            | 0     |       |                 |         |
| The number of smokers in family        | Three or more people  | 0.12  | 0.093 | −0.063 to 0.302 | 0.199   |
|                                        | One or two people     | 0.103 | 0.068 | −0.029 to 0.236 | 0.127   |
|                                        | None                  | 0     |       |                 |         |
| The number of smokers among friends    | Three or more people  | 0.051 | 0.052 | −0.05 to 0.153  | 0.324   |
|                                        | One or two people     | 0.094 | 0.074 | −0.05 to 0.239  | 0.201   |
|                                        | None                  | 0     |       |                 |         |
| You altitude towards smoking friends   | Disagree              | 0.235 | 0.132 | −0.023 to 0.493 | 0.075   |
|                                        | Neutral               | 0.213 | 0.128 | −0.038 to 0.464 | 0.096   |
|                                        | Agree                 | 0     |       |                 |         |
| You altitude towards smoking family    | Disagree              | 0.181 | 0.153 | −0.12 to 0.481  | 0.238   |
|                                        | Neutral               | 0.097 | 0.153 | −0.203 to 0.397 | 0.527   |

* Statistically significant (p < 0.05)

* Set to zero because this parameter is redundant
towards friends smoking. Students who approved friends smoking possessed a better knowledge about the harm of smoking. The potential interpretation is that only a few students disagreed with friends smoking and the amount of smokers remained neutral with friends smoking, with less concern for friends smoking status and friends physical health. Besides, smoking initiation was positively associated with having more friends that smoke (Huisman 2014), and previous finding suggested that friends tended to select each other on similar smoking behavior (Voorhees et al. 2011), which might explain that the amount of smokers knowing the hazards of smoking still hold the neutral attitude towards friends smoking and may even they agreed with friends smoking.

Hobbies may affect secondary school students smoking. The study found that non-smokers’ hobbies of reading were statistically significantly higher than smokers’, and smokers’ hobbies of online games and sports were statistically significantly higher than non-smokers’. A previous study in European found that smokers visited more unsupervised places where smoking was permitted, whereas nonsmokers visited libraries or other more supervised places (De Vries et al. 2007). Especially in computer games rooms or playground, male students lack the adult supervision and guidance which are necessary to ensure that youth do not smoke. Besides, parents who know about the adolescent’s free time activities in the past 30 days has a protective effect on the adolescent (Thomas et al. 2016b), because family supervision is important to prevent male students from using tobacco. These findings indicate that tobacco control among secondary students should pay more attention to the students who have hobbies of online games and sports.

This study has several limitations. Firstly, the instrument was primarily measuring attitudes and was based on self-reports. It would not have been possible to use any other means to measure them. Secondly, 72.3% of subjects were high school students, only 27.7% of subjects were middle school students and this outcome may affect the representativeness of secondary school students, which requires cautious interpretations of the study results, especially among middle school students. Thirdly, our study only investigates secondary students in the city, and is not representative of rural secondary

### Table 6 Generalized estimating equation to probe factors affect knowledge of smoking-related diseases in Chongqing, China

| Parameter | Category | B     | SE  | 95% CI        | p value |
|-----------|----------|-------|-----|---------------|---------|
| Intercept |          | −0.679| 0.151| −0.974 to −0.384 | 0       |
| School category | | 0.123 | 0.057| 0.011 to 0.235 | 0.032*  |
| Middle school | 0a | | | | |
| Family financial circumstances | Rich | 0.222 | 0.079 | 0.067 to 0.376 | 0.005*  |
| Average | 0.038 | 0.063 | −0.086 to 0.162 | 0.547  |
| Impoverished | 0a | | | | |
| Father’s smoking status | Smoker | −0.095 | 0.064 | −0.221 to 0.031 | 0.139  |
| Non-smoker | 0a | | | | |
| Mother’s smoking status | Smoker | 0.001 | 0.127 | −0.248 to 0.25 | 0.995  |
| Non-smoker | 0a | | | | |
| The number of smokers in family | Three or more persons | −0.082 | 0.099 | −0.277 to 0.113 | 0.411  |
| One or two persons | 0.025 | 0.071 | −0.115 to 0.165 | 0.723  |
| None | 0a | | | | |
| The number of smokers among friends | Three or more | 0.044 | 0.055 | −0.065 to 0.152 | 0.43  |
| One or two | 0.069 | 0.077 | −0.082 to 0.221 | 0.37  |
| None | 0a | | | | |
| You attitude towards friends smoke | Disagree | −0.371 | 0.142 | −0.649 to −0.092 | 0.009*  |
| Neutral | −0.278 | 0.138 | −0.549 to −0.007 | 0.044*  |
| Agree | 0a | | | | |
| You attitude towards family members smoke | Disagree | 0.588 | 0.168 | 0.259–0.917 | 0.000*  |
| Neutral | 0.445 | 0.168 | 0.116–0.774 | 0.008*  |
| Agree | 0a | | | | |

* Statistically significant (p < 0.05)
* Set to zero because this parameter is redundant
school students. In China, smoking prevalence was higher among rural secondary students (China CDC 2015). It would be useful to replicate our work in rural secondary school students. Fourthly, the design of this study was cross-sectional and as such nothing can be said about temporality of the association. The predictive direction of proposed relationships can be ascertained by longitudinal studies.

Conclusions
The findings of the current study suggest that many Chinese secondary school students have cognitive limitations on the specific knowledge of smoking-related diseases. Students whose father smoke and mother smoke have received less tobacco-related knowledge. High school students with rich family economic condition and with a positive attitude towards smoking had better understanding of the smoking-related knowledge. Male students who disagree or were neutral towards friends smoking were in a negative correlation with the knowledge of smoking hazards. The findings of the present study will contribute to a better understanding of the smoking-related knowledge among secondary school students and will allow for the development of health-prevention programs for urban male secondary school students in China. Targeted educational programs for secondary school students in China are needed to promote tobacco control and tobacco use reduction and cessation among students.

Authors’ contributions
All authors contributed to the design of the study. XX was responsible for literature searches, the interpretation of the results, and writing the manuscript. XX, CC and YZ participated in the development of the study protocol, data collection. CC analyzed the data. XX, CC, AS, MS, HL, YZ contributed to the drafting of the manuscript. YZ was responsible for the conception of the study and overall supervision of the data collection and analysis, the interpretation of the results, and manuscript preparation. All authors have read and approved of the final manuscript.

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Competing interests
The authors declare that they have no competing interests.

Ethical approval
We obtained written informed consents from all parents or main caregivers of the enrolled children through parent–teacher conferences. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Chongqing Medical University.

References
Belchamber K, Hall DA, Hourani SM (2014) Smoking enhances the proinflammatory effects of nucleotides on cytokine release from human lung. PLoS ONE 9:e99711
Bird Y, Staines-Orozco H, Moranos J (2016) Adolescents' smoking experiences, family structure, parental smoking and socio-economic status in Ciudad Juárez, Mexico. Int J Equity Health 15:29
Cheng HG, McBride O, Phillips AR (2015) Relationship between knowledge about the harms of smoking and smoking status in the 2010 Global Adult Tobacco China Survey. Tob Control 24(1):54–61. doi:10.1136/tobaccocontrol-2013-051163
China CDC (2015) China Youth Tobacco Survey, 2014. Beijing. http://tcrc.org.cn/html/zy/cbwy/c2827.html
De Vries H, van't Rett J, Panday S, Reubsaet A (2007) Access point analysis in smoking and nonsmoking adolescents: findings from the European Smoking Prevention Framework Approach study. Eur J Prev Med 16(3):257–265
Farrellly MC, Hussain A, Bauer UE (2007) Effectiveness and cost effectiveness of television, radio and print advertisements in promoting the New York smokers' quitline. Tob Control 16:21–23
Goh YM, Chua S (2016) Knowledge, attitude and practices for design safety: a study on civil & structural engineers. Accid Anal Prev 93:260–266
Guindon GE, Boisclair D (2003) Past, current and future trends in tobacco use: HNP Discussion Paper. The World Bank, Washington. http://escholarship.org/uc/item/4qs7d5xy (Accessed on 17 Nov 2010)
Hu L, Sekine M, Gaina A (2007) Association of smoking behavior and sociodemographic factors, work, lifestyle and mental health of Japanese civil. J Occup Health 49:443–452
Huisman C (2014) Does it matter what friends think, say, or do? The role of friends’ smoking attitudes and behavior for Dutch adolescents’ smoking behavior. Subst Use Misuse 49(6):715–723. doi:10.3109/10826084.2013.863347
Jordan JN, McElroy JA, Everett KD (2014) Smoking initiation, tobacco product use, and secondhand smoke exposure among general population and Sexual Minority Youth, Missouri, 2011–2012. Prev Chronic Dis 11:E113
Liang KY, Zeger SL (1986) Longitudinal data analysis using generalized linear models. Biometrika 73:13–22
Liu X, Zhang JY (2006) Analysis of ordinal repeated measures data using generalized estimating equation. Sichuan Da Xue Xue Bao Yi Xue Ban 37:798–800 (in Chinese) http://www.ncbi.nlm.nih.gov/pubmed/17037756
Mahabee-Gittens EM, Collins BN, Murphy S (2014) The parent–child dyad and risk perceptions among parents who quit smoking. Am J Prev Med 47(5):596–603
Martinovic M, Belojevic G, Evans GW (2015) Prevalence of and contributing factors for overweight and obesity among Montenegrin school children. Eur J Public Health 25(5):833–839. doi:10.1093/eurpub/ckv071
Moore CS, Grant MD, Zink TA, Panizzon MS, Franz CE, Logue MW et al (2014) Erectile dysfunction, vascular risk, and cognitive performance in late middle age. Psychol Aging 29:163–172
Mullenburg JL, Laschober TC, Eby LT (2015) Substance use disorder counselors’ reports of tobacco cessation services availability, implementation, and tobacco related knowledge. J Addict Nurs Health 57(3):327–333. doi:10.1016/j.jadh.2015.06.001
Parasuraman R, Jiang Y (2012) Individual differences in cognition, affect, and performance: behavioral, neuroimaging, and molecular genetic approaches. Neuroimage 59:70–82

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Prochaska JJ, Fromont SC, Christina W (2013) Tobacco use and its treatment among young people in mental health settings: a qualitative analysis. Nicotine Tob Res 15(8):1427–1435
Richardson JG, Trafiłow M, Madson L (2012) Future health-related behavioral intention formation: the role of affect and cognition. J Soc Psychol 152:775–779
Ruano-Ravina A, García-Lavandeira JA, Torres-Durán M (2014) Leisure time activities related to carcinogen exposure and lung cancer risk in never smokers. A case–control study. Environ Res 132:33–37
Singh S, Vijayakumar N, Priyadarshini HR (2015) Tobacco use among high school children in Bangalore, India: a study of knowledge, attitude and practice. Indian J Cancer 52(4):690–693. doi:10.4103/0019-509X.179413
The Ministry of health of the people’s Republic of China (2012) The health report on smoking in China. People's Health Publishing House, Beijing
Thomas RE, Baker PRA, Thomas BC (2016a) Family-based interventions in preventing children and adolescents from using tobacco: a systematic review and meta-analysis. Acad Pediatrics 16(5):419–429
Thomas RE, Baker PR, Thomas BC (2016b) Family-based interventions in preventing children and adolescents from using tobacco: a systematic review and meta-analysis. Acad Pediatr 16(5):419–429
U.S. Department of Health and Human Services (2012) Preventing tobacco use among youth and young adults: a report of the surgeon general. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Atlanta
Ustinavičienė R, Škėmienė L, Lukšienė D (2016) Problematic computer game use as expression of Internet addiction and its association with self-rated health in the Lithuanian adolescent population. Medicina 52(3):199–204
Voorhees CC, Ye C, Carter-Pokras O, MacPherson L (2011) Peers, tobacco advertising, and secondhand smoke exposure influences smoking initiation in diverse adolescents. Am J Health Promot 25(3):e1–e11. doi:10.4278/ajhp.090604-QUAN-180
Windham GC, Mitchell P, Anderson M, Lasley BL (2005) Cigarette smoking and effects on hormone function in premenopausal women. Environ Health Perspect 113:1285–1290
World Health Organization (2009) Global adult tobacco survey: Egypt Country Report 2009/World Health Organization, Regional Office for the Eastern Mediterranean, World Health Organization, Nasr City
World Health Organization (2012) Mortality attributable to tobacco. Geneva. http://www.who.int/tobacco/publications/surveillance/rep_mortality_attribution/en/
World Health Organization (2013) WHO Report on the Global Tobacco Epidemic, Country Profile China, 2013: the MPOWER Package. World Health Organization, Geneva. http://www.who.int/tobacco/surveillance/policy/country_profile/chn.pdf?ua=1 (Accessed on 10 July 2013)
World Health Organization (2015) WHO report on the Global Tobacco Epidemic, 2015 Country profile Nepal. Geneva. http://www.who.int/tobacco/surveillance/policy/country_profile/npl.pdf?ua=1
Xu X, Gong T, Zhang Y, Wu C, Xie Y, Wang HH et al (2015a) Evaluation of anti-smoking television advertising on tobacco control among urban community populations, China. Tob Induc Dis 13(1):31
Xu X-L, Zhu R, Sharma M, Deng S, Liu S, Liu D-Y et al (2015b) Smoking attitudes between smokers and non-smoker secondary school students in three geographic areas of China: a cross-sectional survey based on social cognitive theory. Lancet 386(Special Issue):S78. doi:10.1016/S0140-6736(15)00659-5
Zawahir S, Omar M, Awang R (2013) Effectiveness of antismoking media messages and education among adolescents in Malaysia and Thailand: findings from the international tobacco control southeast Asia project. Nicotine Tob Res 15:482–491
Zhang C, Fan J (2013) A study of the perception of health risks among college students in China. Int J Environ Res Public Health 10:2133–2149

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