

BMJ Open Prevalence and associated factors of smoking in middle and high school students: a school-based cross-sectional study in Zhejiang Province, China

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ABSTRACT

Objectives: To determine the prevalence and associated factors of smoking in a Chinese adolescent population.

Setting: A multistage, stratified cluster sampling technique was used in the present cross-sectional study conducted in Zhejiang Province of China. Based on socioeconomic status, school levels and geographical positions, 253 middle school classes, 122 academic school classes and 115 vocational high school classes located in 12 urban areas and 18 rural areas were chosen.

Participants: A total of 9617 middle school students, 5495 academic high school students and 4430 vocational high school students were recruited in this survey.

Primary and secondary outcome measures: Ever, current smoking status and associated factors were collected via a self-administered questionnaire. Logistic regression models were used to examine the associations between current smoking and the associated factors. ORs with their 95% CIs were reported.

Results: Overall, the prevalence of ever-smokers and current smokers was 33.83% and 7.93%, respectively. Focused on current smokers, significantly higher risks of adolescent smoking were observed in an older age group, boys, rural areas and vocational high school. Other significant factors were parents smoking, secondhand smoke exposure, parental divorce or separation, living with family, school performance and belief that smoking is harmful.

Conclusions: The prevalence of smoking was relatively high among Chinese adolescents in Zhejiang Province. Factors related to personal characteristics, family and school were associated with adolescent smoking.

INTRODUCTION

Tobacco use is one of the most serious public health threats worldwide. As the second leading contributor, tobacco smoking accounted for 6.3% of the global disease

Strengths and limitations of this study

- The present study had several strengths. This was a school-based study with relatively large sample size, high response rate and representative provincial samples from China. Besides, the study questionnaire involved a great number of factors, which might help us better understand how to prevent adolescent smoking.
- Our study also had some limitations. First, with its cross-sectional design, our study could not provide causal associations and further longitudinal researches are urgently needed. Second, in the current study, the smoking status of the participants was collected via self-administered questionnaires, which might underestimate the smoking prevalence among adolescents. Third, as the participants were selected in Zhejiang Province, our findings cannot be generalisable to the broader Chinese adolescent population.

burden in 2010.¹ Considerable evidence has indicated that smoking is associated with many types of cancers and cardiovascular diseases.² According to the WHO, tobacco claims nearly six million lives annually, and this figure is expected to rise to more than eight million by the year 2030.³ With 301 million current smokers, China is facing the largest smoking problem on Earth, which poses a great public health challenge.⁴ In recent decades, high rates of smoking among adolescents have become a public health concern across the world, and China is no exception. A national survey focused on elementary and middle school students reported that the prevalence of ever-smokers and current smokers was 19.0% and 5.4%, respectively.⁵ In addition, a meta-analysis of smoking prevalence among Chinese adolescents showed high levels of male smoking and a rapid increase in female smoking between 1981 and 2010.⁶ To develop more effective strategies against tobacco use



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among youths, it is crucial to study the associated factors of adolescent smoking. The causes of adolescent smoking are complex and multifactorial. Aside from the factors of sex, socioeconomic status and parental or friends smoking,^{7–9} with social and economic development, psychosocial factors within the family such as parental divorce or separation need more comprehensive research.

Although some research regarding smoking has been conducted in China, studies on the prevalence of adolescent smoking and associated factors are still lacking. Therefore, the primary objective of this study is to estimate the prevalence of smoking among Chinese middle and high school students, and to explore the associated factors of adolescent smoking.

MATERIALS AND METHODS

Participants

The present school-based cross-sectional study was conducted in Zhejiang Province of China in 2012. Middle and high school students were recruited to investigate the prevalence and associated factors of smoking among them. In China, at the age of 6 years, children enter the first grade of primary education, which lasts 6 years. After primary education, they all enter middle school at 12 years of age for 3 years of education. Then, after an entrance examination, they enter high school (including academic and vocational) for another 3 years of education. When drawing the samples, a multistage, stratified cluster sampling technique was used. In the first stage, 30 counties, including 12 urban areas and 18 rural areas, were sampled from all 90 counties of Zhejiang Province on the basis of socioeconomic status. The 12 urban areas included Shangcheng, Xiacheng, Haishu, Lucheng, Putuo, Kecheng, Wuxing, Nanhu, Wucheng, Yuecheng, Jiaojiang and Liandu. The 18 rural areas included Fuyang, Jiande, Yuyao, Fenghua, Jiashan, Tongxiang, Yueqing, Pingyang, Xianju, Wenling, Shangyu, Xinchang, Wuyi, Dongyang, Anji, Kaihua, Suichang and Yunhe. Then, all schools in selected counties were stratified according to their levels (middle school, academic and vocational high school) and geographical positions (from west to east, from north to south). In the second stage, based on the number of students in each level of school, samples of classes were chosen in each level of school (253 middle school classes, 122 academic school classes and 115 vocational high school classes). Finally, students in all selected classes were invited to participate in the survey.

Questionnaire

The self-administered questionnaire was developed based on the US 1991–2015 Youth Risk Behavior Surveillance System (YRBSS) and Global School-based Student Health Survey (GSHS) supported by the WHO. The questionnaire was reviewed, checked and approved by experts, and revised after a pilot study. The

questionnaire covered information on demographic characteristics, health status and quality of life, physical activity, cigarette smoking and alcohol use, internet use, diet, violence, injuries and sexual behaviours. Without teachers present, students independently filled in the anonymous questionnaire in the classroom. After completion, the questionnaires were collected on the spot by the researchers. To make all participation voluntary, parents and school officials were sent a written letter to inform them that a study was to be conducted to examine issues relevant to adolescent health, and given the option to refuse the students' participation in the study. Besides, all the researchers were strictly trained to protect the students' privacy and ensure the confidentiality of personal data. In particular, our study abided by the 'Declaration of Helsinki'

Definition of study variables

Participants' smoking behaviours were assessed in the questionnaire according to the following queries: (1) 'Have you ever tried cigarette smoking, even one or two puffs?' (Yes or No); (2) 'During the past 30 days, on how many days did you smoke cigarettes?' (0, 1–2, 3–5, 6–9, 10–19, 20–29, 30 days). Ever-smokers were identified if they answered that they had tried cigarette smoking, even one or two puffs. Participants were considered as current smokers if they answered that they had smoked at least 1 day during the past 30 days.

The explanatory variables were also taken into consideration in this study. They were age range (≤ 13 , 14, 15, ≥ 16 years), gender (girls, boys), location of school (urban, rural), father's education level (<middle school graduate, middle school graduate, >middle school graduate), mother's education level (<middle school graduate, middle school graduate, >middle school graduate), only child (yes, no), school level (middle school, academic high school, vocational high school), parental marriage status (married, divorced/widowed/separated), parents smoking (no, one parent, both), belief that smoking is harmful (yes, no), secondhand smoke exposure (yes, no), school performance (below average, average, excellent), and living with family (yes, no).

Statistical analysis

Descriptive statistics were used to estimate the prevalence of ever-smokers and current smokers among middle and high school students. To explore the associated factors of adolescents smoking, logistic regression analyses were conducted using two steps in sequence. First, univariate logistic regression analyses were carried out to preliminarily determine which of the potential factors (in tables 1 and 2) were associated with current smoking among adolescents. Second, a multivariate logistic regression model was constructed by adding all the significant factors from the above univariate logistic regression analyses. The effect values were reported by OR with their 95% CIs. All analyses were performed

Table 1 Univariate analysis on the associations between demographic characteristics and the risk of adolescent current smoking

Characteristics	Smokers (N=1549; %)	Non-smokers (N=17 993; %)	OR	95% CI
Age range (years)				
≤13	107 (2.74)	3797 (97.26)	Ref.	
14–	144 (4.74)	2894 (95.26)	1.77	1.37 to 2.28
15–	276 (8.36)	3026 (91.64)	3.24	2.58 to 4.07
≥16	1022 (10.99)	8276 (89.01)	4.38	3.58 to 5.37
Gender				
Girls	242 (2.46)	9577 (97.54)	Ref.	
Boys	1307 (13.44)	8416 (86.56)	6.15	5.34 to 7.07
Location of school				
Urban	488 (6.64)	6858 (93.36)	Ref.	
Rural	1061 (8.70)	11 135 (91.30)	1.34	1.20 to 1.50
Father's education level				
<Middle school graduate	382 (8.87)	3926 (91.13)	Ref.	
Middle school graduate	723 (8.46)	7827 (91.54)	0.95	0.83 to 1.08
>Middle school graduate	444 (7.07)	6240 (92.93)	0.73	0.63 to 0.84
Mother's education level				
<Middle school graduate	531 (8.77)	5522 (91.23)	Ref.	
Middle school graduate	665 (8.28)	7365 (91.72)	0.94	0.83 to 1.06
>Middle school graduate	353 (6.47)	5106 (93.53)	0.72	0.63 to 0.83
Only child				
Yes	850 (8.25)	9450 (91.75)	Ref.	
No	699 (7.56)	8543 (92.44)	0.91	0.82 to 1.01
School level				
Middle school	442 (4.60)	9175 (95.40)	Ref.	
Academic high school	355 (6.46)	5140 (93.54)	1.43	1.24 to 1.66
Vocational high school	752 (16.98)	3678 (83.02)	4.24	3.75 to 4.80
Parental marriage status				
Married	1377 (7.79)	16 303 (92.21)	Ref.	
Divorced/widowed/separated	172 (9.24)	1690 (90.76)	1.21	1.02 to 1.42

using SAS statistical package (V.9.2, SAS Institute, Inc, Cary, North Carolina, USA).

RESULTS

For this survey, 21 110 students were chosen randomly and 20 589 agreed to participate, yielding a response rate of 97.53%. Among the 20 589 completed questionnaires, 108 missing substantial responses and 939 from migrants were excluded from the analysis. In total, this study included 19 542 middle and high school students recruited from 30 counties in Zhejiang Province of China. The mean age was 15.35±1.84 years. Among them, there were 9819 (50.25%) girls and 9723 (49.75%) boys; and 9617 (49.21%) middle and 9925 (50.79%) high school students. Overall, 33.83% (95% CI 33.17% to 34.51%) of the participants had ever-smoked, of whom, boys and girls accounted for 44.79% (95% CI 43.80% to 45.78%) and 22.99% (95% CI 22.16% to 23.82%), respectively. Only 7.93% (95% CI 7.52% to 8.28%) of the participants were current smokers and the prevalence was much higher in boys (13.44%, 95% CI 12.76% to 14.12%) than in girls (2.42%, 95% CI 2.12% to 2.72%).

The following analyses focused only on current smokers. **Table 1** shows the risks of current smoking

among adolescents with different demographic characteristics: age (16 years or more vs <13 years; OR=4.38, 95% CI 3.58 to 5.37), gender (boys vs girls; OR=6.15, 95% CI 5.34 to 7.07), location of school (rural vs urban; OR=1.34, 95% CI 1.20 to 1.50), school level (vocational high school vs middle school; OR=4.24, 95% CI 3.75 to 4.80), father's education level (more than middle school graduate vs less than middle school graduate; OR=0.73, 95% CI 0.63 to 0.84), mother's education level (more than middle school graduate vs less than middle school graduate; OR=0.72, 95% CI 0.63 to 0.83) and parental marriage status (divorced/widowed/separated vs married; OR=1.21, 95% CI 1.02 to 1.42).

Table 2 shows the analysis on the associations between related factors and the risk of adolescent current smoking. There were significant associations between smoking and the following factors: parents smoking (both vs none; OR=2.61, 95% CI 1.79 to 3.81), belief that smoking is harmful (yes vs no; OR=0.29, 95% CI 0.22 to 0.40), secondhand smoke exposure (yes vs no; OR=2.22, 95% CI 1.99 to 2.48), school performance (excellent vs below average; OR=0.25, 95% CI 0.21 to 0.29) and living with family (yes vs no; OR=0.64, 95% CI 0.57 to 0.71).

Table 3 displays the results of multivariate analysis including all the significant factors on current

Table 2 Univariate analysis on the associations between related factors and the risk of adolescent current smoking

Factors	Smokers (N=1549; %)	Non-smokers (N=17 993; %)	OR	95% CI
Parents smoking				
No	433 (6.08)	6688 (93.92)	Ref.	
One parent	1082 (8.88)	11 104 (91.12)	1.51	1.34 to 1.69
Both	34 (14.47)	201 (85.53)	2.61	1.79 to 3.81
Belief that smoking is harmful				
No	57 (22.27)	199 (77.73)	Ref.	
Yes	1492 (7.74)	17 794 (92.26)	0.29	0.22 to 0.40
Secondhand smoke exposure				
No	499 (5.12)	9242 (94.88)	Ref.	
Yes	1050 (10.71)	8751 (89.29)	2.22	1.99 to 2.48
School performance				
Below average	759 (14.25)	4568 (85.75)	Ref.	
Average	617 (6.28)	9206 (93.72)	0.40	0.36 to 0.45
Excellent	173 (3.94)	4219 (96.06)	0.25	0.21 to 0.29
Living with family				
No	990 (9.39)	9555 (90.61)	Ref.	
Yes	559 (6.21)	8438 (93.79)	0.64	0.57 to 0.71

Table 3 Multivariate analysis on the associations between related factors and the risk of adolescent current smoking

Factors	Smokers (N=1549; %)	Non-smokers (N=17 993; %)	OR*	95% CI
Age range (years)				
≤13	107 (2.74)	3797 (97.26)	Ref.	
14–	144 (4.74)	2894 (95.26)	1.69	1.30 to 2.19
15–	276 (8.36)	3026 (91.64)	2.50	1.95 to 3.20
≥16	1022 (10.99)	8276 (89.01)	2.54	1.88 to 3.44
Gender				
Girls	242 (2.46)	9577 (97.54)	Ref.	
Boys	1307 (13.44)	8416 (86.56)	6.85	5.92 to 7.92
Location of school				
Urban	488 (6.64)	6858 (93.36)	Ref.	
Rural	1061 (8.70)	11 135 (91.30)	1.24	1.10 to 1.41
School level				
Middle school	442 (4.60)	9175 (95.40)	Ref.	
Academic high school	355 (6.46)	5140 (93.54)	0.99	0.77 to 1.26
Vocational high school	752 (16.98)	3678 (83.02)	3.14	2.49 to 3.98
Parental marriage status				
Married	1377 (7.79)	16 303 (92.21)	Ref.	
Divorced/widowed/separated	172 (9.24)	1690 (90.76)	1.33	1.11 to 1.59
Parents smoking				
No	433 (6.08)	6688 (93.92)	Ref.	
One parent	1082 (8.88)	11 104 (91.12)	1.24	1.09 to 1.40
Both	34 (14.47)	201 (85.53)	2.05	1.33 to 3.15
Belief that smoking is harmful				
No	57 (22.27)	199 (77.73)	Ref.	
Yes	1492 (7.74)	17 794 (92.26)	0.31	0.22 to 0.44
Secondhand smoke exposure				
No	499 (5.12)	9242 (94.88)	Ref.	
Yes	1050 (10.71)	8751 (89.29)	2.05	1.82 to 2.31
School performance				
Below average	759 (14.25)	4568 (85.75)	Ref.	
Average	617 (6.28)	9206 (93.72)	0.44	0.39 to 0.50
Excellent	173 (3.94)	4219 (96.06)	0.28	0.24 to 0.34
Living with family				
No	990 (9.39)	9555 (90.61)	Ref.	
Yes	559 (6.21)	8438 (93.79)	0.78	0.69 to 0.88

*ORs were adjusted for all significant variables listed in tables 1 and 2.

adolescents smoking. After adjusting for various factors, listed in tables 1 and 2, significantly higher risk in older age group and lower risk in adolescents with excellent school performance were observed. For three age groups (14–15, 15–16, ≥ 16 years), the ORs ranged from 1.69 to 2.54 and the 95% CI did not include the null. Compared to adolescents with below average school performance, the ORs of adolescents with average and excellent school performance ranged from 0.28 to 0.44, and the 95% CI did not include the null. Compared to girls and urban area, boys and students in rural areas were, respectively, 6.85 (OR=6.85, 95% CI 5.92 to 7.92) and 1.24 (OR=1.24, 95% CI 1.10 to 1.41) times more likely to smoke currently. School level was positively associated with adolescent current smoking and the risk was 3.14 (OR=3.14, 95% CI 2.49 to 3.98) among vocational high school students. A significant risk of adolescents currently smoking was also found associated with parents smoking. The risk was 1.24 (OR=1.24, 95% CI 1.09 to 1.40) for adolescents having one parent smoking and 2.05 (OR=2.05, 95% CI 1.33 to 3.15) for those having both parents smoking. Our results showed that adolescents with adverse parental marriage status (OR=1.33, 95% CI 1.11 to 1.59) and secondhand smoke exposure (OR=2.05, 95% CI 1.82 to 2.31) had a higher risk of current smoking. In addition, adolescents who believed the harmful effects of smoking (OR=0.31, 95% CI 0.22 to 0.44) and lived with family (OR=0.78, 95% CI 0.69 to 0.88) had a lower risk of current smoking.

DISCUSSION

On the basis of 19 542 middle and high school students, this study was performed to estimate the prevalence of smoking and explore the associated factors in a Chinese adolescent population. In this survey, the overall prevalence of current smokers was 7.93% (including 13.44% of boys and 2.46% of girls). According to the newly released data from the 2014 Global Youth Tobacco Survey (GYTS), 5.9% of students (9.9% of boys and 1.6% of girls) aged 13–15 years were current cigarette smokers in China,¹⁰ results that were lower than ours. Some research has been carried out in other countries. For example, the Florida Youth Tobacco Survey (FYTS) 2014 indicated that 8.7% of high school and 2.9% of middle school students had smoked cigarettes in the past month,¹¹ which were higher than our results of academic high school (6.46%) and lower than that of middle school students (4.60%), respectively. Besides, according to a large cross-sectional survey conducted in London in 2011–2012, a current smoking prevalence of 3.4% was reported among students in secondary schools.¹² The smoking prevalence among adolescents varied in these studies, which might be due to the different samples, smoking definition and social circumstances. In 1998, a school-based survey conducted in Zhejiang Province reported that only 0.3% in total, and no girls, in Chinese secondary school students were

regular smokers (defined as at least 1 cigarette per week).⁷ Although the samples and smoking definition were different, the comparison with our prevalence data revealed a fast growing number of adolescent smokers in China since the 1990s.

Associated factors of adolescent current smoking have been examined in this study and particular attention should be focused on certain groups. In the present study, significantly increased risks of current smoking were observed in an older age group, boys, rural areas and vocational high school, which was consistent with previous researches showing the role of personal characteristics in adolescents' smoking initiation and continuation.^{8 13} Family influence has been extensively analysed and a wide range of family factors were reported to be associated with adolescent smoking. Parental smoking has been considered a strong predictor of adolescent smoking.^{14–16} We found consistent evidence that parental smoking significantly impacted their children's current smoking behaviour. Specifically, adolescents having both parents smoking are at a greater current smoking risk than those having only one parent smoking (2.05 vs 1.24). Besides, studies further indicated that adolescents were more likely to smoke when the mothers smoked, and the mothers' smoking influenced girls' more than boys' smoking.^{17 18} Secondhand smoke is a significant public health problem among never-smoking adolescents.¹⁹ However, the independent influence of secondhand smoke on adolescent smoking has scarcely been explored. In this study, we found a higher risk of current smoking among adolescents exposed to secondhand smoke (OR=2.05, 95% CI 1.82 to 2.31), which was equal to the effect of having both parents smoking. Many studies have documented evidence that adolescents from divorced or separated families were more likely to smoke.^{20 21} Our observations indicated a consistent positive association between parental divorce or separation and adolescents' current smoking behaviour. As for how parental divorce influences adolescent smoking, family conflicts and family disharmony might be important contributors; the relationship with adolescents' smoking behaviours has been explored by various studies.^{14 22 23} A lower risk of current smoking was observed among adolescents who lived with family (OR=0.78, 95% CI 0.69 to 0.88), which reinforced a positive role of parental monitoring in preventing adolescent smoking.²⁴ Except for family influence, school-related factors, especially academic achievement, was also identified as a predicting factor of adolescent smoking.^{25 26} In our study, good performance (average, excellent) at school was found to be consistently associated with lower risk of adolescent current smoking. Finally, belief that smoking is harmful was reported to be negatively associated with the risk of smoking among adolescents. In the current study, a lower risk of current smoking was observed among adolescents who believed smoking is harmful, which confirmed the results of previous studies.^{27 28}

In conclusion, the prevalence of smoking was relatively high among Chinese adolescents in Zhejiang Province. Personal characteristics played a role in influencing adolescents' smoking behaviour. Parental smoking, second-hand smoke exposure, parental divorce, living with family, school performance and belief that smoking is harmful were also associated with adolescent smoking. In developing school-based antismoking policy and programmes, particular attention should be focused on adolescents with the factors aforementioned.

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Competing interests None declared.

Ethics approval Ethics Committee of Zhejiang Provincial Center for Disease Control and Prevention.

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