Original Article

Smoking susceptibility among school children aged 13–15 in Vietnam: a multilevel analysis of data from Global Youth Tobacco Use data (GYTS) 2014

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ABSTRACT

Background: We aim to assess the prevalence of smoking susceptibility and identify factors at school and individual levels that are associated with individual susceptibility to smoking among school children aged 13–15 years in Vietnam.

Methods: Data came from Vietnam Global Youth Tobacco Survey (GYTS) 2014. A 2-stage sample design and proportion to population size (PPS) technique was employed to select a representative sample of study participants. Independent variables include both individual and school-level characteristics. Both descriptive and inferential statistics were performed. Logistic multilevel models were constructed to analyze the association between independent variables and smoking susceptibility status.

Results: The overall percentage of smoking susceptibility status was 11.2%. Boys were more susceptible to smoking than girls. The odds of smoking susceptibility were higher among students who had both of their parents smoking (adjusted odds ratio [aOR], 3.91; 95% confidence interval [CI], 2.17–7.05) and those whose best friends smoked (aOR, 4.79; 95% CI, 2.40–9.54). Knowledge on harmfulness of smoking was associated with lower odds of smoking susceptibility. Among school level factors, the schools with greater access to anti-smoking media were associated with lower susceptibility to smoking among their students (coefficient = −0.028; standard error = 0.011, $P < 0.05$).

Conclusion: This study highlights the importance of contextual exposure to anti-smoking media among the children. With the availability of multilevel modeling as an analytical tool, further refinements in the understanding of contextual effects on smoking status are needed to facilitate the development of school level policy and interventions in addition to individual level approaches.

Keywords: Tobacco smoking; Adolescent health; Statistics; Multilevel analysis; School health

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Conflict of Interest

The authors whose names are listed above certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Author Contributions

Conceptualization: Hoang VM, Oh J; Data curation: Hoang VM; Formal analysis: Bui TTQ; Investigation: Oh J; Methodology: Hoang VM, Oh J, Bui TTQ, Kim BG; Project administration: Hoang VM; Supervision: Hoang VM, Oh J; Validation: Hoang VM, Oh J; Writing - original draft: Hoang VM, Oh J; Writing - review & editing: Hoang VM, Oh J, Bui TTQ, Vu THL, Le TH, Nguyen TL, Kim BG, Luu NM, Le QC, Luu NH.

INTRODUCTION

Smoking is very common in Vietnam, especially among men. Data from the Vietnam Global Adult Tobacco Surveys (GATS) showed that the prevalence of tobacco smoking among Vietnamese adults aged 15 years and over was 23.8% (47.4% among men and 1.4% among women) in 2010¹ and 22.5% (45.3% among men and 1.1% among women) in 2015.²

Even though the prevalence of current smoking among adolescents in Vietnam seems to be low, i.e. 3.9% (5.9% among boys and 1.2% among girls) in 2007³ and 3.5% (6.3% among boys and 0.9% among girls) in 2014,⁴ the problem of youth smoking in Vietnam should not be underestimated because tobacco industry has been trying to expand cigarette markets by promoting cigarettes to adolescents. Also, youth smokers are 3 times more likely to use alcohol, 8 times more likely to use marijuana, and 22 times more likely to use cocaine than non-smokers. Smoking is associated with a host of other risky behaviors, such as fighting and engaging in unprotected sex, etc.⁵

Smoking uptake behavior among adolescents was shown to progress through a sequence of developmental stages, including preparation, contemplation, trier, experimenter, and regular and established smoker.⁶ Susceptibility to smoking is an important cognitive change during the preparation stage that leads to experimentation with cigarettes.⁷ Susceptibility to smoking is defined as "lack of firm decision against smoking and usually starts in the perception and/or initiation stages of smoking behavior".⁷

Taking advantage of data from the Vietnam Global Youth Tobacco Survey (GYTS) 2014, which was initiated by the World Health Organization (WHO), Tobacco Free Initiative, and the Center for Disease Control and Prevention (CDC) Office on Smoking and Health,^{8,9} we aim to assess the prevalence of susceptibility to smoking among school children aged 13–15 years in Vietnam and to identify factors at school and individual levels that have associations with individual susceptibility to smoking.

METHODS

Participants

We used the data from Vietnam GYTS 2014. GYTS is an internationally standardized school-based survey that has been conducted in more than 140 countries.¹⁰ The Vietnam GYTS 2014 was conducted among 3,549 school children aged 13 to 15 years from 40 schools in the country. A 2-stage sample design and proportion to population size (PPS) technique was employed to select a representative sample of study children. The international version of the original questionnaire was adapted to the Vietnamese context and used for the survey.¹¹ Data collection was coordinated by the Hanoi Medical University and Vietnam Steering Committee on Smoking and Health (VINACOSH). CDC's guidance was applied in all procedures of data collection and management. The overall response rate of the Vietnam GYTS 2014 was 95.1%.⁹

Instruments

The description of the study variables is presented in **Table 1**. Dependent variable is smoking susceptibility status among school children aged 13–15 years in Vietnam. Smoking susceptibility was assessed through the following questions and responses:

Table 1. Description of the study variables

Variables	Questions	Original response options	Definition used in this paper
Dependent variables			
Smoking susceptibility	If one of your best friends invited you a tobacco product, would you smoke it? During the next 12 months, do you think you will smoke any form of tobacco product?	1 = Definitely not, 2 = Probably not, 3 = Probably yes, 4 = Definitely yes 1 = Definitely not, 2 = Probably not, 3 = Probably yes, 4 = Definitely yes	Students who answered “definitely not” to both questions were considered non-susceptible and all the other students were considered susceptible
Independent variables			
Individual characteristics			
Gender		1 = Boy, 2 = Girl	1 = Boy, 2 = Girl
Age	How old are you?	1 = Aged 13, 2 = Aged 14, 3 = Aged 15	1 = Aged 13, 2 = Aged 14, 3 = Aged 15
Parental smoking	Do your parents smoke?	1 = None, 2 = Both, 3 = Father, 4 = Mother	1 = None, 2 = Either father or mother, 3 = Both parents
Best friend smoking	Do any of your closest friends smoke cigarettes?	1 = None, 2 = Some of them, 3 = Most of them, 4 = All of them	1 = None, 2 = Some of them, 3 = Many of them (response options 3–4)
Knowledge that smoking is harmful for your health	Do you think cigarette smoking is harmful to your health?	1 = Definitely not, 2 = Probably not, 3 = Probably yes, 4 = Definitely yes	1 = Yes (respond option 4), 0 = No (respond options 1–3)
School-level factors			
Access to anti-smoking media	During the past 30 days, did you see or hear any anti-tobacco messages from any type or media?	1 = Yes, 2 = No	The percentage of students in school who reported “yes”.
Taking part in classes or seminar on harmful effects of smoking	During the past 12 months, were you taught in any of your classes or took part in a seminar about the danger of smoking?	1 = Yes, 2 = No	The percentage of students in school who reported “yes”.
Exposure to tobacco advertisements or promotions	During the past 30 days, did you see any tobacco advertisements or promotions on TV, video, movies?	1 = Yes, 2 = No	The percentage of students in school who reported “yes”.
Noticing teachers smoking	During school hours, how often do you see teachers smoking in the school?	1 = Everyday, 2 = Sometimes, 3 = Never, 4 = I do not know	The percentage of students in school who reported “1 = Every day” or “2 = Sometimes”

1. If one of your best friends invited you a tobacco product, would you smoke it? (response options are: 1 = definitely not, 2 = probably not, 3 = probably yes, and 4 = definitely yes).
2. During the next 12 months, do you think you will smoke any form of tobacco product? (response options are: 1 = definitely not, 2 = probably not, 3 = probably yes, and 4 = definitely yes).

Susceptibility to smoking was defined based on definition by Pierce et al.⁷: students who answered “definitely not” to both questions were considered non-susceptible and all the other students were considered susceptible.

Independent variables include both individual and school-level characteristics. Individual-level characteristics are gender, age, knowledge of harmful effect of smoking, parental smoking, and best friend smoking. School-level characteristics were measured by aggregations of individual students' responses for each school. The following school-level variables were created:

1. Access to anti-smoking media (the percentage of students in school who reported watching or hearing any anti-tobacco messages from any type or media during the past 30 days).
2. Taking part in classes or seminar on harmful effects of smoking (the percentage of students who had been taught or took part in a seminar about the danger of smoking during the last 12 months).
3. Exposure to tobacco advertisements or promotions (the percentage of students who reported seeing any tobacco advertisements or promotions on TV, Video, Movies during the past 30 days)

4. Noticing teachers smoking (the percentage of students who reported teachers smoking in the school).

Data analysis

Both descriptive and inferential statistics were performed. Descriptive statistics were carried out by calculating frequencies and percentages of the variables of interest. Logistic multilevel models were constructed to analyze the effects of individual and school-level factors on smoking susceptibility status of the study participants. Specifically, a 2-level random intercept multilevel model for a binary response (y , whether a non-smoking student was susceptible to smoking or not) for individual student i (level 1) nested within school j (level 2).

$$\pi_{ij} = \Pr(y_{ij} = 1)$$

$$\text{logit}(\pi_{ij}) = \log[\pi_{ij}/(1 - \pi_{ij})] = \beta_0 + \beta_1 X_{ij} + \beta_2 X_{2j} + u_{0j}$$

The equation has 2 parts: 1) A fixed part ($\beta_0 + \beta_1 X_{ij} + \beta_2 X_{2j}$): the coefficients for independent variables at individual and school level per each; and 2) A random part (u_{0j}): random part for school. The results of fixed part (indicating the association between dependent and independent variables) were presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). The results of random part were presented as school random variance with standard errors (SEs) and variance partition coefficient (%). A significance level of $P < 0.05$ was used. The MLwiN software, version 3.01 (University of Bristol, Bristol, UK) and Stata 14.0 (Stata, College Station, TX, USA) were used for the analyses. Parameters were estimated using the iterative generalised least squares (IGLS) and predictive (or penalized) quasi-likelihood (PQL) estimation type.¹²

Ethical considerations

This study used secondary data which was accepted by Hanoi University of Public Health Ethical Review Board with ID number, HSPH.DDI.010101. Metadata of this study can be found on Hanoi University of Public Health website (<http://data.huph.edu.vn/index.php/catalog/10/study-description>).

RESULTS

Characteristics of the study participants

The proportions of boys and girls were 49.1% and 50.9%, respectively. The number of participants aged 13, 14, and 15 years old made up 27.8%, 35.0%, and 37.2%, respectively. The prevalence of current tobacco smoking was 3.5% (6.3% among boys and 0.9% among girls). After removing the number of smoking students ($n = 345$) from the sample, the number of the total sample of non-smoker was 3,427 students. Key characteristics of the study participants are described in **Table 2**. **Fig. 1** shows the distributions of the school-level variables.

Smoking susceptibility status among the 13–15-year school students

As shown in **Fig. 2**, the overall percentage of smoking susceptibility status among the 13–15-year school students was 11.2%. Boys were more susceptible than girls (15.3% vs. 7.5%). Students aged 15 years had the highest percentage of smoking susceptibility (12.4%) as compared to younger groups.

Fig. 1. Distributions of the school-level variables.

Multilevel analysis of effects of individual and school-level factors on smoking susceptibility status

A 2-level random intercept multilevel logistic model for a binary response was applied to examine the effects of individual and school-level factors on smoking susceptibility status. In the first model, the null model without any individual/school factors, the school variance was statistically significant and accounted for 2.8% of the total variability in susceptibility to smoking (95% CI, 1.1%–7.9%). In the final model (**Table 3**), when all the individual/school

Table 2. Key characteristics of the study participants

Characteristics	Frequency (unweighted)	Weighted percentage
Gender		
Boys	1,622	48.5
Girls	1,801	51.5
Age		
13	1,090	28.3
14	1,200	35.4
15	1,030	36.3
Parental smoking		
None	1,929	55.4
Either father or mother	1,359	42.2
Both parents	79	2.4
Best friend smoking		
None	2,370	67.6
Some of them	990	30.7
Many of them	56	1.7
Knowledge that smoking is harmful for child's health		
Yes	378	11.4
No	3,049	88.6
Access to anti-smoking media		
Yes	487	15.3
No	2,926	84.7
Taking part in classes or seminar on harmful effects of smoking		
Yes	1,332	41.7
No	2,095	58.3
Exposure to tobacco advertisements or promotions		
Yes	2,768	80.7
No	659	19.3
Noticing teachers smoking		
Yes	1,846	52.0
No	1,581	48.0

Smoking susceptibility of school children in Vietnam

Table 3. Logistic multilevel analyses of effects of individual and school-level factors on smoking susceptibility status among the 13–15-year-old school students, Vietnam 2014

Variable	Coefficient (SE)	OR (95% CI)	P-value
Gender (Girl vs. Boy)	−0.630 (0.131)	0.53 (0.41–0.69)	0.00
Age (14 years vs. 13 years)	0.149 (0.158)	1.16 (0.85–1.58)	0.35
Age (15 years vs. 13 years)	0.074 (0.174)	1.08 (0.76–1.52)	0.67
Parental smoking (Either father or mother vs. None)	0.253 (0.131)	1.29 (1.00–1.67)	0.05
Parental smoking (Both father or mother vs. None)	1.363 (0.301)	3.91* (2.17–7.05)	0.00
Best friends smoking (Some vs. None)	0.825 (0.134)	2.28* (1.75–2.97)	0.00
Best friends smoking (Many vs. None)	1.566 (0.352)	4.79* (2.40–9.54)	0.00
Knowledge that smoking is harmful for child's health (Yes vs. No)	−1.519 (0.146)	0.22* (0.16–0.29)	0.00
Access to anti-smoking media*	−0.028 (0.011)	-	0.01
Taking part in classes or seminar on harmful effects of smoking*	−0.005 (0.005)	-	0.32
Exposure to tobacco advertisements or promotions*	0.014 (0.009)	-	0.11
Noticing teachers smoking*	−0.001 (0.003)	-	0.65

SE = standard error; OR = odds ratio; CI = confidence interval.

*Level 2 variable, only the coefficients and P-value are presented (because the OR derived from the coefficients correspond to an effect equivalent to 1-unit change in the independent variable would be too small).

factors were considered, the variance at school level still stayed significant but now only accounted for 0.9% (95% CI, 0.04%–15.9%) of the variability in the outcome.

The fixed part of the model shows that female students were less likely to be susceptible to smoking than males (aOR, 0.53; 95% CI, 0.41–0.69). The odds of smoking susceptibility were higher among students who had both of their parents smoking (aOR, 3.91; 95% CI, 2.17–7.05). Students whose best friends smoked had greater odds of being susceptible to smoking (some of best friends smoked: aOR, 2.28; 95% CI, 1.75–2.97; many of best friends smoked: aOR, 4.79; 95% CI, 2.40–9.54). Those who believed smoking was harmful to health were less likely to be susceptible to smoking (aOR, 0.22; 95% CI, 0.16–0.29). For the school-level factors, access to anti-smoking media was shown to be significantly associated with lower susceptibility to smoking. For ease of interpretation of the school factors, we estimated the OR corresponding to a difference between the top 10th percentiles and the lowest 10th percentiles of the school-level factors (therefore the OR represents the maximum impact of school-level factor on the outcome). The OR on smoking susceptibility for a school at the lowest 10th percentiles for access to anti-smoking media compared to a school at the top 10th percentiles was 1.56 (95% CI, 1.54–1.58).

Fig. 2. Smoking susceptibility status among the 13–15-year school students by gender and age (individual level).

DISCUSSION

Our study found that the overall percentage of smoking susceptibility status among the 13–15-year school students was 11.2% (15.3% and 7.5% among boys and girls, respectively). These figures are similar to previous results from GYTS 2003 in Vietnam (in which the overall prevalence of smoking susceptibility was 13.8%, and 23.6% among boys and 7.4% among girls).¹³ Yet, these numbers are lower than the figures of 27.7% (47.6% among boys, 10.8% among girls) reported in a study by Page et al.¹⁴ This variation might be due to difference in study sites sampling. More specifically, the GYTS 2014 was a national standardized school-based survey that was conducted among 40 secondary schools representing various types of areas in Vietnam. On the other hand, the study conducted by Page et al.¹⁴ only collected data in 2 schools, 1 in the most busiest district in Hanoi, and 1 in a rural area of Hai Duong province which is not comparable to Hanoi in terms of lifestyle, economic status, etc. Therefore, the national representativeness of this prior study was not guaranteed. Remarkably, there was an increase in the prevalence of girls who were susceptible to smoking compared to the results of a previous analysis using GYTS 2007 in Vietnam (1.5%).¹⁵

Susceptibility to smoking has been studied in both developed and developing countries and this figure tends to be higher in developed countries. An analysis of data from the Monitoring the Future Survey (2014–2016) by Owotomo and Maslowsky¹⁶ in 2018 showed that among American never-smokers of conventional cigarettes, 16.7% were susceptible to smoking. In a previous analysis of data from 2010–2011 Youth Smoking Survey, about 29% of 12,894 Canadian never-smoker students in grades 6–8 were identified to be susceptible to smoking in the future.¹⁷ Another study in Canada found that a quarter of youths who had never smoked in 2006 were able to smoke in the future.¹⁸ In Nigeria, the proportion of susceptibility to smoking was found to be 13.6% (14.5% among males and 11.4% among females, respectively) in a study by Odukoya et al.¹⁹ In Nepal, the prevalence of smoking susceptibility among 2,878 adolescents was 22.8%.²⁰ In addition, a 3-year long longitudinal study (2007–2009) of 1,736 Malaysian students showed that 16.3% were susceptible to smoking.²¹

Our study also revealed that boys were more susceptible to smoking than girls. This finding aligns with findings from previous studies.^{14,17,19–24} For instance, in 2012, a cross-sectional study in Vietnam showed that there was a significant difference in the percentage of smoking susceptibility between high school male students (47.5%) and female students (10.7%).²³ In addition, a 2007–2009 cohort-study among 2,301 Malaysians indicated that more males than females were susceptible to smoking (aOR, 2.05; 95% CI, 1.23–3.39).²¹ Along with it, a recent cross-sectional study involving 1,973 Japanese students grades 7–9 demonstrated that 53% of males and 37% of females were susceptible to smoking and this difference in the proportions was statistically significant ($P < 0.001$).²⁴ However, an analysis of data from the Pakistan GYTS 2004 among 6,204 students grades 8–10 in 3 cities found that female students were 1.53 times (95% CI, 1.24–1.89) more likely to be susceptible to smoking than male students.²⁵

The odds of smoking susceptibility were statistically significantly higher among students who had both of their parents smoking. Same finding was demonstrated by an analysis of GYTS data from Cambodia, Laos and Vietnam.¹³ This was similar to the findings from other international studies. For examples, a previous analysis of data from 2010–2011 Youth Smoking Survey in Canada showed that those whose siblings smoked were 1.67 times more likely to be susceptible to smoking than those whose siblings did not smoke (95% CI, 1.46–1.93).¹⁷ Remarkably, in 2013, in an analysis of data from an intervention study, Odukoya,

Odeyemi¹⁹ indicated that Nigerian students who were sent to buy cigarette products by older adults were more likely to be susceptible to smoking compared to those who were not exposed to such chores (OR, 3.68; 95% CI, 2.41–5.61).

We found that students whose best friends smoked also had greater odds of susceptibility to smoking. A previous study in Vietnam also showed that those people who had smoker friends were 3.2 times more likely to smoke in the future compared those who had no friends smoking (95% CI, 2.1–4.8).¹⁵ The presence of friends or peers who smoke has been found to be an important predictor of smoking in the future in a number of international studies.^{13,15,19–21,25–28} For example, a study conducted in Nigeria showed that having smoker friends increased the odds of susceptibility to smoking among 989 high school students (OR, 2.26; 95% CI, 1.27–4.01).¹⁹ Similarly, results from a 3-year-long longitudinal study in Malaysia showed that secondary school students who had smoking friends were 1.76 times more likely to smoke in the future compared to those who did not have smoking friends (95% CI, 1.10–2.83).²¹ Additionally, in 2014, an analysis of the 2004 GYTS data in 3 Pakistan cities indicated that having close friends who smoked was associated with increased susceptibility to smoking (OR, 2.77; 95% CI, 2.27–3.40).²⁵ In 2015, another analysis of the GYTS in Nepal showed that having smoking friends increased the odds of smoking susceptibility (aOR, 1.97; 95% CI, 1.53–2.52).²⁰ Noticeably, one of the most recent reports in Nigeria in 2017 showed that those who had smoking close friends were 6.54 times more likely to be susceptible to smoking compared to those who did not have smoking close friends (95% CI, 4.45–9.62).²⁸ In particular, an analysis of data from the GYTS in 5 African countries (Libya, Egypt, Tunisia, Morocco, and Sudan) revealed that male students were significantly more likely to have smoking friends compared to female students.²⁷

Our study showed that those who knew smoking was harmful to health were less likely to be susceptible to smoking. In fact, knowing risk of smoking was shown to be a significant protecting factor to smoking susceptibility. A study from Japan found that students who were interested in learning about health and practicing what they learned, were negatively associated with susceptibility to future smoking.²⁴ These results were also similar to the findings from a cross-sectional study in 2,000 Nigerian secondary school students in 2017 in which those who had poor knowledge of harmful effects of smoking were 2.35 times (95% CI, 1.64–3.36) more likely to be more susceptible to smoking than those who had good knowledge.²⁸ Similarly, in Vietnam, it was shown that attendance at school classes that described the harmful effects of smoking had significant effects in reducing cigarette smoking.¹⁵ In Malaysia, a study showed that the odds of smoking susceptibility was higher among students who had poor academic achievement (aOR, 1.60; 95% CI, 1.05–2.44).²¹

We have demonstrated that school level factors appear to have impacts on students' susceptibility to smoking. Students with access to anti-smoking media were shown to be less susceptible to smoking than those who did not. Previous studies in Southeast Asia and Canada also showed that susceptibility to smoking among never-smokers significantly varied across schools.^{13,18} For instance, the study in Southeast Asia indicated that 4.5% and 4.2% of the variation in smoking susceptibility were associated with school and class differences, respectively.¹³ Anti-smoking ads and interventions were shown to be an effective way to reduce susceptibility to smoking among adolescents.¹⁶ It was also demonstrated that young people who had accessed to anti-smoking media (OR, 0.73; 95% CI, 0.59–0.89) were less likely to be susceptible to smoking.²⁵ Furthermore, in 2015, a study conducted in the United Kingdom showed that recognizing higher number of tobacco brands doubled the risk of smoking susceptibility and becoming a smoker among non-susceptible never smokers.²⁹

Of particular interest in this study was the results from multilevel analysis on the effects of compositional factors and contextual factors on susceptibility to smoking status. Both individual-level and school-level characteristics were shown to contribute to observed variation in cigarette smoking susceptibility status of the study participants.

We need to note some limitations of our data. Firstly, the GYTS relies on self-completion of the questionnaires. The accuracy of reporting in this study is not known. However, Brener et al.³⁰ has reported high reliability of results on teenage smoking when questionnaires were administered and self-completed. Secondly, the GYTS applied only to youths who were in schools on the day of the survey and who completed the survey, so our findings are likely to be conservative. Thirdly, the GYTS is limited to school students. Hence, our findings may not be generalizable to adolescents who do not attend schools. Fourthly, the measure of susceptibility developed by Pierce et al.⁷ has not been validated in low- and middle-income countries even though there is considerable evidence that the measure of susceptibility is a good predictor of experimentation.

In conclusion, the present paper used a representative sample of Vietnam to assess the smoking susceptibility status among 13–15-year school students and its relationship with both individual and school-level factors. The paper highlights the importance of contextual exposure to anti-smoking media among the children. With the availability of multilevel modeling as an analytical tool, further refinements in the understanding of contextual effects on smoking status are needed to facilitate the development of school level policy and interventions such as enhancing anti-smoking media within schools as well as banning tobacco advertisements to ensure a smoke-free school environment for students.

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