


BMJ Open Using an ecological model of health behaviour to identify factors associated with smoking behaviour among Buddhist novices in Thailand: a cross-sectional digital survey

Sarunya Benjakul ¹, Saroj Nakju ², Wisit Thitavisiddho (Wongsai),³ Thawatchai Junjula³

To cite: Benjakul S, Nakju S, Thitavisiddho (Wongsai) W, *et al*. Using an ecological model of health behaviour to identify factors associated with smoking behaviour among Buddhist novices in Thailand: a cross-sectional digital survey. *BMJ Open* 2024;**14**:e082734. doi:10.1136/bmjopen-2023-082734

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<https://doi.org/10.1136/bmjopen-2023-082734>).

Received 02 December 2023
Accepted 28 March 2024



© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Department of Health Education and Behavioral Sciences, Faculty of Public Health, Mahidol University, Bangkok, Thailand

²Faculty of Public Health, Ramkhamhaeng University, Bangkok, Thailand

³Mahachulalongkornrajavidyalaya University, Chiang Mai, Thailand

Correspondence to

Dr Sarunya Benjakul;
sarunya.ben@mahidol.ac.th

ABSTRACT

Objective Buddhist novices reside in Buddhist temples, which are legally designated as smoke-free areas. Nevertheless, similar to other men in their age group, they are susceptible to various risk factors that lead to smoking. This digital survey aimed to examine tobacco smoking and its associated factors among Buddhist novices in Thailand.

Design A cross-sectional digital survey.

Setting 88 temple-based schools in Thailand.

Participants A stratified two-stage cluster sampling method was employed to select 5371 novices. Data were collected between June and August 2022 using self-administered electronic questionnaires.

Measure Descriptive statistics and multivariable logistic regression analysis were used to identify the associated factors.

Results Overall, 32.8% of the respondents reported they had tried smoking, and the average age of initiation was 12.4 years. In the past 30 days, 25.7% had smoked any tobacco product. Multiple factors following the ecological model of health behaviour were found to be statistically associated with smoking by 37.3%. Among these were intrapersonal-level factors, such as age, living in the southern region and attempted smoking. Two were interpersonal-level factors: the smoking behaviour of close relatives, specifically parents, and their respected monks. Two were institutional-level factors: perceiving that temple-based schools are smoke-free areas and exposure to secondhand smoke. Three factors at the community and policy levels were noticed tobacco advertising at the point of sale, social media and tobacco promotion.

Conclusion The findings of this study support the development of comprehensive intervention programmes that address the multiple factors to prevent Buddhist novices from smoking.

INTRODUCTION

Tobacco use causes the deaths of over 8 million people worldwide each year, including non-smokers who are exposed to secondhand smoke.¹ Meanwhile, a well-known percept of Buddhists is their refrain from killing²; 92.5%

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Multistage stratified cluster sampling was used to obtain a representative sample, facilitating accurate generalisation.
- ⇒ Some respondents attempted to complete the questionnaire without paying proper attention because of their young age.
- ⇒ The time for completing the questionnaire varied. Early finishers made noise, potentially distracting others.

of Thai people are adherents of Buddhism.³ Thus, Buddhist temples in Thailand are locations for religious ceremonies and residences for novices, monks and nuns. Furthermore, they provide education for these groups of people. Those who wish to become novices in Buddhism should be between the ages of 7 and 20 years.⁴ A related study has found that 57.4% of novices are between the ages of 15 and 19 years.⁵ Furthermore, since 2010,⁶ Buddhist temples have been designated as 100% smoke-free public places. Buddhist temples are ranked among the top five public places where people are exposed to secondhand smoke, according to national surveys conducted between 2011 and 2021.⁷ Approximately 20% of those who visit these locations are close to secondhand smoke.⁷ Considering the smoking rate, Buddhist monks smoked one time more than Thai men. A similar survey conducted in 2017⁸ and 2021⁷ has revealed that 37.7% and 34.7% of Thai men are smokers. In contrast, the smoking rate among Thai monks has increased from 53.7% in 2019⁹ to 66.6% in 2020.¹⁰

In addition to spreading Buddhist teaching, Thai monks are essential for nurturing novices and developing their conscience to

produce valuable Buddhist offspring.¹¹ Therefore, in addition to being vulnerable to the negative effects of smoking, monks who are close to novices and demonstrate their behaviour may cultivate a positive attitude toward smoking, which can result in imitative behaviour.¹² According to a literature review based on the *Thai Journal Online*, only one study on Thai novices was conducted approximately 10 years ago. It was discovered that 26.1% of the respondents smoked.¹³ Furthermore, the results of the national survey excluded novice students enrolled in temple-based institutions and concentrated on school students of 13–15 years.^{14–16}

It is worthwhile to invest in human capital development as it is a prevention strategy.¹⁷ All nations must adopt tobacco control policies to prevent minors from smoking.^{18 19} Since nicotine addiction develops before the age of 25 years, it has both short-term and long-term impacts on cognitive function, mood and attention performance in the frontal lobe of the brain.^{20 21} Furthermore, the tobacco industry will eventually sell its products to children and adolescents who will replace the smokers who quit or die.²² Therefore, all organisations involved in tobacco control must prioritise safeguarding children and adolescents against nicotine addiction and second-hand smoke exposure.

This study seeks to ascertain the prevalence of current tobacco use among novice students enrolled in a general education programme at temple-based schools known as Phrapariyattidham schools. These schools are affiliated with the Buddhist Studies Division of the Office of National Buddhism following National Education Act B.E.2542.²³ Further, it seeks to investigate the relationship between multiple factors and tobacco use using an ecological model of health behaviour.^{24–26} In public health, the model is widely used to comprehend how various factors affect people's health behaviours. These factors include intrapersonal, interpersonal, institutional, and community and policy levels.²⁶ The findings of this study will help develop tobacco control programmes that address each of these multiple-level factors. Finally, it would be possible to successfully shield novices, an adolescent group in Thai communities, surrounded by enabling conditions conducive to smoking, enabling them to maintain their health and engage in productive leisure activities.

METHODOLOGY

Study design and participants

This cross-sectional study involved novice students at the junior and senior high school levels in Phrapariyattidham Schools, encompassing all 12 Buddhist education areas in Thailand. The sample size was calculated using a finite population proportion formula.²⁷ The study population comprised 27 890 novices,²⁸ with a proportion of 0.261 smoking novices.¹³ Additionally, the study considered a designed effect of 2.0 and a relative error of 0.08. The response rate was 65%, as novices have religious duties similar to Buddhist monks and may be absent from their

studies more frequently than students in general schools. Therefore, the sample size for this study was 4929.

A probability sampling method was used to select the samples. This method involved stratified two-stage cluster random sampling and simple random sampling. Furthermore, 302 Phrapariyattidham schools in 12 Buddhist education areas were classified into three groups based on the number of novices. These groups were small schools with fewer than 120 novices, medium schools with 120–300 novices and large schools with more than 300 novices. Each group covered 242, 56 and 4 schools, respectively. A list of school names and the number of novices in each group were compiled. Thereafter, the number of novices in each group was calculated using the proportional probability to size technique. The sampling method was carried out as follows. Step 1: schools were randomly selected to obtain the number of novices already calculated. 88 schools were selected, including 67, 19 and 2 schools from each group, respectively. Step 2: a classroom was selected from each educational level (grades 7–12) to obtain six classrooms in each school. We selected 528 classrooms from the 88 schools. Finally, data were collected from all novices who agreed to provide information, attend the selected classrooms and have the necessary devices to access the electronic questionnaire by scanning QR codes, such as a smartphone, tablet, iPad or notebook.

Measurement

The research team created a set of electronic questionnaires that the participants could complete online on a website. This website-based questionnaire was designed to be user-friendly, allowing respondents to skip irrelevant questions. The interface was designed to be colourful and engaging for the target group. Additionally, the team ensured data security using a private cloud. The detailed questionnaire is described below.

Current tobacco smoking

This section was based on two standard questionnaires administered to the youth.^{29 30} The questionnaire began by asking respondents if they had ever tried or experimented with any smoked tobacco product, even one or two puffs in their lifetime (yes/no). If yes, the questionnaire asked about the age at which the participants started smoking (in years). Thereafter, all participants were asked how many days they had spent smoking any smoked tobacco products during the past 30 days. If they had, they were asked to specify the types of tobacco products they used, such as manufactured cigarettes, electronic cigarettes (e-cigarettes), hand-rolled cigarettes or other products, such as baraku, water pipes, pipes or cigars. Participants were classified as either non-smokers or current smokers who had used any smoked tobacco product on 1 or more days in the past 30 days. For smokers, two additional questions were asked: whether they smoked before or after ordaining and where they

regularly smoked, such as cubicles, toilets, dining rooms in monasteries and temple yards.

Multiple factors related to current smoking

Several elements are associated with current smoking habits. Based on the ecological model of health behaviour, this section comprised four-level factors.²⁶ These factors were as follows: (1) intrapersonal-level factors consisted of seven items that asked about general characteristics, such as age (years), age of ordination, nationality, region of residence (North, Northeast, South and Central, including Bangkok), had tried smoking (yes/no), had studied tobacco issues in classrooms (yes/no), channels of receiving anti-smoking information, such as online news, health information messages on cigarette packs, sermons in temples or community campaign activities (yes/no). Subsequently, (2) interpersonal-level factors consisted of two questions regarding the smoking behaviours of the close associates of the novices: parents (yes/no) and monks (yes/no). (3) Institutional-level factors included three items about the perception of smoking policies and the physical environment in educational institutions. The perception of schools as smoke-free zones, including e-cigarettes, (yes/no), noticing no-smoking signs in schools (yes/no), and exposure to secondhand smoke in schools or temples (yes/no) were covered by these questions. (4) The three items in the community-level and policy-level variables were designed to evaluate if the tobacco control law enacted on 4 June 2017 was violated.³¹ The following questions aimed to identify tobacco advertising and promotion by asking respondents if they had noticed it at the point of sale in local retail stores near the temples (yes/no), on online social media (yes/no) and in any form of tobacco promotion (yes/no) within the past 30 days.

The self-reporting questionnaire required the respondents to answer sincerely and truthfully. Five subject specialists in smoke control, religious leaders and instructors in schools located in temples provided input for the revision and assessment of the content validity of the questionnaire. Thereafter, the updated survey was administered to 36 novices who shared the same traits as the sample. The questions on the questionnaire were straightforward and intelligible and required approximately 15 min to complete.

Data collection

Data were collected every Monday from 20 June to 8 August 2022. The survey involved four rounds of data collection each day. Each round lasted 45–60 min. The process involved 32 rounds to improve the response rate because of variations in the free time availability of the sampled schools. The researchers contacted the school director to designate schoolteachers as points of contact for coordinating the data collection process and distributing and compiling written informed consent forms from the parents of the novices. The data collection process involved four steps. The schoolteacher set up the

locations, such as a hall, computer room or Wi-Fi station, where the participants may self-report using an electronic questionnaire. Second, to ensure that the sample was ready, the schoolteacher moved the camera after logging in to Zoom using the URL address provided by the study team. The samples were accessed through Zoom using a single main screen. Third, the research team explained the objectives, protected the rights of the respondents and obtained their consent. Finally, the research team displayed the questionnaire QR code on the screen and sent a link to the electronic questionnaire through the Chatbox as an alternative channel for the respondents to access. Nonetheless, the research team was available on Zoom to answer questions during the data-gathering procedure.

Statistical analysis

Data analysis was performed using SPSS Statistics for Windows, V.18.0 (Thai Version, which was licensed to Mahidol University). Descriptive statistics were used to analyse the general data. A X^2 test was employed to determine the differences in the variables between the sampled groups who had and had never smoked. Unadjusted ORs with a 95% CI were analysed using simple logistic regression to select pre-filter variables with a p value of <0.25. Multivariate logistic regression with the enter method was used to calculate the adjusted OR (AOR) with a 95% CI for assessing the association between the dependent and independent variables. The Hosmer-Lemeshow statistics were used to determine the goodness of fit of the model before running the multivariate logistic regression. A good model fit was found, as indicated by the X^2 test (7.484, $p=0.485$). The level of statistical significance was two sided, with a p value of <0.05.

RESULTS

Sample characteristics

The study enrolled 5371 participants who completed the questionnaires. Owing to a discrepancy between the database used for the sample size calculation in 2021 and the actual number gathered in the first academic semester of 2022, this figure exceeded the estimated sample size calculation. The findings revealed that with an average age of 15.3 years, 63.1% of the respondents were between the ages of 15 and 19 years. Their minimum and maximum ages were 12 and 19 years, respectively. Furthermore, 19.6% of the respondents were enrolled in grade 8, and 32.1% had been ordained for 1 to less than 3 years, with an average year of 2.8 years.

Had tried smoking

According to the study, 32.8% (95% CI: 31.6%, 34.1%) of the respondents had tried smoking, and the average age of smoking initiation was 12.4 years old. The study indicated that the following characteristics were significantly associated with having smoked: being in the age group of 15–19 years ($p<0.001$), having an ordination of

**Table 1** Number and percentage of samples who had tried smoking by personal characteristics

Personal characteristic	Total	Number of those who had tried smoking	% (95% CI)	P value
Total	5371	1764	32.8 (31.6, 34.1)	–
Age (years)				
12–14	1983	579	29.2 (27.2, 31.2)	<0.001
15–19	3388	1185	35.0 (33.4, 36.6)	
Educational level				
Junior high	3042	966	31.8 (30.1, 33.4)	0.052
Senior high	2329	798	34.3 (32.3, 36.2)	
Year of ordination				
<3 years	2524	774	30.7 (28.9, 32.5)	0.001
≥3 years	2847	990	34.8 (33.0, 36.5)	
Region of residence				
Central & Bangkok	548	186	33.9 (30.0, 37.9)	<0.001
Northeast	2430	920	37.9 (35.9, 39.8)	
North	2211	569	25.7 (23.9, 27.6)	
South	182	89	48.9 (41.6, 56.2)	

The answer code of 'had tried smoking' is yes/no and data on 'yes' are presented.

more than 3 years ($p=0.001$) and residing in the southern region ($p<0.001$) (table 1).

Current tobacco smoking

Approximately 25.7% (95% CI: 24.5%, 26.8%) of respondents had used any smoked tobacco products in the past 30 days. Hand-rolled and e-cigarettes were the most commonly used products (15.4%, 95% CI: 14.4%, 16.4% vs 14.4%, 95% CI: 13.5%, 15.4%), followed by manufactured cigarettes (11.1%, 95% CI: 10.3%, 12.0%). Approximately 5.3% (95% CI: 4.7%, 5.9%) of respondents used other products, such as baraku and cannabis mixed with tobacco (table 2).

55% of current smokers started smoking before being ordained. Most smoked regularly in a cubicle (50.8%), with the toilet coming in second (27.3%). Regarding the interpersonal-level factors, the study found that 38.1% (95% CI: 36.8%, 39.4%) of respondents had parents who smoked, and 44.4% (95% CI: 43.1%, 45.8%) had respected monks who smoked nearby.

Table 2 Number and percentage of the samples by types of smoked tobacco products (n=5371)

Smoked tobacco products	Number of current smokers	% (95% CI)
All types	1379	25.7 (24.5, 26.8)
Types of smoked tobacco products		
Manufactured cigarettes	598	11.1 (10.3, 12.0)
Electronic cigarettes	775	14.4 (13.5, 15.4)
Hand-rolled cigarettes	827	15.4 (14.4, 16.4)
Other	285	5.3 (4.7, 5.9)

Exploring multilevel factors related to tobacco smoking

During the past 12 months, 67.0% of the respondents reported studying subjects related to tobacco use in their classrooms. Specifically, 72.8% thought that their schools were legally required to designate places free of smoke, including e-cigarettes. Further, 81.0% of respondents reported having encountered anti-smoking content in the previous year from a variety of sources, including internet news, sermons delivered in temples, community campaign events and health warnings on cigarette packs. Furthermore, 83.6% of respondents reported seeing a no-smoking sign in their school. Conversely, 54.3% were exposed to secondhand smoke at places where they regularly went, like their school, the temple where they were ordained and cubicles. Additionally, 32.8% and 45.5% of people saw tobacco advertisements at the point of sale in the stores around the temple and on social media, respectively. For instance, cigarette packs and prices were prominently displayed. Online social media sites, such as websites, Line, Facebook, Instagram, TikTok, YouTube and Twitter, were used for tobacco advertising. In total, 15.8% of respondents reported seeing tobacco promotions, which included product discounts; free cigarette samples; and presents, prizes or rewards for consumers who purchased tobacco products (table 3).

Multilevel factors associated with tobacco smoking

15 factors in the ecological model were significantly associated with the current tobacco smoking habits of the respondents. These consisted of eight intrapersonal factors: age, year of ordination, region of residence, covering the Northeast, North, and South regions, having tried smoking, having studied tobacco-related lessons

Table 3 Number and percentage of samples by multiple factors related to smoking (n=5371)

Factor	Number	%
Had studied tobacco-related topics in a classroom	3599	67.0
Perceived that schools are smoke-free areas, including e-cigarettes	3912	72.8
Received any anti-smoking information	4349	81.0
Noticed a no-smoking sign in the school	4488	83.6
Exposed to secondhand smoke in the places of their daily living	2915	54.3
Noticed tobacco advertisements at the point of sale	1762	32.8
Noticed tobacco advertisements through various online social media	2444	45.5
Noticed any form of tobacco promotion	849	15.8

e-cigarettes, electronic cigarettes.

in classrooms and having received information against smoking. Two interpersonal-level factors were parents' smoking and the respected monks close to them smoking. Two institute-level factors were the perception that schools were smoke-free areas, including e-cigarettes and exposure to secondhand smoke. Finally, tobacco smoking among current smokers was significantly influenced by three community-level and policy-level factors: tobacco advertisements observed at the point of sale, social media and tobacco promotion in any form.

Multivariable logistic regression analysis showed that the variation in current smoking could be explained by 10 factors at 37.3% (Nagelkerke $R^2=0.373$). These factors were classified into four categories. Three factors were shown to be intrapersonal: age, living in the south and having tried smoking. Two factors were identified at the interpersonal level: parents were smokers and respected monks who were close to the smokers were smokers. Two factors were found at the institute level: the perception that schools were smoke-free areas (including e-cigarettes) and exposure to secondhand smoke. The three factors combined to make up the observed tobacco advertisements at the community and policy levels were point of sale, online social media and any kind of tobacco promotion. Table 4 shows that the first three factors that were discovered to be highly and significantly associated with current smoking were having tried smoking (AOR=6.068, 95% CI: 5.162, 7.133), exposure to secondhand smoke (AOR=2.374, 95% CI: 1.987, 2.849) and parents' smoking (AOR=1.952, 95% CI: 1.672, 2.278) (table 4).

DISCUSSION

Based on an ecological model, smoking among Buddhist novices aged 12–19 years is influenced by multiple factors. These factors include intrapersonal, interpersonal, institutional, and community and policy levels. The main influencing factor is intrapersonal, namely having previously tried smoking. Compared with individuals who had never tried smoking, those who had tried smoking were approximately six times more likely to smoke. Three in 10 respondents (32.8%, 95% CI: 31.6%, 34.1%) had tried

smoking at an average age of 12.4 years. Comparable results were found in the Global Youth Tobacco Survey, which was conducted in 144 countries from 2010 to 2020. According to the study, the highest proportion of adolescents who tried smoking was at ages 12–13 years,³² which was similar to the study findings. A single-trial smoking experience during adolescence may have contributed to nicotine exposure in the prefrontal cortex area of the frontal lobe of the brain. Owing to immature development throughout adolescence, exposure to nicotine may result in a range of issues such as low IQ, emotional immaturity, a high risk of psychiatric disorders, and brain recession or memory loss as a result of cognitive impairment in later life.^{33 34}

The study found that 25.7% (95% CI: 24.5%, 26.8%) of the respondents currently smoke tobacco. This finding is consistent with the results of two relevant surveys. As of 2021, 22.3% (95% CI: 18.8% to 26.3%) of Thai students in grades 7–12, aged 13–17 years, were smokers.³⁵ 10 years ago, another survey found that 26.1% of Thai novices were current smokers.¹³ In addition to using conventional tobacco products, including manufactured cigarettes and hand-rolled cigarettes, 14.4% (95% CI: 13.5%, 15.4%) of the population presently uses e-cigarettes. The rate of e-cigarette smoking among novice respondents was similar to that observed in the 2021 survey among Thai students aged 13–17 years at 18.7% (95% CI: 15.2%, 22.8%).³⁵ Additionally, a meta-analysis encompassing 146 studies from 2014 to 2020 shows that 11% (95% CI: 10% to 12%) of adolescent and school students use e-cigarettes.³⁶ Thus, Thai adolescents, either general students or novices attending Phrapariyattidham schools, were surrounded by risky health behaviours. Intensive law enforcement should prioritise targeting both retail shops and online sellers, as e-cigarettes are illegal under the Tobacco Control Act (B.E.2560).³¹

Regarding the interpersonal-level factors, smoking by close individuals significantly affected the novices' smoking. More novices were influenced to smoke by their parents' smoking than by the smoking of revered monks who lived nearby (AOR=1.952; 95% CI: 1.672,

**Table 4** Factors associated with novices' current smoking

Selected factor	Crude OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Intrapersonal-level factors				
Age (years)	1.110 (1.072, 1.150)	<0.001	1.083 (1.021, 1.150)	0.008
Year of ordination	1.049 (1.018, 1.082)	0.002	0.972 (0.924, 1.023)	0.281
Region of residence				
Central & Bangkok	1 (reference)			
Northeast	1.494 (1.206, 1.852)	<0.001	1.235 (0.948, 1.608)	0.118
North	0.712 (0.569, 0.892)	0.003	0.795 (0.602, 1.049)	0.105
South	2.358 (1.655, 3.359)	<0.001	1.896 (1.216, 2.956)	0.005
Had tried smoking				
Never	1 (reference)			
Had	8.187 (7.142, 9.385)	<0.001	6.068 (5.162, 7.133)	<0.001
Had studied tobacco-related topics in a classroom				
Yes	1 (reference)			
No	1.241 (1.086, 1.417)	0.001	1.063 (0.875, 1.291)	0.539
Received any anti-smoking information				
Yes	1 (reference)			
No	1.575 (1.329, 1.865)	<0.001	0.814 (0.634, 1.044)	0.105
Interpersonal-level factors				
Parents' smoking				
No	1 (reference)			
Yes	2.986 (2.628, 3.393)	<0.001	1.952 (1.672, 2.278)	<0.001
Respected monks' smoking				
No	1 (reference)			
Yes	3.126 (2.761, 3.538)	<0.001	1.645 (1.397, 1.938)	<0.001
Institution-level factors				
Perceived that schools are smoke-free areas including e-cigarettes				
Yes	1 (reference)			
No	1.148 (1.007, 1.309)	0.039	1.227 (1.018, 1.479)	0.032
Noticed a no-smoking sign in the school				
Yes	1 (reference)			
No	0.879 (0.746, 1.035)	0.121	0.859 (0.682, 1.083)	0.199
Exposed to secondhand smoke in the places of their daily living				
No	1 (reference)			
Yes	4.779 (4.151, 5.503)	<0.001	2.374 (1.987, 2.849)	<0.001
Community-level and policy-level factors				
Noticed tobacco advertisements at the point of sale				
No	1 (reference)			
Yes	2.565 (2.269, 2.900)	<0.001	1.534 (1.288, 1.827)	<0.001
Noticed tobacco advertisements through various online social media				
No	1 (reference)			
Yes	2.199 (1.949, 2.481)	<0.001	1.414 (1.186, 1.685)	<0.001
Noticed any form of tobacco promotion				
No	1 (reference)			
Yes	3.108 (2.681, 3.608)	<0.001	1.909 (1.565, 2.327)	<0.001

Significant entries in table 4 are highlighted in bold typeface. e-cigarettes, electronic cigarettes.

2.278; AOR=1.645; 95% CI: 1.397, 1.938, respectively). This was because 55.0% of the novice respondents had smoked before ordination. This finding was aligned with a 5-year prospective follow-up study. It showed that during the base year, adolescents aged 12–17 years who had smoking parents became regular smokers, and they were 1.2 times more than those without smoking parents (95% CI: 1.1, 1.3).³⁷ The family members' smoking was a predictor of adolescents' smoking.³⁸ According to a Chinese study, individuals aged 8–19 years who had smoking parents were 1.57 times more likely to smoke than those who had non-smoking parents (95% CI: 1.40 to 1.77, $p<0.001$). Additionally, those who knew one or more of their teachers smoked were more susceptible to smoking than those whose teachers did not smoke (prevalence ratio (PR)=1.275, 95% CI: 1.16 to 1.41, $p<0.001$; PR=1.339, 95% CI: 1.23 to 1.46, $p<0.001$).³⁹ These role models influenced people's beliefs, attitudes and intentions to follow them.⁴⁰ Thus, the smoking behaviour of those close to novices, that is, their parents and monks, could influence their beliefs about smoking. These include beliefs that smoking is not harmful and a positive attitude toward smoking. This could develop the motivation and novice's intention to smoke in the imitation of the models. Furthermore, it could give the impression that smoking is an acceptable practice in society.

Regarding institute-level factors, the study found that respondents were more likely to smoke if they did not know whether their schools were smoke-free areas (including e-cigarettes) and if they had exposure to secondhand smoke in the places where they live daily. The temple-based schools are known as Phrapariyattidham schools. Those locations are legally recognised smoke-free areas.³¹ Exposure to secondhand smoke causes exposure to harmful toxins and cancer-causing substances in smoke,^{41–43} and it affects imitation behaviour. A related study conducted in China found that school students aged 13–18 years exposed to secondhand smoke in any place were 4.2 times (95% CI: 2.3, 7.6) more likely to smoke than those not exposed to secondhand smoke.⁴⁴

Regarding community-level and policy-level factors, noticing tobacco advertising at the point of sale in the retail shops of the communities surrounding temples and through online social media on various platforms influenced novices' smoking once to twice more than those who did not experience exposure. Tobacco advertisement is the primary marketing strategy in the tobacco industry, targeting children and adolescents.^{45–47} Additionally, Thailand has enforced a comprehensive ban on tobacco advertising and promotion since 1992.⁴⁸ This law is based on Article 13 of the WHO's Framework Convention on Tobacco Control, which provides tobacco advertising, promotion and sponsorship guidelines.⁴⁹ Enforcing the law in Buddhist temples might be challenging because they are cultural landmarks for religious events. Additionally, these temples are public places and places for mentally attached Buddhists. Therefore, strict

law enforcement in these areas is a sensitive issue, which often results in legal violations.

The stakeholder relevance at each level, based on the ecological model, should be involved in designing a comprehensive prevention programme to prevent novices from becoming new smokers. Communities participating in religious events or funeral ceremonies organised in Buddhist temples should be engaged. First, information regarding past tobacco use is needed from novices, their parents and monks. Current smokers should be advised to quit or not smoke in legally designated smoke-free areas, such as schools or temples. Second, no-smoking signs should be at the building's entrances, exits and high-risk areas, such as cubicles, toilets and temple yards. Third, regular campaign activities and public relations campaigns should be organised through the community broadcasting media to raise public knowledge that schools and temples are smoke-free places. Finally, community volunteers should be empowered to establish a community surveillance system to monitor tobacco products sold in retail shops and smoking in smoke-free areas. Instead of imposing legal fines, stakeholders can develop community norms regarding anti-smoking policies.

This study had both strengths and limitations. Probability sampling methods, specifically multistage stratified cluster sampling, were employed to obtain a representative sample, facilitating accurate generalisation. This study had some limitations. The time taken by the respondents to complete the questionnaire varied. Some people who completed the questionnaire early made a lot of noise, which could have distracted those who were still answering the questionnaire. Some participants attempted to complete the questionnaire without focusing on it. These were the natural characteristics of the young respondents. Additionally, the cross-sectional research design of this study hindered the ability to establish a cause-and-effect relationship.

CONCLUSION

This study revealed that multiple factors based on the ecological model of health behaviour were significantly associated with the smoking habits of novices. The chances of novices smoking tobacco products are high if they have experimented with smoking, have been exposed to secondhand smoke, have role models who smoke, such as parents or respected monks, and have been exposed to tobacco advertising and promotion, whether at points of sale or on social media. Therefore, developing a comprehensive tobacco control programme to prevent newcomers from smoking is imperative. The involvement of multiple stakeholders surrounding novices should be integral to the design of such a programme.

Contributors SB participated in the study's design, field investigation, data curation, formal analysis, initial drafting of the manuscript, writing (reviewing and editing) the manuscript and supervision. SN contributed to the initial drafting of the manuscript and field investigation. WT and TJ contributed to the manuscript review.

All the authors have approved the final manuscript for submission. The guarantor responsible for the overall content of this study was SB.

Funding The study was supported by the Phothiyalai Foundation and Thai Health Promotion Foundation (PY 028/2022) for conducting the field implementation, except for writing the manuscript.

Competing interests None declared.

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

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and the Ethics Review Committee for Human Research, Faculty of Public Health, Mahidol University approved the study ethically (COA no. MUPH 2022-048, 23 March 2022). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Sarunya Benjakul <http://orcid.org/0000-0002-8396-8935>

Saraj Nakju <http://orcid.org/0000-0002-5282-7187>

REFERENCES

- World Health Organization. Tobacco. Available: <https://www.who.int/docs/default-source/campaigns-and-initiatives/world-no-tobacco-day-2020/wntd-tobacco-fact-sheet.pdf> [Accessed 10 Nov 2023].
- Buddhaghosa B. The path of purification (Visuddhimagga). Samayawardaya printers. Available: <https://www.accesstoinsight.org/lib/authors/nanamoli/PathofPurification2011.pdf> [Accessed 10 Nov 2023].
- Office of international religious freedom. 2022 report on international religious freedom: Thailand. Available: <https://www.state.gov/wp-content/uploads/2023/05/441219-THAILAND-2022-INTERNATIONAL-RELIGIOUS-FREEDOM-REPORT.pdf> [Accessed 30 Oct 2023].
- Wijayarathna M. *Buddhist monastic life: according to the texts of the theravada tradition*. Cambridge: Cambridge University Press, 1990.
- Kanchanaphiphith P, Aphipanya S, Phitaktanakhom C. A study of the life style of novices in Bangkok temple, [in Thai]. Ayutthaya Mahachulalongkornrajavidyalaya University; 2010.
- Ministry of public health notice (no. 19) of 2010: designation of names and types of public places that shall protect the health of non-smokers and designating all or part of such public places as smoking areas or tobacco-free areas, under the non-smokers' health protection act of 1992. Available: <https://assets.tobaccocontrolaws.org/uploads/legislation/Thailand/Thailand-2010-MoPH-Notice.pdf> [Accessed 28 Jul 2023].
- National Statistical Office. The 2021 health behavior of population survey [in Thai]. 2021. Available: https://www.nso.go.th/nsoweb/nso/survey_detail/w6 [Accessed 18 Jun 2022].
- National Statistical Office. The smoking and drinking behaviour survey, 2017. Bangkok: Pimdeekarnpim Co. National Statistical office. The 2017 smoking and drinking behaviour survey [in Thai]. National Statistical Office; 2017. Available: https://www.nso.go.th/nsoweb/nso/survey_detail/IX [Accessed 10 Jun 2023].
- Champat C, Kusol K, Sonpaveerawong J. Factors related to smoking among buddhist monks in Muang District of Surat Thani province [in Thai]. *The Southern College Network Journal of Nursing and Public Health* 2019;6:81–90. Available: <https://he01.tci-thaijo.org/index.php/snet/article/view/153368/129887>
- Yangthisan N, Joosing R, Roopmodee Y, et al. Smoking situation and factors affected to smoking of monks in the central region [in Thai]. *Journal of Public Health Naresuan University* 2020;2:28–40. Available: <https://he01.tci-thaijo.org/index.php/JPHNU/article/view/238327/164490>
- Vachiramano V, Kulmanee S, Kanchanaphet A. The role of monks in modern Thai society development [in Thai]. *Journal Maha Chula Thani Mahachulalongkornrajavidyalaya University* 2021;3:42–9. Available: <https://so02.tci-thaijo.org/index.php/mcupnpbcr/article/view/250049>
- Lee Y, Lee KS. Factors related to smoking status among young adults: an analysis of younger and older young adults in Korea. *J Prev Med Public Health* 2019;52:92–100.
- Khuthannavanichpong N, Poomriew R, Leyatikul P, et al. Cigarette smoking situation among monks, novices, nuns and followers and effects of program for development of temple smoke-free area Nakhon Ratchasima province [in Thai]. *Thailand Journal of Health Promotion and Environmental Health* 2014;37:94–107. Available: https://km.anamai.moph.go.th/web-upload/53x55a084987dc6d8919ac62a437d2bcf15/m_magazine/35519/2491/file_download/9f347cf7cf746be4cd71ae4a73e4e32b.pdf
- Regional Office for South-East Asia, World Health Organization. Report on global youth tobacco survey (GYTS). Thailand, 2006. Available: <https://extranet.who.int/ncdsmicrodata/index.php/catalog/277/related-materials>
- Regional Office for South-East Asia, World Health Organization. Fact sheet: Thailand (ages 13 – 15) global youth tobacco survey (GYTS). 2009. Available: <https://extranet.who.int/ncdsmicrodata/index.php/catalog/239/related-materials>
- Regional Office for South-East Asia, World Health Organization. Global youth tobacco survey: Thailand, 2015. WHO Regional Office for South-East Asia; 2016. Available: <https://apps.who.int/iris/handle/10665/251465>
- Jacobs W, Lu W, McDonald A, et al. Human capital development factors and black adolescent tobacco and cannabis use. *Nicotine Tob Res* 2023;25:1447–54.
- World Health Organization. *WHO global report: mortality attributable of tobacco*. Geneva: World Health Organization, 2012.
- World Health Organization. WHO MPOWER report on the global tobacco epidemic, 2017. Geneva, 2017.
- Yuan M, Cross SJ, Loughlin SE, et al. Nicotine and the adolescent brain. *J Physiol* 2015;593:3397–412.
- Leslie FM. Unique, long-term effects of nicotine on adolescent brain. *Pharmacol Biochem Behav* 2020;197:173010.
- U.S. Food and Drug Administration. The public health rationale for recommended restrictions on new tobacco product labeling, advertising, marketing and promotion. 2019. Available: <https://www.fda.gov/media/124174/download> [Accessed 12 Jun 2023].
- Office of the National Education Commission, Office of the Prime Minister, Kingdom of Thailand. National education act B.E.2542 (1999). Available: http://www.onesqa.or.th/upload/download/file_697c80087cce7f0f83ce0e2a98205aa3.pdf [Accessed 12 Jun 2023].
- Sallis JF, Owen N, Fisher EB. Ecological models of health behavior. In: Glanz K, Rimer BK, Viswanath K, eds. *Health behavior and health education: theory, research, and practice*. Jossey-Bass, 2008: 465–85.
- Hovell M, Wahlgren D, Adams M. The logical and empirical basis for the behavioral ecological model. In: DiClemente RJ, Crosby RA, Kegler MC, eds. *Emerging theories in health promotion practice and research*. Jossey-Bass/Wiley, 2009: 415–49.
- Golden SD, Earp JAL. Social ecological approaches to individuals and their contexts: twenty years of health education & behavior health promotion interventions. *Health Educ Behav* 2012;39:364–72.
- Wayne WD. *Biostatistics: a foundation of analysis in the health sciences*, 6th Ed. John Wiley & Son, Inc, 1995.
- Department of Education Buddhism, National Office of Buddhism. Statistics of. n.d. Available: <https://deb.onab.go.th/th/content/page/index/id/6681>
- Global Youth Tobacco Survey Collaborative Group. Tobacco questions for surveys of youth (TQS-youth): a subset of key questions from the global youth tobacco survey (GYTS). 2019. Available: <https://www.cdc.gov/tobacco/global/> [Accessed 12 Dec 2021].
- Global Youth Tobacco Survey Collaborative Group. Global youth tobacco survey (GYTS): core questionnaire with optional questions, version 1.2. Atlanta, GA Centers for Disease Control and Prevention; 2014. Available: <https://www.who.int/teams/noncommunicable->

- diseases/surveillance/systems-tools/global-youth-tobacco-survey/questionnaire [accessed 12 Dec 2021]
- 31 Department of Disease Control, Bureau of Tobacco Control. Tobacco products control act B.E. 2560 (2017). Bureau of Tobacco Control; 2017. Available: http://www.ashthailand.or.th/en/content_attachment/attach/new_thai_law.pdf [accessed 15 Jul 2023]
 - 32 Xing S, Zhao M, Magnussen CG, *et al.* Proportion and trend in the age of cigarette smoking initiation among adolescent smoking experiencers aged 13-15 years in 148 countries/territories. *Front Public Health* 2022;10:1054842.
 - 33 Goriounova NA, Mansvelder HD. Short- and long-term consequences of nicotine exposure during adolescence for prefrontal cortex neuronal network function. *Cold Spring Harb Perspect Med* 2012;2:a012120.
 - 34 Le Foll B, Piper ME, Fowler CD, *et al.* Tobacco and nicotine use. *Nat Rev Dis Primers* 2022;8:19.
 - 35 Department of Health, Ministry of Public Health. Thailand global school-based student health survey, 2021: GSHS. Nonthaburi, Minnie group CO., LTD [in Thai]. 2022. Available: <https://kb.hsri.or.th/dspace/bitstream/handle/11228/5784/hs2920.pdf?sequence=1&isAllowed=y> [Accessed 15 Jul 2023].
 - 36 Tehrani H, Rajabi A, Ghelichi-Ghojogh M, *et al.* The prevalence of electronic cigarettes vaping globally: a systematic review and meta-analysis. *Arch Public Health* 2022;80:240.
 - 37 Mays D, Gilman SE, Rende R, *et al.* Parental smoking exposure and adolescent smoking trajectories. *Pediatrics* 2014;133:983-91.
 - 38 Steeger CM, Epstein M, Hill KG, *et al.* Time-varying effects of family smoking and family management on adolescent daily smoking: the moderating roles of behavioral disinhibition and anxiety. *Drug Alcohol Depend* 2019;204:107572.
 - 39 Cheng X, Guo X, Jin C. Social determinants of smoking among school adolescents in Beijing, China. *Tob Induc Dis* 2022;20:73.
 - 40 Horsburgh J, Ippolito K. A skill to be worked at: using social learning theory to explore the process of learning from role models in clinical settings. *BMC Med Educ* 2018;18:156.
 - 41 Naeem Z. Second-hand smoke - ignored implications. *Int J Health Sci (Qassim)* 2015;9:V-VI.
 - 42 Braun M, Klingelhöfer D, Oremek GM, *et al.* Influence of second-hand smoke and prenatal tobacco smoke exposure on biomarkers, genetics and physiological processes in children-an overview in research insights of the last few years. *Int J Environ Res Public Health* 2020;17:3212.
 - 43 Li Y, Hecht SS. Carcinogenic components of tobacco and tobacco smoke: a 2022 update. *Food Chem Toxicol* 2022;165:113179.
 - 44 Yang X, Yan Z, Xu G, *et al.* How secondhand smoke exposure affects tobacco use and smoking susceptibility of adolescents: sex and school differences. *Tob Induc Dis* 2021;19:68.
 - 45 McDaniel PA, Forsyth SR. Exploiting the "Video game craze": a case study of the tobacco industry's use of video games as a marketing tool. *PLoS One* 2019;14:e0220407.
 - 46 Isip U, Calvert J. Analyzing big tobacco's global youth marketing strategies and factors influencing smoking initiation by Nigeria youths using the theory of Triadic influence. *BMC Public Health* 2020;20:377.
 - 47 Brown JL, Rosen D, Carmona MG, *et al.* Spinning a global web: tactics used by big tobacco to attract children at tobacco points-of-sale tobacco control published online first. *Tob Control* 2023;32:645-51.
 - 48 Food and Agriculture Organization of the United Nations. FAOLEX database, Thailand: tobacco products control act. B.E.2535 (1992). Available: <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC160929/> [Accessed 20 Jul 2023].
 - 49 WHO. Guidelines for Implementations of article 13: tobacco advertising, promotion and sponsorship. adopted by the conference of the parties at its third session (decision FCTC/Cop3(12)). 2008. Available: https://www.who.int/fctc/treaty_instruments/adopted/Guidelines_Article_13_English.pdf [Accessed 16 Jul 2023].