


# Prevalence of smoking among health science students in Vietnam in 2018 and associated factors: A cross-sectional study

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## Abstract

Smoking is a global health problem among health science students. The objectives of this study were to estimate the prevalence of smoking and to examine associated factors among health science students from five universities in Vietnam. Among 5946 participants (95.0% response rate), the smoking prevalence was 19.2% (95% CI:17.4–21.0%) among male students and 2.9% (95% CI:2.4–3.5%) among female students. In the multivariable regression models, significant factors for smoking were the perceived financial burden, the respondent's year in university, a non-self-determined motivation profile, self-reported depression and/or anxiety, the level of vigorous physical activity, and alcohol drinking.

## Keywords

anxiety, depression, health behaviour, health psychology, smoking, students

## Introduction

Smoking is an unhealthy habit and brings about serious health consequences, such as lung cancer and many other types of cancers (Saha et al., 2007), respiratory disease, cardiovascular disease (Action on Smoking Health, 2016), stroke, blindness, deafness, back pain, osteoporosis, and peripheral vascular disease (US Department of Health and Human Services, 2004). Every year, more than 8 million people die from smoking, most of which occur in low- and middle-income countries (World Health Organization, 2019). The prevalence of smoking among health science students is increasing worldwide. A study across 70 countries, with the participation of 107,527 students from four health professional disciplines, indicated that the prevalence of smoking was the highest in European countries (20% among medical students and 40% among dental students) and the Americas (13% among pharmacy students

to 23% among dental students) (Sreeramareddy et al., 2018). Health science students will become healthcare workers in the future and play an important role in providing counselling for patients on smoking and its

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consequences. If they do not give up smoking habits, they will not be able to persuade their patients to quit either (Smith and Leggat, 2007a, 2007b).

In Vietnam, there have been a few studies on smoking and selected related factors among students (Nguyen Van Huy, 2008). However, the sample size was limited and only investigated across one university. Furthermore, although several studies within a number of countries have indicated the prevalence of smoking among medical, dental, pharmacy, and nursing students (Lei et al., 1997; Patkar et al., 2003; Sreeramareddy et al., 2018), many associated factors – such as the perceived financial burden, academic motivation, depression, anxiety, and so forth – remain unexplored. In this study, we aimed to estimate the prevalence of smoking among health science students in Vietnam and to examine the association between various factors which are not well reported in previous studies.

## Methods

### Study design and study population

A cross-sectional study design was chosen; the study was conducted on 6257 full-time health science students at the Hanoi University of Public Health, Hanoi Medical University, the Hanoi University of Pharmacy, the Military Medical University, and Hanoi Medical College. The differences in these types of institution in Vietnam were described elsewhere (Trines, 2017). These universities are located in Hanoi city, Vietnam, and each of them would send out the questionnaire to its entire study cohort, or randomly select several classes within each cohort. Data collection was conducted at the beginning of the 2018–2019 academic year (from October to November 2018). Data were collected through self-report, paper-based questionnaires with the support from the various Student Affairs Departments of the universities. At Hanoi Medical University, data was collected via a computer-based questionnaire, and the representative of the research team guided students in completing this electronic questionnaire. The details regarding our sample size and study population are reported in Table 1.

We did not include students who were on a leave of absence, or disagreed to participate in our survey.

### Study variables

Our main dependent variable was smoking status (current smokers/yes; and non-current cigarette smokers/no). Students, who responded “Yes” to the question “Have you ever tried or experimented with cigarette smoking, (even one or two puffs)? and who also smoked for at least 1 day after being asked “During the past 30 days, on how many days did you smoke cigarettes?” were categorised as current smokers. Non-current cigarette smokers were participants who had never tried or experimented with cigarette

smoking (never smokers) as well as had tried or experimented with cigarette smoking but did not smoke cigarettes during the previous month (former smokers) (Tami-Maury et al., 2017).

Independent variables included demographic information (age, marital status, types of housemate, and perceived financial burden), academic factors (the respondents’ year in university, academic performance, and academic motivation), mental health-related factors (the number of stress events using the list of common stress events (18 events) in the last 12 months, which was developed by Quynh Anh et al (Anh, 2015b), self-reported depression and anxiety), lifestyle factors (physical activity, and alcohol drinking in the last 12 months).

### Study instruments

The study instruments included questions on sociodemographic information, the Patient Health Questionnaire (PHQ-9), the Generalised Anxiety Disorder Questionnaire (GAD-7) to screen for depressive and anxiety symptoms, and the academic motivation scale (AMS) to measure academic motivation. More details about the PHQ-9, GAD-7, and AMS were described in several previous studies (Milic et al., 2019; Pham et al., 2019).

The value and reliability of the PHQ-9 when translated into Vietnamese were evidenced in previous studies (Nguyen et al., 2016b; Niemi et al., 2016). There has not been a specific study to investigate the value and reliability of the Vietnamese translation of GAD-7 and AMS. However, they have been standardised translation and used in many studies in Vietnam (Nguyen et al., 2016a; Pham et al., 2019). In short, these questionnaires were translated into Vietnamese before being back-translated into English by independent and certified translators. The original English and the back-translated versions were compared to one another by another independent translator so as to ensure the appropriateness of the translation. The final questionnaires were then modified slightly so as to fit the Vietnamese culture and language.

### Data analysis

The main survey results were analysed using the Stata 15.1 Survey package; we used Chi-square, T-test, and Wilcoxon rank-sum test methodologies to compare the differences between the two genders (StataCorp, 2017a, 2017b).

Before conducting multivariable analysis, we used the multiple imputations in Stata (mi chained – the sequential imputation using chained equations without statistical interactions) to impute the missing data (Jakobsen et al., 2017; Sterne et al., 2009). Categorical variables – including marital status, types of housemate, physical activity, smoking status, and alcohol drinking – were imputed using mlogit (multinomial logistic regression) for a nominal variable.

**Table 1.** Sample of study.

No.	University's name	University description	Majors covered by this study	Final Sample size (5946)	Non-response	Entire selection of student cohorts or random selection of several classes within each cohort
1	Hanoi University of Public Health (HUPH)	HUPH now has more than 2000 students pursuing 11 different undergraduate and graduate courses. HUPH has its own strategic development plan between 2013 and 2020 with the vision to become the leading institution in Vietnam and in the region on Public Health training, research and consultancy.	4 year-Undergraduate: Bachelor of Public Health; Nutrition; Laboratory Technology in Preventive Medicine; and Social Work	855	3.5%	Entire selection of majors covered by this study within four cohorts (1st, 2nd, 3rd, 4th year)
2	Hanoi Medical University (HMU)	HMU is a leading and the oldest university in Vietnam, established in 1902. The university provides 10 undergraduate programs and around 200 post-graduate programs including master, PhD, the first and the second levels of professional specialty. The total number of current students is about 12,000. HMU has trained the top-level physicians and health staff in Vietnam. HMU has Students office to support and supervise student's learning process.	Undergraduate training includes 6-year medical programs (general medicine; preventive medicine, traditional medicine, odonto-smatology) and the 4-year bachelor programs (nursing; nutrition; public health; medical technology; ophthalmometry).	1718	6.0%	Entire selection of majors covered by this study within two cohorts (first and the last year)
3	Hanoi University of Pharmacy (HUP)	Until 2018, HUP has granted bachelor degrees for 21,000 pharmacists who is highly qualified in accordance with national demands. Regular Pharmacist is trained to focus on five main orientations:- Pharmaceutical industry- Clinical pharmacy- Pharmacognosy and traditional pharmacy- Pharmacoeconomics and administration- Drug quality control	5 year-Undergraduate: Bachelor of Pharmacy	923	10%	Entire selection of majors covered by this study within two cohorts (1st, 4th year)
4	Vietnam Military Medical University (VMMU)	VMMU is a unique medical facility directly belong to the Ministry of National Defence that has three political core missions: to train medical and pharmaceutical officers at various grades ranging from primary level to graduated and post-graduate level for Vietnamese army and citizen organisations; to perform clinical treatment and to do science research, especially in military medical fields.	6 year-Undergraduate: Doctor of General Medicine 5 year-Undergraduate: Bachelor of Pharmacy 3 year-Undergraduate: Nursing; Pharmacy	617	5.1%	Entire selection of majors covered by this study within three cohorts (1st, 2nd, 3rd year)
5	Hanoi Medical College	Hanoi Medical College has 9 Line Departments, 5 Faculties with 18 Departments. There are 4000 students trained each year and our graduate employment rate is 80%.	3 year- undergraduate: Nursing; Midwife; Medical Image Technology; Medical Testing Technology; and Pharmacy	1833	1.8%	Random selection of several classes of Nursing and Pharmacy within three cohorts (1st, 2nd, 3rd year) Entire selection of Midwife, Medical Image Technology, and Medical Testing Technology within three cohorts (1st, 2nd, 3rd year)

Binary variables – including self-reported depression, self-reported anxiety, personal history of depression and/or anxiety, personal history of other mental health disorders, family history of mental health and neurological disorders, perceived financial burden, and the academic motivation profile – were imputed using logit (the logistic regression for a binary variable). Finally, continuous variables – age and number of siblings – were imputed using regress (- linear regression for a continuous variable).

Other auxiliary variables included in the imputation procedure were gender, number of stress events in the last 12 months and the respondents' year in university. We created 20 imputed datasets with Stata default burn-in iteration – an imputation created after every 10th imputation (StataCorp, 2017a; UCLA: Statistical Consulting Group, 2020).

To identify potential factors for smoking, we used prior knowledge from the literature to create a simple causal diagram (also known as DAG - directed acyclic graph) to examine the relationship between potential factors and smoking (Hernán et al., 2002; VanderWeele, 2019; VanderWeele and Shpitser, 2011). VanderWeele et al. and Hernán et al. pointed out that such approach would be less bias compared to traditional approach, such as backward selection and forward selection procedures (Hernán et al., 2002; VanderWeele, 2019; VanderWeele and Shpitser, 2011). We created two separate models in male and female. Because the smoking prevalence among males is high, using odds ratios from logistic regression would overestimate the association (Barros and Hirakata, 2003; Zou, 2004). To deal with this issue, we could estimate Prevalence Ratios (PRs) from log-binomial regression models; however, such models usually fail to converge (Williamson et al., 2013). Therefore, we decided to fit modified Poisson regression models, with robust error variances, with our binary outcome data in order to estimate PRs, which would produce similar results compared to the log-binomial model (Barros and Hirakata, 2003; Chen et al., 2018; Zou, 2004).

After obtaining the models' estimation from Stata 15.1, we used R software ver. 3.4.0 and the forest plot package to create the graphs used in this paper (Max Gordon, 2018; R Core Team, 2017; StataCorp, 2017b).

### **Ethical considerations**

This study sought to ensure that all ethical principles in biomedical research was followed. Students' participation was completely voluntary; students could withdraw from the study at any time without any risk.

The protocol of this study was reviewed and approved by the Scientific and Ethical Committee in Biomedical Research, from the Hanoi University of Public Health, according to Decision No. 430/2018 /YTCC-HD3.

## **Results**

### **General characteristics of the study sample**

Among 6257 sampled students, 5946 completed the questionnaires, giving the study a response rate of 95.0%.

Table 2 shows the sociodemographic characteristics of the study sample. More than half of respondents were female (67.8%). The mean age of the students was 20.64 (SD = 1.88). About 98.3% of the students were single, and 49.5% of the students lived with roommate(s) at the time of our survey. We also found that 19.9% of the students reported having financial burdens. The prevalence of male respondents who reported experiencing financial burdens (24.4%) was higher than that of female respondents (17.8%). Regarding academic factors, 3062 students in their freshman year did not have their academic performance at the time of the survey.

Comparing the male and female students, there was a clear difference in academic motivation, self-reported anxiety and lifestyle factors. Specifically, the prevalence of male students with non-self-determined motivation was higher than that of the female students (50.4% vs 34.4%). The anxiety prevalence among male respondents was also higher than that of their female counterparts (10.4% vs 7.9%). By lifestyle, the prevalence of male students who participate in vigorous physical activity was double that of the female students questioned (58.9% vs 28.5%). The male students also reported drinking more alcohol than the female students, with a lower prevalence of never drinking alcohol as well (50.8% vs 79.3%).

### **Prevalence of smoking among health science students**

Table 3 presents the smoking prevalence of male health science students according to different factors. The prevalence of smoking among the male students was 19.2% (95% CI: 17.4–21.0%) with a median smoking initiation age of 18 years old among male smokers.

We found statistically significant differences between smoking and all related factors, except of marital status. Students with financial burdens also displayed a greater smoking prevalence than those without financial burdens (31.5% vs 15.2%,  $p < 0.001$ ). The relationships between smoking and academic factors – such as the respondent's year in university and academic performance – were not significant ( $p > 0.05$ ). We also revealed statistically significant differences in male students with a non-self-determined motivation, who had a smoking prevalence higher than male students with a self-determined motivation (24.1% vs 15.1%,  $p < 0.001$ ). The smoking prevalence of the male students with anxiety and depressive symptoms were also higher than male students without these symptoms (36.2% vs 17.2%, 32% vs 16.6%,  $p < 0.001$ , respectively).

**Table 2.** Sociodemographic characteristics of participants.

Columns by: Gender	Male	Female	Total	Missings / N (Pct)
<i>n</i> (%)	1912 (32.2)	4034 (67.8)	5946 (100.0)	0 / 5946 (0.00)
<b>Demographic</b>				
Age, mean (sd)	21.08 (2.20)	20.43 (1.67)	20.64 (1.88)	438 / 5946 (7.37)
<b>Marital status, <i>n</i> (%)</b>				
Single, <i>n</i> (%)	1873 (98.4)	3948 (98.3)	5821 (98.3)	27 / 5946 (0.45)
Married, <i>n</i> (%)	17 (0.9)	56 (1.4)	73 (1.2)	
Other, <i>n</i> (%)	13 (0.7)	12 (0.3)	25 (0.4)	
<b>Types of housemate, <i>n</i> (%)</b>				
Living alone, <i>n</i> (%)	264 (13.9)	305 (7.6)	569 (9.6)	29 / 5946 (0.49)
Living with family, <i>n</i> (%)	646 (34.0)	1558 (38.8)	2204 (37.2)	
Living with roommate(s), <i>n</i> (%)	942 (49.6)	1988 (49.5)	2930 (49.5)	
Other, <i>n</i> (%)	48 (2.5)	166 (4.1)	214 (3.6)	
<b>Perceived financial burden, <i>n</i> (%)</b>				
No, <i>n</i> (%)	1427 (75.6)	3288 (82.2)	4715 (80.1)	
Yes, <i>n</i> (%)	461 (24.4)	714 (17.8)	1175 (19.9)	56 / 5946 (0.94)
<b>Academic factors</b>				
<b>Year in university, <i>n</i> (%)</b>				
Freshman and sophomore year, <i>n</i> (%)	1191 (62.3)	2362 (58.6)	3553 (59.8)	0 / 5946 (0.00)
Junior and senior year, <i>n</i> (%)	721 (37.7)	1672 (41.4)	2393 (40.2)	
<b>Academic performance, <i>n</i> (%)</b>				
Academic performance reports are not available (Freshman year students), <i>n</i> (%)	1053 (55.5)	2009 (50.0)	3062 (51.8)	34 / 5946 (0.57)
Fail, <i>n</i> (%)	8 (0.4)	1 (0.0)	9 (0.2)	
Pass, <i>n</i> (%)	247 (13.0)	431 (10.7)	678 (11.5)	
Average, <i>n</i> (%)	30 (1.6)	223 (5.6)	253 (4.3)	
Good, <i>n</i> (%)	468 (24.7)	1099 (27.4)	1567 (26.5)	
Excellent/Very good, <i>n</i> (%)	89 (4.7)	239 (6.0)	328 (5.5)	
Outstanding, <i>n</i> (%)	2 (0.1)	6 (0.1)	8 (0.1)	
Unknown, <i>n</i> (%)	0 (0.0)	7 (0.2)	7 (0.1)	
<b>Academic motivation profile, <i>n</i> (%)</b>				
Self-determined, <i>n</i> (%)	847 (49.6)	2427 (65.6)	3274 (60.6)	
Non-self-determined, <i>n</i> (%)	860 (50.4)	1271 (34.4)	2131 (39.4)	541 / 5946 (9.10)
<b>Mental health-related factors</b>				
Number of stress events in the last 12 months, median (iqr)	1.00 (2.00)	1.00 (2.00)	1.00 (2.00)	0 / 5946 (0.00)
<b>Self-reported depression, <i>n</i> (%)</b>				
No, <i>n</i> (%)	1514 (83.6)	3271 (84.1)	4785 (84.0)	247 / 5946 (4.15)
Yes, <i>n</i> (%)	296 (16.4)	618 (15.9)	914 (16.0)	
<b>Self-reported anxiety, <i>n</i> (%)</b>				
No, <i>n</i> (%)	1614 (89.6)	3597 (92.1)	5211 (91.3)	238 / 5946 (4.00)
Yes, <i>n</i> (%)	188 (10.4)	309 (7.9)	497 (8.7)	
<b>Lifestyle factors</b>				
<b>Physical activity, <i>n</i> (%)</b>				
Not participate in moderate and/or vigorous physical activity, <i>n</i> (%)	535 (29.6)	1892 (48.4)	2427 (42.5)	234 / 5946 (3.94)
Participate in moderate physical activity, <i>n</i> (%)	208 (11.5)	899 (23.0)	1107 (19.4)	
Participate in vigorous physical activity, <i>n</i> (%)	1063 (58.9)	1115 (28.5)	2178 (38.1)	
<b>Alcohol drinking in the last 12 months, <i>n</i> (%)</b>				
Never drink, <i>n</i> (%)	906 (50.8)	3047 (79.3)	3953 (70.2)	
More than once a month, <i>n</i> (%)	571 (32.0)	632 (16.4)	1203 (21.4)	
About 2–4 times a month, <i>n</i> (%)	241 (13.5)	137 (3.6)	378 (6.7)	
About 2–3 times a week, <i>n</i> (%)	45 (2.5)	16 (0.4)	61 (1.1)	
More than 4 times a week, <i>n</i> (%)	22 (1.2)	11 (0.3)	33 (0.6)	318 / 5946 (5.35)

**Table 3.** Prevalence of smoking among male health science students.

Columns by: smoking status	No	Yes	Total	p-value	Missings / N (Pct)
<i>n</i> (%)	<b>1462 (80.8)</b>	<b>347 (19.2)</b>	<b>1809 (100.0)</b>		<b>103 / 1912 (5.39)</b>
Prevalence of smoking among male					
Age at starting smoking, median (iqr)	N/A	18.00 (3.00)	18.00 (3.00)		1776 / 1912 (92.89)
<i>Demographic</i>					
Age, mean (sd)	20.94 (2.15)	21.58 (2.21)	21.06 (2.18)	<b>&lt;0.001</b>	143 / 1912 (7.48)
Marital status, <i>n</i> (%)					
Single, <i>n</i> (%)	1437 (80.8)	341 (19.2)	1778 (100.0)	0.71	9 / 1912 (0.47)
Married, <i>n</i> (%)	11 (73.3)	4 (26.7)	15 (100.0)		
Other, <i>n</i> (%)	8 (80.0)	2 (20.0)	10 (100.0)		
Types of housemate, <i>n</i> (%)					
Living alone, <i>n</i> (%)	203 (84.6)	37 (15.4)	240 (100.0)	<b>&lt;0.001</b>	12 / 1912 (0.63)
Living with family, <i>n</i> (%)	531 (86.5)	83 (13.5)	614 (100.0)		
Living with roommate(s), <i>n</i> (%)	679 (75.4)	221 (24.6)	900 (100.0)		
Other, <i>n</i> (%)	42 (91.3)	4 (8.7)	46 (100.0)		
Perceived financial burden, <i>n</i> (%)					
No, <i>n</i> (%)	1153 (84.8)	206 (15.2)	1359 (100.0)	<b>&lt;0.001</b>	24 / 1912 (1.26)
Yes, <i>n</i> (%)	305 (68.5)	140 (31.5)	445 (100.0)		
<i>Academic factors</i>					
Year in university, <i>n</i> (%)					
Freshman and sophomore year, <i>n</i> (%)	907 (79.8)	230 (20.2)	1137 (100.0)	0.141	0 / 1912 (0.00)
Junior and senior year, <i>n</i> (%)	555 (82.6)	117 (17.4)	672 (100.0)		
Academic performance, <i>n</i> (%)					
Academic performance reports are not available (Freshman year students), <i>n</i> (%)	805 (80.6)	194 (19.4)	999 (100.0)	0.45	15 / 1912 (0.78)
Fail, <i>n</i> (%)	4 (57.1)	3 (42.9)	7 (100.0)		
Pass, <i>n</i> (%)	191 (79.6)	49 (20.4)	240 (100.0)		
Average, <i>n</i> (%)	25 (83.3)	5 (16.7)	30 (100.0)		
Good, <i>n</i> (%)	355 (82.4)	76 (17.6)	431 (100.0)		
Excellent/Very good, <i>n</i> (%)	67 (78.8)	18 (21.2)	85 (100.0)		
Outstanding, <i>n</i> (%)	1 (50.0)	1 (50.0)	2 (100.0)		
Academic motivation profile, <i>n</i> (%)					
Self-determined, <i>n</i> (%)	718 (84.9)	128 (15.1)	846 (100.0)	<b>&lt;0.001</b>	205 / 1912 (10.72)
Non-self-determined, <i>n</i> (%)	649 (75.9)	206 (24.1)	855 (100.0)		
<i>Mental health-related factors</i>					
Number of stress events in the last 12 months, median (iqr)	1.00 (2.00)	1.00 (2.00)	1.00 (2.00)	0.359	0 / 1912 (0.00)
Self-reported depression, <i>n</i> (%)					
No, <i>n</i> (%)	1248 (83.4)	248 (16.6)	1496 (100.0)	<b>&lt;0.001</b>	102 / 1912 (5.33)
Yes, <i>n</i> (%)	200 (68.0)	94 (32.0)	294 (100.0)		
Self-reported anxiety, <i>n</i> (%)					
No, <i>n</i> (%)	1326 (82.8)	275 (17.2)	1601 (100.0)	<b>&lt;0.001</b>	110 / 1912 (5.75)
Yes, <i>n</i> (%)	120 (63.8)	68 (36.2)	188 (100.0)		
<i>Lifestyle factors</i>					
Physical activity, <i>n</i> (%)					
Not participate in moderate and/or vigorous physical activity, <i>n</i> (%)	446 (83.8)	86 (16.2)	532 (100.0)	<b>&lt;0.001</b>	106 / 1912 (5.54)
Participate in moderate physical activity, <i>n</i> (%)	186 (89.9)	21 (10.1)	207 (100.0)		
Participate in vigorous physical activity, <i>n</i> (%)	823 (77.5)	239 (22.5)	1062 (100.0)		

(Continued)

**Table 3.** (Continued)

Columns by: smoking status	No	Yes	Total	p-value	Missings / N (Pct)
Alcohol drinking in the last 12 months, <i>n</i> (%)					
Never drink, <i>n</i> (%)	781 (86.8)	119 (13.2)	900 (100.0)	<b>&lt;0.001</b>	127 / 1912 (6.64)
More than once a month, <i>n</i> (%)	459 (80.7)	110 (19.3)	569 (100.0)		
About 2–4 times a month, <i>n</i> (%)	170 (70.5)	71 (29.5)	241 (100.0)		
About 2–3 times a week, <i>n</i> (%)	25 (55.6)	20 (44.4)	45 (100.0)		
More than 4 times a week, <i>n</i> (%)	5 (23.8)	16 (76.2)	21 (100.0)		

Statistical comparison using Fisher’s exact test for Marital status, Types of housemate, Academic performance - display as *n* (%). Chi-square test for other categorical variables - display as *n* (%). T test for continuous-normally distributed variables - display as mean (sd). Wilcoxon rank-sum test for continuous-skewed variables - display as median (iqr). The bold *p*-value indicated statistical significance (*p* < 0.05). N/A: Not applicable.

Smoking prevalence among male students who participate in vigorous physical activity (22.5%) was higher than students who do not participate in moderate and/or vigorous physical activity (16.2%). Smoking prevalence was lowest among male students who participate in moderate physical activity (10.1%). The smoking prevalence of male students who drink alcohol (24%) was greater than in male students who do not drink alcohol (13.2%).

Table 4 presents the smoking prevalence of female health science students across different factors. The prevalence of smoking among the female students was 2.9% (95% CI: 2.4–3.5%) with a smoking initiation age of 12 years old (among these female smokers).

The female students with non-self-determined motivation had a smoking prevalence higher than female students with self-determined motivation (5.9% vs 1%, *p* < 0.001). Female students with anxiety and depressive symptoms had a smoking prevalence higher than female students without these symptoms (10.1% vs 2.2%, 8.5% vs 1.8%, *p* < 0.001, respectively). Regarding lifestyle factors, smoking prevalence was also higher in female students who participate in vigorous physical activity (5.1%) when compared to female students who participate in moderate and/or vigorous physical activity (1.1%) and those who are physically inactive (2.4%). The smoking prevalence among female students who drink alcohol was higher than among female students who do not drink alcohol (6.6% vs 2%, *p* < 0.001).

**Associated factors for smoking among health science students**

In the multivariable regression model (Table 5), the association between marital status/types of housemate and smoking were not statistically significant in either gender.

Regarding demographic information, male students with financial burdens have an increased smoking prevalence by a factor of 1.69 (PR = 1.69, 95% CI: 1.35–2.12); however, we did not find the same association among the female respondents. The prevalence of smoking among junior and senior year students was 21% lower than among male freshman and sophomore year students (PR = 0.79, 95% CI: 0.63–0.99) but not among females (PR = 0.91, 95% CI:

0.62–1.34). The non-self-determined motivation increased smoking prevalence by a factor of 1.58 among males (PR = 1.58, 95% CI: 1.26–1.98) compared to a factor of 3.89 among females (PR = 3.89, 95% CI: 2.48–6.09). Self-reported depression and/or anxiety also increased smoking prevalence by a factor of 1.56 among males (PR = 1.56, 95% CI: 1.23–1.98) and by a factor of 2.68 among females (PR = 2.68, 95% CI: 1.8–4.01). Regarding lifestyle factors, both male and female students who participate in vigorous physical activity had a higher smoking prevalence (male PR = 1.33, 95% CI: 1.03–1.72; female PR = 1.86, 95% CI: 1.25–2.78) compared to the physically inactive groups. We saw a dose-response in smoking prevalence and alcohol consumption as smoking prevalence increased steadily with alcohol drinking frequency. This effect was also stronger in females when compared to males. However, we did not find an association among the female students who drank alcohol more than 4 times a week, as there is only one student in this group.

**Discussion**

Our study found that the prevalence of smoking among male students was 19.2% and among female students was 2.9% students and that were lower than what reported in United Arab Emirates (male 84.6%, female 15.4%) (Mandil et al., 2007). In comparison to the Global Adult Tobacco Survey in Vietnam in 2015, the smoking prevalence among males in our study was lower than that of the overall male population of Vietnam in 2015 (19.2% vs 45.3%), the smoking prevalence among females in our study was higher than that among the overall female population of Vietnam in 2015 (2.9% vs 1.1%) (Van Minh et al., 2017). This could explain the differences in study time and participants. In recent years, the universities of health sciences in Vietnam have increased communication about the health risks of smoking (Minh Minh, 2017; Ministry of Health (MOH), 2019). Therefore, male students in our study might be more aware of tobacco harm than the overall male population of Vietnam. Moreover, data from this study indicated that the smoking prevalence among male students was 6.6 times higher than for female students. In Asian countries, the

**Table 4.** Prevalence of smoking among female health science students.

Columns by: smoking status	No	Yes	Total	p-value	Missings / N (Pct)
<i>n</i> (%)	3795 (97.1)	115 (2.9)	3910 (100.0)		124 / 4034 (3.07)
Prevalence of smoking among female					
Age at starting smoking, median (iqr)	N/A	12.00 (10.00)	12.00 (10.00)		4032 / 4034 (99.95)
<i>Demographic</i>					
Age, mean (sd)	20.40 (1.61)	21.30 (2.57)	20.42 (1.65)	<b>&lt;0.001</b>	295 / 4034 (7.31)
Marital status, <i>n</i> (%)					
Single, <i>n</i> (%)	3718 (97.1)	111 (2.9)	3829 (100.0)	0.11	18 / 4034 (0.45)
Married, <i>n</i> (%)	52 (94.5)	3 (5.5)	55 (100.0)		
Other, <i>n</i> (%)	10 (90.9)	1 (9.1)	11 (100.0)		
Types of housemate, <i>n</i> (%)					
Living alone, <i>n</i> (%)	288 (96.6)	10 (3.4)	298 (100.0)	0.16	17 / 4034 (0.42)
Living with family, <i>n</i> (%)	1470 (96.4)	55 (3.6)	1525 (100.0)		
Living with roommate(s), <i>n</i> (%)	1869 (97.6)	45 (2.4)	1914 (100.0)		
Other, <i>n</i> (%)	155 (97.5)	4 (2.5)	159 (100.0)		
Perceived financial burden, <i>n</i> (%)					
No, <i>n</i> (%)	3112 (97.3)	87 (2.7)	3199 (100.0)	0.096	32 / 4034 (0.79)
Yes, <i>n</i> (%)	666 (96.1)	27 (3.9)	693 (100.0)		
<i>Academic factors</i>					
Year in university, <i>n</i> (%)					
Freshman and sophomore year, <i>n</i> (%)	2218 (97.2)	64 (2.8)	2282 (100.0)	0.549	0 / 4034 (0.00)
Junior and senior year, <i>n</i> (%)	1577 (96.9)	51 (3.1)	1628 (100.0)		
Academic performance, <i>n</i> (%)					
Academic performance reports are not available (Freshman year students), <i>n</i> (%)	1881 (97.5)	48 (2.5)	1929 (100.0)	0.20	19 / 4034 (0.47)
Fail, <i>n</i> (%)	1 (100.0)	0 (0.0)	1 (100.0)		
Pass, <i>n</i> (%)	415 (97.0)	13 (3.0)	428 (100.0)		
Average, <i>n</i> (%)	218 (98.2)	4 (1.8)	222 (100.0)		
Good, <i>n</i> (%)	1020 (95.8)	45 (4.2)	1065 (100.0)		
Excellent/Very good, <i>n</i> (%)	230 (97.9)	5 (2.1)	235 (100.0)		
Outstanding, <i>n</i> (%)	5 (100.0)	0 (0.0)	5 (100.0)		
Unknown, <i>n</i> (%)	6 (100.0)	0 (0.0)	6 (100.0)		
Academic motivation profile, <i>n</i> (%)					
Self-determined, <i>n</i> (%)	2396 (99.0)	25 (1.0)	2421 (100.0)	<b>&lt;0.001</b>	336 / 4034 (8.33)
Non-self-determined, <i>n</i> (%)	1189 (94.1)	75 (5.9)	1264 (100.0)		
<i>Mental health-related factors</i>					
Number of stress events in the last 12 months, median (iqr)	1.00 (2.00)	1.00 (2.00)	1.00 (2.00)	0.801	0 / 4034 (0.00)
Self-reported depression, <i>n</i> (%)					
No, <i>n</i> (%)	3181 (98.2)	58 (1.8)	3239 (100.0)	<b>&lt;0.001</b>	145 / 4034 (3.59)
Yes, <i>n</i> (%)	561 (91.5)	52 (8.5)	613 (100.0)		
Self-reported anxiety, <i>n</i> (%)					
No, <i>n</i> (%)	3491 (97.8)	80 (2.2)	3571 (100.0)	<b>&lt;0.001</b>	128 / 4034 (3.17)
Yes, <i>n</i> (%)	276 (89.9)	31 (10.1)	307 (100.0)		
<i>Lifestyle factors</i>					
Physical activity, <i>n</i> (%)					
Not participate in moderate and/or vigorous physical activity, <i>n</i> (%)	1840 (97.6)	45 (2.4)	1885 (100.0)	<b>&lt;0.001</b>	128 / 4034 (3.17)
Participate in moderate physical activity, <i>n</i> (%)	887 (98.9)	10 (1.1)	897 (100.0)		
Participate in vigorous physical activity, <i>n</i> (%)	1052 (94.9)	56 (5.1)	1108 (100.0)		

(Continued)



**Table 4.** (Continued)

Columns by: smoking status	No	Yes	Total	p-value	Missings / N (Pct)
Alcohol drinking in the last 12 months, <i>n</i> (%)					
Never drink, <i>n</i> (%)	2975 (98.0)	61 (2.0)	3036 (100.0)	<b>&lt;0.001</b>	191 / 4034 (4.73)
More than once a month, <i>n</i> (%)	607 (96.7)	21 (3.3)	628 (100.0)		
About 2–4 times a month, <i>n</i> (%)	112 (81.8)	25 (18.2)	137 (100.0)		
About 2–3 times a week, <i>n</i> (%)	11 (68.8)	5 (31.3)	16 (100.0)		
More than 4 times a week, <i>n</i> (%)	10 (90.9)	1 (9.1)	11 (100.0)		

Statistical comparison using Fisher's exact test for Marital status, Types of housemate, Academic performance, Alcohol drinking in the last 12 months - display as *n*(%). Chi-square test for other categorical variables - display as *n*(%). T test for continuous-normally distributed variables - display as mean(sd). Wilcoxon rank-sum test for continuous-skewed variables - display as median(iqr). The bold *p*-value indicated statistical significance (*p* < 0.05). N/A: Not applicable.

smoking prevalence of female students was lower than that of male students because smoking may not be culturally and socially acceptable among women (Kocabas et al., 1994). In addition, according to Vietnamese culture, smoking among women is uncommon (Le Thi et al., 2012).

In the regression models, we also demonstrated that a perceived financial burden showed an association with smoking among male students. Health science students in Vietnam have coped with financial problems due to the limited number of scholarships, the rising tuition fees and living costs, especially in urban areas (Anh, 2015a; Lan, 2007; Trines, 2017). Students may use cigarettes to relieve stress brought on by financial problems. Smoking can be used as a manner to deal with stressors in life. Some pointed that financial burdens are a stressor and risk factor for smoking (Advani et al., 2014). Furthermore, smokers under financial burden have more difficulty quitting, due to increased daily stress (Kendzor et al., 2010; Siahpush and Carlin, 2006). The female students surveyed also suffer from financial burden. However, the level of financial pressure among female students might be less severe than among male students. In Asian traditions, men often think more financially than women. Furthermore, this also shows gender inequalities present in Vietnam; for example: rich families could send their daughters to school, while poor families would only have their sons go to school. Therefore, financial burden did not increase smoking prevalence among the female students in our study. We suggest that the issue should be investigated further.

Data from this study also shows an association between the respondent's year in university and smoking among male students. Previous studies found that smoking prevalence among medical students tended to increase between the year of entry and the final year (Smith and Leggat, 2007a). In our findings, smoking prevalence among male students tended to decrease across academic years. The exact reasons for this phenomenon are still unknown, but we hypothesise that universities have achieved good results in raising awareness among health science students about the harmful effects of tobacco through health education.

However, the effect of this health-education could be lower in the female students compared to male students. Moreover, many female students smoke due to special reasons – such as mental health problems, smoking as a means of trying to cope, and sedition (Gaffney et al., 2002; Koura et al., 2011).

It was found that the male and female students with non-self-determined motivation were associated with smoking, and this association is independent of self-reported depression/anxiety symptoms. Academic issues may lead to students with non-self-determined motivation. Students who perform better academically are less likely to smoke, while students who perform weak academically smoke much more often (Schnohr et al., 2009). This association was stronger among female students compared to male students, which could be partly explained by the fact that male students could have different ways to reduce academic stress, such as playing game, and drinking alcohol as compared to female students who may have fewer avenues for stress relief.

When we looked at the regression model, self-reported depression and/or anxiety was found to be a factor associated with smoking in both genders. This result was consistent with the previous finding that there is a strong association between depression and smoking among college students (Magid et al., 2009). The students with better mental health displayed lower likelihood of engagement in unhealthy behaviours, such as smoking (Ma and Lai, 2018). Health science students often suffer from academic pressure, whereas some students are not interested in studying. Tung Pham et al. also pointed out that, among medical students at Hanoi Medical University, the prevalence of self-reported depression was 15.2%, whereas suicidal ideation was 7.7% (Pham et al., 2019). Students could smoke to relieve psychological stress and to achieve a balance between their academic and non-academic lives. Therefore, smoking prevalence was higher in students who display the symptoms of depression and anxiety. Evidence also shows that smokers with mental disorders may have more difficulty quitting smoking (Lasser et al., 2000). According to our results, female students who reported the symptoms of

**Table 5.** The multivariable regression model.

Factors for smoking	Male smoking status		Female smoking status	
	PR	95% CI	PR	95% CI
<b>Marital status</b>				
Single	REF		REF	
Married	1,68	0,63–4,46	1,82	0,56–5,89
Other	0,99	0,29–3,33	3,17	0,43–23,3
<b>Types of housemate</b>				
Living alone	REF		REF	
Living with family	0,86	0,59–1,26	1,26	0,64–2,5
Living with roommate(s)	1,32	0,94–1,87	0,86	0,43–1,71
Other	0,48	0,17–1,34	0,91	0,28–2,98
<b>Perceived financial burden</b>				
No	REF		REF	
Yes	1,69	1,35–2,12***	1,26	0,81–1,97
<b>Year in university</b>				
Freshman and sophomore year	REF		REF	
Junior and senior year	0,79	0,63–0,99*	0,91	0,62–1,34
<b>Academic motivation profile</b>				
Self-determined	REF		REF	
Non-self-determined	1,58	1,26–1,98***	3,89	2,48–6,09***
Number of stress events in the last 12 months	1.00	0,95–1,06	0,93	0,82–1,05
<b>Self-reported depression and/or anxiety</b>				
No	REF		REF	
Yes	1,56	1,23–1,98***	2,68	1,8–4,01***
<b>Physical activity</b>				
Not participate in moderate and/or vigorous physical activity	REF		REF	
Participate in moderate physical activity	0,66	0,41–1,08	0,68	0,35–1,35
Participate in vigorous physical activity	1,33	1,03–1,72*	1,86	1,25–2,78**
<b>Alcohol drinking in the last 12 months</b>				
Never drink	REF		REF	
More than once a month	1,53	1,18–1,99**	1,72	1,04–2,84*
About 2–4 times a month	2,09	1,54–2,82***	6,05	3,74–9,77***
About 2–3 times a week	2,7	1,66–4,38 ***	6,94	2,65–18,18***
More than 4 times a week	3,85	2,27–6,55***	2,03	0,27–15,53
Observations	1912		4034	

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

depression and anxiety had a higher prevalence of smoking compared to male students who also reported these symptoms. Smoking among female students might stem from different reasons (Gaffney et al., 2002), which could also influence their mental health in a significant way. These reasons are quite strong, so it is very difficult for female students (compared to their male counterparts) to stop smoking.

We revealed that a vigorous level of physical activity was associated with smoking in both genders. Contrary to our study, previous studies pointed out a high smoking prevalence among people who exercise less (Conway and Cronan, 1992; Heydari et al., 2015; Nduaguba et al., 2019). The reason may be residuals confounding in our analysis. However, there may be an explanation in that, in Vietnam,

students who are physically active are more likely to interact socially and, as a result, smoke more. In our study, the social interaction could understand that students communicate with close friends who smoked. Previous studies pointed out that the strong association was between smoking and having close friends who smoked (Al-Kaabba et al., 2011; Karadoğan et al., 2018; Saari et al., 2014).

We found evidence of a significant association between drinking alcohol and smoking. Besides physical activity, the prevalence of smoking is directly proportional to the frequency of alcohol drinking among students. This result might be due to alcohol drinking often being paired with smoking, and these behaviours is one of the unhealthy habits in the students. Studies have demonstrated that people who smoke are much more likely to drink, and that people

who drink are also much more likely to smoke (Bobo and Husten, 2000).

One of the strengths of this study was the large sample of health science students; as a result, we achieved a good response rate. To our knowledge, this is the first study in Vietnam to investigate associated factors for smoking among the health science students such as their academic motivation profile, self-reported depression and anxiety, perceived financial burdens, physical activity, and alcohol drinking. We analysed smoking prevalence by gender and made comparisons between the male and female students according to a number of factors for smoking via the regression model. Other positive aspect in our study was the use of the PHQ-9, GAD-7, and AMS questionnaires in screening for symptoms of depression and anxiety, and academic motivation which were associated with the prevalence of smoking among the respondents. These questionnaires had high sensitivity and specificity.

The findings of this study are subject to several limitations. Firstly, we did not clearly divide the smoking prevalence of students by the sub-majors of health studies. Secondly, although our questionnaires were translated and back translated carefully, we acknowledge that the lack of a validated translation may threaten the validity of our results. Thirdly, we collected the data using a mix of method (paper-based, computer-based, and internet-based) at both universities and colleges level. Such differences in data collection methods and types of institution could potentially give raise to differential biases in our analysis. Fourthly, the multiple imputation approach in our analysis assumed that the data was missing at random – although we included several auxiliary variables to increase the likelihood of this assumption, as well as increase the number of imputations, the inferences in this study could be severely affected by the missing data. Lastly, the cross-sectional design only observed variables' associations, rather than their causal relationships. We hope that an intervention study would be needed to solve the limitations in our study, as well as to give more evidence to universities and policy makers related to students' smoking in Vietnam.

In summary, the prevalence of smoking among male health science students in Vietnam was lower than the prevalence of smoking among the overall male population of Vietnam. However, female students in our study smoked more than the overall female population of Vietnam. We also found a strong association between smoking and various factors such as the perceived financial burden, the respondent's year in university, a non-self-determined motivation profile, self-reported depression and/or anxiety, the level of vigorous physical activity, and alcohol drinking. We call for prospective studies to confirm our findings. Moreover, our results may suggest that universities and policy makers concerned with public health,

psychology, and social work need to track these factors and the associated policies in order to promote action on smoking among the health science students.

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## Supplemental material

Supplemental material for this article is available online.

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