Research Paper

Methods and factors influencing successful smoking cessation in Thailand: A case-control study among smokers at the community level

Bundit Sornpaisarn[1,2,3], Nadia Parvez[2], Werayut Chatakan[4], Weena Thitiprasert[5], Pattanapong Precha[6], Ronnachai Kongsakol[7], Udomsak Saengow[8,9,10], Jürgen Rehm[1,2,11,12,13,14]

ABSTRACT

INTRODUCTION Despite comprehensive tobacco control policies being in place since 1992, smoking prevalence in Thailand has not declined since 2009, indicating a potential need for individual-level measures. This study examined factors influencing successful smoking cessation attempts in Thailand.

METHODS With a case-control design, smoking cessation experiences of 284 successful (defined as having quit smoking for at least six months) and 837 unsuccessful quitters, who were all lifetime daily smokers, were compared, using sociodemographic data, smoking behaviors, and smoking cessation experiences from their last quitting attempt. Data were collected between August and December 2020. Multivariate-adjusted logistic regressions were employed.

RESULTS Unaided smoking cessation was the most popular method among Thais attempting to quit smoking; more than 99% of both successful and unsuccessful quitters used this method. A significantly higher proportion of successful quitters favored stopping their smoking abruptly than did unsuccessful quitters. Depending on the cessation phases (nicotine withdrawal or relapse prevention), cessation-supporting factors included a doctor's recommendation to stop smoking due to smoker's sickness (OR=2.6; 95% CI: 1.9–3.6), having a grandchild (OR=2.5; 95% CI: 1.1–5.6) or child (OR=2.0; 95% CI: 1.2–3.1), exercising (OR=13.9; 95% CI: 7.2–26.9), avoiding smokers (OR=6.7; 95% CI: 4.1–11.1), self-efficacy (OR=8.5; 95% CI: 3.6–20.0), having a good appetite (OR=1.9; 95% CI: 1.3–2.8), wishing to avoid the unpleasant smell of other people's smoking after cessation (OR=3.7; 95% CI: 2.5–5.5), smoking prohibitions in public places (OR=2.8; 95% CI: 1.2–6.4) and workplaces (OR=4.5; 95% CI: 1.9–10.3), and expensive tobacco (OR=1.9; 95% CI: 1.3–2.9). Barriers to successful cessation included using roll-your-own (OR=0.4; 95% CI: 0.3–0.5), insomnia (OR=0.3; 95% CI: 0.2–0.5), social pressure to smoke (OR=0.4; 95% CI: 0.3–0.6), associating smoking with a habit/specific activity (OR=0.4; 95% CI: 0.3–0.5), and pleasure of smoking (OR=0.5; 95% CI: 0.3–0.7).

CONCLUSIONS This study highlights several factors found to influence successful smoking cessation among Thai smokers which can be used to design a guideline for unaided smoking cessation, and for smoking cessation enhancement programs and policies.

AFFILIATION
1 Institute for Mental Health Policy Research, Centre for Addiction and Mental Health, Toronto, Canada
2 Dalla Lana School of Public Health, University of Toronto, Toronto, Canada
3 Faculty of Public Health, Mahidol University, Bangkok, Thailand
4 Graduate School, Nakhon Sri Thammarat Rajabhat University, Nakhon Sri Thammarat, Thailand
5 Association of Innovation for Thailand Development, Nakhon Sri Thammarat, Thailand
6 Noppitham Hospital, Nakhon Sri Thammarat Provincial Office, Nakhon Sri Thammarat, Thailand
7 Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
8 Center of Excellence in Data Science for Health Study, Nakhon Sri Thammarat, Thailand
9 School of Medicine, Walailak University, Nakhon Sri Thammarat, Thailand
10 Research Institute for Health Sciences, Nakhon Sri Thammarat, Thailand
11 Campbell Family Mental Health Research Institute, Centre for Addiction and Mental Health, Toronto, Canada
12 Department of Psychiatry, University of Toronto, Toronto, Canada
13 Institute of Medical Science, University of Toronto, Toronto, Canada
14 Department of International Health Projects, Institute for Leadership and Health Management, Mascow, Russian Federation

CORRESPONDENCE TO
Bundit Sornpaisarn. Centre for Addiction and Mental Health, 33 Ursula Franklin Street, Toronto, M5S 2S1 Ontario, Canada.
E-mail: bundit.sornpaisarn@alum.utoronto.ca
ORCID ID: https://orcid.org/0000-0001-8541-1172

INTRODUCTION

Although the global prevalence of smoking has decreased significantly since 1990, there were still 1.1 billion current smokers who consumed 7.4 trillion cigarette-equivalents of tobacco1 in 2019. In that year, 6.6% of women and 32.7% of men were current smokers[1], and smoking was associated with 7.7 million deaths, making it the leading risk factor for death among men. These 7.7 million deaths were mainly of current smokers (86.9%)[1].

The smoking situation in Thailand followed the prevalence reduction seen at the global level. From 1990 to 2019, Thai women had reduced their smoking prevalence by 46.5%, while Thai men had reduced theirs by 25.5%[1]. Among adult Thai people, 3.5% of women and 39.8% of men were current smokers in 2019[1]. Tobacco smoking was the risk factor causing most deaths and DALYs in Thailand both in 2009 and 2019[2].

There is good evidence demonstrating that public policies increase people's motivation to quit and help maintain quit attempts[3]. Thailand is one of the countries which has implemented proactive tobacco control policies for many years, with a total ban on tobacco advertising (since 1989), 100% smoke-free public places since 2010, several tax increases between 1992 and 2017[3], and pictorial health warnings on packaging since 2004[4]. Lastly, a new tobacco control law was enacted in 2017 which allowed the government and parliament to enact a plain tobacco packaging measure in the future, if needed[5].

The impacts of these population-based tobacco control policies may explain the reduction in smoking prevalence in Thai adults from 32.0% in 1991 to 20.7% in 2009[6]. However, the smoking prevalence in Thailand has been stable at 19–20% since 2009, up until the last national survey in 2017, which provided a prevalence for 2017 of 19.1%[6]. This stability in smoking prevalence seems to indicate that additional individual-level measures may be needed to further reduce smoking prevalence in Thailand.

Previous international studies show which individual-level factors influence successful smoking cessation. These factors include: taking medications and using counseling services[3]; lifetime tobacco exposure (pack-years), education level, alcohol drinking status, and smoker's age[7]; severity of nicotine dependence and the presence of comorbidity (such as cardiovascular diseases and hypertension)[8]; concerns for self-health and family's support[9], social pressures[9,10], and encountering environments previously associated with smoking (e.g. establishments that serve alcohol)[3].

Studies in Thailand found some positive influencing factors as well. These factors include smokers' knowledge (e.g. perceived risk and benefits of smoking) and attitudes (e.g. self-efficacy in smoking cessation) affecting successful smoking cessation for Thai male smokers with hypertension (a cross-sectional survey conducted at a hospital)[11]; a father serving as a role model for quitting smoking (a one-year follow-up study with smokers in a factory)[12]; prior abstinence for six months and older age (an international survey)[13]. There is a need in Thailand to explore effective individual-level factors influencing successful smoking cessation at the community level. Thus, this study aimed to examine the factors which influenced successful smoking cessation among Thai ever-regular smokers (regular smokers who have experienced at least one smoking cessation attempt in their lifetime). These factors of interest included the cessation method used, quitters' behaviors during the cessation attempt period, and other potential modifiable influencing factors.

METHODS

Study design, setting, and participants

This study employed a case-control design to compare successful quitters and unsuccessful quitters regarding the smoking cessation methods they used, quitters' behaviors during the nicotine withdrawal and relapse prevention periods, supporting factors and obstacles, and other influencing factors. We conducted our study in Nakorn Sri Thammarat and Trung provinces (both in the Southern part of Thailand Province) for two reasons. First, these two provinces had the fifth (with the prevalence of 27.4%) and the ninth (26.4%) highest smoking prevalence, respectively, out of 77 provinces in Thailand, based on Thailand's national tobacco consumption survey in 2017[14]. Second, they were conveniently located for the research team to travel to collect the data. We employed a disproportionate stratified random sampling method. In each province, one big and one small district were randomly selected from groupings based on population size (simple random sampling

within the two groups). Furthermore, we used the same sampling method to choose two big and two small sub-districts from each district. In each sub-district, we then applied a simple random sampling method to select one community. We collected data from all participants in 16 communities.

The study participants were daily smokers (smoking at least one cigarette per day) at some point in their lifetime. Furthermore, they had tried to quit smoking (stopped smoking for at least one day) at least once in their lifetime. There was a two-step recruitment process. In the first step, the community health volunteers screened all community members aged ≥15 years in 16 studied communities according to three inclusion criteria: 1) they had smoked at least 100 cigarettes over their lifetime, 2) had once been regular smokers; and 3) had at least once attempted to quit smoking. People who said 'no' to any one of these criteria were not eligible for the study. Those who said 'yes' to all these three questions were asked a fourth question regarding their current smoking behaviors. Those who currently smoked were identified as 'unsuccessful quitters' while those who had quit smoking for at least six months were identified as 'successful quitters'. However, those who had stopped smoking for less than six months were also excluded from our study because they were not yet clearly successful quitters. If the eligible community members allowed it, the community health volunteers would give prospective study participants' contact information to the research team to invite them to participate in the study. In the second step, the researchers interviewed the eligible participants using the structured questionnaire, after explaining the study protocol and obtaining their consent. The main variables we assessed were participants' sociodemographic data, smoking behaviors, and smoking cessation experiences of the last quit attempt, which included the cessation method used, the quitter's behaviors during the cessation attempt period, and other potential influencing factors for the successful quit attempt. Data were collected from August to December 2020.

Measures and data collection
The outcome measure in our study was the result of the last smoking cessation attempt. We defined ex-smokers who had quit smoking for at least six months

as 'successful quitters', and we defined current smokers who had stopped smoking for less than six months in their last attempt as 'unsuccessful quitters'. We measured various independent variables which included sociodemographic data, smoking behaviors, motivation for quitting, withdrawal symptoms after quit attempt, smokers' techniques supporting quitting and preventing relapse, and other influencing factors.

We did test-retest reliability test for our questionnaire among 10 successful quitters and 10 unsuccessful quitters before implementing our survey. Our original questionnaire contained 110 sub-questions (in the 39-question questionnaire). There were 102 sub-questions for which the participants' answers were perfectly matched for the test and the retest. Eight sub-questions had some discrepancies in participants' answers; however, only five sub-questions were considered unreliable. We did not keep these five sub-questions in our final analyses.

All interviewers were trained and supervised by study researchers. Trained field staff collected data from participants using a 39-question structured interview questionnaire developed by the research team covering all the abovementioned variables. Each interview lasted approximately 10–15 minutes.

Data analysis
For univariate analysis (Table 1), we calculated means with 95% confidence intervals (CI) for the continuous variables (with t-tests to compare the difference of these variables' values between the successful and unsuccessful quitters), or tabulated frequencies and percentages for the categorical variables using chi-squared tests. Furthermore, case-control data were analyzed using a multiple logistic regression (Table 2) to estimate multivariable-adjusted odds ratios (ORs) and 95% CI of the various independent adjusted variables, including age (16–44, 45–60, and ≥60 years); marital status (married, single/widow), occupation (agriculture, freelance labor, merchant, unemployed, and other), residence (urban, rural), yearly income (0–60000, 60001–120000, and >120000 Thai Baht), smoking behaviors (regular, occasional), tobacco product types used (cigarette, roll-your-own), and whether or not a doctor had recommended that the participant stop smoking because of smoker's illness (yes, no), as contributors to a successful smoking cessation outcome. We called

Table 1. Characteristics of and cessation methods used by successful and unsuccessful quitters, Thailand 2020

Characteristics	Successful quitters (N=284) n (%)	Unsuccessful quitters (N=837) n (%)	p [a]
Age (years), mean (95% CI)	62.2 (60.8–63.7)	53.9 (53.1–54.8)	<0.001***
Sex			
Male	281 (98.9)	822 (98.2)	0.394
Female	3 (1.1)	15 (1.8)	
Marital status			
Single	12 (4.2)	59 (7.1)	0.220
Married	266 (93.7)	764 (91.3)	
Widow	6 (2.1)	14 (1.7)	
Occupation			
Agriculture worker	146 (51.4)	443 (53.1)	<0.001***
Freelance laborer	46 (16.2)	201 (24.1)	
Merchant	15 (5.3)	82 (9.8)	
Government official	5 (1.8)	27 (3.2)	
Business employee	4 (1.4)	8 (1.0)	
Unemployed	61 (21.5)	65 (7.8)	
Retired government officer	6 (2.1)	8 (1.0)	
Other	1 (0.1)	1 (0.4)	
Residence			
Urban	133 (46.8)	424 (50.7)	0.265
Rural	151 (53.2)	413 (49.3)	
Yearly income (THB), mean (95% CI)	100464.3 (87504.0–113424.5)	105286.4 (98262.3–112310.4)	0.520
Age of smoking initiation, mean year (95% CI)	18.0 (17.4–18.5)	18.1 (17.9–18.4)	0.643
Age of regularly smoking initiation, mean year (95% CI)	18.8 (18.2–19.4)	19.1 (18.8–19.4)	0.318
Smoking behavior			
Regularly	261 (91.9)	824 (98.5)	<0.001***
Occasionally	23 (8.1)	13 (1.6)	
Product type			
Cigarette	157 (55.3)	304 (36.3)	<0.001***
Roll your own	127 (44.7)	533 (63.7)	
Cessation method			
Unaided method	283 (99.7)	830 (99.2)	0.402
Aided method	1 (0.4)	7 (0.8)	
Detailed self-method			
Stop abruptly (cold turkey)	277 (97.9)	738 (88.9)	<0.001***
Reduction to quit	6 (2.1)	92 (11.1)	
Sickness as motivator			
No	140 (49.5)	578 (69.1)	<0.001***
Yes	143 (50.5)	258 (30.9)	

THB: 1000 Thai Baht about 28 US$. *p<0.05. **p<0.01. ***p<0.001. a The p was from a t-test for the continuous variables and a chi-squared test for the categorical variables.

the logistic regression that included all the mentioned variables 'Model 1'. We did a number of logistic regression modellings by adding one additional variable at a time to the full Model 1 from a few sets of factors influencing successful quit attempts. These sets of factors included the cessation method used, technique used if employing self-cessation, motivation

to quit, and withdrawal symptoms after stopping smoking (Table 3); and techniques supporting quitting, techniques preventing relapse, and other factors (Table 4). All tables show only variables that have at least 10 observations for either successful or unsuccessful quitters, and are reliable questions. The reason we added one influencing factor at a time into our logistic regression analyses was that these factors are not independent. Statistical analyses were conducted using STATA version 15.0.

RESULTS

Table 1 shows the distribution of each independent variable stratified by the outcome group (successful and unsuccessful quitters) and binary variable relationship analyses between the outcome (successful smoking cessation) and each of these potential influencing factors. On average, among successful quitters versus unsuccessful quitters, the successful quitters were older (aged 62.2 vs 53.9 years, p<0.001) and had different occupation, such as unemployment (21.5% vs 7.8%, p<0.001). In terms of smoking behaviors, they were more often occasional smokers (8.1% vs 1.6%, p<0.001) and used less roll-your-own cigarettes (44.7% vs 63.7%, p<0.001). Even though most of the successful and the unsuccessful quitters employed the self-cessation method similarly (99.7% vs 99.2%, p=0.402), more of the successful quitters applied the 'cold turkey' method (stopped smoking abruptly) (97.9% vs 88.9%, p<0.001). Lastly, more of the successful quitters had been advised to stop smoking as a result of their illness (50.5% vs 30.9%, p<0.001).

In Table 2, our logistic regression analyses (Model 1) demonstrate that there were statistically significant positive relationships between successful smoking cessation and the following factors: aged ≥45 years (OR=2.06; 95% CI: 1.15–3.71 for those aged 45–60 years; and OR=4.74; 95% CI: 2.62–8.59 for the those aged >60 years); occupation (unemployed) (OR=1.87; 95% CI: 1.13–3.11); living in rural areas (OR=1.36; 95% CI: 1.00–1.85); occasional smoking behaviors (compared to smoking regularly) (OR=8.52; 95% CI: 3.98–18.23); using commercially rolled cigarettes (compared to using roll-your-own) (OR=2.80; 95% CI: 2.04–3.81); motivated to quit due to a doctor's recommendation because of smoker's illness (OR=2.63; 95% CI: 1.93–3.59). This model explained

Table 2. Logistic regression of potential influencing factors on the outcome of quitting smoking successfully: sociodemographic and smoking-related, Thailand, 2020

Variables[a]	Multivariable-adjusted[b]	
	OR (95% CI)	p
Age (years)		
16–44 (Ref.)	1	
45–60	2.06 (1.15–3.71)	0.016*
≥60	4.74 (2.62–8.59)	<0.001***
Marital status		
Married (Ref.)	1	
Not-married	0.91 (0.48–1.70)	0.760
Occupation		
Agriculture (Ref.)	1	
Freelance labor	0.98 (0.65–1.49)	0.943
Merchant	0.63 (0.33–1.22)	0.169
Unemployment	1.87 (1.13–3.11)	0.015*
Other	0.94 (0.46–1.94)	0.869
Residence		
Urban (Ref.)	1	
Rural	1.36 (1.00–1.85)	0.050*
Yearly income (THB)		
0–60000 (Ref.)	1	
60001–120000	0.72 (0.48–1.07)	0.107
>120000	0.86 (0.54–1.38)	0.527
Smoking behavior		
Regular (Ref.)	1	
Occasional	8.52 (3.98–18.23)	<0.001***
Product type		
Roll your own (Ref.)	1	
Cigarette	2.80 (2.04–3.81)	<0.001***
Sickness as motivation to quit		
No (Ref.)	1	
Yes	2.63 (1.93–3.59)	<0.001***

THB: 1000 Thai Baht about 28 US$. a We combined answers that have less than ten observations in either group of successful or unsuccessful quitters together. b This regression model (Model 1) provided a statistics of Pseudo R²=0.158 (p<0.001). *p< 0.05. **p<0.01. ***p<0.001.

15.8% of the variance of the study outcome at p<0.001 (data not shown in the table).

Table 3 shows that powerful motivations for successful cessation included a doctor's recommendation to stop smoking because of smoker's illness (OR=2.63; 95% CI: 1.93–3.59) and having a child (OR=1.96; 95% CI: 1.22–3.14) or grandchild (OR=2.50; 95% CI: 1.12–5.58). The median age was four years old for both the successful quitters' child and grandchild (data not shown in the table). Conversely, self-motivation to quit had a negative relationship with quitting success (OR=0.64; 95% CI: 0.43–0.94). In terms of withdrawal symptoms during the nicotine withdrawal period, insomnia reduced the chances of success (OR=0.28; 95% CI: 0.16–0.50) while feeling hungry/having a good appetite increased it (OR=1.92; 95% CI: 1.33–2.77).

Table 4 illustrates techniques for supporting successful quitting during the nicotine withdrawal phase, techniques for preventing relapse, and other influencing factors for successful quitting. During the nicotine withdrawal phase, exercising (OR=2.00; 95% CI: 1.44–2.77) was a good strategy for smoking cessation, whereas being patient (OR=0.14; 95% CI: 0.06–0.33) and eating/drinking herbs (OR=0.42; 95% CI: 0.24–0.73) worked against it. If the quitters could successfully make it through the nicotine withdrawal phase, avoiding smokers (OR=6.72; 95% CI: 4.06–11.13) and exercising (OR=13.87; 95% CI: 7.15–26.93) were good strategies during the relapse prevention phase. The following were other success-influencing factors: self-efficacy in smoking cessation (OR=8.48; 95% CI: 3.59–20.00), having used expensive tobacco (OR=1.92; 95% CI: 1.26–2.93), smoking prohibitions in public places (OR=2.82; 95% CI: 1.24–6.42), smoking prohibitions in the workplace (OR=4.47; 95% CI: 1.94–10.32), and disliking the smell of other people's smoking (OR=3.68; 95% CI: 2.46–5.50). Conversely, factors that reduced the quitting success included social pressure to smoke (OR=0.40; 95% CI: 0.27–0.60), associating smoking with a habit/specific activity (OR=0.36; 95% CI: 0.25–0.52), and a sense that smoking generates a good feeling or reduces stress (OR=0.45; 95% CI: 0.30–0.65).

Table 3. Logistic regression of potential influencing factors on the outcome of quitting smoking successfully: motivation and withdrawal symptoms, Thailand (2020)

Variables[a]	Successful quitters (N=284) n (%)	Unsuccessful quitters (N=837) n (%)	Multivariable-adjusted[b] OR (95% CI)[c]	p
Motivation				
Had a child	38 (13.4)	80 (9.6)	1.96 (1.22–3.14)	0.005**
Had a grandchild	13 (4.6)	22 (2.6)	2.50 (1.12–5.58)	0.026*
Family asked me to quit	47 (16.6)	109 (13.0)	1.41 (0.92–2.17)	0.116
Relatives asked me to quit	23 (8.1)	74 (8.8)	0.78 (0.45–1.36)	0.381
Doctor's recommendation to stop smoking because of smoker's sickness	143 (50.4)	258 (30.8)	2.63 (1.93–3.59)	<0.001***
Self-motivation	79 (27.8)	323 (38.6)	0.64 (0.43–0.94)	0.024*
Withdrawal symptoms				
Severe craving	188 (66.2)	601 (71.8)	0.80 (0.57–1.11)	0.179
Irritable, angry, stress	101 (35.6)	326 (39.0)	0.77 (0.56–1.06)	0.108
Headache	10 (3.5)	35 (4.2)	0.71 (0.32–1.55)	0.389
Insomnia	17 (6.0)	117 (14.0)	0.28 (0.16–0.50)	<0.001***
Hungry/good appetite	80 (28.2)	139 (16.6)	1.92 (1.33–2.77)	<0.001**

a We combined answers that have less than ten observations in either group of successful or unsuccessful quitters together. b All predictors in Model 1 (Table 2) (including age, marital status, occupation, place of resident, income, smoking behavior, product type used, and whether having sickness or not) and each variable shown in Table 3 were simultaneously modelled in the same logistic regression. c The OR with Ref. (reference category) is written in the variables that the study participants could answer only one choice, but are not shown in the variables that they could answer all that applied. The reference category in the latter variables means not having that factor. *p<0.05. **p<0.01. ***p<0.001.

Table 4. Logistic regression of potential influencing factors on the outcome of quitting smoking successfully: techniques supporting quitting and preventing relapse, and other factors, Thailand (2020)

Variables[a]	Successful quitters (N=284) n (%)	Unsuccessful quitters (N=837) n (%)	Multivariable-adjusted[b] OR (95% CI)[c]	p
Technique supporting quitting				
Be patient	268 (94.4)	828 (98.9)	0.14 (0.06–0.33)	<0.001***
Avoid smokers	115 (40.5)	371 (44.3)	0.92 (0.67–1.25)	0.579
Reduce craving (eating sour food)	66 (23.2)	189 (22.6)	0.99 (0.69–1.41)	0.958
Engage in leisure activities	45 (15.9)	104 (12.4)	1.43 (0.94–2.19)	0.098
Exercise	113 (39.8)	230 (27.5)	2.00 (1.44–2.77)	<0.001***
Eat/drink herbs	20 (7.0)	110 (13.1)	0.42 (0.24–0.73)	0.002**
Smell balm	58 (20.4)	144 (17.2)	1.35 (0.91–2.00)	0.132
Technique preventing relapse				
Avoid smokers	63 (22.2)	37 (4.4)	6.72 (4.06–11.13)	<0.001***
Exercise	57 (20.1)	14 (1.7)	13.87 (7.15–26.93)	<0.001***
Other influencing factors				
Self-efficacy in successful cessation	278 (97.9)	709 (84.7)	8.48 (3.59–20.00)	<0.001***
Family encouragement	135 (47.5)	385 (46.0)	0.87 (0.64–1.19)	0.383
A rule of not smoke at home	21 (7.4)	47 (5.6)	0.99 (0.54–1.81)	0.983
VHV ask to stop	24 (8.5)	61 (7.3)	1.56 (0.89–2.75)	0.122
Carbon monoxide test	55 (19.4)	157 (18.8)	1.02 (0.69–1.50)	0.931
Expensive tobacco	50 (17.6)	104 (12.4)	1.92 (1.26–2.93)	0.003**
Smoking prohibition in public places	16 (5.6)	16 (1.9)	2.82 (1.24–6.42)	0.013*
Smoking prohibition in workplace	17 (6.0)	11 (1.3)	4.47 (1.94–10.32)	<0.001***
Unpleasant smell of smoking	83 (29.2)	68 (8.1)	3.68 (2.46–5.50)	<0.001***
Use alcohol/other drugs	18 (6.3)	56 (6.7)	0.95 (0.52–1.74)	0.875
Family member smoked	18 (6.3)	75 (9.0)	0.82 (046–1.48)	0.517
Friend smoked	66 (23.2)	250 (29.9)	0.86 (0.61–1.22)	0.396
Social pressure to smoke	40 (14.1)	269 (32.2)	0.40 (0.27–0.60)	<0.001***
Associating smoking with a habit/specific activity	52 (18.3)	371 (44.3)	0.36 (0.25–0.52)	<0.001***
Pleasure of smoking	47 (16.6)	250 (29.9)	0.45 (0.30–0.65)	<0.001***

a We combined answers that have less than ten observations in either group of successful or unsuccessful quitters together. b All predictors in Model 1 (including age, marital status, occupation, residence, income, smoking behavior, product type used, and whether having sickness or not) and each variable shown in Table 4 were simultaneously modelled in the same logistic regression. c The OR with Ref. (reference category) is written so that the study participants could select only one choice, and not select all that are applicable. The reference category in the latter variables means not having that factor. *p<0.05. **p<0.01. ***p<0.001.

DISCUSSION

Our study found various influencing factors for successful smoking cessation. This information can be used to design a guideline for unaided smoking cessation, and smoking cessation enhancement programs and policies.

Smoking cessation methods and techniques

We found that almost all successful and unsuccessful Thai quitters in our study employed unaided methods in their quit attempts. An unaided method means smoking cessation accomplished without the assistance from others or involving the use of

medication. Successful quitters with unaided methods employed a cold turkey technique (abruptly stopping smoking) significantly more often than a cut-down-to-quit technique.

Even though there is evidence suggesting that both behavioral counselling and smoking cessation medical interventions increase success in smoking cessation compared with self-help materials or no treatment[3], evidence in both Thailand and internationally has shown that unaided methods are crucially important in the real world of smoking cessation implementation. Based on the Thai national smoking survey, among successful ex-smokers, 94.0% quit smoking by themselves, and only 6.0% used some form of help to quit[4]. These 6.0% consisted of: 1.9% using medication, 0.6% using the national quit help line counseling service, 1.8% receiving smoking cessation services from health personnel, and 1.7% using other methods[4]. Similarly, only 30% of tobacco users worldwide had access to tools that could help them stop smoking, although approximately 60% said they wanted to quit[15]. Other studies also showed that many people are able to quit by unassisted strategies such as the 'cold turkey' method or cutting down and then quitting[16]. This means that unaided methods are crucially important in the real world of smoking cessation implementation.

Demographic data and smoking behaviors

Based on our findings, successful quitters were those aged ≥45 years and unemployed. A Korean study, involving males, also found that middle aged smokers (aged 40–64 years) and older smokers (aged ≥65 years) had a higher chance of successful quitting than younger smokers (aged 19–39 years)[17]. The reason was that older male Korean smokers have experienced more illness than younger ones, leading to a higher quit attempt rate and successful smoking cessation rate. The illnesses which had a positive effect on a successful smoking attempt included cardiovascular diseases and higher blood pressure[8,17], as well as high body mass index[17]. Since expensive cigarettes reduce tobacco consumption[3], unemployed people in our study may have had higher motivation to quit than their employed counterparts for financial reasons.

Our study found that occasional smokers were more successful in their quit attempts than regular smokers. Similarly, the International Tobacco Control Southeast

Asia (ITC-SEA Thailand) survey showed that Thai regular and heavy cigarette smokers had a higher relapse rate than occasional smokers, and that relapse was common after one month of quitting[18]. Using roll-your-own (RYO) (rather than commercial cigarettes) was a barrier to quitting in our study. As seen from the Global Adult Tobacco Survey conducted in Thailand in 2009, Thai men who smoked RYO were more likely to report not being interested in quitting compared to those who smoked manufactured cigarettes as there were fewer financial costs associated with RYO products[19]. Overall, smokers who were of older age, unemployed, smoked occasionally, or used commercial cigarettes (rather than RYO) had a higher chance of successful smoking cessation than their counterparts.

Motivational factors

Our study found that tangible motivational factors were more influential than intangible motivational factors. For instance, a doctor's recommendation to stop smoking due to a smoker's illness, or having a grandchild or a child more heavily impacted a successful quitting attempt than quit attempts motivated by oneself, families, relatives, or friends.

Concordant with our finding of the importance of a smoker's illness to motivate them to quit, the Surgeon General Report 2020 on smoking cessation concluded that there is sufficient global evidence to suggest that certain life events (e.g. hospitalization, surgery, and lung cancer screening) can trigger smoking cessation attempts, smoking cessation treatment uptake, and successful cessation[3]. Health concerns are also an influential factor for cessation[20]. Often a new mother will ask the father to quit smoking[20], and since half of children and grandchildren of successful quitters were four years of age (data are not shown), 'well-baby' clinics may be good targets in health facilities to advise smokers to quit. Buczkowski et al.[21] found that smokers largely quit smoking spontaneously without any planning involved.

Our study found that self-motivation predicted failed quit attempts: in fact, 38.5% of unsuccessful quitters and 27.1% of the successful quitters had self-motivation to quit. A possible explanation is that self-motivation is not a strong positive influencing factor for a successful quit attempt because it is often unstable, even over a short period of time (<14 days). As a result, most quit attempts end in relapse, with

an estimated average of 30 or more quit attempts undertaken by a smoker before eventual success[22]. Hence, employing external, tangible motivators (e.g. doctors' recommendation over a smokers' illness, having a child or grandchild) to encourage smokers to quit is crucial in smoking cessation.

Withdrawal symptoms

Our study found that even though severe cravings (66.2% of successful quitters and 71.8% of unsuccessful quitters) and irritable mood/anger / stress (35.6% of successful quitters and 39.0% of unsuccessful quitters) were the most common nicotine withdrawal symptoms among our study participants, they did not actually cause failure in quit attempts (Table 3). In fact, we found that insomnia (6.0% of successful quitters and 14.0% of unsuccessful quitters) significantly reduced the chance of successful quit attempts, similar to the findings of Ashare et al.[23]. This sleep-disturbance symptom, either as a smoker characteristic or as a nicotine withdrawal symptom, is common among smokers and predicts smoking cessation failure and must therefore be reduced for successful smoking cessation[23].

Quitters' having a good appetite after quitting increased the chance of success of smoking cessation in our study; this, of course may lead to weight gain. A study found that an average weight increase of 3.8–6.8 kg, with a minimum significant weight gain of 1–16 kg, has been reported by patients who successfully stopped smoking[24].

Techniques supporting successful quitting during the nicotine withdrawal phase and techniques preventing relapse if quitters make it through the nicotine withdrawal phase

Our study found that exercise worked well in both the nicotine withdrawal and the relapse prevention phases, while avoiding smokers was a good strategy to employ during the relapse prevention phase.

Since chronic exposure to nicotine changes the mesocorticolimbic dopamine system, an area of the brain which processes rewarding sensory stimuli, the altered brain condition requires nicotine to be maintained in order the brain to produce reward and prevent withdrawal symptoms[25]. Aerobic exercise increases dopamine and serotonin, leading to mood improvement[26], and it was shown to predict successful smoking cessation, both in the nicotine withdrawal and the relapse prevention phases of our study. Evidently, in our study, exercising during the nicotine withdrawal phase increased the chances of successful smoking cessation with an OR of 2.00, and with an OR of 13.87 if the quitters performed exercise during the relapse prevention phase.

Supporting our finding, Shiffman et al.[10] examined 21539 smoking episodes and 26930 non-smoking episodes among 212 occasional smokers and 192 daily smokers and found that avoiding smokers could prevent indulgent smoking. In practice, a smoking cessation guideline should suggest that quitters do exercise in both the withdrawal and relapse prevention phases, and to avoid being around smokers during the relapse prevention phase.

Other influencing factors

Other success-influencing factors included self-efficacy in smoking cessation, feeling that tobacco is expensive, a smoking prohibition in public places, a smoking prohibition in workplace, and a desire to avoid the unpleasant smell of other people's smoking once they had stopped smoking themselves.

Our study provides more individual-level evidence to confirm the effectiveness of population-level policy interventions in enhancing smoking cessation. The policies used to increase the smoking cessation rate include: raising cigarette prices, employing comprehensive smoke-free policies, implementing mass media campaigns, requiring pictorial health warnings on packaging, maintaining comprehensive nationwide tobacco control programs, and providing insurance coverage for smoking cessation treatment that is comprehensive[3]. Thus, our study confirmed that implementing the WHO's best buys policy interventions – to reduce affordability by increasing excise taxes and prices on tobacco products, and eliminate exposure to secondhand tobacco smoke in all indoor workplaces, public places, and public transportation[15] – not only reduced access to tobacco products and smoke but also increased the chances of successfully quitting smoking. Based on their qualitative study with 15 current smokers and 16 former smokers, Buczkowski et al.[20] summarized that two very crucial motivations for smoking cessation were a smoking ban at home and at work due to non-smokers' wishes and rules, as well as the high cost of

cigarettes. When smokers successfully quit smoking themselves, smelling the smoke coming from smokers can become an aversive effect and, in fact, strengthen their resolve not to relapse to smoking again[27].

Conversely, our study found that other factors that reduced quitting success included pleasure enhancement or the reduction in stress brought about by smoking, the social pressure to smoke, and associating smoking with another activity.

Buczkowski et al.[20] found that stress and the need to reduce it by smoking a cigarette and the need to experience the smoking-connected pleasure were reasons why smokers sometimes relapsed. A study showed that in an environment where there is social pressure to quit smoking, individuals practice abstinence from smoking for a longer duration[28]. Keeping away from the influence of peers who smoke was helpful in smoking cessation attempts[29]. Tiffany et al.[30] also highlighted the importance of behaviors during smoking cessation attempts, as those who tend to smoke directly after activities such as exercise or dinner may continue to smoke habitually without much craving prompting it.

Strengths and limitations

Strengths of our study include: 1) we assessed the characteristics of the last smoking cessation attempt rather than the characteristics of the quitter, which has resulted in a study which can provide us with insights regarding practical positive influencing factors that can be employed in the real world; 2) we examined the effects of a comprehensive set of influencing factors of successful smoking cessation and found a number of interesting positive influencing factors, which can be used in developing smoking cessation guidelines, programs, and policies; 3) we separated influencing factors in the withdrawal and the relapse prevention phases, and found that some factors functioned differently between two phases; and 4) we employed the case-control design which is appropriate for studying the real past smoking cessation experiences between successful and unsuccessful quitters. However, our study also has some limitations. They include: 1) there may be some recall bias embedded in the case-control study design; and 2) our study had too few samples who used quitting aids (medication or counseling), hence we could not compare the positive influencing factors

between aided and unaided methods, or between the 'stopping smoking abruptly (cold turkey)' and the 'cutting down and then quitting' methods. Furthermore, having only small samples of people who engaged in some influencing factors made it impossible to analyze the effects of a few potentially interesting factors, including avoiding being around tobacco products or stressful experiences.

CONCLUSIONS

This study identified factors facilitating successful cessation of cigarette smoking, which can be used to guide smoking cessation enhancement programs and policies in an upper middle-income country with a high level of tobacco control policies. A number of facilitating factors and barriers are laid out, including factors under the control of individuals attempting to quit (e.g. exercise, avoid smokers, and self-efficacy), and factors which are amenable to further policy changes (e.g. enforcement of smoking prohibition in public and workplaces, increasing taxes to make tobacco products more expensive, and policies to guide GPs).

REFERENCES

1. GBD 2019 Tobacco Collaborators. Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990-2019: a systematic analysis from the Global Burden of Disease Study 2019. Lancet. 2021;397(10292):2337-2360. doi:10.1016/s0140-6736(21)01169-7

2. Institute for Health Metrics and Evaluation. Thailand. Accessed September 21, 2021. http://www.healthdata.org/thailand

3. United States Public Health Service Office of the Surgeon General, National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. Smoking Cessation: A Report of the Surgeon General [Internet]. US Department of Health and Human Services; 2020. Accessed April 23, 2022. https://www.ncbi.nlm.nih.gov/books/NBK555591/

4. Smokefreezone. Cigarette alarm number data set. In Thai. Accessed April 21, 2022. http://www.smokefreezone.or.th/media_page/437/%E0%B8%8A%E0%B8%B8%E0%B8%94%E0%B8%82%E0%B9%89%E0%B8%AD%E0%B8%A1%E0%B8%B9%E0%B8%A5%E0%B8%95%E0%B8%B1%E0%B8%A7%E0%B9%80%E0%B8%A5%E0%B8%82%E0%B9%80%E0%B8%95%E0%B8%B7%E0%B8%AD%E0%B8%99%E0%B8%A0%E0%B8%B1%E0%B8%A2%E0%B8%9A%E0%B8%B8%E0%B8%AB%E0%B8%A3%E0%B8%B5%E0%B9%88.html

5. Department of Disease Control - Bureau of Tobacco Control. Tobacco Products Control Act: B.E. 2560 (2017). Bureau of Tobacco Control; 2017. Accessed September 21, 2021. http://www.ashthailand.or.th/en/content_attachment/attach/new_thai_law.pdf

6. Health Information System Development Office. The 5th Thai National Healthcare Survey Report. In Thai. Accessed July 20, 2022. https://www.hiso.or.th/hiso5/report/report9.php

7. Yang JJ, Song M, Yoon HS, et al. What Are the Major Determinants in the Success of Smoking Cessation: Results from the Health Examinees Study. PLoS One. 2015;10(12):e0143303. doi:10.1371/journal.pone.0143303

8. Eum YH, Kim HJ, Bak S, et al. Factors related to the success of smoking cessation: A retrospective cohort study in Korea. Tob Induc Dis. 2022;20(February). doi:10.18332/tid/144272

9. Martins RS, Junaid MU, Khan MS, et al. Factors motivating smoking cessation: a cross-sectional study in a lower-middle-income country. BMC Public Health. 2021;21(1):1419. doi:10.1186/s12889-021-11477-2

10. Shiffman S, Dunbar MS, Li X, et al. Smoking patterns and stimulus control in intermittent and daily smokers. PloS One. 2014;9(3):e89911. doi:10.1371/journal.pone.0089911

11. Jianvitayakij S, Panpakdee O, Malathum P, Duffy SA, Viwatwongkasem C. Factors influencing smoking cessation behavior among Thai male smokers with hypertension. Pacific Rim International Journal of Nursing Research. 2014;18(2):100-110. Accessed April 23, 2022. https://he02.tci-thaijo.org/index.php/PRIJNR/article/view/12528

12. Sujirarat D, Silpasuwan P, Viwatwongkasem C, Sirichothiratana N. Factors affecting failure to quit smoking after exposure to pictorial cigarette pack warnings among employees in Thailand. Southeast Asian J Trop Med Public Health. 2011;42(4):988-995. Accessed April 23, 2022. https://pubmed.ncbi.nlm.nih.gov/22299482/

13. Li L, Borland R, Yong HH, et al. Predictors of smoking cessation among adult smokers in Malaysia and Thailand: findings from the International Tobacco Control Southeast Asia Survey. Nicotine Tob Res. 2010;12 Suppl(Suppl 1):S34-S44. doi:10.1093/ntr/ntq030

14. Kongsakon R, Pattanathepapon A. Thailand tobacco consumption report 2019. In Thai. Tobacco Research Centre; 2021. Accessed September 21, 2021. https://www.trc.or.th/th/attachments/article/527/%E0%B8%A3%E0%B8%B2%E0%B8%A2%E0%B8%87%E0%B8%B2%E0%B8%99%E0%B8%AA%E0%B8%96%E0%B8%B2%E0%B8%99%E0%B8%81%E0%B8%B2%E0%B8%A3%E0%B8%93%E0%B9%8C%20%E0%B8%81%E0%B8%B2%E0%B8%A3%E0%B8%9A%E0%B8%A3%E0%B8%B4%E0%B9%82%E0%B8%A0%E0%B8%84%E0%B8%A2%E0%B8%B2%E0%B8%AA%E0%B8%B9%E0%B8%9A%E0%B8%82%E0%B8%AD%E0%B8%87%E0%B8%9B%E0%B8%A3%E0%B8%B0%E0%B9%80%E0%B8%97%E0%B8%A8%E0%B9%84%E0%B8%97%E0%B8%A2%20%E0%B8%9E.%E0%B8%A8.2562.pdf

15. World Health Organization. Noncommunicable diseases progress monitor 2020. World Health Organization; 2020. Accessed September 21, 2021. https://www.who.int/publications/i/item/ncd-progress-monitor-2020

16. Chapman S, MacKenzie R. The global research neglect of unassisted smoking cessation: causes and consequences. PLoS Med. 2010;7(2):e1000216. doi:10.1371/journal.pmed.1000216

17. Kim Y, Lee JS, Cho WK. Factors Associated with Successful Smoking Cessation According to Age Group: Findings of an 11-Year Korea National Survey. Int J Environ Res Public Health. 2021;18(4). doi:10.3390/ijerph18041576

18. Jampaklay A, Borland R, Yong HH, Sirirassamee B, Fotuhi O, Fong G. Predictors of Successful Quitting among Thai Adult Smokers: Evidence from ITC-SEA (Thailand) Survey. International Journal of Environmental Research and Public Health. 2015;12(10):12095-12109. doi:10.3390/ijerph121012095

19. Benjakul S, Termsirikulchai L, Hsia J, et al. Current manufactured cigarette smoking and roll-your-own cigarette smoking in Thailand: findings from the 2009 Global Adult Tobacco Survey. BMC Public Health. 2013;13(1):277. doi:10.1186/1471-2458-13-277

20. Buczkowski K, Marcinowicz L, Czachowski S, Piszczek E. Motivations toward smoking cessation, reasons for relapse, and modes of quitting: results from a qualitative study among former and current smokers. Patient Prefer Adherence. 2014;8:1353-1363. doi:10.2147/ppa.S67767

21. Hughes JR, Keely JP, Fagerstrom KO, Callas PW. Intentions to quit smoking change over short periods of time. Addict Behav. 2005;30(4):653-662. doi:10.1016/j.addbeh.2004.08.011

22. Chaiton M, Diemert L, Cohen JE, et al. Estimating the number of quit attempts it takes to quit smoking successfully in a longitudinal cohort of smokers. BMJ Open. 2016;6(6):e011045. doi:10.1136/bmjopen-2016-011045

23. Ashare RL, Lerman C, Tyndale RF, et al. Sleep Disturbance During Smoking Cessation: Withdrawal or Side Effect of Treatment? J Smok Cessat. 2017;12(2):63-70. doi:10.1017/jsc.2016.11

24. Can G, Oztuna F, Topbaş M. Complaints related to smoking cessation. Tuberk Toraks. 2007;55(4):364-369. Accessed April 23, 2022. https://pubmed.ncbi.nlm.nih.gov/18224504/

25. De Biasi M, Dani JA. Reward, addiction, withdrawal to nicotine. Annu Rev Neurosci. 2011;34(1):105-130. doi:10.1146/annurev-neuro-061010-113734

26. Heijnen S, Hommel B, Kibele A, Colzato LS. Neuromodulation of Aerobic Exercise-A Review. Front Psychol. 2015;6:1890. doi:10.3389/fpsyg.2015.01890

27. Pomerleau OF, Collins AC, Shiffman S, Pomerleau CS. Why some people smoke and others do not: new perspectives. J Consult Clin Psychol. 1993;61(5):723. doi:10.1037/0022-006X.61.5.723

28. Shaheen K, Oyebode O, Masud H. Experiences of young smokers in quitting smoking in twin cities of Pakistan: a phenomenological study. BMC Public Health. 2018;18(1):466. doi:10.1186/s12889-018-5388-7

29. Schauer GL, Malarcher AM, Berg CJ. Differences in smoking and cessation characteristics among adult nondaily smokers in the United States: findings from the 2009-2010 National Adult Tobacco Survey. Nicotine Tob Res. 2014;16(1):58-68. doi:10.1093/ntr/ntt113

30. Tiffany ST. Cognitive concepts of craving. Alcohol Res Health. 1999;23(3):215. Accessed April 23, 2022. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6760370/pdf/arh-23-3-215.pdf