KNOWLEDGE, ATTITUDES AND PRACTICES OF SMOKING AMONG UNIVERSITY STUDENTS IN THAILAND: A QUANTITATIVE STUDY

BUSABAN CHIRTKIATSAKUL

FACULTY OF BUSINESS AND ECONOMICS
UNIVERSITI MALAYA
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KNOWLEDGE, ATTITUDES AND PRACTICES OF SMOKING AMONG UNIVERSITY STUDENTS IN THAILAND: A QUANTITATIVE STUDY

ABSTRACT

Smoking remains a public health concern in several countries, especially among young adults. The aim of this study is to: 1) determine the prevalence of smoking among university students in Thailand and identify associated factors, 2) examine the general level of knowledge, attitudes and practices with regards to smoking and identify associated factors, and 3) investigate whether attitude domains mediate the relationship between knowledge domains and practice domains. A cross-sectional study was conducted among 1,299 students from five public universities in Thailand using a self-administered questionnaire. Factor analysis, multiple logistic regression, multiple linear regression, the causal-step approach, and 95% confidence interval bootstrap percentiles were used for analysis. Results showed that 28.2% of students were smokers. 75.3% of students had a high knowledge, 49.5% had equivocal attitude and 79.0% had poor practice. Factors significantly associated with smoking were male, aged 21 years and above, enrolled in a non-science major, living off campus, having a family member or friend who smoked, having a favorable attitude toward smoking, and having an equivocal attitude about smoking. Gender, age group, and field of study were important factors influencing knowledge about smoking. Being a male was associated with less anti-smoking attitudes, less positive preventive practices, more positive perceptions about smoking, and more negative practices. Having a family member who smoked was associated with more positive perceptions about smoking; however, having a family member who smoked was associated with higher positive preventive practices. Having a friend who smoked was associated with more positive perceptions about smoking and more negative practices toward smoking. Based on the mediation analysis, anti-smoking attitude mediates the relationship between the domains of knowledge and positive

preventive practice, and also mediates the relationship between the domains of knowledge and negative practice. Positive perceptions about smoking act as a mediator between all knowledge domains and negative practices. Understanding the influencing factors of smoking, knowledge, attitudes, and practices toward smoking, and the connection among them provides helpful insights for tobacco control policies in universities.

Keywords: smoking prevalence, knowledge, attitude, practice, university students

PENGETAHUAN, SIKAP DAN AMALAN MEROKOK DALAM KALANGAN PELAJAR UNIVERSITI DI THAILAND: SATU KAJIAN KUANTITATIF

ABSTRAK

Merokok masih kekal sebagai satu topik kesihatan awam yang penting di beberapa negara, terutama di kalangan orang dewasa muda. Tujuan kajian ini adalah untuk: 1) menentukan prevalens merokok dalam kalangan pelajar universiti di Thailand dan mengenal pasti faktor-faktor pengaruh yang berkaitan, 2) memeriksa tahap pengetahuan, sikap dan amalan umum mengenai merokok dan mengenal pasti faktor yang berkaitan, dan 3) menyelidik sama ada domain sikap merupakan mediasi kepada hubungan antara domain pengetahuan dan domain amalan. Kajian keratan rentas dijalankan ke atas 1,299 pelajar dari lima buah universiti awam di Thailand dengan menggunakan soalan kaji selidik. Analisis faktor, regresi logistik berganda, regresi linear berganda, kaedah kausal-langkah, dan persentil *bootstrap* dengan selang keyakinan 95% digunakan untuk analisis. Hasil kajian menunjukkan bahawa 28.2% pelajar adalah perokok. 75.3% pelajar mempunyai pengetahuan yang tinggi, 49.5% mempunyai sikap samar-samar iaitu tidak pasti dan 79.0% mempunyai amalan yang lemah. Faktor-faktor yang berkaitan dengan merokok adalah jantina lelaki, berumur 21 tahun ke atas, mendaftar di jurusan bukan sains, tinggal di luar kampus, mempunyai ahli keluarga atau rakan yang merokok, mempunyai sikap suka merokok, dan mempunyai sikap tidak pasti mengenai merokok. Jantina, kumpulan umur, dan bidang kajian merupakan faktor penting yang mempengaruhi pengetahuan mengenai merokok. Jantina lelaki dikaitkan dengan kurang mempunyai sikap anti-merokok, kurang amalan pencegahan yang positif, mempunyai persepsi positif terhadap merokok, dan mempunyai lebih banyak amalan negatif terhadap merokok. Mempunyai ahli keluarga yang merokok dikaitkan dengan persepsi positif mengenai merokok; namun, mempunyai ahli keluarga yang merokok dikaitkan dengan amalan pencegahan positif

yang lebih tinggi. Mempunyai rakan yang merokok dikaitkan dengan persepsi positif mengenai merokok dan amalan negatif yang lebih banyak terhadap merokok. Berdasarkan analisis mediasi, sikap anti-merokok merupakan mediasi kepada hubungan antara domain pengetahuan dan amalan pencegahan positif, dan juga mediasi kepada hubungan antara domain pengetahuan dan amalan negatif. Persepsi positif mengenai merokok bertindak sebagai mediator di antara semua domain pengetahuan dan amalan negatif. Memahami faktor-faktor yang mempengaruhi merokok, pengetahuan, sikap, dan amalan terhadap merokok, dan hubungan di antara faktor-faktor ini boleh dijadikan input serta pandangan berguna dalam membina dasar kawalan tembakau di peringkat universiti atau institusi pengajian tinggi.

Kata kunci: prevalen merokok, pengetahuan, sikap, amalan, pelajar universiti

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LIST OF SYMBOLS AND ABBREVIATIONS

AUC	:	Area Under the ROC Curve
CI	:	Confidence Interval
DALYs	:	Disability-Adjusted Life Years
EFA	:	Exploratory Factor Analysis
HDI	:	Human Development Index
KAP	:	Knowledge, Attitude, and Practice
OR	:	Odds Ratio
ROC	:	Receiver Operation Characteristics
SEATCA	:	Southeast Asia Tobacco Control Alliance
VIF	:	Variance Inflation Factor
WHO	:	World Health Organization

LIST OF APPENDICE

CHAPTER 1: INTRODUCTION

This thesis aims to determine the prevalence of and factors associated with smoking among Thai University students, as well as to examine their knowledge, attitudes, and practices of smoking and identify associated factors. In addition, the mediating role of attitude is also determined to see their influence between knowledge and practice. This chapter presents an introduction of the thesis. It starts with the research background, including the smoking situation and an overview of tobacco control policies in Thailand. The problem statement is elaborated and research questions and objectives are determined. This chapter also includes significance of the research, scope of this study, definition of the expressions, and organization of the thesis.

1.1 Research Background

Tobacco smoking is one of the leading causes of morbidity and mortality in the world (Drope et al., 2018; World Health Organization [WHO], 2017a). Tobacco kills up to two thirds of regular smokers, resulting in more than 8 million deaths each year (WHO, 2020a) and kills more people than tuberculosis, HIV/AIDS and malaria combined. More than 7 million deaths are the result of direct tobacco use and about 1.2 million deaths are the result of non-smokers being exposed to second-hand smoke. Over 80% of the 1.3 billion smokers in the world live in low- and middle-income countries (WHO, 2020a). It is estimated that by the year 2030, if these trends continue, it will likely cause more than 8 million deaths annually. Approximately 80% of these premature deaths occur in low- and middle-income countries (Tan & Dorotheo, 2018; WHO, 2011b). Tobacco use is a major risk factor for non-communicable diseases (NCDs), including cardiovascular diseases, cancer, diabetes and chronic respiratory disease (Eriksen et al., 2015; WHO, 2014). It has been estimated (Figure 1.1) that about

68% of all lung cancer deaths and 46% of all deaths from chronic obstructive pulmonary disease are due to tobacco use. Similarly, 18.6% and 17.7% of heart disease and stroke are caused by smoking (Drope et al., 2018).

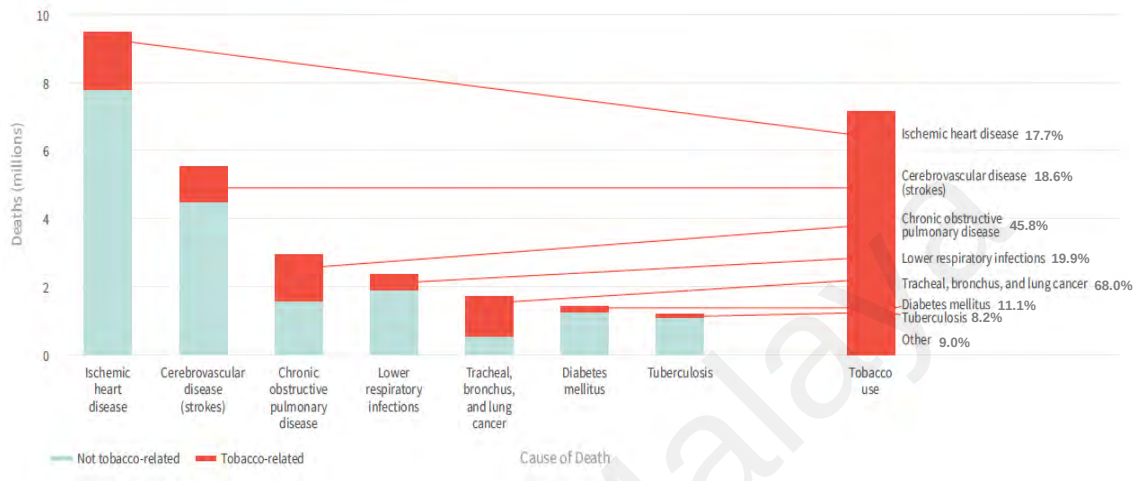

Figure 1.1: Percentage of deaths due to tobacco use for various illness

Source: Drope et al. (2018)

Globally, the estimated prevalence of current smoking in 2018 among adults was 18.9% (WHO, 2019). Almost two-thirds (64%) of all adult current smokers live in the Asia Pacific region and around 122 million, or 10% of the world's adult smokers, reside in ten Southeast Asia countries. There was an average age of smoking initiation before the age of 20 (Tan & Dorotheo, 2018). In addition, according to Tobacco Atlas (Drope et al., 2018), the smoking prevalence has remained at high levels in several medium or high human development index (HDI)[1] countries. In 2015, approximately 77% of male daily smokers live in medium or high HDI countries while around 51% of female daily smokers live in very high HDI countries (Figure 1.2).

[1] HDI is a summary composite measure of a country's average achievements in three basic aspects of human development: health, knowledge and standard of living.

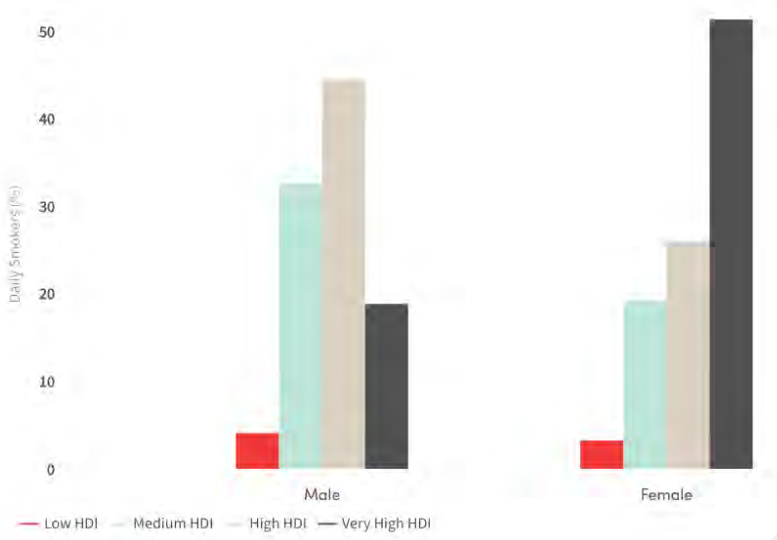

Figure 1.2: Percentage of male and female daily smokers globally by human development index level in 2015

Source: Drope et al. (2018)

1.2 Situation of Smoking in Thailand

Thailand is located in the centre of mainland Southeast Asia with a population of 68 million. Thailand is a parliamentary democracy with a constitutional monarchy. The administration of the country is carried out by the prime minister who is elected through an open vote. Out of 189 countries, Thailand has been at the 79th rank in the HDI. It fell in the high human development category with an HDI value of 0.777. Thailand's healthcare system is overseen by the Ministry of Public Health, along with several other private and public agencies. With regard to tobacco control organizations in Thailand, there are three major organizations consist of the Ministry of Public Health, NGOs, and an academic institute. The Ministry of Public Health is the organization set up as being responsible for national tobacco control. NGOs would be involved in carrying out the tobacco control policy and launched campaigns. Tobacco Control Research and Knowledge Management Centre is the academic institute which is responsible for

providing knowledge, research and evaluation of tobacco control programs (Kengkarnpanich et al., 2012)

Tobacco-related illnesses and deaths are growing problems in many developing countries including Thailand. In 2014, approximately 55,000 deaths, or 11.2% of total deaths, were due to tobacco-related diseases. Tobacco use caused the most deaths from cancer (38.0%), followed by heart disease (26.0%) and chronic respiratory disease (26.0%). Tobacco ranked as the highest health risk for the Thai male population and ranked fifth highest for Thai females in 2014. Tobacco use contributed to 12.5% of Disability-Adjusted Life Years (DALYs)[2] in males and 2.2% of DALYs in females (Table 1.1). The burden of disease due to tobacco has increased in the past decade. In 2004, tobacco use ranked third highest for males after alcohol use and unsafe sex, and sixth highest for females as a risk factor contributing to burden of disease in Thailand, causing 9.7% of DALYs lost in males and 1.9% of DALYs lost in females (Table 1.3). Five years later, in 2009, tobacco use ranked second highest for males, after alcohol use, and sixth highest for females, accounting for 11.3% and 2.2% of total DALYs, respectively (Burden of Disease Research Program Thailand, 2018).

[2] DALYs is the sum of year of potential life lost due to premature mortality and the years of productive life lost due to disability.

Table 1.1: Top ten risk factors for burden of disease in Thailand in 2014

Males		Rank	Females	
Risk factor	**% of DALYs**		**Risk factor**	**% of DALYs**
Tobacco use	12.5	1	Overweight/obesity	9.5
Alcohol use	12.4	2	High blood pressure	7.3
High blood pressure	8.1	3	Unsafe sex	4.5
Overweight/obesity	4.9	4	High blood cholesterol	3.2
High blood cholesterol	3.5	5	Tobacco use	2.2
Not using helmet	2.8	6	Low fruit/vegetables intake	2.1
Low fruit/vegetables intake	2.8	7	Physical inactivity	1.6
Illicit drug use	2.0	8	Alcohol use	1.4
Unsafe sex	1.9	9	Not using helmet	0.9
Physical inactivity	1.1	10	Ambient particulate matter pollution	0.9

Source: Burden of Disease Research Program Thailand (2018)

Table 1.2: Top ten risk factors for burden of disease in Thailand in 2009

Males		Rank	Females	
Risk factor	**% of DALYs**		**Risk factor**	**% of DALYs**
Alcohol use	15.7	1	Overweight/obesity	7.7
Tobacco use	11.3	2	High blood pressure	6.0
High blood pressure	6.2	3	Unsafe sex	5.4
Not using helmet	5.5	4	High blood cholesterol	3.2
High blood cholesterol	3.1	5	Low fruit/vegetables intake	2.2
Overweight/obesity	3.0	6	Tobacco use	2.2
Unsafe sex	2.7	7	Not using helmet	1.9
Low fruit/vegetables intake	2.5	8	Physical inactivity	1.8
Physical inactivity	1.0	9	Alcohol use	1.1
Ambient particulate matter pollution	0.8	10	Ambient particulate matter pollution	0.6

Source: Burden of Disease Research Program Thailand (2018)

Table 1.3: Top ten risk factors for burden of disease in Thailand in 2004

Males		Rank	Females	
Risk factor	**% of DALYs**		**Risk factor**	**% of DALYs**
Alcohol use	14.0	1	Unsafe sex	10.2
Unsafe sex	10.1	2	High blood pressure	6.7
Tobacco use	9.7	3	Overweight/obesity	6.4
Not using helmet	6.6	4	High blood cholesterol	2.8
High blood pressure	5.8	5	Not using helmet	2.0
Overweight/obesity	2.5	6	Tobacco use	1.9
High blood cholesterol	2.3	7	Physical inactivity	1.9
Illicit drug use	2.2	8	Low fruit/vegetables intake	1.7
Low fruit/vegetables intake	1.8	9	Alcohol use	1.1
Physical inactivity	1.0	10	Ambient particulate matter pollution	0.9

Source: Burden of Disease Research Program Thailand (2018)

Smoking remains widely prevalent among young persons in Thailand. Findings from a recent population-based study indicated that approximately 19.1% of Thai adults aged 15 years and above were current smokers, the percentage being much higher in males (37.7%) compared to females (1.7%), and the average age of smoking debut was 18 years (Tan & Dorotheo, 2018). The highest prevalence of smoking was in the Southern region (WHO Regional Office for South-East Asia, 2012). According to the Tobacco Control Research and Knowledge Management Center (2018) the overall prevalence of smoking among persons over 15 years of age has declined from 28.8% in 1996 to 19.1% in 2017 (Figure 1.2). In addition, the smoking rate among men had decreased from 54.5% in 1996 to 37.7% in 2017 and among women had decreased from 3.5% in 1996 to 1.7% in 2017.

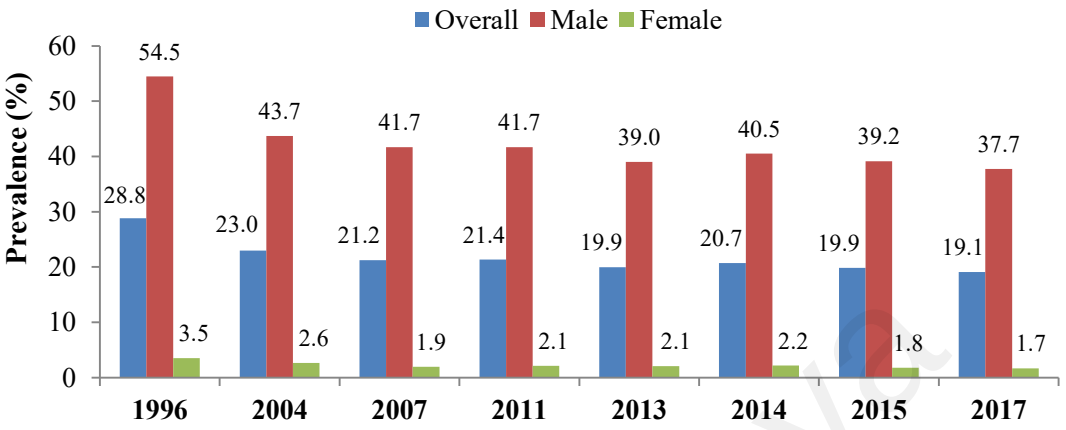

Figure 1.3: Trend of smoking among Thai adults aged 15 years and above, 1996-2017

Source: Tobacco Control Research and Knowledge Management Center (2018)

In this study we evaluated the smoking behaviours among university students who are at a transitional age, the period between adolescence and early adulthood where many important lifestyle decisions are formed. Investigating the health behaviors among this group in important for early prevention policies. Initiation of unhealthy behaviours can develop at this stage of development and these may be malleable or consolidated into lifetime patterns (Gray, 1993). In addition, their changing social context and living circumstances can affect their smoking behaviours. Most of them move away from home, develop greater independence, often living in places where tobacco products are more accessible, and the smoking status of who they live with can have a large effect on them (Delaney et al., 2018).

Few studies have focused on tobacco smoking among Thai university students. Most found that males were more likely to smoke than females. Most of them started smoking when they were in senior high school or soon after they had entered university

and they smoked 1-10 cigarettes per day (Pachanee et al., 2011; Phanucharas & Chalongsuk, 2009). A study from northern Thailand reported that most of the students smoked less than 10 cigarettes per day, 40% of smokers purchased cigarettes from a grocery store and males were more likely to ask for cigarettes from their friends than females (Chinworg et al., 2018). Urban environment, socioeconomic class, and guardian's education were more influential on their smoking behaviours (Pachanee et al., 2011). The main reasons for smoking were to relax, socialize, and a preference for tobacco products' smell and taste (Setchoduk, 2018). Most previous studies examined only on one or two variables from knowledge, attitude, and practice (KAP) toward smoking. A study from Silpakorn University revealed that although many smokers knew smoking can cause several diseases, few of them could specify the toxic chemicals in a cigarette which are harmful to their body (Phanucharas & Chalongsuk, 2009). In addition, electronic cigarette users were found to have more misperceptions in terms of health impacts, addiction, appearance, and effectiveness as a smoking cessation tool (Kochsiripong & Pitirattanaworranat, 2021).

1.3 Overview of tobacco control policies in Thailand

Thailand has long been at the forefront of tobacco control policy in Southeast Asia, with support from a large number of national level tobacco control staff. Thailand became a signatory to the WHO Framework Convention on Tobacco Control on 27 February 2005. A brief of the tobacco control laws in Thailand includes bans on selling tobacco products to anyone under the age of 20 years and prohibits the hire of anyone under the age of 18 to sell or provide tobacco products. The law bans the sale of single cigarettes, small packets of cigarettes and e-cigarettes. All forms of tobacco advertising and promotion are prohibited and the sale of tobacco products is prohibited at religious sites, hospitals, and drugstores, all educational institutions, public parks, zoos and

amusement parks. Sponsoring individuals or organizations to promote products is also outlawed, while businesses are not allowed to display products for sale. Also prohibited is the sale of tobacco from vending machine, electronic media or computer network, sales outside the location for which a tobacco sale permit has been granted, and hawking and peddling tobacco products. At least 85% of the two largest surfaces of cigarette packs must be covered with graphic health warnings. An operator has the duty to publicize and give a warning notice that their place is a non-smoking area and control, warn or take any other act to prevent smoking in non-smoking areas. No one is allowed to smoke in a non-smoking area, only in a designated smoking area (Ministry of Public Health, 2017).

In addition, the Notification of the Ministry of Public Health (Volume. 19) B.E. 2553 issued by the virtue of the Non-smoker's Health Protection Act B.E. 2535 designates the names and types of public places that are declared as tobacco-free. Article 2 (2.3) states that college level educational facilities, specifically within buildings or structures, shall be designated as public places by declaring them as smoke-free areas to protect the health of non-smokers (Ministry of Public Health, 2010). In 2014, the Thai Health Promotion Foundation, in cooperation with the Thai Health Professional Alliance Against Tobacco, conducted a smoke-free university project, aiming to encourage all government and private universities to be a smoke-free campus, as required by law (Thai Health Promotion Foundation, 2014). Since many universities in Thailand still under implementing a smoke-free university policy, only a few studies have conducted to examine the outcome of smoke-free university policy. One study was performed after two years of the smoke-free university policy's implementation among university students in the Northeast of Thailand. They found that the regular smoking rate was lower than expected. The smoking cessation rate was significantly increased and the smoke-free environment was improved. Law and organizational support were

significantly associated with organization policy management while organization policy management was significantly associated with being a smoke-free university (Sookaneknun et al., 2018). A study from Mae Fah Luang University revealed that the outcomes of the implementation of a smoke-free university policy between 2009 and 2017 were at the good level. The students who were current smokers stated that they were satisfied with the help to quit smoking of student leaders. The main approach used in helping the current smokers to quit smoking was motivation building (Matrakul et al., 2018). Srimoragot (2021) reported that 28 out of 41 universities under higher education commission established smoke-free indoor areas and set the smoke zone for smokers, which varied from 1 to 20 areas outdoor. 22 universities used traditional PR approaches while only 4 universities used social media as a PR channel for the stop smoking campaigns.

1.4 Overview of factors associated with smoking and KAP toward smoking

It is critically important to determine the factors associated with smoking behaviour, particularly knowledge of, and attitudes towards smoking, and socio-economic and socio-demographic characteristics, in order to discourage people who do not smoke from initiating smoking and to provide smokers who want to quit smoking with the appropriate support on smoking cessation. The prevalence of smoking varies by gender, age group, and other factors. A number of previous studies have reported that most of the adult smokers started smoking between the ages 16-20 years (Babaoğlu et al., 2017; Jamshed et al., 2017; Shomar et al., 2014). Males have a higher rate of smoking than females (Al-Naggar & Saghir, 2011; Elkalmi et al., 2016; Mandil et al., 2010; Tsai et al., 2008) and males begin smoking at a younger age than females (Al-Badri et al., 2017; Tsai et al., 2008). Apart from education level (Jamshed et al., 2017; Rath et al., 2012; Sreeramareddy et al., 2014) parental education achievement (Fida &

Abdelmoneim, 2013; Hussain & Satar, 2013; Tucktuck et al., 2018) also affects the smoking behaviour of individuals. Some studies found that type of education also has an impact on smoking behaviour such as a student who was studying in arts and humanities were more likely to become cigarette tobacco smokers compared to those studying in science and health sciences (Jafari et al., 2011; Jafari et al., 2014; Musmar, 2012; Tucktuck et al., 2018). Moreover, family members who smoke (Huang et al., 2014; Karimi et al., 2017; Rashid & Azizah, 2011; Scragg & Laugesen, 2007) and friends who smoke (Ngahane et al., 2015; Urrutia-Pereira et al., 2017) can influence smoking behaviours.

Considering the knowledge, attitude and practice (KAP) towards smoking, a study conducted at three universities in Jordan showed that students who smoke were not due to their lack of knowledge about the risk of smoking but because of their misguided beliefs and attitude (Sharif et al., 2013). Previous studies reported that the level of knowledge regarding health effects due to smoking was lower among smokers than non-smokers (Al-Naggar et al., 2011; Elkalmi et al., 2016; Latif et al., 2017). A study from China (Xu et al., 2015) reported that there was a significant difference between smokers and non-smokers with regard to their knowledge of smoking. The same study also reported that smokers were more likely to believe smoking is pleasurable, it relaxes them, makes them look strong, is not a waste of money, and helps them study better. Izzati et al. (2016) found that there was a weak positive correlation between knowledge with attitude and practice toward smoking, as well as a moderate correlation between attitude and practice toward smoking. In addition, factors such as gender (Egbe et al., 2016), family financial circumstances (Xu et al., 2016), level of education and place of residence (Demaio et al., 2014) have been shown to have an effect on people's knowledge regarding smoking. Gender has also been found to be a significant factor of attitude toward tobacco use (Musmar, 2012).

The aims of this study are to identify factors associated with smoking status among university students in Thailand and to investigate the relationship between knowledge, attitude and practice toward tobacco smoking among university students in Thailand.

1.5 Problem Statement

Tobacco smoking not only harms the smoker but also affects those who are nearby. It is a risk factor for mortality and a burden of several diseases such as lung cancer, upper aerodigestive cancer, various other cancers, chronic obstructive pulmonary disease (COPD), heart disease, stroke, chronic respiratory disease, cardiovascular diseases and a range of other medical causes (WHO, 2002). Smoking kills more people every year than HIV/AIDs, malaria and tuberculosis combined (Tan & Dorotheo, 2018). There are more than 7000 types of toxic chemicals detected in the smoke of tobacco, including at least 70 known carcinogens that can damage nearly every organ system in the body (Drope et al., 2018). Although the dangers of smoking are well known, many studies have shown a high prevalence of smoking in Thai population and its contribution to the disease burden in Thailand as mentioned above.

Since December 2019, the epidemic of a novel coronavirus disease 2019 (COVID-19) has become a major public health issue around the world. Globally, there have been over 169.1 million confirmed cases of COVID-19, including more than 3.52 million deaths, reported to WHO through the week ending 29 May 2021 (WHO, 2020b). The COVID-19 pandemic shows no sign of stopping. Unfortunately, several studies revealed that there was a significant association between history of smoking and progression of COVID-19. Patanavanich and Glantz (2020) published a meta-analysis of 19 studies on smoking and COVID-19. They showed that those with a history of smoking were 1.91 times more likely to have disease progression than those who never

smoked. Current smokers were 1.19 times more likely to have disease progression than never smokers. Simons et al. (2020) reviewed 26 studies and reported that current and former smokers were 1.05 and 1.51 times more likely to have an increased risk of hospitalization with COVID-19 compared with never smokers, respectively. Current and former smokers were 1.15 and 1.51 times more likely to increase risk of greater diseases severity compared with never smokers. The same study also found significant differences between the risk of death from COVID-19 between current/ever smokers and never smokers.

It is a critical time to persuade young people who are currently smoking, or thinking to initiate smoking, to realize the damages caused by smoking, be it on their health, social or financial situation, their families, and the environmental.

Most previous studies on tobacco smoking in Thailand focused on the prevalence, patterns and trends of smoking (Chinwong et al., 2018; Lim & McNeil, 2016; Pachanee et al., 2011; Phanucharas & Chalongsuk, 2009; Rudatsikira et al., 2008), or targeted adolescents and factors associated with smoking behaviour (Lee et al., 2015; Rerksuppaphol & Rerksuppaphol, 2015; Sirirassamee et al., 2009). However, a study on individual knowledge, attitude and practice pertaining to smoking among adults and special groups, such as university students has not been widely conducted. The health behaviours of these individuals are important because it is a developmental period in which life-long health behaviours are established and the responsibility for one's own healthcare is paramount (Stroud et al., 2015). In recent years, a few studies on smoking among tertiary students have been conducted as part of graduate study. A study conducted only among students who smoked at Silpakorn University. They revealed the information about smoking behaviour and smoking-related knowledge of students (Phanucharas & Chalongsuk, 2009). A study among students studying in six private universities in Bangkok reported the factors contributing to smoking behaviours

(Prasomsak, 2009). A study among students at Sukhothai Thammathirat Open University (Pachanee et al., 2011) estimated the prevalence of smoking and described smoking patterns in relation to the personal and social characteristics of student. A study among students attending at a university in northern Thailand reported gender differences in smoking behaviour among students who were current smokers (Chinwong et al., 2018). A study among students attending the Assumption University explored the tobacco smoking behaviour which included the type, amount, frequency, duration, reason and family history of smoking (Setchoduk, 2018). A study among undergraduate health science students at Rangsit University explored the attitude and perception toward electronic cigarette use found that students who use electronic cigarette had more misperceptions about electronic cigarette in terms of addiction, health impacts, appearance, and effectiveness as smoking cessation tool (Kochsiripong & Pitirattanaworranat, 2021).

Moreover, in order to be able to achieve the "smoke-free university" project, which is conducted by the Thai Health Promotion Foundation and the Thai Health Professional Alliance Against Tobacco, it is important to evaluate the connection among the knowledge, attitude, and practice of smoking of the university students, and identify factors associated with smoking prevalence among these students to develop effective standard methods to prevent and reduce the smoking prevalence. This research addresses this knowledge gap which is an evidence-based guide to help government plan and can contribute to more comprehensive tobacco control policy. Finally, university health practitioners can use the results of this survey to develop and conduct programs to prevent smoking and promote smoking cessation in their particular campus.

1.6 Research Questions

The following research questions are addressed.

1. What is the smoking prevalence among university students in Thailand?
2. What is the level of knowledge, attitudes and practices with regards to smoking among university student in Thailand?
3. What are the factors associated with smoking status among university students in Thailand?
4. What are the factors that influence the knowledge, attitudes, and practices toward smoking?
5. Does attitude domain mediate the relationship between knowledge domain and practice domain?

1.7 Research Objectives

1. To determine the prevalence of smoking among university students in Thailand.
2. To examine the general level of knowledge, attitudes and practices with regards to smoking among university students in Thailand.
3. To identify factors associated with smoking status among university students in Thailand.
4. To identify factors associated with KAP domains among university students in Thailand.
5. To investigate whether attitude domains mediate the relationship between knowledge domains and practice domains.

1.8 Significance of the study

To achieve the "smoke-free university" project in Thailand, the result of this study could be a source of information for building up advocates of smoke-free campaigns for university student volunteers. These university advocates can then build up the next generation of younger advocates from secondary schools. Eventually both will be going out as adults into the mainstream communities in the future. If they have been inspired and equipped to perform advocacy work on smoke-free campaigns, it is anticipated that they can be the agent of change and an influential force towards smoke-free efforts in the future.

The results of this survey will provide baseline data to develop an anti-smoking program to limit smoking at universities by implementing policies against smoking. The findings will also provide evidence that may vitally be important for local government's future policy-making, and information may help health researchers to better understand adult tobacco smoking and risk factors, as well as aid in developing the health education syllabus, tobacco control programs and intervention of smoking cessation, which could lead to reducing or preventing tobacco use in Thailand.

1.9 Scope of the Study

This study focuses on university students in the five public universities in Thailand, namely Chiang Mai University (CMU) in the northern region, Mahasarakham University (MSU) in the north-eastern region, Prince of Songkla University (PSU) in the southern region, Burapha University (BUU) in the eastern region and Kasetsart University (KU) in the central region. The inclusion criteria for the subject of this study were being a student of the institution during the period of data collection and aged 18 years and above. Several potential factors influencing the smoking behaviour, the knowledge, attitude and practice (KAP) towards smoking of these university students

are analysed in this study. Furthermore, the analysis on whether *attitude* towards smoking mediates the relationship between *knowledge* about smoking and *practice* toward smoking are also highlighted in this study.

1.10 Operational definition

The following is a list of relevant terms for this study.

Smoking is defined as the act of inhaling and exhaling the fumes of burning tobacco in various forms. Smoked forms of tobacco include many kinds of cigarettes (manufacture, hand-rolled, filtered, un-filtered and flavored) cigar and pipe (Hilton et al., 2017).

Smoking status is classified as smoker and non-smoker. For smokers, "**former smokers**" is defined as those who used any smoking product, even only a few puffs, but had stopped at the time of the survey, and "**current smokers**" is defined as those who currently use any smoking product. The **non-smokers** are defined as those who had never tried any types of smoking products in their lifetime.

Prevalence refers to the number of all individuals who have an attribute or disease or health condition, or deaths in a population at a designated time divided by the number of persons in that population at that time (Last, 2001). In this study, **prevalence of smoking** is the number of students who were ever-smokers and current smokers divided by the total student sample. Prevalence is often expressed as a percentage.

Knowledge toward smoking refers to the students' knowledge of tobacco smoking and consists of information about tobacco smoking products, the diseases caused by smoking and side effects of smoking.

Attitude toward smoking refers to the student's feelings, beliefs and opinions toward smoking. Favorable attitudes are those beliefs which support the use of tobacco by indicating the perceived benefits of use. On the other hand, unfavorable attitudes are those beliefs that discourage the use of tobacco.

Practice toward smoking refers to the way a student shows the knowledge and attitudes through their actions toward smoking.

1.11 Organization of the Study

The present study is arranged into five chapters and the outline of each chapter is as follows:

Chapter 1 presents the research background of the study, followed by the smoking situation in Thailand and an overview of tobacco control policies in Thailand. The problem statement, research questions, research objectives, significance of the research, scope of this study, and definition of the expressions are then presented.

Chapter 2 provides a comprehensive literature review that introduces the findings and results from previous studies. The chapter provides a history of smoking, smoking and health. Next, is the explanation on the prevalence and trend of smoking. Factors associated with smoking are also evaluated. Knowledge, attitude and practice regarding smoking and its associated factors, and tobacco control policy in Thailand were identified. The literature on statistical tools and techniques relevant to the study, and the research gaps are also described in this chapter. Finally, the last section outlines a comprehensive summary relevant to the study based on the discussed points.

Chapter 3 provides information on the research design and methodology used in this study. It is also describes the research variables, the theoretical and conceptual framework for the study variables used to guide this survey. The instrument and data

collection are defined and elaborated. The statistical tools and techniques used for analysis are also presented.

Chapter 4 provides results of preliminary data analysis and furthers data analysis. Both descriptive and inferential statistical analysis is shown.

Chapter 5 provides a summary of the major finding along with some suggestions for developing the smoking cessation program to limit smoking at university and possible ideas for future research on the topic.

1.12 Chapter Summary

This chapter presents an overview of the thesis. The background of the study, the overview of smoking situation and tobacco control policy in Thailand, statement of the research problem, research questions, research objectives, the significance of the study, scope of the study, operational definitions, and the structure of the thesis are presented in this chapter.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a comprehensive literature review in order to help readers gain a better understanding of the necessity of conducting this study. Eight sections are presented in this chapter. The first section presents the search strategy. The second and third sections describe the definition of smoking and smoking-related health issues. The next section reviews the prevalence and trends of smoking around the world and in Thailand. The fifth section discusses the factors that are associated with smoking behaviours. The sixth section reviews the smoking status. Research on knowledge, attitude, and practice toward smoking are presented in the seventh section. Tobacco control policy in Thailand is described in section eighth. The ninth section reviews the theories related to health behaviors and the tenth section reviews the literature on statistical tools and techniques relevant to the study. The research gaps are highlighted in the eleventh section. Finally, the last section outlines a comprehensive summary relevant to the study based on the discussed points.

2.1 Search strategy

We electronically searched the following databases without language restrictions, PubMed, MEDLINE, EMBASE, Wiley Cochrane, Web of Knowledge databases, Science Direct, Scopus, and Google Scholar. Government reports and PhD thesis are also included. The following search terms were used in the search strategy in all databases and within the rules of each database: “smoking”, “tobacco smoking”, “tobacco use”, “prevalence”, “knowledge”, “attitude”, “practice”, “determinant”, “factor”, “university students”, “tobacco control policy”, “KAP model”, “theory”, “logistic regression”, “linear regression”, “mediator”. The search terms were used with Boolean operators (OR, AND) and truncations, which differed depending on the

database to combine the keywords mentioned above. All the keywords used in the literature search are presented in Table 2.1. We also hand-searched the reference lists of key articles and reviews for additional studies.

Table 2.1: Keywords used for literature search

No.	Keywords	No.	Keywords
1	smoking	9	factor
2	tobacco smoking	10	university students
3	tobacco use	11	tobacco control policy
4	prevalence	12	KAP model
5	knowledge	13	theory
6	attitude	14	logistic regression
7	practice	15	linear regression
8	determinant	16	mediator
Search	1 AND 4 3 AND 4 1 OR 2 OR 3 AND 14 6 AND 16 1 OR 2 OR 3 AND 5 OR 6 OR 7 1 OR 2 OR 3 AND 4 AND 8 OR 9 1 OR 2 OR 3 AND 4 AND 10 AND 8 OR 9		2 AND 4 1 OR 2 OR 3 AND 12 1 OR 2 OR 3 AND 15 10 AND 11 1 OR 2 OR 3 AND 13 1 OR 2 OR 3 AND 10 1 OR 2 OR 3 AND 5 OR 6 OR 7 AND 8 OR 9

We used the following inclusion criteria: (1) studies on tobacco smoking; (2) studies examining knowledge, attitude and practice of smoking; (3) studies examining factors associated with smoking; (4) university students with any appropriate demographic characteristics and socioeconomic status; (5) participants in the study were current or former smokers or non-smokers. The exclusion criteria were studies on smokeless tobacco use.

2.2 Introduction of smoking

Smoking is defined as the act of inhaling and exhaling the fumes of burning tobacco in various forms. Smoked forms of tobacco include many kinds of cigarettes (manufactured, hand-rolled, filtered, un-filtered and flavored) cigars and pipes (Hilton

et al., 2017). There are more than 7,000 types of toxic chemicals detected in the smoke of tobacco, including at least 70 known carcinogens that can damage nearly every organ system in the body (Drope et al., 2018). Some of the chemicals found in tobacco smoke include: nicotine, tar, carbon monoxide, hydrogen dioxide, nitrogen dioxide, cyanide, menthol, acetaldehyde, cadmium, formaldehyde, nitrosamines, polonium 210, ammonia, arsenic, and lead. Nicotine and poisonous alkaloids are addictive substances which can have both stimulating and tranquilizing psychoactive effects. Tobacco has a long history from its usages in the early American Indians. It was introduced into Europe by the explorers of the New World and quickly spread to other areas. At present, tobacco use is popularly practiced around the world (Hilton et al., 2017). Tobacco products can generally be divided into two types: smoked tobacco and smokeless tobacco. However, this study only focuses on smoked tobacco products. Several smoked forms of tobacco have spread widely across the globe.

Manufactured cigarettes consist of shredded or reconstituted tobacco, processed with hundreds of chemicals and rolled into a paper-wrapped cylinder. Often filtered, they are manufactured by a machine, and are the predominant form of tobacco used worldwide (Shafey et al., 2009).

Kreteks, also known as clove-flavoured cigarettes, contain a wide range of exotic flavourings and eugenol, which has an anaesthetic effect, allowing for deeper and more harmful smoke inhalation (Shafey et al., 2009).

Hand-rolled cigarettes or roll-your-own (RYO) cigarettes are cigarettes hand-filled by the smoker from fine-cut, loose tobacco rolled in a cigarette paper. RYO cigarette smokers are exposed to high concentrations of tobacco particulates, tar nicotine, and tobacco-specific nitrosamines, and are at increased risk for developing cancers of the mouth, pharynx, larynx, lung, and esophagus (Shafey et al., 2009).

Cigars are made of air-cured and fermented tobaccos with a tobacco wrapper, and come in many shapes and sizes, from cigarette-sized cigarillos, double coronas, cheroots, stumpen, chuttas and dhumtis. In reverse chutta and dhumti smoking, the ignited end of the cigar is placed inside the mouth. There was a revival of cigar smoking at the end of the 20th century, among both men and women (Shafey et al., 2009).

Pipes are made of briar, slate, clay or other substance. Tobacco is placed into the bowl and inhaled through the stem, sometimes through water (Shafey et al., 2009).

Water pipes are sometimes referred to as **shisha**, **hookah**, or **narghile**, and are operated by water filtration and indirect heat. Flavored tobacco is burned in a smoking bowl covered with foil and coal. The smoke is cooled by filtration through a basin of water and consumed through a hose and mouthpiece (Shafey et al., 2009). It comes in different flavours, for instance mint, chocolate, apple, coconut, cappuccino, and watermelon.

Bidis consist of small amounts of sun-dried, hand-wrapped tobacco in a dried temburni leaf (plants native to Asia) and tied with string. Despite their small size, their tar and carbon monoxide deliveries can be higher than manufactured cigarettes because the user needs to puff harder to keep the bidis lit (Shafey et al., 2009).

Electronic cigarettes are known by many different names. They are sometimes called “e-cigarettes”, “e-pipes”, “e-hookahs”, “vape pens”, “vapes”, “e-cigars”, and “electronic nicotine delivery systems (ENDS)”. They come in many shapes and sizes like pens, USB memory sticks, or basic cylinders. Most have a battery, a heating element, and a place to hold the liquid. Electronic cigarettes produce an aerosol by heating a liquid that may or may not contain nicotine, flavouring, and other additives, all of which can be toxic to health (WHO, 2021).

2.3 Smoking and Health

Smoking is a risk factor for mortality and several diseases such as lung cancer, upper aerodigestive cancer, various other cancers, chronic obstructive pulmonary disease (COPD), heart disease, stroke, chronic respiratory disease, cardiovascular diseases and a range of other medical conditions (WHO, 2002). People who smoke not only expose themselves to toxic chemicals but the people around them are also exposed to the same chemicals through secondhand smoke. In 1900, many researchers studied the relationship between smoking and cancer, particularly lung cancer and cancers of certain other organs, heart diseases and blood vessels. This is because they started noting the parallel increase in cigarette consumption and lung cancer. Between 1950 and 1960, a number of organizations declared that smoking was an important health hazard, particularly with respect to lung cancer and cardiovascular disease (U.S. Department of Health, Education, and Welfare, 1964). Currently, the tobacco epidemic is one of the largest public health problems in the world, killing more than 8 million people a year. Approximately 80% of the world's more than 1.3 billion smokers live in low-income and middle-income countries (WHO, 2020a).

2.4 Prevalence of smoking and trend

2.4.1 Worldwide prevalence and trend

Several global surveys have been implemented to monitor the prevalence, trends and patterns of tobacco use throughout the world and a large number of studies have been reported on the prevalence of smoking in specific countries and world regions. According to WHO, the overall prevalence of smoking in 195 countries among persons over 15 years of age declined from 23.5% in 2007 to 20.7% in 2015. Although the smoking rate has dropped by 2.8% in the past 8 years, the smoking rate has not decreased significantly in all counties. In five countries smoking rates have increased

while in 47 the prevalence has not significantly changed (WHO, 2017b). One study conducted using data from 30 countries in sub–Saharan Africa between 2006 and 2013 found that the overall prevalence of smoking was 6.4%, with the highest rate seen in Sierra Leone (37.7%) among people aged 15 years and above (Sreeramareddy et al., 2014). A study conducted in 15 countries across African, Central and Western Asia, and Latin America between 2005 and 2012 found that the prevalence of smoking was higher than 40% among males in most countries of Central and West Asia, and the prevalence among females was lower than among males (Sreeramareddy & Pradhan, 2015). Other surveys performed in 11 European countries reported that the current smoking rate among adolescents was 30.9%, Israel had the highest rate whereas the lowest rate was found in Ireland (Banzer et al., 2017).

In recent years, trends in smoking prevalence are country-specific. A cross-sectional study conducted by White et al. (2003) between 1980 and 2001 found that the smoking prevalence decreased from 35% to 23% among Australian adults over the age of 18 years. Similarly, there was a steady decrease in current tobacco smoking from 41.5% to 25.8% between 1991 and 2003 among Samoan adults (Linhart et al., 2017). In contrast, the overall prevalence of smoking in Russia has increased from 61% in 1996 to 63% in 2004 among adults aged 18 years and above (Bobak et al., 2006), while a study by Perlman et al. (2007) showed that the age–adjusted prevalence of current smoking among Russians aged more than 18 years old increased gradually from 28.2% in 1992 to 34.9% in 2003. Likewise, in Ukraine, there was rising trend in the smoking prevalence from 34% in 2001 to 40% in 2005 (Andreeva & Krasovsky, 2007).

2.4.2 Prevalence of smoking in Southeast Asia

There are variations in trends of tobacco use among Southeast Asian countries. A survey from the Southeast Asia Tobacco Control Alliance found that the smoking prevalence among Thai students aged between 12 and 19 years was 6.8% in 2003 and the rate among those aged between 15 and 19 years doubled from 6.35% in 1999 to 15.6% in 2003. This survey also reported that 43.2% of Vietnamese male students in Hanoi and Phu Ly started to experiment with smoking (Efroymson & Jones, 2007). A study conducted by Sreeramareddy et al. (2014) using data from the Demographic and Health Surveys (DHS) reported that the highest prevalence of tobacco use among men aged over 15 years was found in Indonesia, followed by Timor-Leste and Cambodia whilst among women was found in Philippines, followed by Timor-Leste, Cambodia and Indonesia.

A recent study indicated that around 122.4 million adult smokers were living in the ten ASEAN (Association of Southeast Asian Nations) countries, more than half (approximately 65 million) of them residing in Indonesia. In contrast, the lowest smoking rates for this region were found in Singapore at around 13.3%. For men, the highest smoking rate was seen in Indonesia (66%) whereas Singapore's smoking rate has the lowest in this region (21.1%). For women, the highest smoking rate was seen in Myanmar (8.4%) while the lowest rate was seen in Vietnam (1.1%). The overall average age at smoking debut was 20 years (Tan & Dorotheo, 2018). In addition, a study conducted among school students in Timor-Leste reported a prevalence of current smoking of 51% (Sarmento & Yehadji, 2016). The overall prevalence of smoking in Vietnam was 22.5%, with the prevalence among men higher than women (Minh et al., 2017). In the same year Peltzer and Pengpid (2017) compared the prevalence of tobacco use among school-going adolescents in Cambodia and Vietnam and found that the prevalence was higher in Vietnam than Cambodia.

2.4.3 Smoking prevalence and patterns in Thailand

In Thailand, data from Southeast Asia Tobacco Control Alliance (SEATCA) revealed that approximately 19.1% of Thai adults aged 15 years and above were currently smoking, males smoked 22 times more than females (37.7% against 1.7%). This survey also found that the average age of start smoking was 18 years of age (Tan & Dorotheo, 2018) and the highest prevalence of smoking was in the Southern region (WHO SEARO, 2012). Sangthong et al. (2011, 2012) showed that the overall smoking prevalence among youths greatly declined from 1986 to 2004, with a steady decrease after 2004. Nevertheless, smoking prevalence remained unchanged from 2009 to 2011 (Mbulo et al., 2017).

Few articles have focused on the smoking rate among students in Thailand. Chotbenjamaporn et al. (2017) found that 15% of Thai school students aged 13 – 15 years were current tobacco users and 11.3% were current cigarette smokers. Another study reported that 15% out of 706 adolescents aged 13 – 19 years were smokers (Sirirassamee et al., 2009). In addition, more than half (52.2%) of university student started smoking after 18 years old or after they had entered university (Phanucharas & Chalongsuk, 2009). Similarly, a study conducted with Sukhothai Thammathirat Open University students showed that 10.4% were current smokers and most of students started smoking when they were in senior high school (Pachanee et al., 2011).

Most Thai secondary school students who were smokers reported that they smoked more than one cigarette per day. More than half bought cigarettes from small groceries, stalls, flea markets, or convenience stores. Some of them purchased cigarettes as individual sticks or a divided packet because they were underage (Chotbenjamaporn et al., 2017). Regarding tobacco use behaviors among Thai adults, The Southeast Asia Tobacco Control Alliance (SEATCA) (Tan & Dorotheo, 2018) survey provide

comprehensive research results to date. These results showed that the average number of cigarettes consumed per day among Thai adult smokers was 10 sticks. While university student smokers smoked 1–10 cigarettes a day (Phanucharas & Chalongsuk, 2009), males smoked more cigarettes than females. Most males smoked 10 cigarettes per day while females smoked 1–4 cigarettes per day (Pachanee et al., 2011). Furthermore, adult men and women preferred different types of cigarettes. Men are more likely to smoke manufactured cigarettes in contrast to women who tend to smoke hand-rolled cigarettes. In addition, adult smokers with a university level education preferred to smoke manufactured cigarettes while those with lower than primary education preferred to smoke hand-rolled cigarettes. Smokers who live in rural areas tend to use hand-rolled cigarettes more often whilst those who reside in urban areas tend to use manufactured cigarettes more often (WHO, 2011a).

Although several countries have developed tobacco control policy to reduce tobacco consumption, the overall trends in prevalence of current smoking still remain constant and some countries have shown a slight increase. This may be because "they are concerned that the harm caused by tobacco may be offset by the economic benefits that the country derives from growing, processing, manufacturing, exporting and taxing tobacco" (World Bank, 2003, p.3). Furthermore, most adult smokers started smoking regularly at the age of 18 years, meaning that they initiated smoking after entering university. There are also many factors that influence smoking initiation and continuation such as socio-demographic and socio-economic characteristics, and knowledge, attitudes and practices toward smoking.

2.5 Smoking status

In this study, the outcome is smoking status which was classified into two categories: smoker and non-smoker. Current and former smokers were grouped as Smokers. Current smokers were defined as individuals who reported smoking either regularly or occasionally. A study conducted among adults aged 15 years or above in Malaysia reported that the majority of current smokers were males, age 25-44 years, those with secondary education level, working in the private sector, and living in urban area (Lim, et al., 2018). In Thailand, the studies conducted among undergraduate students reported that the majority of current smokers were males, being around smokers (Kochsiripong & Pitirattanaworranat, 2021), moderate or high level of relationships with friends, and consuming alcohol (Khongsuwan et al., 2020). Most of the e-cigarette users believed that using e-cigarette is more stylish than conventional cigarette and e-cigarettes help people to stop smoking (Kochsiripong & Pitirattanaworranat, 2021). The main reason for smoking among current smoker was for relaxation while the preference for e-cigarette and water-pipe smoking is due to its smell and taste (Setchoduk, 2018). Former smokers were those individuals who reported ever smoked in their lifetime but were not currently smoking A study conducted among adults aged 15 years or older in Lao reported that former smokers were more likely to visit a healthcare provider in the past year, believed that smoking causes illnesses, and banning smoking at home compared to current smokers (Bui et al., 2020). A study conducted among Thai students in Northern University reported that 43.6% were former smokers. The factors associated with smoking cessation were gender, age, place of residence, personal disease, knowledge and attitude towards quitting smoking, perception of smoking cessation and university smoking control policy (Chaitiang & Vongruang, 2021). Never smokers were defined as individuals who reported never tried

smoked. A study conducted among Thai university students reported the reason for not smoking was health concern and the bad smell of tobacco (Setchoduk, 2018).

2.6 Factors associated with smoking

2.6.1 Gender

Several articles have explored the relationship between smoking and gender. As mentioned previously, the smoking prevalence among men is much higher than among women. According to WHO (2017b), the average overall smoking rates for both males and females are decreasing slowly by 4% (39% to 35%) in males and by 2% (8% to 6%) in females. One study among students aged 13 – 15 years in, Ethiopia identified that the overall prevalence of smoking was four times higher among men than women (Rudatsikira et al., 2007). Likewise, the current smoking prevalence for Taiwanese male adults was 45.7% whereas it was only 4.8% for females. This survey also found that men smoked significantly more cigarettes per day than women (Tsai et al., 2008). Similarly, findings from King Saud University students revealed men have higher rate of currently smoking (32.7%) than women (5.9%) (Mandil et al., 2010). A study among Thai university students also found that the e-cigarette users were more likely to be male (Kochsiripong & Pitirattanaworranat, 2021). However, a study among young Canadian adults found that the smoking prevalence among females were slightly higher, 28.8%, as compared to males, 27.8% (Hammond, 2005).

A significant number of studies indicated that men and women differ in their smoking behaviors. Males began smoking at a younger age than females (Al-Badri et al., 2017; Tsai et al., 2008). The number of cigarettes smoked daily was higher in men but both sexes smoked less than five cigarettes per day (Lim et al., 2006; Lim et al., 2010). Males preferred to smoke in the cafeteria while females more often smoked in

the bathroom (Haddad & Malak, 2002). Regarding the brand of cigarettes, females tend to smoke imported cigarettes while males preferred to smoke local cigarettes (Sharif et al., 2013). Considering the consumption pattern of tobacco use in both sexes, males smoked cigarettes more than water pipes whereas females smoked almost equally in both types of tobacco products. This study also reported male students who were not related to health education, having family history of smoking and having smoker friends were more likely to smoke. Mandil et al. (2010) reported female students who were widowed or divorced, having family member who smokes and having smoker friends were more likely to smoke.

Smoking prevalence based on sex and level of education indicated males with lack of education had the highest smoking rate. On the contrary, females with university training had the highest prevalence of smoking (Nejjari et al., 2009). In terms of the association between knowledge of tobacco use and current smoking across both sexes, there was significant correlation between knowledge and gender, with females having higher knowledge toward smoking than males (Mbulo et al., 2017). Surprisingly, there was a gender difference in smoking cessation, male smokers wanted to quit smoking more than female smokers (Sharif et al., 2013).

2.6.2 Age

Age also plays an important role in increasing smoking prevalence. Many studies have examined how age contributes to smoking initiation in various countries, particularly developing nations. Kelishadi et al. (2007) found that the average age of starting cigarette and water pipe smoking among Iranians was 14.5 and 11.2 years, respectively. Similarly, students in Thailand, Vietnam and Malaysia began smoking at the age of 14, 16 and 13, respectively (Efroymson & Jones, 2007). In addition, the age of smoking initiation among adolescent smokers in West Africa was 17 years or less

(Veeranki et al., 2017). Moreover, two studies conducted in Palestine and Turkey found that most university student smokers started smoking before the age of 18 years, with an average age for smoking onset of 17 years (Babaoğlu et al., 2017; Shomar et al., 2014). Over 80% of adult women smokers in five European countries had started smoking by the age of 20 with an overall average age at smoking initiation of 18.2 (Oh et al., 2010).

The rates of regular tobacco smoking are higher in older individuals. A survey showed differing smoking rates between developed and developing countries. For developing countries, the highest smoking prevalence was seen in males aged 45–49 years and females aged 40–54 years. In developed countries, the highest smoking rate in males occurred between the ages of 30–34 years and in women between 20–49 years (Ng et al., 2014). Several studies conducted in secondary school revealed that the prevalence of smoking was higher among students aged 16 years and above than those aged 13 years or less (Barreto et al., 2011; Peltzer & Pengpid, 2017; Rahman et al., 2011). Considering the smoking rates among adults, younger adults were more likely to smoke, however a survey conducted in rural areas of south west China suggested that older women were significantly more likely to smoke than younger women (Cai et al., 2013). Thus, the effect of age on smoking appears to be country-specific.

2.6.3 Marital status

The literature also indicates a strong association between smoking and marital status. A survey conducted in 15 countries which included nine North African, Central and West Asian countries and six Latin American and Caribbean countries reported that single males were more likely to be smoker in almost every country while single females were more likely to be smoker in some countries (Sreeramareddy & Pradhan, 2015). Similarly, in a study among healthcare professionals at the largest hospital in Cyprus, both physicians and nurses who were single, divorced or widowed were the

most likely groups to become smokers (Zinonos et al., 2016). Likewise, among male university students in Pakistan, the prevalence of cigarette smoking was double among unmarried students compared with married students (Jamshed et al., 2017). Nevertheless, Abu-Helalah et al. (2015) found that adult Jordanians who were divorced were more likely to be daily smokers or heavy hookah smokers than those who were single, married or widowed.

2.6.4 Education Levels

Education is one of the most crucial protective factors against tobacco smoking. Previous studies conducted on health research suggested that there is a negatively relationship between education and smoking prevalence. This means that each year of additional schooling will reduce the smoking rate (Cutler & Lleras-Muney, 2010). A survey of health behaviors among Estonian adults showed that education attainment plays an important role for daily smoking. Between 1990 and 2010, there were significant decreases in the prevalence of current daily smoking among higher educated smokers. However, the prevalence was double among women with basic education during this period (Parna et al., 2014). In a longitudinal cohort study among young adults in the U.S., the prevalence of cigarette smoking was significantly higher among adults with a high school education or less. Those with a graduate or professional degree and bachelor's degree were less likely to smoke cigarettes compared to those with a college education. In contrast, those with less than a high school education were 2 times more likely to smoke cigarettes compared to those with some college education (Rath et al., 2012). In a cross sectional survey conducted in nine South and Southeast Asian countries, tobacco use among both men and women were strongly associated with less education (Sreeramareddy et al., 2014). Similarly, university students who had less

education had higher prevalence of cigarette smoking compared to more highly educated students (Jamshed et al., 2017).

On the other hand, a survey performed by the National Center for Health Statistics and The Substance Abuse and Mental Health Services Administration among US adult smokers revealed those with a bachelor's degree were significantly more likely to smoke <100 cigarettes during their lifetime compared to those with less than a high school education. Those with college education had almost a two-fold odds of having a lifetime smoking level of <100 cigarettes than those with less than a high school education (Ryan et al., 2012).

Few studies have focused on type of education and its relationship with smoking. A study conducted by Morrell et al. (2008) found that healthcare students were less likely to be smokers than their counterparts. Two studies showed that students enrolled in the Faculty of Arts and Humanities were more likely to be cigarette smokers compared to those studying in the Faculties of Sciences and Health Sciences (Musmar, 2012; Tucktuck et al., 2018). Moreover, there was a significant correlation between student who were studying in non-science and smoking of at least 1 complete cigarette. This study also showed that male students who were studying in the Faculties of Arts and Commerce were 3.03 and 2.5 times more likely to be lifetime smokers compared to those were studying in biological science, respectively (Katulanda et al., 2015).

2.6.5 Race/Ethnicity

Race and ethnicity have varying impact on the prevalence of tobacco use. In a study among adults who were current cigarette smokers in San Francisco, there was a significant difference in cigarette smoking behavior between ethnicity groups. More than 50% of Latinos reported that they smoked 1–9 cigarettes per day compared with

only 12% of non-Latino Whites (Perez-Stable et al., 1998). Latinos were less likely to smoke cigarettes when they talked on the telephone, drank alcoholic beverages, finished eating, felt bored, or were at a bar compared to non-Latino Whites. In contrast, Latinos were 1.72 times significantly more likely to smoke cigarettes when they were at a party compared with non-Latino Whites. A longitudinal cohort study conducted among young adults in the US showed that Hispanics were significantly less likely to smoke cigarettes compared to non-Hispanic Whites (Rath et al., 2012). In addition, a comparison of estimates between the 2008 National Center for Health Statistics (NCHS) and a Substance Abuse and Mental Health Services Administration (SAMHSA) study reported that racial and ethnic minorities were most influenced by the lifetime cigarette smoking among US adults who currently smoke. Compared to non-Hispanic Whites, Hispanic or Latino smokers were 4.8 times more likely to smoke <100 cigarettes during their lifetime, followed by American Indians/Alaskan natives (3.6 times), non-Hispanic blacks (2.4 times), and Asians (2.2 times) (Ryan et al., 2012).

A previous study by Lim et al. (2017) found that there was a significant association between smoking status and ethnic group among secondary school students in Malaysia. Malays were more likely to smoke than Chinese and Indians. Similarly, a study conducted among elderly in Malaysia found that Malays and other Bumiputras were around 2.5 times and Indians 1.04 times more likely to become smokers compared to Chinese (Lim et al., 2016).

2.6.6 Occupation

Type of job, work stress and competition also show an impact on smoking behavior. A Demographic and Health Survey conducted in 15 countries found that unskilled male workers were more likely to smoke than those who were unemployed. However, women who were both manual workers and professionals were more likely to

smoke compared to those who were unemployed (Sreeramareddy & Pradhan, 2015). This is similar to a finding from a study in Shanghai conducted among rural-to-urban migrant workers. Female migrants who were working at construction sites, hotels or restaurants and entertainment venues were more likely to be smokers than those working at factories. Male migrants who were employed as service workers in hotels or restaurants were more likely to be smokers compared to those who work in a factory (Liu et al., 2015). In addition, Iraqi woman who were self-employed were more likely to be smokers compared to those in other careers (Al-Badri et al., 2017).

2.6.7 Place of residence

One of the factors determining smoking behavior is the place of residence. According to Global Adult Tobacco Survey conducted in Vietnam, the prevalence of cigarette use significant decreased in urban areas, by14% from 2010 to 2015 (Minh et al., 2017). This result is similar to a study in Palestine where students living in rural areas were almost 2 times more likely to be current cigarette smokers compared to those living in urban areas or camps (Tucktuck et al., 2018). In contrast, the results of a survey by Demaio et al. (2014) reported that urban Mongolian smokers were 2.2 times more likely to be tobacco smokers than those were from a rural area. In addition, university students who were living far from their family were more likely to start smoking, particularly if they lived with a friend (Babaoğlu et al., 2017) Similarly, a study among Burapha University students, Thailand reported that students who stayed alone were more likely to smoke cigarette compared to those who stayed with their parents Krungkraipetch & Krungkraipetch, 2017).

2.6.8 Economic status

Smoking rate also revealed an association with financial status, although results are conflicting. A longitudinal study conducted with young adults in US found those who reported that their incomes did not meet their basic expenses were 2.79 times more likely to smoke cigarettes (Rath et al., 2012). A study conducted among Thai students reported the rate of smoking declined steadily among students with higher income levels (Pachanee et al., 2011). Similarly, Chinese students with the lowest living expenses were more likely to smoke than those with higher living expenses (Xu et al., 2015). However, in an analysis of migrant workers in China, female workers with low income were less likely to be smokers (Liu et al., 2015). Likewise, Palestinian university students with a very good financial standing were about 1.7 times more likely to be current smokers compared to those with a poor financial standing (Tucktuck et al., 2018).

2.6.9 Family influence

Many previous studies have examined the relationship between parental smoking and smoking behaviour. A survey conducted in the US reported that children whose parents had never smoked were least likely to smoke (odds reduced by 71%) compared to parents who were current smokers and children who had parents that ceased smoking had a reduced odds of smoking themselves (Bricker et al., 2002). A cross-sectional survey in New Zealand found that parent's behavior is a key factor of smoking among adolescents. Students with smoking parents were more likely to be daily smokers (31.4%) whereas students with neither parent smokers were least likely to be daily smokers (6.5%) and students who have an older sibling who smoked had a very strong effect on daily smoking (Scragg & Laugesen, 2007). A study conducted among nursing students found that the prevalence of smoking among those who had at least one smoker

parent was 71.2% and among those who had at least one smoker sibling was 50% (Biraghi & Tortorano, 2010).

In a qualitative study conducted among Chinese women in Hong Kong, current smokers and never-smokers had very different views of the values and perceived social norms of smoking. The current smokers mostly grew up in smoking families. Consequently, they tended to perceive smoking as a social norm and a way for communication with their friends. On the other hand, most people who never smoked at all grew up with their parents or guardians not smoking. Because their families considered that Chinese society do not accept woman smokers and it is a violation of Chinese culture and tradition. Therefore, they thought women smoking as carrying a stigma and that women smoking was something bad and evil (Li et al., 2015). Moreover, two studies performed in Taiwan and Iran showed that there was a strong association between father smoking and current smoker. Having a sibling who smoked was the strongest predictor of student's cigarette smoking status (Huang et al., 2014; Karimi et al., 2017). Nevertheless, a study conducted among European adolescents also revealed family problem issues like parental smoking, family member drunkenness, and living in broken homes were significantly associated with adolescent smoking behavior (Banzer et al., 2017). Thus, family members have a strong influence on their children regarding acceptability of smoking and smoking initiation.

Previous studies have shown a relationship between smoking and parental education achievement and the relationship between smoking and parental occupation. A survey of cigarette smoking by government and private college students in Karachi found that students with fathers who had no formal schooling were more likely to smoke while students whose mothers were not working were also more likely to smoke (Rozi et al., 2007). A study in Brazil reported that the prevalence of current smoking among Brazilian adolescents was associated with education level of the mother (Barreto

et al., 2011). A similar study conducted in Baghdad, Iraq found that students with an illiterate parent had a higher risk of tobacco smoking (Hussain & Satar, 2013). Likewise, Fida and Abdelmoneim (2013) found that male students whose both parents had attained a high school degree or less were more likely to be smokers compared to those whose both parents had attained a university degree. In contrast, Tucktuck et al., (2018) reported students whose mother had a high school education or above were more likely to be regular cigarette smokers compared to those whose mother had less than a high school education. It appears that students who belong to families with less education were more likely to be smoker.

2.6.10 Peer influence

Children who have a friend who smokes appears to be the most important factor influencing smoking prevalence. Several authors considered peers as a stronger predictor than family member. Two studies conducted in 2013 found that students who had friends who smoked were significantly more likely to be smokers (Fida & Abdelmoneim, 2013). Particularly, students whose friends were all current smokers were 8.18 times more likely to be smokers themselves (Hussain & Satar, 2013). A cross-sectional survey conducted in nine high schools in Taiwan revealed that having friend smokers were significantly related to both ever and current smoking (Huang et al., 2014). Many surveys from different regions of the world found similar results. The main factor associated with cigarette smoking among adolescents was having smoking friends (Ngahane et al., 2015; Urrutia-Pereira et al., 2017). Students who had less than half of their friends who smoked were less likely to be smokers (Liozidou et al., 2015). The main influencing source of Thai university students' perceptions about e-cigarettes was friends (Kochsiripong & Pitirattanaworranat, 2021).

A qualitative study conducted among Hong Kong Chinese women who were current and ever smokers revealed that they began smoking because of their friends, especially their best friend. This study also indicated that enhanced friendship, socialization and peer influence were the main reasons for continued smoking. They mentioned that the societal pressure had made a great impact on their weight control strategy. They feared that if they stopped smoking, they would gain weight, thus, they decided to continue smoking (Li et al., 2015).

It was associated between age at start smoking and friend smoking, student age between 14 and 15 years and having friends smoking were 4.55 times more likely to started smoking (Veeranki et al., 2017). It can be concluded that both family members smoking and having peer smokers were significant risk factors for starting to smoke, and increasing smoking prevalence.

2.6.11 Religion

Religion is an important predictor of health behavior and substance use. It plays an effective role in creating self-awareness and helping smokers to initiate smoking cessation. Several previous studies examined the relationship between the role of religion and perception on smoking and the relationship between religion and smoking cessation. In a study comparing the perception of the role of religion, intention to quit and subsequent quitting between Malaysian Muslims and Thai Buddhist adults, Malaysian Muslims who believed that smoking should not be allowed inside their mosque were 6.7 times more likely than Thai Buddhists who believed that smoking should not be allowed in their temple. Malaysian Muslims who were very religious were more likely to report that the fasting month motivated them to quit smoking. This study also showed that among Malaysians with common beliefs such as religiosity, religion discourages smoking, leader said to quit and leader would motivate quitting

were positively associated with both attempts to quit smoking and successful quitting. On the other hand, among Thai Buddhists with only belief that religious leader would motivate them to quit smoking was associated with successful quitting (Yong et al., 2009).

In addition, a preliminary study conducted in Western China revealed that non-Muslims were more likely to be current smokers than Muslims. Males, particularly Muslim males, who participated in religious activities at least twice a week were less likely to be current smokers. Furthermore, there was an inverse relationship between current smoking and all of religious involvement which consist of religious activities attendance, importance of religion or spiritual beliefs, and high religiosity (Wang et al., 2015). In another study among university students in Malaysia, 94.9% of non-smokers believed that Islam prohibits smoking because of its potential human health hazards. A significant proportion of non-smokers believed that smoking was an immoral activity and harmful to health. Islam effects anyone's decision to smoke and people who indulge in religious practices were less likely to smoke (Elkalmi et al., 2016).

2.7 Research on Knowledge, Attitude, and Practice (KAP) toward smoking

KAP studies are important because they measure the knowledge, attitude and practices of the basis of a community. Most previous studies examined only on one or two variables from the three KAP domains and their relationship with smoking.

2.7.1 Knowledge and awareness about smoking

Knowledge regarding tobacco smoking has been evaluated in several previous studies. A study by Musmar (2012) showed that most Palestinian university students had above-average knowledge about the negative effects of smoking on health. Shomar et al. (2014) found that more than 80% of students realized that smoking cigarettes and

water pipes and inhaling smoke from someone else's cigarette is harmful to their health. Xu et al. (2015) found that there was a significant difference between Chinese students who were smoking and those who were not smoking regarding to the perception that smoking is harmful, smoking is harmful to children and infants and smoking could cause lung cancer. Furthermore, a cross-sectional study was done to assess smoking patterns among students from three universities in Jordan. It was found that more than 86% of all students were well aware that smoking causes serious diseases and passive smoking has a negative impact on others around the smokers. Students who smoked were less likely to know those issues than non-smoking students, and most of them knew that smoking is difficult to quit (Sharif et al., 2013). A study performed in five regional governorates in Jordan reported that 73.4% of all subjects strongly agreed that smoking hookah was hazardous to health, and 88.8% said that cigarettes were harmful to health (Abu-Helalah et al., 2015). Most of Saudi Arabia's university students knew that the leading cause of diseases, such as lung cancer is tobacco use whereas only half of them did not know that smoking increases the risk of cerebral stroke (Alrehaili et al., 2015). In China, approximately 95% of all male secondary school students knew that smoking was harmful to health; however, less than 20% knew the specific knowledge of smoking-related diseases whether it is heart disease, peptic ulcer, and cerebral stroke (Xu et al., 2016). Likewise, knowledge among Saudi university male students about the negative health effects of tobacco smoking was low (Awan et al., 2016).

In terms of prevention of smoking, 76.4% Palestinian students had tried to recommend or help smokers to quit smoking. Around 94.3% of all students did not know that there were smoking cessation centers in their country (Shomar et al., 2014). This study also showed that more than 70% of Palestinians did not know the law about banned the scenes in media that demonstrate smoking and prohibited selling cigarettes to children under age 18 years old, as well as the law that restricts of smoking in public

areas. Similarly, a study conducted among Thai university students revealed that 30.5% did not know about Thai law banned tobacco advertisements and 13.8% did not know smoking is prohibited in the educational institutions (Wiriya et al., 2019).

2.7.2 Attitude toward smoking

There were many studies have been conducted to assess beliefs and attitudes of people in general toward smoking. A study performed in Jordan University of Science and Technology revealed that students who were non-smokers were more aware of the negative impact and harmful effects of smoking than those who were smokers. They also had more positive attitudes against smoking. In contrast, male smokers were more likely to agree with negative statements against smoking such as smoking is not as harmful as taking drugs or alcohol, and smoking low tar cigarettes reduces the risk of developing serious diseases (Haddad & Malak, 2002). Similarly, Iranian students who did not smoke had higher negative attitudes toward smoking than those who had experience of tobacco smoking (Chaman et al., 2015). In Palestine, university students who were current smokers tended to be more tolerant of smoking and its use for recreational purposes, 34.4% would be allowed smoking inside their home while 28.7% would allow their children to smoke in the future. They were also less active about banning smoking in public areas (Musmar, 2012). Many Jordanian students who smoke were more likely to believe that smoking helps them fit in with their friends, having a strong personality, being more attractive, helps to increase concentration while studying, as well as helps to avoid gaining weight (Sharif et al., 2013). Likewise, Abu-Helalah et al. (2015) also found that more than 75% of Jordanian smokers agreed that smoking is done for leisure, lowers tension and lowers anger levels. A study conducted by Xu et al., (2015) showed that Chinese students who were current smokers were more likely to believe that smoking is pleasurable, and it is a type of self-presentation,

smoking helps them to relax, lose weight, improve their athletic performance and study better, as well as smoking makes them look tougher, and feel more mature and confident. Likewise, the reasons for continuing to smoke among Hong Kong Chinese women were that it helps them to increase concentration and smoking would not further affect their health (Li et al., 2015). A study by Wiriya et al. (2019) showed that 71.4% of Thai students strongly agreed that smoking makes people look more attractive, 64.80% strongly agreed that smoking makes people look more stylish, and 64.20% strongly agreed that smoking during exam times helps to increase concentration in studies.

However, when looking at a suggestion to advocate a university law that would ban smoking, nearly 70% of all Jordanian students agreed with this issue but only one third of the smokers indicated that they would support such a law (Sharif et al., 2013). Furthermore, in Turkey, most of university students said that indoor smoking should be banned, movies and television with smoking scenes need to be censored, the tobacco price should be increased, as well as a ban on selling tobacco products to anyone under the age of 18 years (Babaoğlu et al., 2017).

2.7.3 Attitude about smoking cessation

Attitudes about smoking cessation have been assessed in many previous studies. In Palestine, 80.6% of student smokers intended to quit smoking, of which 53.3% were ready to quit if assistance was offered (Shomar et al., 2014). In Jordan, 50% of daily smokers said their career helped them to reduce the frequency of cigarettes or hookah smoking and made them think of quitting. Around 73.8% stated that if they were a health care professional, they would stop smoking (Abu-Helalah et al., 2015). Approximately 71% of Saudi Arabia's university students indicated that smoking should be banned in public places and around 75% of smokers wanted to stop smoking

(Alrehaili et al., 2015). A survey by Algorinees et al. (2016) revealed that almost 80% of students who were current smokers were thinking to quit, especially if appropriately supported. However, a previous study revealed that the reasons why some smokers did not want to quit were social attitudes, addiction, and they did not know how to stop (Haddad & Malak, 2002).

2.7.4 Practice toward smoking

A study of tobacco use among Iranian students reported that there was significant difference between the mean of practice toward smoking scores and place of residence, and students who were living alone had the highest mean score (Askarian et al., 2013). A study conducted among students and workers in university reported that 48.7% and 39.1% had good and moderate practice scores toward smoking, respectively (Izzati et al., 2016). Al-Shami et al. (2018) reported that males had a higher percentage of good practice toward smoking compared to females, and the highest percentage of students with poor practice toward smoking was observed among fourth year students. A study in Tehran revealed that 91.2% of smokers reported their best friend offered them a cigarette, 50.5% advised nonsmokers not to start smoking, 41.7% talked with others about smoking hazards and 34.0% advised smokers to reduce the number of cigarettes they smoked (Aryanpur et al., 2014). A study performed among Thai university students revealed that only 17.60% of students often advise smokers to quit smoking (Wiriya et al., 2019).

2.7.5 Intention to quit smoking / reasons for quitting

A cross-sectional survey conducted among adults who were current cigarette smokers in San Francisco to assess their reasons for quitting smoking found that criticism by family, family pressure, damaging children's health, setting a good role

model for their children, ruined clothes, and having bad breath were important reasons for them to stop smoking (Perez-Stable et al., 1998). A study conducted with former daily smokers in Jordan reported that health issues, awareness of smoking risks, having a family history with ischemic heart disease or cancer were common reasons for quitting (Abu-Helalah et al., 2015). Similarly, among college students in Douala, Cameroon, indicated that the main reasons of the desire to quit smoking were to stay healthy, self-discipline and to save money (Ngahane et al., 2015). A qualitative study conducted by Li et al. (2015) reported the several reasons to stop smoking among Chinese women in Hong Kong were awareness of the health hazards to others, especially their babies during pregnancy and lactation and health concerns, in particular when their relative or friends were diagnosed with an illness. Other mentioned the Chinese society which does not accept female smokers, as well as raising cigarette prices through increased taxes having an effect on smokers with lower incomes. Another study revealed that the most common reasons among university students for not initiating smoking were health concerns, hatred of the habit, religion, saving money, and social acceptability (Haddad & Malak, 2002).

2.7.6 Anti-tobacco campaign and legislation to smoking

Li et al. (2015) reported that if the Hong Kong government increased the tax or tobacco price, it could decrease the prevalence of tobacco consumption. Most non-smokers reported that a ban on smoking in public places such as restaurants and indoor areas was effective. However, smoking cessation advertisements were not enough, and the publicity of smoking cessation was not as strong as that on the drug abuse prevention. They also suggested that law enforcement was insufficient.

2.7.7 Factors associated with Knowledge, Attitude, and Practice (KAP) toward smoking

Previous studies have demonstrated the factors associated with knowledge, attitude, and practice toward smoking. With regards to the factors associated with knowledge toward smoking. Haddad et al. (2020) and Mohmad et al. (2022) found that being a female and high monthly income were significantly associated with higher smoking knowledge score. Al-Shami et al. (2018) found that fourth year students showed the highest proportion with good smoking knowledge compared to students from other study years. Having high education level was significant associated with higher smoking-related knowledge score (Haddad et al. 2020).

Considering the factors associated with attitude toward smoking, Haddad et al., (2020) found that age (older), university educated and high knowledge score were significantly associated with higher attitudes score. In contrast, having a father who smokes was significantly associated with lower attitude score. Previous studies also showed gender as an important factor for smoking attitude; females have a more significantly negative attitude towards smoking scores compared to males (Amirah et al., 2021; Izzati et al., 2016: Mohmad et al., 2022). Higher income was significantly associated with higher smoking attitude scores (Boonma et al., 2019).

With regard to the factors associated with practice toward smoking, Amirah et al. (2021) and Mohmad et al. (2022) found that male students tended to have negative smoking practice score compared to female students. Another study found that being older, female, not having existing tobacco-related morbidity, and having poor attitude towards secondhand smoke were significantly associated with poor preventive practice (Mahdi et al., 2020).

2.7.8 The mediating role of attitude on the relationship between knowledge and practice

Several previous studies found evidence to support the role of attitude as mediator in the relationship between knowledge and practice in various research areas. Tolvanen et al. (2012) conducted the study among adolescents to confirm the inter-relationships between knowledge, attitudes and practice related to dental health and hygiene. The study found that knowledge related to toothbrushing and dental health influenced oral hygiene practice directly and via attitudes related to toothbrushing and dental health. A study conducted among secondary school students reported that the attitude towards sustainable development acts as a mediating variable between knowledge about sustainable development and behaviour towards sustainable development (Domínguez-Valerio et al., 2019). Two studies conducted on university students to determine the food safety knowledge, attitude and practices. It was found that the knowledge of food safety could be mediated by the attitude towards the importance of food safety when it comes to food safety practicing (Marklinder et al., 2022; Sayuti et al., 2020). A study aimed to investigate parents' knowledge, attitude, and practice regarding child sexual abuse prevention and found that parents' knowledge about child sexual abuse prevention had an indirect on their educational practice regarding child sexual abuse prevention through attitude toward child sexual abuse prevention education (Jin et al., 2019). Another study conducted among food handlers in restaurants, hospital, and hotels reported that food handlers' attitudes was a significant mediator of the relationship between food safety knowledge and the kitchen hygiene practices (Kwol et al., 2020).

2.8 Tobacco control policies in Thailand

Tobacco consumption control in Thailand began in 1970's after confirmation by the chief medical officer of the Ministry of Public Health, United States that smoking caused lung cancer and other chronic diseases. It began, in 1973, with prohibiting the selling of cigarettes to those who were under 16 years of age, followed a year later by the printing of a health warning message on all cigarette packets, and banning of smoking in cinemas and on public buses in Bangkok area in 1976 (Vateesatogkit, 2020).

In 2005, Thailand became a Party to the WHO Framework Convention on Tobacco Control. A brief history of the important chronology of tobacco control policies in Thailand between 1974 and 2021 is described in Table 2.1 (Ministry of Public Health, 2018, 2021; Termsirikulchai et al., 2008; The Thai Official Gazette, 2021; Tobacco Control Research and Knowledge Management Center, 2017).

Table 2.2: Tobacco control chronology, Thailand

Year	Situation / Action
1974	- Printing of a health warning information on cigarette packets.
1976	- Banning of smoking in cinemas and on public buses in the Bangkok area.
1980	- Big campaign for the World No-Tobacco Day.
1986	- Establishment of Action on Smoking and Health Thailand (a non-government organization).
1987	- Rural Medical Professional Association campaigned for the right of non-smokers.
1988	- Tobacco control policy was formulated by cabinet. - Banning tobacco advertising. - World Health Organization (WHO) initiated an event called the World No Tobacco Day. - Banning smoking on all domestic flights.
1989	- Establishment of the National Committee for the Control of Tobacco Use. - Banning smoking on all public transportation.

Table 2.2, continued

Year	Situation / Action
1990	- Establishment of the Tobacco Control Office at the Ministry of Public Health. - Thailand imported foreign cigarettes under the General Agreement on Tariffs and Trade (GATT).
1992	The passing of: 1. The Tobacco Product Control Act 1992 and The Non-smoker's Health Protection Act 1992. 2. Start enforcing the printing warnings on the cigarette packs by increasing the font size and adding 10 warning messages.
1993	- Successfully lobbying for the Thai Cabinet to regularly increase cigarette taxes (starting at 55 percent) according to inflation. - Ministry of Public Health asks for cooperation from the Excise Department not to issue a license to sell chewing tobacco or smokeless tobacco. - The smoking cessation hotline 1600 was established.
1994	- An increase in cigarette tax from 55 to 60 percent. - Against the tobacco industry which target marketing to women. - The "Thai women do not smoke" project was set up. - The smoke-free restaurants project was initiated. - Establishment of Thailand Health Promotion Institute.
1995	- An increase in cigarette tax from 60 to 62 percent. - The smoke-free temples project was initiated.
1996	- An increase in cigarette tax from 62 percent to 68 percent.
1997	- Adding the warning label "Smoking impairs sexual performance". - An increase of the health warning on cigarette packets from 25 percent to 50 percent of the front and back sides of the packets.
1998	- An increase in cigarette tax from 68 to 70 percent. - The law requires that either locally produced or imported cigarettes must print the warning messages in Thai.
1999	- An increase in cigarette tax from 70 to 71.5 percent. - Impact of ASEAN Free Trade Agreement on the price of imported cigarettes.
2000	- Banning of smoking scenes on television.
2001	- An increase in cigarette tax from 71.5 to 75 percent. - Passing of the Thai Health Promotion Act 2001 (using 2 percent dedicated cigarette and alcohol tax for health promotion, equivalent to US$4 million per year) and Thai Health Promotion Foundation was established.
2002	- Expanding of smoke-free zones (under Notification of the Ministry of Public Health No. 10). All air-conditioned restaurants are made 100 percent smoke-free.

Table 2.2, continued

Year	Situation / Action
2003	- Encourage schools to develop smoke-free policies.
2004	- Strengthening the ban of smoking by minor under the age of 18 years. - Pictorial health warning is required on cigarette packets.
2005	- An increase in cigarette tax from 75 to 79 percent. - Ban on displaying of cigarettes at point of sales. - Enforcement of pictorial health warning on cigarette packet started on 25 March 2005 with pictures not less than 50 percent of packet. - Establishment of Tobacco Control Research and Knowledge Management Center (TRC). - The Thai Health Professional Alliance against Tobacco (ThaiPAT) was established. - Thailand became a Party to the WHO Framework Convention on Tobacco Control.
2006	- Requiring written toxic ingredient warning on cigarette packets (under Notification of the Ministry of Public Health No. 10). - Changing and increasing pictorial health warning on cigarette packets from 6 to 9 pictures and the picture shall be printed in 4 colors (under Notification of the Ministry of Public Health No. 11). - Not contain the words that may mislead consumers to perceive that they are safe such as Mild, Medium, Light, Ultra Low Tar, etc. (under Notification of the Ministry of Public Health No. 12). - Expanding of smoke-free zones (under Notification of the Ministry of Public Health No. 17).
2007	- An increase in cigarette tax from 79 to 80 percent. - Requiring pictorial health warning for 5 pictures on cigarette packets and 2 pictures on own-rolled packages. - Expanding of smoke-free zone in air-conditioned restaurants, pub bars and market, (under Notification of the Ministry of Public Health No. 18). - The smoke-free hospitals project was initiated.
2008	- Modifying on template of pictorial health warning on cigarette packets - Arrange for the signs in the smoking or non-smoking areas in accordance with the criteria and procedures designated by the Minister
2009	- An increase in cigarette tax from 80 to 85 percent. - Notice of rules, procedures, and conditions for the display and content of cigarette labels.

Table 2.2, continued

Year	Situation / Action
2010	- Increasing pictorial health warning on cigarette packets from 9 to 10 pictures and increasing area size of pictorial label from 50 to 55 percent. - Designating the name 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 smoke-free areas. - Designating five public places as smoke-free areas consist of 1) Public health service and health promotion sites, 2) Educational facilities, 3) Multi-purpose public facilities, 4) Public vehicles and transport terminals, and 5) Religious facilities and ceremonial sites for religions and denominations.
2011	- Notice of rules, procedures, and conditions for the display of word or statements that might cause misunderstanding or encourage consumption on the labels of cigarette, cigars, loose tobacco, and flavored loose tobacco (under Ministry of Public Health Notice Volume 15, A.D. 2011). - Notice of rules, procedures, and conditions for the display of statements concerning toxins and carcinogens on cigarette labels (under Ministry of Public Health Notice under the Tobacco Products Control Act of 1992, No. 16, A.D. 2011).
2012	- Banning of all corporate social responsibility activities by tobacco companies. - An increase in cigarette tax from 85 to 87 percent (or 1 baht/gram). - An increase of loose tobacco tax form 0.01 Baht/ 10 grams to 0.01 baht/gram.
2013	- The National Alliance for Tobacco Free Thailand was launched. - Requiring four types of picture with warning statement and provide contact channels to quit tobacco on cigarette packages as specified by Ministry.
2014	- Increasing the pictorial health warning size from 55 to 85 percent (under Ministry of Public Health Notice, 2013). - Banned the imports of hookah, electronic hookah, or electronic cigarettes into Thailand (under Notification of the Ministry of Commerce, A.D. 2014).
2015	- Banned the sale and service of hookahs, electronic hookahs, and electronic cigarettes, smoking materials for hookahs, and liquids for filling electronic hookahs and electronic cigarettes. (under Consumer Protection Board Order, No. 9/2015). - Modifying on template of 10 types of pictorial health warning on cigarette packets (under Ministry of Public Health Notice No 18, A.D. 2015).

Table 2.2, continued

Year	Situation / Action
2016	- An increase in cigarette tax from 87 to 90 percent (or 1 baht/gram).
2017	- Bans selling any tobacco product to Thai adolescents under the age of 20 years and prohibits the hire of anyone under the age of 18 to sell or provide tobacco products (under The Tobacco Products Control Act of A.D. 2017).
2018	- Identification of types or names of public places, work places and vehicles, entirely (both indoor and outdoor areas) or in part, as non-smoking areas or smoking areas in non-smoking areas (under Notification of the Ministry of Public Health, A.D. 2018). - Requiring for the plain packaging of cigarettes and an updated set of health warnings (under Notification of the Ministry of Public Health, A.D. 2018).
2021	- Notification a new set of health warning and messages required to appear on packs and requirements for plain packaging (under Notification of the Ministry of Public Health A.D. 2021).
2021	- Notification a new excise tax structure for cigarettes, a cigarette pack with a retail price of up to 72 baht will be taxed at 25 percent, and a pack priced higher than 72 baht will be taxed at 42 percent (under The Thai Official Gazette September 30, published Ministerial Regulation No. 17, setting the excise tax rate for cigarettes).

2.9 Theoretical Framework

2.9.1 Health Belief Model

The health belief model (HBM) is one of the most widely used models in health behaviour research. It explains the change and maintenance of human health behaviours. The HBM was developed by a group of social psychologists in the US Public health service in the 1950s to understand people's failure in programs to prevent and detect disease (Hochbaum, 1958). There are several key constructs in the model as shown in Figure 2.1. Modifying factors include various demographic, socio-psychological, and structural variables which directly effects an individual's health perceptions and thus indirectly affects health-related behaviours. Health beliefs contain

the major constructs of the HBM: perceived threat (perceived susceptibility and perceived severity), perceived benefits, perceived barriers, and perceived self-efficacy. The combination of health beliefs and cues to action directly influences health-related behaviour.

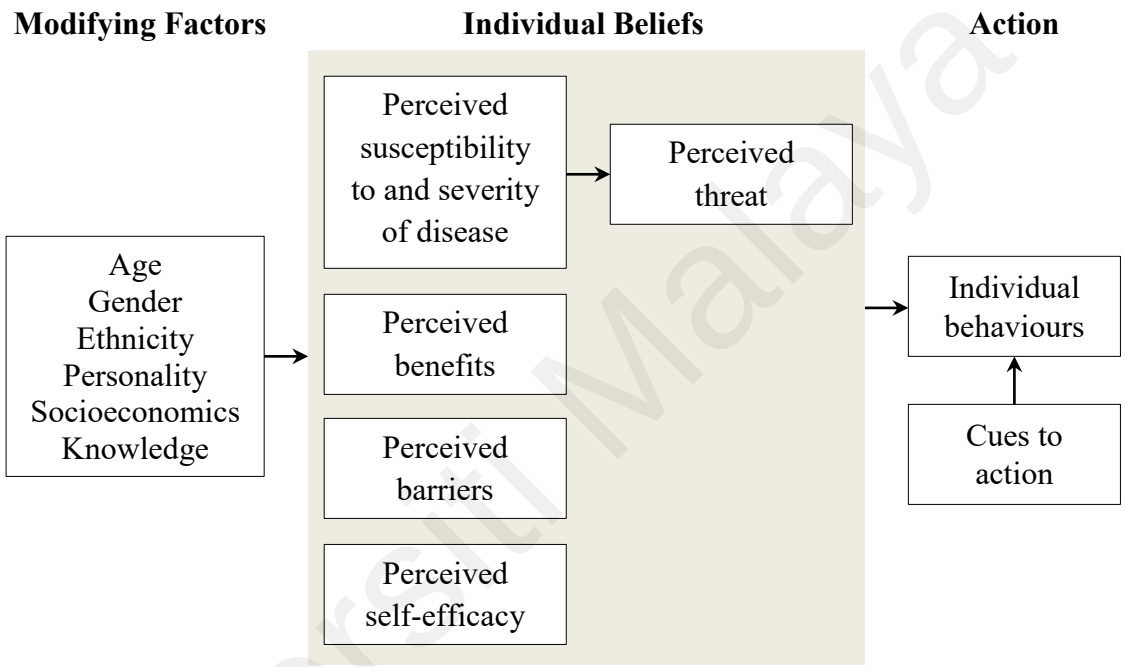

Figure 2.1: Health Belief Model Components and Linkages

Source: Glanz et al. (2008)

2.9.2 Social Cognitive Theory

The social cognitive theory (SCT) started as a social learning theory; it was developed by Albert Bandura in the 1960s (Bandura, 1977). SCT was based on the operation of established principles of learning within the human social context. SCT contributes to our understanding of how people learn from experience, observation, and symbolic communication (Bandura, 1986). Reciprocal determinism is the central concept of SCT which denotes that person, behavior, and their environment interact and

influence one another. The key concepts of SCT can be grouped into five categories: (1) psychological determinants of behaviour (outcome expectations, self-efficacy belief, and collective efficacy), (2) observational learning, (3) environmental determinants of behavior (incentive motivation and facilitation), self-regulation, and moral disengagement (Glanz et al., 2008).

2.9.3 Theory of Triadic Influence

The theory of triadic influence (TTI) is the major contemporary theory pertinent to understanding adolescent tobacco use. TTI posits that there are direct and interactive influences of sociological and psychological factors on behaviour onset and change (Petraitis et al., 1995). Figure 2.2 displays the TTI pathways between the three major types of distal influences and the three major types of proximal influences through several tiers of processes, mediating, and intervening variables. The most distal influences or ultimate cause, socio-cultural environment influences on knowledge and cultural beliefs. Social situation-context influences on social bonding and the behaviour and attitudes of others. Intrapersonal influences on sense of self and social competence. The proximal influences, expectancy and evaluation are derived from the ultimate and distal influences. Attitudes toward the behaviour are influenced by the expected outcome of the behaviour and the value placed on those outcomes. These are influenced by information/opportunity and cultural religion. Social normative beliefs are influenced by perceived norms and motivation to comply. These are influenced by attitudes and behaviors of others and social bonding. Self-efficacy is influenced by social skills and self-determination. These are influenced by social competence and sense of self. Finally, decisions of whether to act or not act in a certain way are influenced by attitudes toward the behaviour, social normative beliefs, and self-efficacy behaviour control (Flay, 1999).

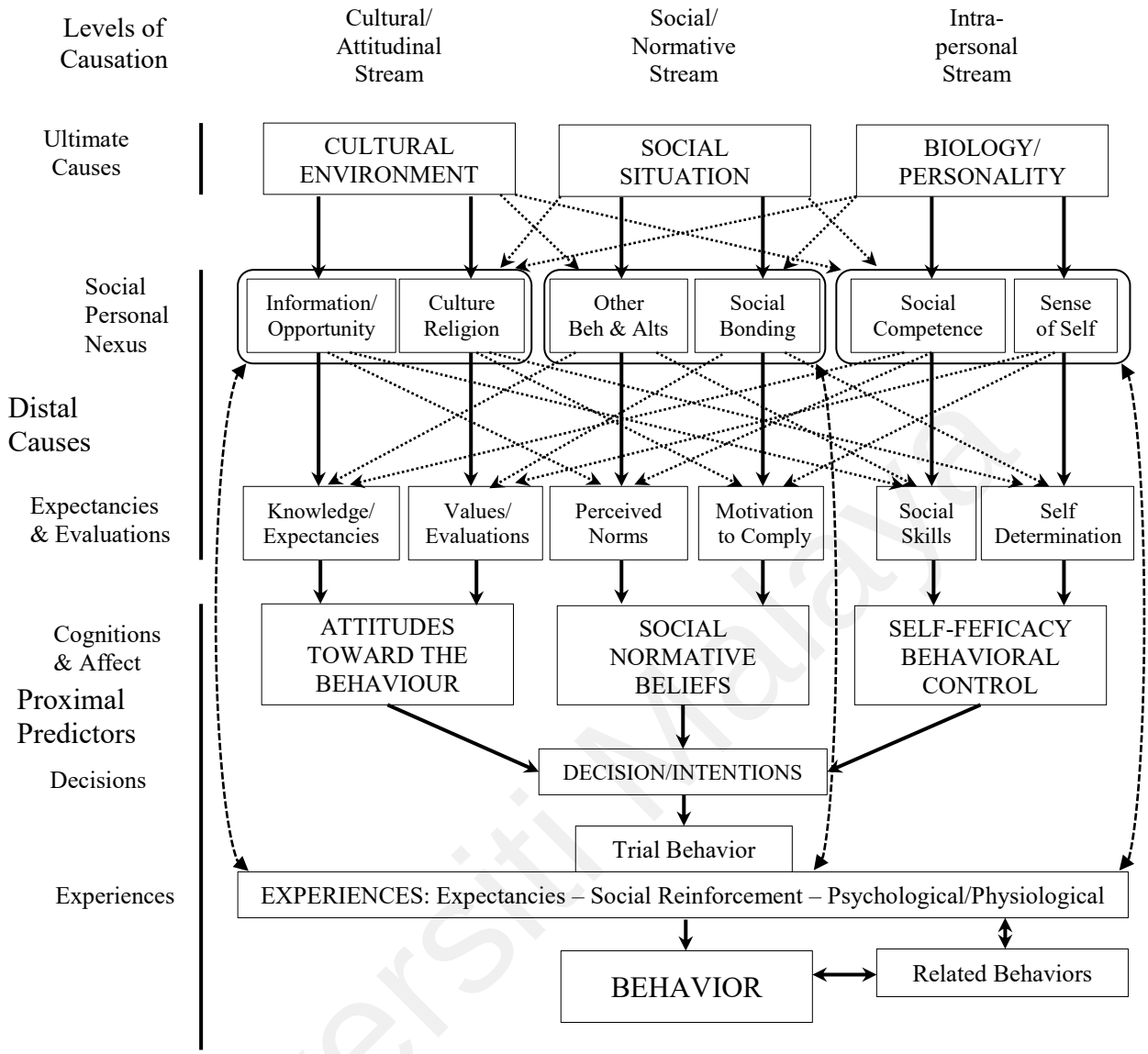

Figure 2.2: The Theory of Triadic Influence

Source: Flay (1999)

2.9.4 Knowledge, Attitude, and Practice model

The Knowledge, Attitude, and Practice (KAP) model (sometimes KAB model, referring to Knowledge, Attitude, and Behaviour) is one of the most widely used quantitative methods in studies covering various phenomena, especially health education and human behaviour when affected by a disease or health problem. The model was developed for family planning and population studies in the 1950s. This

model assumes that knowledge, attitude, and practice are inter-related. Typical questions of knowledge are used to measure what individuals know about the disease or health problem. Questions of attitude measure a person's feeling and beliefs about the disease or health problem. Information on practice is used to measure the preventive behaviours that individuals follow to avoid disease or health problems (Rav-Marathe et al., 2016).

The World Health Organization (WHO, 2008) indicates that a KAP survey is a representative study of a specific population to collect information on what is known (knowledge), believed (attitude) and done (practiced) in the context of the topic of interest. A KAP study can be used to identify knowledge gaps, attitudes, cultural beliefs, or behavioural patterns that may identify needs, problems, and barriers related to the development of effective and locally relevant public health interventions. It can identify information that is commonly known and attitudes that are commonly held, as well as factors that influence behaviour. A KAP survey can assess communication processes and sources important for program implementation and effectiveness. Kaliyaperumal (2004) argue that the aim of a KAP study is to explore changes in knowledge, attitude and practices of a community. It tells us what people know about certain things, how they feel and how they behave as you measure their knowledge, attitude, and practice. The definitions of a KAP model are discussed in the following section.

Badran (1995) defined knowledge as "the capacity to acquire, retain and use the information; a mixture of comprehension, experience, discernment and skill" (p. 9). Education is the prerequisite of knowledge, while Kaliyaperumal (2004) posited that knowledge possessed by a community refers to their understanding of any given topic. According to Moorman and Matulich (1993), health knowledge refers to "the extent to which consumers have enduring health related cognitive structures" (p. 210), while

Jayanti and Burns (1998) define health knowledge as "an individual's storehouse of information about preventive health care behaviors" (p. 9). Attitude means the "inclinations to react in a certain way to certain situations; to see and interpret events according to certain predispositions; or to organize options into a coherent and interrelated structure" (Badran, 1995, p. 9). Krech, Crutchfield and Ballachey (1962, p. 139; cited in Pratkanis et al., 1989, p. 6), describe attitude as "enduring systems of positive or negative evaluations, emotional feelings, and pro or con action tendencies with respect to social objects". Kenyon (1968) define attitude as "a latent non-observable complex but relatively stable behavioral disposition reflecting both direction and intensity of feeling toward a particular object whether it be concrete or abstract". Practice refers to "the application of rules and knowledge that leads to action" (Badran, 1995, p. 9). It can be also defined as the way knowledge and attitude is exhibited (Kaliyaperumal, 2004).

Schwartz (1975) developed four types of KAP models based on cognitive, affective and behaviour theory to explain the relationship between knowledge, attitude, and practice, which is used as the main theoretical framework for the current research study. Figure 3.1 shows the four possible relationships between knowledge, attitude, and practice. In model 1 knowledge and attitude are correlated but there is no correlation between knowledge and practice. In model 2 knowledge and attitude may independently influence practice, but have no relationship between themselves. Model 3 indicates that knowledge and attitudes influence each other while in model 4, knowledge has a direct and indirect influence on practice, and at the same time attitudes may mediate knowledge and practice.

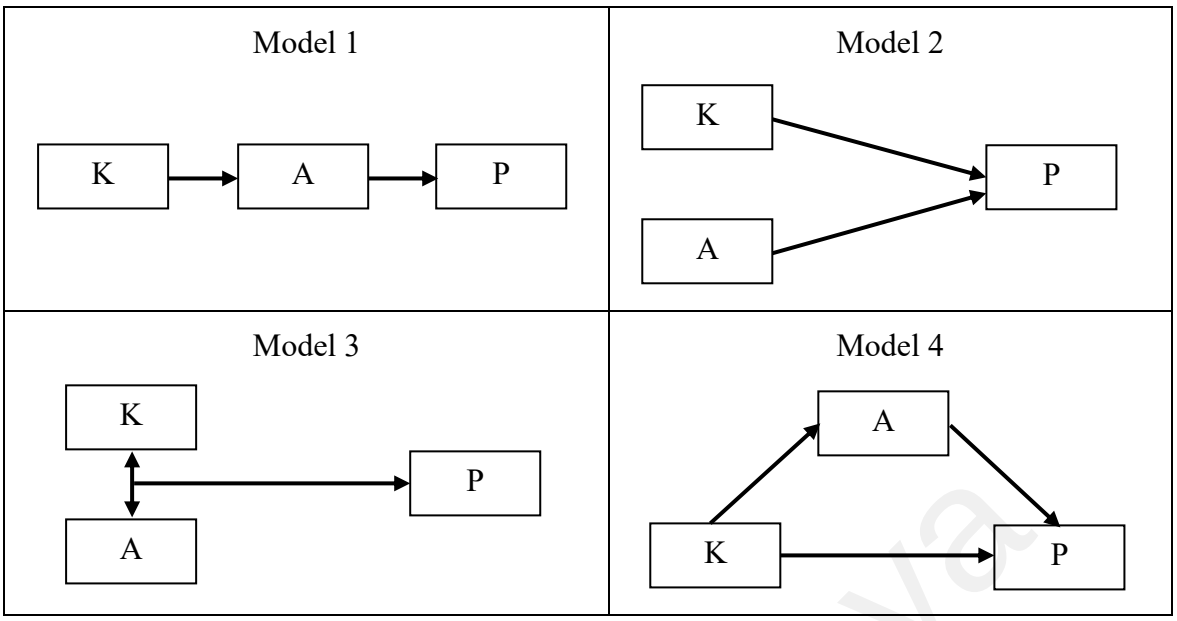

Figure 2.3: Models showing the relationship between knowledge (K), attitude (A) and practice (P)

2.10 Statistical techniques

Several previous studies of smoking behavior have examined the prevalence of smoking and non-smoking and explored the associated factors (Abou-Faddan & Ahmed, 2018; Ahmed et al., 2020; Al-Badri et al., 2017; Chotbenjamaporn et al., 2017; Karadoğan et al., 2018; Lee et al., 2020; Ngahane et al., 2012; Oktay et al., 2013; Omotehinwa et al., 2018; Peltzer & Pengpid, 2014; Tucktuck et al., 2018; Urrutia et al., 2017). Thus, the type of outcome variable in those studies was dichotomous which have only two categories. The appropriate regression statistical analysis method used to deal with dichotomous outcome variable is logistic regression analysis (McNeil, 1996; Tabachnick & Fidell, 2013). Logistic regression is used to predict the outcome variable based on one or more independent variables. In addition, when the type of predictor variable is categorical, one category is usually taken as the reference group for comparison with other groups. This method is called “treatment contrasts”. Another choice is to use “sum contrasts”.

When the outcome variable is continuous, the appropriate statistical technique used to identify associated factors is linear regression (Chai et al., 2018; Sadeghi et al., 2019; Tabachnick & Fidell, 2013). Similar to logistic regression, if the predictor variable is a categorical variable, the analyst usually chooses one group or category to be the reference group for comparing each mean with the specified reference group.

2.11 Research Gaps

2.11.1 Gaps in Empirical Finding

Most previous studies on tobacco smoking in Thailand reported on the prevalence, patterns, and trends of smoking. The target group in several previous studies were youths and adolescents. Only a few studies on smoking among university students have been conducted, and mostly as a part of a graduate study. They revealed the information about smoking behaviors, the prevalence of smoking, factors contributing to smoking behaviors, as well as smoking-related knowledge of students. In these studies, however, there are limitations for evaluating the connection among university student's knowledge, attitude, and practice toward smoking.

2.11.2 Methodological Gaps

Binary logistic regression analysis is the statistical tool that was mostly used for analysing studies on smoking behavior. It is the appropriate regression analysis to conduct when the outcome variable is dichotomous. The result from fitting a logistic regression model can be also presented as a graph of confidence intervals, to compare the proportion in each group with a specified reference group. However, there are limited studies on tobacco use using weighted sum contrasts for comparing each proportion with the overall proportion rather than a specified reference group.

Linear regression models are used when the outcome variable is continuous. The results from these models can be presented as a graph of confidence intervals, and again the graph gives an informative confidence interval for comparing each mean with a specified reference group. In this study, knowledge, attitude, and practice toward smoking are all continuous variables. The author aims to identify factors associated with KAP using linear regression. Most of the previous studies on KAP toward smoking utilized linear regression models for comparing the difference between means by treating one of the groups as the reference group. However, the use of linear regression based on weighted sum contrasts with corresponding confidence interval graph for comparing each mean with the overall mean has not been widely conducted, especially on KAP toward smoking.

2.12 Chapter Summary

This chapter began with an overview on the history of smoking and global prevalence and trends of smoking. A summary of the literature review was also presented for various variables of the study, including demographic characteristic, socioeconomic, smoking knowledge, attitude towards smoking, and practice towards smoking. In addition, the theoretical framework, the statistical techniques related to this research objective and the research gaps were also presented in this chapter.

CHAPTER 3: METHODOLOGY

This chapter outlines the research methodology and statistical techniques employed in this study. The first three sections present the research design, target population, sample and sample size. Section 3.4 describes the research variables. Section 3.5 discusses the theoretical and conceptual framework of the research. Section 3.6 illustrates the questionnaire design and data collection is presented in Section 3.7. Ethical consideration and pilot study are presented in Section 3.8 and Section 3.9. Section 3.10 describes the analysis techniques applied in the study and flow of data processing is presented in Section 3.11. Finally, Section 3.12 summarizes this chapter.

3.1 Research Design

A cross-sectional survey was conducted using self-administered questionnaires among university students in five public universities in Thailand between July 2019 and February 2020.

3.2 Target Population and Sample

3.2.1 Target population

The target population comprises all students who were attending a public university in Thailand and aged over 18 years. All public universities in Thailand have been participating in smoke-free university project.

3.2.2 Sample

The sample consisted of students who attended one of five public universities in Thailand. Thailand is divided into five geographic regions which consist of North,

Northeast, South, East and Central. The sample was selected based on the sampling frame that contains a list of all public universities in each region. Then, one university from each region was selected using simple random sampling method for the study. Respondents from each university identified were then selected via convenience approach to participate in the study. The five universities included Chiang Mai University (CMU), Mahasarakham University (MSU), Prince of Songkla University (PSU), Burapha University (BUU) and Kasetsart University (KU). The inclusion criteria for sample selection is students aged 18 and above.

3.3 Sample Size

Adequacy of sample size was ascertained based on the data analysis that was conducted in this study. Sample size plays an important role in the estimation and interpretation of factor analysis result. One of the proposed data analysis techniques for this research is factor analysis. Several suggestions on the minimum sample size needed for factor analysis have been recommended by various literatures. Gorsuch (1983) opined that the minimum satisfactory sample size should be 100 subjects or five subjects per variable. On the other hand, Guilford (1954) asserted that a minimum sample size of 200 is adequate and Cattell (1978) suggested that a minimum sample size should be 250 subjects or 6 subjects per variable. In addition, Comrey and Lee (1992) provided the following guideline for determining the minimum sample size in factor analysis: 50 = very poor, 100 = poor, 200 = fair, 300 = good, 500 = very good, and 1,000 or more = excellent.

Another statistical technique used in this study was multiple regression analysis. According to Tabackmick and Fidell (2013) in multiple regression from a practical point of view, there are two simple rules of thumb to calculate the sample size. The first method is a minimum sample size (n) $\geq$ 50 + (8) $\times$ (IVs) (IVs is the number of

independent variables) for testing the multiple correlation. The second method is minimum sample size (n) ≥ 104 + IVs for testing individual prediction. In this study, there are 12 independent variables which consist of 5 demographic characteristics variables, 5 socioeconomic variables, and 2 smoking history of family and friend variables. Therefore, the minimum sample size is 50 + (8) × 12 = 146 for testing the multiple correlation, and 116 (104 + 12) for testing individual prediction.

Moreover, another method used in this study to determine the sample size was calculated using single population proportion formula (Daniel & Cross, 2013):

$$n = \frac{z^2 p(1-p)}{d^2}$$

where n = sample size

p = proportion of population sampling

z = critical value for 95% confidence interval = 1.96

d = error of sampling = 0.05

Based on a previous prevalence survey in Thailand, the prevalence of smoking among Thai adults was reported to be 19.1% (National Statistical Office, 2017).

$$n = \frac{(1.96)^2(0.19)(1-0.19)}{(0.05)^2}$$

$$= 236.48$$

In conclusion, a minimal sample size of 236 from each participating university would be able to meet the requirement of statistical analysis used in this study. 1,500 questionnaires were distributed to students. A total of 1,334 students responded which represents a response rate of 88.9%. Out of the collected questionnaires, 35 responses

were excluded because of missing data, resulting in a final sample of 1,299 for data analyses. Table 3.1 presents the sample size stratified by university.

Table 3.1: Number of respondents at each university

University	n	%
Chiang Mai University (CMU)	255	19.63
Mahasarakham University (MSU)	263	20.25
Prince of Songkla University (PSU)	260	20.02
Burapha University (BU)	267	20.55
Kasetsart University (KU)	254	19.55

3.4 Research Variables

3.4.1 Dependent variables

The dependent variables of this study are smoking status and practice toward smoking. Smoking status was classified into two categories: smokers and non-smokers. A person who reported having ever smoked cigarettes or other tobacco products in their lifetime was classified as a smoker while a person who never smoked was classified as a non-smoker. Practices toward smoking, respondents were asked to indicate how frequently they performed each activity. The item was measured based on a seven-point Liker scale: 1 = never, 2 = rarely, 3 = occasionally, 4 = sometimes, 5 = frequently, 6 = usually, and 7 = always. The order of scores was reversed when appropriate. The total raw scores were proportionately transformed to 0–100.

3.4.2 Independent variables

The independent variables are knowledge regarding smoking, attitudes toward smoking, demographic characteristics of the respondents (gender, age group, field of study, place of residence, and original place of residence), socioeconomic status (father's education level, mother's education level, father's occupation, mother's

occupation, and monthly household income), and whether a family member or friend smokes.

Knowledge regarding smoking was measured by asking respondents whether they know about harmful tobacco ingredients and smoking associated disease. Each correct response was given 1 point and each incorrect response was given 0 point. The total raw scores were proportionately transformed to 0–100.

Attitude towards smoking was measured by asking respondents to state their level of agreeableness about attitude towards smoking and anti-smoking. The seven-point Likert scale was employed from 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree or disagree, 5 = somewhat agree, 6 = agree, and 7 = strongly agree. The order of scores was reversed when appropriate. The total raw scores were proportionately transformed to 0–100.

For demographic characteristics of the respondents, gender was classified into two categories: male and female, age group was classified into three categories: 18-20 years, 21-22 years, and ≥ 23 years, field of study was classified into two categories: science and non-science, place of residence was classified into two categories: on campus and off campus, and original place of residence was classified into two categories: rural and urban.

For socioeconomic status, father's education level and mother's education level were classified into four categories: no formal education, primary school, secondary school, and college/university. Father's occupation and mother's occupation were classified into five categories: not working, government sector, private sector, self-employed, and other occupation. Monthly household income was classified into four categories: ≤ 15,000 Baht, 15,001 – 30,000 Baht, 30,001 – 50,000 Baht, and ≥ 50,001 Baht.

Finally, family member's smoking status was classified into two categories: smoke and did not smoke and friend's smoking status was classified into two categories: smoke and did not smoke.

3.5 Conceptual Framework of the Research

The conceptual framework used in this research is the KAP theory discussed in Chapter 2, Section 2.9.4. This study aims to examine the role of attitude toward smoking in the relationships between knowledge about smoking and practice toward smoking. Therefore, Model 4 (see section 2.9.4) was selected, which has been applied to the knowledge, attitude, and practice toward smoking, as displayed in Figure 3.1.

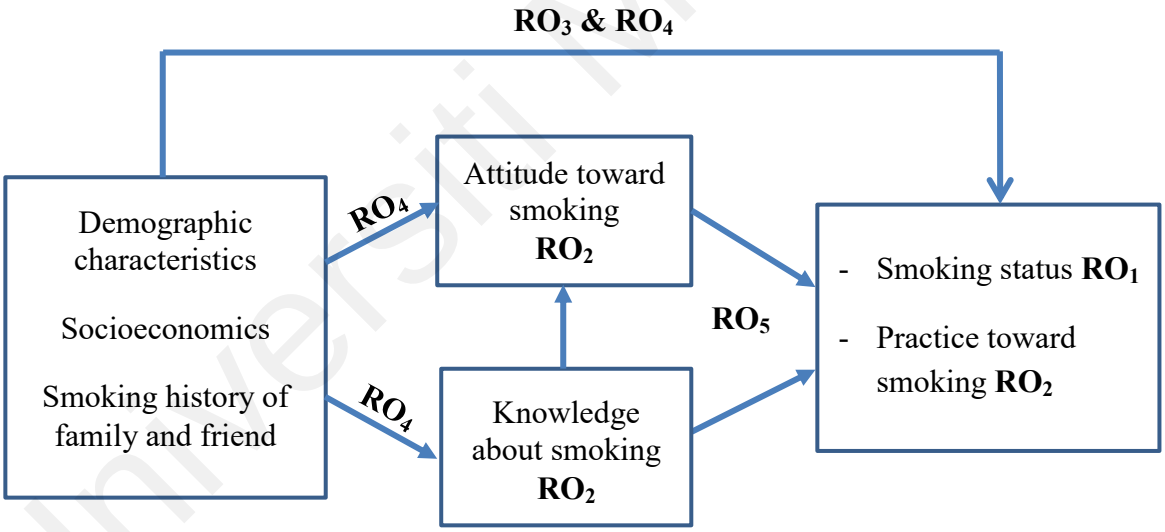

Figure 3.1: Conceptual framework

3.6 Survey Instrument

A self-administrated questionnaire was developed by incorporating questions based on previous studies (Global Youth Tobacco Survey Collaborative Group, 2012; Institute for Public Health, 2012). The survey questionnaire consists of mainly closed-

ended types of questions to allow for uniformity and consistency throughout the data collection process. The questionnaire was constructed in English and then translated into Thai. Back translation was used to ensure that the meanings of key words and phrases were retained. Both languages were presented to the respondents in the questionnaire. A copy of the original survey can be seen in Appendix A. The questionnaire comprised six main sections:

Section A: Socio-demographic information

There were 18 questions in section A that asked respondents to provide information on their demographic background which consisted of age, gender, religion, marital status, current level of study, field of study, year of study, current place of residence, father's education level, mother's education level, father's occupation, mother's occupation, monthly household income, place of residence, parents smoke, brother smoked, sister smoked and closest friends smoke.

Section B: Background information about smoking

There were 25 questions in section B that asked respondents to provide background information about smoking. The smoking behaviour of the students was assessed by asking whether the individual had smoked, even if only a few puffs, the age and particular reasons for initiation of smoking, type of smoking products and frequency of smoking. This section also included questions about smoking practice with 14 items as shown in Table 3.2. The smoking practice was represented by the level of frequency ranging from 1 - 7 (1 = never, 2 = rarely, 3 = occasionally, 4 = sometimes, 5 = frequently, 6 = usually, 7 = always).

Table 3.2: List of smoking practice statements

No.	Statement
1	I was drawn into smoking by someone who I looked up to and respected who is a smoker (e.g. teacher, sports star, neighbour).
2	I started smoking after accepting a challenge or bet from a friend.
3	I started smoking before enrolment in a school/university.
4	I use other forms of smoking products to quit smoking (e.g. vape, shisha).
5	I was encouraged by someone to quit smoking (e.g. parents, teachers, boyfriend, girlfriend).
6	I had sought the advice of the physician to quit smoking before.
7	I only smoke local brand of cigarettes.
8	I started smoking after enrollment in a school/university.
9	I smoke imported brand of cigarettes.
10	I had/often received cigarettes as a gift.
11	I habitually smoked at public places (e.g. recreational park, school, government building).
12	I only smoked at home.
13	I also smoked at home.
14	I smoke first thing in the morning.

Section C: Knowledge about smoking

Smoking-related knowledge was measured with 20 questions about harmful tobacco ingredients and smoking associated disease. This part consisted of questions such as the respondent's knowledge that cigarettes contain more than 4,000 kinds of chemical materials, Tar is harmful to the body, Smoking can cause lung cancer and Smoking can cause premature birth. Each correct response was given 1 point and each incorrect response was given 0 points. Table 3.3 shows the 20 items used in measuring knowledge toward smoking

Table 3.3: Knowledge toward smoking

No.	Statement
1	A cigarette contains more than 4000 kinds of chemical materials.
2	Smoking cigarettes can cause health disorders.
3	Smoking can cause stroke.
4	Counseling provided by quit-smoking clinic is helpful.
5	A cigarette contains 40 materials that can cause cancer.
6	Smoking can cause a person to cough and develop rhinorrhea.
7	Smoking can cause lung cancer.
8	Nicotine replacement therapy can be effective to reduce smoking.
9	Nicotine is harmful to the body.
10	Pregnant women who smoke can cause complications to the pregnancy.
11	Smoking can cause oral cancer.
12	Switching to smokeless tobacco can help to reduce smoking.
13	The tar is harmful to the body.
14	Inhaling cigarette smoke from other smokers can affect one's health.
15	Smoking can cause throat cancer.
16	Having more anti-smoking campaign can influence smokers to quit smoking.
17	Carbon monoxide is harmful to the body.
18	Nicotine in cigarettes can cause addiction.
19	Smoking can cause premature birth.
20	Tar level in cigarettes is a factor that influences lung cancer incidence.

Section D: Attitude toward smoking

Smoking-related attitude was measured with 20 questions (e.g., Smoking helps people forget their worries, Smoking helps to increase concentration in studies) as portrayed in table 3.4. A standard Likert scale with the response categories "strongly disagree", "disagree", "somewhat disagree", "neither agree or disagree", "somewhat agree", "agree", "strongly agree" were 1, 2, 3, 4, 5, 6 and 7. Vice versa marking was done for negative question.

Table 3.4: Attitude toward smoking

No.	Statement
1	Smoking helps people forget their worries.
2	Smoking related diseases can easily be cured.
3	It will be difficult to quit once people have started smoking.
4	Smoking should be banned in all outdoor places where young people frequently go.
5	Smoking helps people to relax.
6	Smoking is only dangerous to elderly people.
7	Some religion forbids smoking.
8	There should be fewer places where cigarettes and tobacco product are be sold.
9	Smoking helps to increase concentration in studies.
10	Smoking a few cigarettes will not damage my health condition.
11	Smoking can be stopped if you wanted to.
12	Tobacco companies should not be allowed to promote cigarettes and tobacco products with cool-looking packaging.
13	Smoking makes people look more grown-up and mature.
14	Chemical in cigarette can increase the chances of getting cancer (e.g. tar and nicotine).
15	The desire to smoke is difficult to overcome.
16	Cigarette and tobacco should not be sold in Thailand for the next 10 years.
17	Smoking does not influence my grades/CGPA.
18	Cigarette and tobacco products should be made more expensive so that children and young people cannot afford to buy them.
19	Smoking is a way to express individual independence.
20	I want to live in a country where no one smokes.

Section E: Practice on smoking

There were 12 questions that examined the respondents' practice on smoking. Respondents were asked to state how frequently they performed each activity based on the 12 items listed in the Table 3.5. A standard Likert scale with the response categories "never", "rarely", "occasionally", "sometimes", "frequently", "usually" and "always" were 1, 2, 3, 4, 5, 6 and 7. The order of score was reversed when appropriate. Vice versa scoring was used for negative question.

Table 3.5: Practice toward smoking

No.	Statement
1	Many of my friends encouraged me to try smoking (e.g. peers, classmates).
2	I am involved in training and helping people to quit smoking.
3	I advise my family and friends not to start smoking
4	I encourage smokers to quit smoking as soon as possible.
5	I urge parents to quit smoking.
6	I talked to and shared with others about smoking hazards.
7	I offer cigarettes as a gift.
8	I recommend smokers to reduce the number of cigarettes they smoke.
9	I participate as a volunteer in one of the "no-smoking" programme.
10	I liked the smell of cigarette and thought the taste would be a pleasant experience.
11	I advise smokers to seek physician advise to quit smoking.
12	I am coaxing teachers to quit smoking.

Section F: Feeling toward stop smoking

There were 12 questions in section F inquiring about the feeling toward stop smoking among respondents. This section consisted of questions such as the respondent's feeling on the term "smoke-free policy", "helping to quit smoking" and "promoting smoking cessation".

3.7 Data Collection Procedure

Survey questionnaires were used to obtain the required data for this cross-sectional study. The data collection assistants were lecturers and students in target universities, who volunteered. They explained the research objectives and distributed the questionnaire to students who gave written consent to participate. Respondents required 15-20 minutes to complete the questionnaire. The questionnaires were given to the students' classroom after taking prior permission from the concerned lecturer. Data was collected between July 2019 and February 2020.

3.8 Ethical Consideration

This research study was approved by the University Malaya Research Ethics Committee (Ref. No: UM.TNC2/UMREC – 546). An informed consent was taken from all respondents prior to distribution of questionnaires. Respondents were free to withdraw from the study during any stage of data collection. Respondents were assured that their responses to the questions in the questionnaire would be kept confidential and solely used for this study and academic purposes.

3.9 Pilot Study

Prior to conducting the actual data collection, a pilot study was done among other university students. The questionnaire was validated by experts involved in smoking cessation research. The questionnaire was pretested on 45 respondents and minor modifications were made to the questions' wordings.

Results from the pilot study (Table 3.6) showed that among 45 respondents, 51.1% were female and 48.9% were male. 66.7% of respondents were aged 21-24 years and more than half (53.3%) were majoring in non-science stream. 13.3% of respondents stated that they were former smokers and 13.3% were current smokers.

Table 3.6: Demographic detail of respondents (n = 45)

Demographic characteristics	n	%
Gender		
Male	22	48.9
Female	23	51.1
Age Group (years)		
18 – 20	5	11.1
21 – 24	30	66.7
≥ 25	10	22.2
Field of study		
Science	21	46.7
Non-science	24	53.3
Smoking status		
Never	33	73.3
Former	6	13.3
Current	6	13.3

3.9.1 Reliability of the Instrument

In terms of reliability analysis, the internal consistency is assessed using the Kuder-Richardson Formula 20 (KR-20) for knowledge scores and Cronbach's alpha (α) for attitude and practice score. The KR-20 is a measure of internal consistency for examinations with dichotomous scored items. On the other hand, the Cronbach's alpha is a measure of internal consistency of non-dichotomous variables, particularly for questions using a Likert scale. The cut-off points for the KR-20 and Cronbach's alpha coefficient are as follows (Hinton et al., 2004):

≥ 0.90	Excellent reliability
0.70 to 0.90	High reliability
0.50 to 0.70	Moderate reliability
≤ 0.50	Low reliability

Table 3.7: Reliability index coefficient

Construct	Item	Mean	SD	Alpha Coefficient
Knowledge	20	17.73	2.39	0.7262
Attitude	20	106.10	19.06	0.8483
Practice	12	52.02	12.68	0.7890

All of the construct measurement showed an adequate reliability with index coefficient values ranging from 0.7262 to 0.8483 (Table 3.7).

3.10 Statistical methods

Several statistical techniques were applied to answer the research objectives of the study. Table 3.8 indicates the appropriate method of data analysis employed for answering each research objective.

Table 3.8: Summary of Analysis Method

Research Objectives	Analysis Method
1. To determine the prevalence of smoking among university students in Thailand.	Descriptive analysis was used and results were presented in frequency and percentage.
2. To examine the general level of knowledge, attitudes and practices with regards to smoking among university students in Thailand.	Factor analysis was employed in order to extract the valid items for knowledge, attitude, and practice toward smoking (KAP domains). ▪ Frequency, percentage, mean, and standard deviation were used for each domain.
3. To identify factors associated with smoking status among university students in Thailand.	1) Pearson's chi-squared test and Fisher's exact test were used to test the association between smoking status and selected variables 2) Multiple logistic regression was used to identify factors associated with smoking status.
4. To identify factors associated with KAP domains among university students in Thailand.	After normality checking, non-parametric test was used. 1) Mann-Whitney U Test was used to compare the KAP score between two independents groups. 2) Kruskal-Wallis H Test was used to compare the KAP score across more than two groups. ▪ Multiple linear regression was employed to identify factors associated with KAP domains.
5. To investigate whether attitude domains mediate the relationship between knowledge domains and practice domains.	Causal-step approach and the 95% confidence interval bootstrap percentiles with 5000 simulations were used to test the mediation of attitude domains between knowledge domains and practice domains.

3.10.1 Descriptive statistics

Descriptive statistics are numbers that describe the characteristics of a sample. It involves numerical and graphical presentation. Different statistics are used, depending on whether that variable is continuous or categorical. All categorical variables are summarized and described by frequencies and percentages. On the other hand, mean and standard deviation are used to analyse continuous variables.

3.10.2 Bivariate analysis

3.10.2.1 Pearson's chi-squared test

Pearson's chi-square test used to assess the association between two categorical variables. Pearson's chi-squared statistic for independence is defined as

$$^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}}$$

Where O_{ij} is the observed frequencies in category i of independence and category j of the dependent variable, and E_{ij} is the corresponding expected frequencies, defined as before dividing the product of the marginal totals by the overall total sample size, that is

$$E_{ij} = \frac{\sum_{j=1}^{c} O_{ij} \sum_{i=1}^{r} O_{ij}}{n}$$

When the null hypothesis of independence is true, the right-hand side of previous equation (^{2}) has a chi-squared distribution with $(r-1)(c-1)$ degree of freedom (McNeil, 2006).

3.10.2.2 Fisher's exact test

The Fisher's exact test is an alternative to Pearson's chi-squared test for small samples and procedure for 2 × 2 contingency tables. Fisher's Exact Test is used to determine whether or not there is a significant association between two categorical variables. Suppose we have the 2 × 2 contingency tables as shown in Table 3.9.

Table 3.9: A 2 × 2 contingency table

Row variable	Column variable		Total
	1	2	
1	a	b	n_1
2	c	d	n_2
Total	m_1	m_2	n

To calculate the p-value of Fisher's exact test by using the following formula (Lim, 2016):

$$p(a) = \frac{n_1!\, n_2!\, m_1!\, m_2!}{a!\, b!\, c!\, d!\, n!}$$

3.10.2.3 Mann-Whitney U Test

The Mann-Whitney U test is a non-parametric test that does not require the assumptions of parametric test. It is the alternative test to the independent sample t-test (McKnight & Najab, 2010). This test is used to analyze differences between the medians of two independent groups. The Mann-Whitney U test initially implies the calculation of a U statistic for each group, giving the formula (Nachar, 2008)

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \qquad (1)$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2 \qquad (2)$$

Where n_1 is the number of observations in the first group, n_2 is the number of observations in the second group, R_1 is the sum of the ranks assigned to the first group, and R_2 is the sum of the ranks assigned to the second group. Evaluate $U = \min(U_1, U_2)$, if the value of $U < U_{crit}$ then the test is significant (at the α level).

3.10.2.4 Kruskal-Wallis H Test

The Kruskal-Wallis H test is the non-parametric test equivalent to the independent samples of ANOVA. It does not require specific distributions. This test is used to assess the differences among three or more independently sampled groups on a non-normally distributed continuous variable (McKnight & Najab, 2010). Calculate the Kruskal-Wallis test statistic by using the following formula (Hecke, 2010):

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1)$$

Where N is the total number of observations (all n_i) and R_i is the sum of the ranks for the each group i (i = 1, 2,…, k) of size n_i, H has approximately a chi-square distribution with k-1 degrees of freedom.

3.10.2.5 Spearman's Rank correlation coefficient

Spearman's rank correlation coefficient (ρ) is a non-parametric test equivalent of the Pearson's correlation coefficient. This test used to determine the degree of association between two continuous variables. The formula is expressed in the following equation (Batina et al., 2008).

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Where d_i is the difference between ranks assigned to variables for each cause and n is the number of pairs of rank. The spearman correlation coefficient varies between +1 and -1. A correlation of +1 indicates a perfect positive relationship and -1 indicates a perfect negative relationship. The correlation near zero indicates little or no correlation (Assaf & Al-Hejji, 2006).

3.10.3 Logistic regression

Logistic regression is a statistical method widely used for modeling the association between a binary outcome and a set of determinants. It provides a representation for the log of the odds ratio describing the association of a binary outcome with the explanatory variables. It also provides the estimated of odds ratios and confidence intervals for specific combinations of the risk factor (McNeil, 1996). The logistic regression model takes the following form:

$$ln\left(\frac{p}{1-p}\right) = \alpha + \sum_{i=1}^{n} \beta_i x_i$$

where p is the probability of the outcome occurring, α is the constant coefficient, β is the set of regression coefficients, x_i are the set of independent variables and n is the number of predictor variables. The probability of the outcome $Y = 1$ can be written as

$$P[Y = 1] = \frac{\exp(\alpha + \sum_{i=1}^{n} \beta_i x_i)}{1 + \exp(\alpha + \sum_{i=1}^{n} \beta_i x_i)}$$

For measures of association arising from a 2×2 contingency table by using the logistic regression model, we assume that the smoking status has just two possible values, 0 (non-smoker) and 1 (smoker). Thus, the logistic regression model given $x = 1$ (exposure) can be written as

$$ln\left\{\frac{P(Y = 1|X = 1}{1 - P(Y = 1|X = 1)}\right\} = \alpha + \beta$$

Whereas the logistic regression model given $x = 0$ (no exposure) can be written as

$$ln\left\{\frac{P(Y = 1|X = 0)}{1 - P(Y = 1|X = 0)}\right\} = \alpha$$

Then exponentiation the two equations above, the odds for the exposed and non-exposed can be expressed as $\exp(\alpha + \beta)$ and $\exp(\alpha)$, respectively. Thus, the odds ratio takes the following formula

$$OR = \frac{\exp(\alpha + \beta)}{\exp(\alpha)} = \exp(\beta)$$

3.10.3.1 Model selection methods

The logistic regression procedure provides a mainly two methods available for model selection, which consist of forward selection and backward elimination. Austin and Tu (2004) has summarized these methods, forward selection methods start with a null or basic model and adds significant variables to the model until a predefined stopping rule is satisfied. Stopping rule usually is that if any added variable would not

be significant at a predefined significance level, then no further variables are added to the model. Backward elimination, on the other hand, starts with the full model consisting of all predictor variables and removes insignificant variables from the model until a pre-specified stopping rule is satisfied. The stopping rule is that all variables that remain in the model are significant at a pre-specified significance level.

In this study author use the backward elimination based on likelihood-ratio (LR) statistics. It is a stepwise selection method that begins with a full model and variables are removed using the probability of the likelihood ratio statistics base on the maximum partial likelihood estimates. This involves the comparison of the current model to the model after the removal of the variable. If the removal of the variable results in a better fitting model, then the variable is removed otherwise it is kept in the model. The cut-off for significance is p-value greater than 0.05.

The logistic regression models were fitted using both treatment contrasts and sum contrasts. Treatment contrasts was used to compare each proportion with the specified reference group and weighted sum contrasts was used to compare proportions with overall proportions (Tongkumchum & McNeil, 2009; Venables & Ripley, 2002).

3.10.3.2 Predictive ability of model

The receiver operation characteristics (ROC) curve is a graphical plot that provides predictive accuracy of the logistic model. All significant variables in the model were included in the ROC curve. The area under the ROC curve (AUC) represents the efficiency of the prediction model in discriminating between those subjects who experience the outcome of interest and those who do not (smokers and nonsmokers) (Sarkar & Midi, 2010). An AUC above 0.70 indicates the test possesses good accuracy levels (Hosmer et al., 2013).

3.10.4 Multiple linear regression

Multiple linear regression is used to model the relationship between a set of independent variables and a continuous dependent variable. The multiple regression model equation takes the form:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n + \varepsilon$$

where Y is the predicted value on the dependent variable, β_0 is intercept, $\beta_1, \beta_2, \beta_3, \ldots, \beta_n$ are regression coefficients, $x_1, x_2, x_3, \ldots, x_n$ are the independent variables, and ε is error of prediction.

The linear regression models were fitted using both treatment contrasts and weighted sum contrasts. Treatment contrasts was used to compare each means with the specified reference group and weighted sum contrasts was used to compare means with overall means (Tongkumchum & McNeil, 2009; Venables & Ripley, 2002).

3.10.4.1 Model selection methods

There are three different methods of model selection, which consist of forward stepwise selection, backward elimination and stepwise regression methods. Stepwise regression method was selected in this study. Stepwise selection method is a method of fitting the regression models and is a forward selection method that rechecks at each step the importance of all previously included variables. If the partial sums of squares (F-test) for any previously included variables do not meet a minimum criterion to stay in the model, the selection procedure changes to backward elimination and variables are dropped one at a time until all remaining variables meet the minimum criterion. Then, forward selection resumes (Rawlings et al., 1998).

3.10.5 Factor Analysis

Factor analysis (FA) is a widely used statistical technique in various fields such as social sciences, education, business, and biological sciences. Researchers use this approach to reduce a large number of observed variables which have similar patterns of response into a smaller set of variables (also referred to as factors). It establishes underlying dimensions between measured variables and latent constructs. Moreover, it provides construct validity evidence of self-reporting scale (Williams et al., 2010). Factor analysis can best be understood as a latent variable modeling paradigm in which a set of observed variables are the indicators of a latent variable. The latent is of primary interest but cannot be directly observed. However, it is theorized that the latent variable has a direct influence on each of the observed indicators, so that they can in turn be used to gain insights into the latent variable. This idea is at the core of educational and psychological measurement of abilities (Finch & French, 2015).

Factor analysis is divided to two main categories, namely Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). EFA is, as the title suggests, exploratory in nature and employed when the researcher has either no specific theories about the latent structure underlying the observed data are clearly specified, or there is a lack of empirical work investigating this structure. It allows the investigator to explore the main variables to generate a model or theory from a relatively large set of latent dimensions often represented by a set of items. In contrast, when the investigator has a strong theory regarding the nature of the latent structure of the data, and there is exploratory work suggesting the nature of this structure, then CFA may be most appropriate. CFA is a form of structural equation modeling (SEM) which is a technique used to confirm the hypothesis. In this study, the author will be focusing on EFA.

3.10.5.1 Justification for exploratory factor analysis

Williams et al. (2010) summarized the objectives for using exploratory factor analysis as follow:

(a) Reducing the number of variables.

(b) Examining the structure or relationship between variables.

(c) Detection and evaluation of unidimensionality of a theoretical construct.

(d) Evaluation of the construct validity of a scale, test, or instrument.

(e) Assessment of multicollinearity among variables which are correlated.

(f) Development of theoretical constructs.

(g) Prove/disprove proposed theories.

3.10.5.2 Requirements for exploratory factor analysis

The sample size is important in factor analysis. Comrey and Lee's study (as cited in Yong & Pearce, 2013) suggested that sample sizes should be 300 or greater, and the variables that are subjected to factor analysis each should have at least 5 to 10 observations. However, others such as Guadagnoli and Velicer (1998) recommended that if the dataset has several high factor loading scores, those which are greater than 0.80, a smaller sample sizes may be adequate. Factor loading basically reflect the relationships between the observed variable and the latent variable. In general, loadings score range between -1 and 1, with high factor loading scores being indicative of a closer association between a latent and observed variable. Moreover, a correlation matrix is required in the EFA process which displays the relationships between individual variables. Tabachnick and Fidell (2013) pointed that the correlations must be over 0.30, meaning that the factor account for approximately 30% relationship within the data. If no correlations exceed 0.30, it would indicate a very weak relationship between the variables.

3.10.5.3 Kaiser-Meyer-Olkin and Bartlett's Test

Prior to extraction of the factors, there are some tests that should be conducted to measure the adequacy of sample and suitability of the respondent data for factor analysis. These tests include Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of sphericity. Williams et al. (2010) summarized that the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in the variables that might be caused by underlying factors. The KMO index ranges from 0 to 1, with 0.50 and above considered suitable for factor analysis. If the index is less than 0.50, the results of the factor analysis may not be very useful. In addition, Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix or not. It would indicate that our variables are unrelated and thus unsuitable for structure detection. Bartlett's test provides a chi-square statistic that should be significant (p-value < 0.05) for factor analysis to be suitable.

3.10.5.4 Factor Extraction

There are multiple ways to extract factors in EFA such as principal component analysis (PCA), principal axis factoring (PAF), maximum likelihood (ML), weighed least squares (WLS), image factoring, and alpha factoring (Tabachnick & Fidell, 2013; Thompson, 2004). In this study, principal axis factoring was used for extracting the factors.

3.10.5.5 Factor Rotation Method

After extraction phase, it is important to determine which factor loading solution is optimal for the study purposes. This determination is made using factor rotation, which refers to the transformation of the initial set of factor loadings so as to simplify interpretation of the results by seeking a simple structure solution. There are two broad

families of factor rotation methods which consist of orthogonal and oblique. This analysis used the orthogonal rotation method which called “VARIMAX”. This method tends to produce factor loadings that are uncorrelated and produces results that are easier to interpret (Costello & Osborne, 2005).

3.10.6 Mediation analysis

One of the research objectives in this study is to examine whether attitude domain mediates the relationship between knowledge domain and practice domain. Mediation analysis can be conducted to answer this research objective. Thus, the concept of mediation analysis is to test the existence of an indirect effect from the independent variable (X) to a dependent variable (Y) through a mediating variable (M). As shown in Figure 3.2, in the case of simple mediation, where only one mediator has been proposed to explain the mechanism by which X affects Y. The path **a** indicates the direct effect of X on M. The path **b** indicates the direct effect of M on Y. The path **c** indicates the total effect of X on Y without M. The path **c′** indicates the direct effect of X on Y when M is included in the model. The indirect effect is the product of **a** × **b**. The indirect effect is the difference between the total effect (**c**) and direct effect (**c′**). In other words, it is mathematically denoted as

total effect (**c**) = indirect effect (**a** × **b)** + direct effect (**c′**).

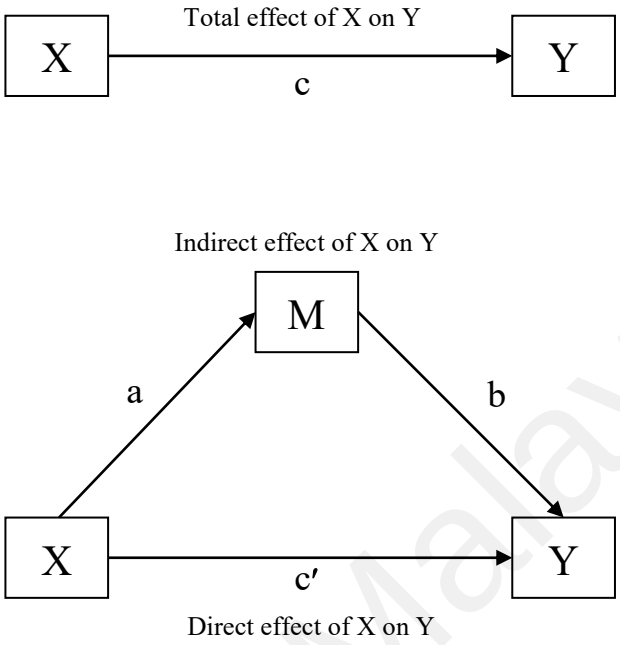

Figure 3.2: Simple Mediation model

A mediator is a variable that changes the relationship between an independent variable and dependent variable (Baron & Kenny, 1986). From the proposed model of KAP (Figure 3.1), it can be identified that the attitude domain is the key mediating variable of the framework. For establishment of the mediation model, the Baron and Kenny (1986) causal-step approach was used to test the mediation of the attitude domain between knowledge domains and practice domains. This approach can show evidence of a valid mediation effect by conducting a series of multiple regressions. There are four conditions that should be met in order to conclude that a mediation effect exists.

First, the independent variable (knowledge domains (X)) must be significantly related to the dependent variable (practice domains (Y)) before the potential mediating

variable is taken into account, here, **c** in Figure 3.2. This condition can be expressed by the following simple linear regression equation of X on Y (Pardo & Román, 2013):

$$Y = i_1 + cX + \varepsilon_1$$

Where i_1 is a constant, c is the regression coefficient that relates X to Y, and ε_1 is a vector of random errors.

Second, the independent variable (knowledge domains (X)) must be significantly related to the mediating variable (attitude domains (M)), here, **a** in Figure 3.2. This condition can be expressed by the following simple linear regression equation of X on M (Pardo & Román, 2013):

$$M = i_2 + aX + \varepsilon_2$$

Where i_2 is a constant, a is the regression coefficient that relates X to M, and ε_2 is a vector of random errors.

Third, the mediating variable (attitude domains (M)) must be significantly related to the dependent variable (practice domains (Y)), controlling for the effect of independent variable (knowledge domains (X)) on the dependent variable, here, **b** in Figure 3.2. This condition can be expressed by the following simple linear regression equation of M on Y (Pardo & Román, 2013):

$$Y = i_3 + aX + bM + \varepsilon_3$$

Where i_3 is a constant, a is the regression coefficient that relates X to Y, b is the regression coefficient that relates X to M, and ε_3 is a vector of random errors.

Fourth, the relationship between the independent variable (knowledge domains (X)) and the dependent variable (practice domains (Y)) should be significantly weaker (partial mediation) or non-significant (full mediation) when the mediating variable is in the model. In other words, in comparison with **c**, the magnitude of **c′** is reduced substantially.

However, there are some drawbacks associated with this method. For instance, if the mediated effect is positive, and the direct effect is negative, both effects will eventually offset each other. As a result, the effect may appear to be non-significant (Hayes, 2013). This situation when a mediating variable works as suppressing variable and is called *inconsistent mediation* (MacKinnon et al., 2007). To avoid the limitation identified above, an additional analysis of the significant mediation model was tested using the 95% confidence interval bootstrap percentiles with 5000 simulations (Shrout & Bolger, 2002), a method which does not depend on an assumption of normality (Hair et al., 2014; Hays, 2009; Pardo & Roman, 2013). A 95% confidence interval is computed and then checked to determine, if the range of confidence interval does not include a zero, indicates that it is significant. Table 3.10 summarized the basic step for considering a variable as a mediator.

Table 3.10: Basic step for considering a variable as a mediator

Path	Partial mediation	Full mediation
Baron and Kenny approach		
c	X significantly predicts Y	X significantly predicts Y
a	X significantly predicts M	X significantly predicts M
c′	The relationship between X and Y should be significantly decrease (c′ < c)	The relationship between X and Y should be non-significant.
b	M significantly predicts Y, when the effect of X is controlled.	M significantly predicts Y, when the effect of X is controlled.
Bootstrap procedure		
indirect (ab)	The range of confidence interval not including a zero	The range of confidence interval not including a zero

Note: X=Independent variable, M=Mediating variable, Y=Dependent variable

3.11 Flow of Data Processing

After data collection, all data was entered using EpiData version 3.1 and exported to R. Then cleaning and checking processes were done using R. Data cleaning include: Remove missing data and data recoding then grouped data. After that using descriptive statistical method to summarize and describe by percentage and using Pearson's chi-square test to assess the association between smoking status and each determinant. Mann-Whitney test and Kruskal-Wallis test were used to find the relationship between each determinant and KAP domains. Then using logistic regression analysis to determine factors associated with smoking status and linear regression to identify factors associated with KAP domains. Finally, causal-step approach and the 95% confidence interval bootstrap percentiles with 5000 simulations technique were used to investigate whether attitude domains mediate the relationship between knowledge domains and practice domains. The graphical and statistical analyses were performed using R and SPSS. The flow diagram for data processing is summarized in Figure 3.3.

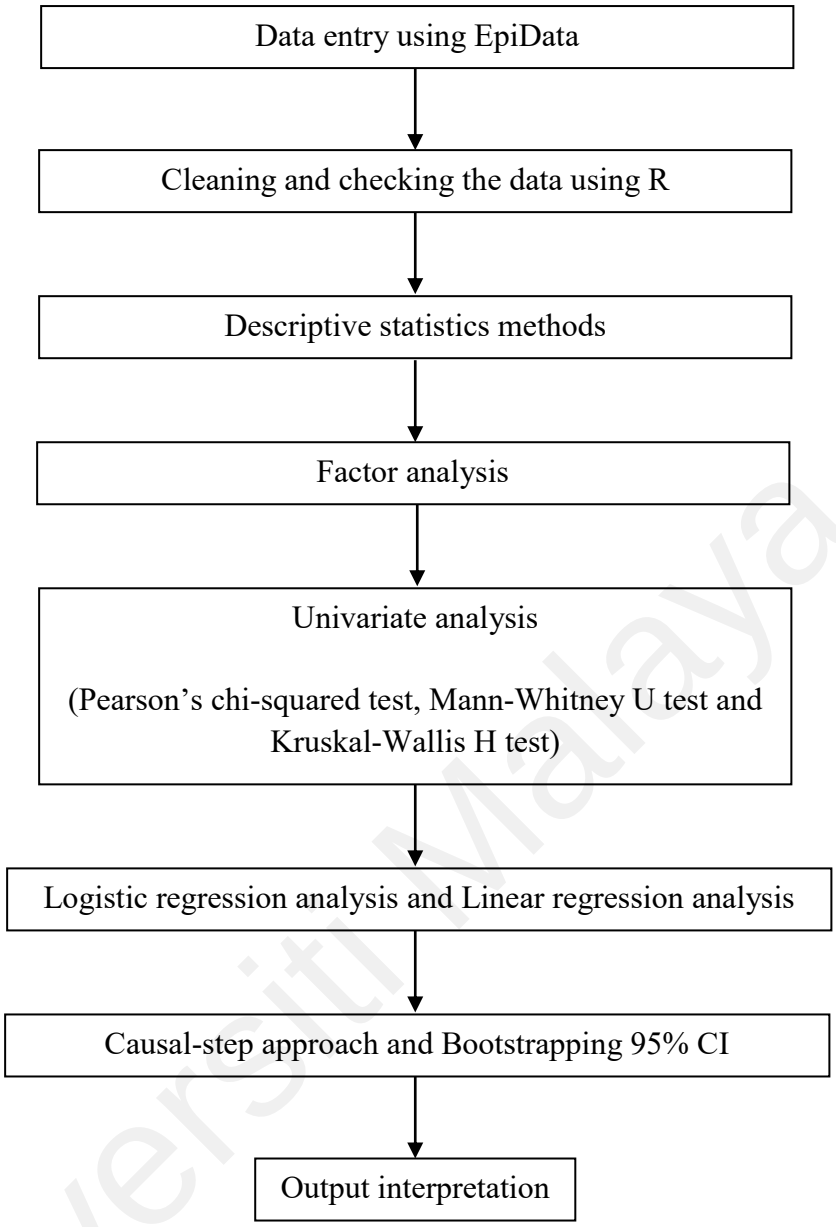

Figure 3.3: Flow diagram for Data Processing

3.12 Chapter Summary

This chapter has elaborated an outline of the research methodology and statistical techniques used in this study. A cross-sectional survey was performed using self-administered questionnaire conducted among five public university students in Thailand. Dependents variables (smoking status and practice toward smoking), independent variables (5 demographic characteristics variables, 5 socioeconomic variables, and 2 smoking history of family members and friend variables, knowledge,

and attitude) were included. Subsequently, appropriate statistical techniques used in this study were described. Factor analysis was performed on the 52-item scale of KAP questions. Multiple logistic regression was then used to identify the factors associated with smoking status, while linear regression was used to identify the factors associated with KAP domains. Causal-step approach and the 95% confidence interval bootstrap percentiles technique were used to examine whether a mediating relationship exists among the variables in the model. The following chapter will present the results followed by data analysis based on the procedures discussed in this chapter.

CHAPTER 4: ANALYSIS AND FINDINGS

This chapter presents the analysis done to answer the research objectives of the study. The chapter is divided into eight sections. The first section describes the results of descriptive statistics of the respondents. Section 4.2 presents the result of exploratory factor analysis. Section 4.3 and Section 4.4 describe the associations between selected independent variables and smoking status and the result from multiple logistic regression analysis of factors associated with smoking, respectively. The comparative analysis of KAP scores and the relationship between selected independent variables and KAP domains are presented in Sections 4.5 and 4.6, respectively. Result of the mediation analysis is given in Section 4.7. Finally, section 4.8 presents the summary of this chapter.

4.1 Descriptive Statistics of Respondents

4.1.1 Demographic Characteristics of Respondents

Research objective 1: To determine the prevalence of smoking among university students in Thailand.

A total of 1,299 students from five universities in Thailand were included in the study. The prevalence of smoking among students was 28.2% (n=366); of these 61.5% (n=225) were current smokers and 38.5% (n=141) were former smokers. Overall, 49.3% were males and 50.7% were females. The majority of students were aged 18 – 20 years (66.8%) followed by aged 21 – 22 years (27.2%) and aged 23 years or above (6.0%). 92.8% of students were Buddhist, 60.6% were studying science, 62.1% were living outside university, and 54.1% came from a rural area.

Table 4.1: Demographic characteristics of respondents (n=1,299)

Demographic variables	Total	
	n	(%)
Gender		
Male	641	(49.3)
Female	658	(50.7)
Age groups (years)		
18 – 20	868	(66.8)
21 – 22	353	(27.2)
≥ 23	78	(6.0)
Religion		
Buddhism	1,205	(92.8)
Other	94	(7.2)
Field of study		
Science	787	(60.6)
Non-science	512	(39.4)
Place of Residence		
On campus	492	(37.9)
Off campus	807	(62.1)
Original place of residence		
Rural	703	(54.1)
Urban	596	(45.9)
Smoking status		
Smokers	366	(28.2)
Non-smokers	933	(71.8)
Current smokers		
Yes	225	(17.3)
No	141	(10.9)
Never smoking	933	(71.8)

4.1.2 Socioeconomic Status

Table 4.2 presents socioeconomic status of students. The majority of students had a father with a college or university education (41.7%) followed by secondary school education level (36.6%). Similarly, most of students had a mother with a college or university education (39.9%) followed by secondary school education level (35.4%). Regarding parent's occupation, 43.1% of students had a father who was self-employed and 45.7% had a mother who was self-employed. 35.5% of students had a monthly family income between 15,001 – 30,000 baht.

Table 4.2: Socioeconomic status (n=1,299)

Socioeconomic variables	Total	
	n	(%)
Father's education level		
No formal education	56	(4.3)
Primary school	225	(17.3)
Secondary school	476	(36.6)
College/university	542	(41.7)
Mother's education level		
No formal education	45	(3.5)
Primary school	276	(21.2)
Secondary school	460	(35.4)
College / university	518	(39.9)
Father's occupation		
Not working	88	(6.8)
Government	262	(20.2)
Private	259	(19.9)
Self-employed	560	(43.1)
Other	130	(10.0)
Mother's occupation		
Not working	157	(12.1)
Government	229	(17.6)
Private	227	(17.5)
Self-employed	594	(45.7)
Other	92	(7.1)
Monthly household income (Thai baht)		
≤ 15,000	238	(18.3)
15,001 – 30,000	457	(35.2)
30,001 – 50,000	349	(26.9)
≥ 50,001	255	(19.6)

4.1.3 Smoking History of Family members and Friend

Table 4.3 presents the smoking history of family and friends of students. About 42% had at least one family member who smoked, but more than half (54.1%) had a friend who smoked.

Table 4.3: Smoking history of family members and friend (n=1,299)

Smoking status	Total	
	n	(%)
Family members smokes		
No	757	(58.3)
Yes	542	(41.7)
Friend smokes		
No	596	(45.9)
Yes	703	(54.1)

4.1.4 Background Information about Smoking among Smokers

The prevalence of smoking among students was 28.2%; of these 61.5% (n=225) were current smokers and 38.5% (n=141) were former smokers. Table 4.4 shows the smoking behaviour among current smokers. The youngest age to start smoking was 8 years old. 62.0% of them had started smoking before 18 years old and the average age at smoking initiation was 16 years old. About half (52%) smoked normal cigarettes and about two-thirds (63.4%) also smoked e-cigarettes. Nearly half (48.6%) smoke tobacco products 2-5 pieces per day and 30.9% spent around 300-500 baht on smoking products per month. 73.7% reported that they purchased smoking products by themselves followed by 25.4% from a friend. Most smoked outside campus (87.1%). Regarding the reasons for initiating smoking, 75.6% said that their decision was their own (stressful situations, to look stylish, curiosity and for fun) while 17.3% said that they were influenced by their peers. More than half (64.9%) of current smokers had tried to quit smoking.

Table 4.4: Smoking history among current smokers

Smoking history	n	%
Smoking starting age (n=205)		
< 18 years	127	62.0
≥ 18 years	78	38.0
Mean = 16.60, SD = 2.332, Range = 8 – 24		
Type of smoking products used (n=223)		
Cigarette	117	52.5
Kretek / clove	2	0.9
Hand – rolled tobacco	13	5.8
Curut / cigarillo	34	15.2
Other	57	25.6
Other types of smoking products used (n=224)		
Pipe	6	2.7
Shisha / hookah	6	2.7
Bidis	6	2.7
E-cigarette	142	63.4
Vape	30	13.4
None of the above	34	15.2
Number of smoked per day (n=214)		
Less than 1 piece	37	17.3
1 piece	31	14.5
2 – 5 pieces	104	48.6
6 – 10 pieces	23	10.7
11 – 20 pieces	14	6.5
21 – 30 pieces	2	0.9
More than 30 pieces	3	1.4
Expenditure on smoking product per month (n=223)		
≤ 100 Baht	42	18.8
101 – 300 Baht	54	24.2
301 – 500 Baht	69	30.9
≥ 501 Baht	39	17.5
I never bought it	19	8.5
Location where smoked (n=224)		
Inside campus	29	12.9
Outside campus	195	87.1
Source of smoking products (n=224)		
I bought it	165	73.7
Took from parents	1	0.4
Took from Siblings	1	0.4
Took from friends	57	25.4
Factors that influenced smoking (n=225)		
Self	170	75.6
Peer	39	17.3
Family	5	2.2
Other	11	4.9
Tried to quit smoking (n=225)		
Yes	146	64.9
No	79	35.1

Table 4.5 shows the response from current smokers to the questionnaire on smoking practice. 62.2% never sought the advice of a physician to quit smoking (statement number 6) and 58.2% never received cigarettes as a gift (statement number 10). 5.8% always only smoked local brands of cigarettes (statement number 7), and 8.9% always smoked imported brands of cigarettes (statement number 9).

Table 4.5: Smoking practice among current smokers

No	Statements	Never	Sometimes	Always
		n (%)	n (%)	n (%)
1	I was drawn into smoking by someone who I looked up to and respected who is a smoker (e.g. teacher, sports star, neighbour).	99 (44.0)	125 (55.6)	1 (0.4)
2	I started smoking after accepting a challenge or bet from a friend.	92 (40.9)	125 (55.6)	8 (3.6)
3	I started smoking before enrolment in a school/university.	42 (18.7)	147 (65.3)	36 (16.0)
4	I use other forms of smoking products to quit smoking (e.g. vape, shisha).	62 (27.6)	132 (58.7)	31 (13.8)
5	I was encouraged by someone to quit smoking (e.g. parents, teachers, boyfriend, girlfriend).	48 (21.3)	145 (64.4)	32 (14.2)
6	I had sought the advice of the physician to quit smoking before.	140 (62.2)	84 (37.3)	1 (0.4)
7	I only smoke local brand of cigarettes.	38 (16.9)	174 (77.3)	13 (5.8)
8	I started smoking after enrolment in a school/university.	68 (30.2)	138 (61.3)	19 (8.4)
9	I smoke imported brand of cigarettes.	39 (17.3)	166 (73.8)	20 (8.9)
10	I had/often received cigarettes as a gift.	131 (58.2)	92 (40.9)	2 (0.9)
11	I habitually smoked at public places (e.g. recreational park, school, government building).	61 (27.1)	149 (66.2)	15 (6.7)
12	I only smoked at home.	69 (30.7)	141 (62.7)	15 (6.7)
13	I also smoked at home.	55 (24.4)	145 (64.4)	25 (11.1)
14	I smoke first thing in the morning.	80 (35.6)	137 (60.9)	8 (3.6)

Table 4.6 shows the smoking behaviour among former smokers. The mean age of smoking initiation was 16 years and 64.1% started smoking before 18 years of age.

Nearly 90% attempted 1-5 times to quit smoking successfully. 97.0% said that they stopped smoking on their own and 94.2% successfully quit abruptly.

Table 4.6: Smoking history among former smokers

Smoking history	n	%
Smoking starting age (n=128)		
< 18 years	82	64.1
≥ 18 years	46	35.9
Mean = 16.09, SD = 3.036, Range = 7–22 years		
Number of quit attempts (Time) (n=95)		
1 – 5	85	89.5
6 – 10	6	6.3
11 – 15	1	1.1
16 and more	3	3.2
Source of getting help to quit smoking (n=105)		
On own	102	97.0
Government clinics	1	1.0
Other clinics	1	1.0
Other	1	1.0
Method used to quit smoking (n=104)		
Abruptly (without any help)	98	94.2
Counseling	3	2.9
Medications	1	1.0
Other	2	1.9

4.1.5 Feeling toward Stop Smoking

The feeling toward stop smoking among all students is presented in Table 4.7. Of 1,299 students, 42.0% knew that their university became a smoke-free campus while 36.6% were unaware. 46.5% knew that the smoke-free policy in their campus is limited to designated areas, 48.0% knew the “say no” campaign by the government and 45.7% believed that the “say no” campaign would achieve only marginal success.

Table 4.7: Feeling toward stop smoking

Statements	Smokers (n=366)		Non-smokers (n=933)		Total (n=1,299)	
	n	(%)	n	(%)	n	(%)
Aware university become smoke-free campus						
Yes	174	(47.5)	371	(39.8)	545	(42.0)
No	135	(36.9)	340	(36.4)	475	(36.6)
Not sure	57	(15.6)	222	(23.8)	279	(21.5)
Know to what extent the smoke-free policy in campus is covered.						
Prohibited to entire campus	91	(24.9)	244	(26.2)	335	(25.8)
Limited to designated areas	182	(49.7)	422	(45.2)	604	(46.5)
Not sure	93	(25.4)	267	(28.6)	360	(27.7)
Aware of the "say no" campaign by the government						
Yes	194	(53.0)	429	(46.0)	623	(48.0)
No	112	(30.6)	219	(23.5)	331	(25.5)
Not sure	60	(16.4)	285	(30.5)	345	(26.6)
Success of the "say no" campaign						
Unsuccessful	75	(20.7)	95	(10.3)	170	(13.1)
Marginal	181	(49.9)	413	(44.7)	594	(45.7)
Fully successful	85	(23.4)	323	(35.0)	408	(31.4)
Excellent	14	(3.9)	57	(6.2)	71	(5.5)
Outstanding	8	(2.2)	36	(3.9)	44	(3.4)

4.2 Factor Analysis

Exploratory Factor Analysis (EFA) using principal factor analysis with varimax rotation was conducted in factoring the 52-items scale (KAP questions) which consists of 20-items knowledge toward smoking, 20-items attitude toward smoking, and 12-items of practice toward smoking. This study used a factor loading estimates higher than 0.30 as a benchmark to indicate a reasonable loading for the items extracted (Amiri et al., 2017; Ghasemi et al., 2012; Sasanfar et al., 2019). Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy index was set at 0.70 and above and Bartlett's test of Sphericity should be significant (*p-value* < 0.05) (Hair et al., 2006). Both statistical measures were used to assess the suitability in performing factor analysis.

4.2.1 Exploratory Factor Analysis

EFA was performed on the 52-items of KAP domains. In the validation process of EFA, three items (i.e. A cigarette contains more than 4,000 kinds of chemical materials, Counseling provided by quit-smoking clinic is helpful, and Nicotine in cigarettes can cause addiction) with poor factor loadings of less than 0.30 were deleted. Table 4.8 shows the result for the KAP domains. There were 10 factors extracted representing 56.85% of the total variance explained and these 10 factors had eigenvalues greater than 1. The KMO value for all items was 0.88, which was above 0.70. Bartlett's test was significant for all variables. Both of these measures indicated that the data were appropriate for factor analysis. The ten factors for KAP domains used in further analyses are shown in Table 4.8.

Table 4.8: Exploratory Factor Analysis for Knowledge, Attitude and Practice toward smoking

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7	Domain 8	Domain 9	Domain 10	Cronbach's alpha
Knowledge Domains											
Cigarette content											0.64
Tar level in cigarettes is a factor that influences lung cancer incidence.	0.665										
A cigarette contains 40 materials that can cause cancer	0.638										
Smoking can cause lung cancer.	0.598										
Tar is harmful to the body.	0.531										
Inhaling cigarette smoke from other smokers can affect the health.	0.503										
Carbon Monoxide is harmful to the body.	0.391										
Treatment for smokers											0.56
Switching to smokeless tobacco can help to reduce smoking		0.744									
Nicotine replacement therapy can be effective to reduce smoking.		0.663									
Having more anti-smoking campaign can influence smokers to quit smoking.		0.583									
Smoking can cause stroke		0.403									
Distal effects of smoking on other systems											0.62
Pregnant women who smoke can cause complications to their pregnancy			0.696								
Nicotine is harmful to the body.			0.680								
Smoking cigarettes can cause health disorders			0.604								
Smoking can cause premature birth.			0.572								

Table 4.8, continued

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7	Domain 8	Domain 9	Domain 10	Cronbach's alpha
Direct effects of smoking on mouth, nose, throat, and lungs											0.50
Smoking can cause throat cancer.				0.696							
Smoking can cause oral cancer.				0.683							
Smoking can cause a person to cough and get rhinorrhea.				0.530							
Attitude Domains											
Anti-smoking attitudes											0.89
Cigarette and tobacco should not be sold in Thailand for the next 10 years.					0.814						
There should be fewer places where cigarettes and tobacco can be sold.					0.795						
Tobacco companies should not be allowed to promote cigarettes and tobacco with cool-looking packaging.					0.780						
Chemical in cigarette can increase the chances of getting cancer (e.g. tar and nicotine).					0.765						
Cigarette and tobacco should be made more expensive so that children and young people cannot afford it.					0.742						
I want to live in a country where no one smokes.					0.712						
Smoking should be banned in all outdoor places where young people frequently go.					0.706						
Some religion forbids smoking.					0.590						
Positive perceptions about smoking											0.86
Smoking helps people to relax.						0.788					
Smoking helps to increase concentration in studies.						0.763					

Table 4.8, continued

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7	Domain 8	Domain 9	Domain 10	Cronbach's alpha
Smoking helps people forget their worries.						0.756					
Smoking is a way to express individual independence.						0.722					
Smoking a few cigarettes will not damage my health condition.						0.694					
Smoking does not influence my grades/CGPA.						0.660					
Smoking makes people look more grown-up and mature.						0.636					
Many of my friends encouraged me to try smoking						0.508					
Negative perceptions on quit smoking											0.34*
It will be difficult to quit once people have started smoking.							0.651				
The desire to smoke is difficult to overcome.							0.617				
Smoking can be stopped if you wanted to.							-0.577				
Disease cure and elderly											0.41*
Smoking is only dangerous to elderly people.								0.757			
Smoking related diseases can easily be cured.								0.468			
Practice Domains											
Positive preventive practice											0.92
I encourage smokers to quit smoking as soon as possible.									0.854		
I advise my family and friends not to start smoking									0.842		

Table 4.8, continued

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7	Domain 8	Domain 9	Domain 10	Cronbach's alpha
I talked to and shared with others about smoking hazards.									0.839		
I am urging parents to quit smoking.									0.814		
I recommend smokers to reduce the number of cigarettes they smoke.									0.781		
I advise smokers to seek physician advise to quit smoking.									0.750		
I participate as a volunteer in any of the "no-smoking" programme.									0.638		
I am involved in training and helping people to quit smoking.									0.595		
I am coaxing teachers to quit smoking.									0.572		
Negative practice											0.77
I offer cigarettes as a gift.										0.620	
I liked the smell of cigarette and thought the taste would be a pleasant experience.										0.590	

Note: * Cronbach's alpha < 0.50

Table 4.9: The ten factors for KAP domains

	Domain	No. of Items	Code	Name
Knowledge domains	1	6	KDom1	Cigarette content
	2	4	KDom2	Treatment for smokers
	3	4	KDom3	Distal effects of smoking on other systems
	4	3	KDom4	Direct effects of smoking on mouth, nose, throat, and lungs
Attitude domains	5	8	ADom5	Anti-smoking attitudes
	6	8	ADom6	Positive perceptions about smoking
	7	3	ADom7	Negative perceptions on quit smoking
	8	2	ADom8	Disease cure and elderly
Practice domains	9	9	PDom9	Positive preventive practice
	10	2	PDom10	Negative practice

4.2.2 Reliability Analysis

The Cronbach's alpha (α) coefficient shows the internal consistency of each domain. The domains with Cronbach's alpha values of 0.50 or higher were retained for subsequent data analysis (Hinton et al., 2004). The results in Table 4.8 indicates that negative perceptions on quit smoking (Domain 7) and disease cure and elderly (Domain 8) were dropped from the analysis due to a low Cronbach's alpha value ($\alpha < 0.50$). Therefore, there were eight factors for KAP domains used for the subsequent analysis.

For a better understanding of the result of the KAP domains, the total raw scores of each domain were proportionately transformed to 0–100 (Amiri et al., 2017; Sasanfar et al., 2019).

Prior to running a further analysis, the normality test was conducted using Kolmogorov-Smirnov test as shown in Table 4.10. Based on the result, all KAP domains did not meet the normality assumption (*p-value* < 0.05). Therefore, non-parametric measure that is Spearman rank correlation was used to assess how well the monotonic relationship between two variables at a time.

Table 4.10: Test of normality

Domains	Kolmogorov-Smirnov		
	Statistic	df	Sig.
KDom1	0.491	1299	< 0.001
KDom2	0.272	1299	< 0.001
KDom3	0.394	1299	< 0.001
KDom4	0.448	1299	< 0.001
ADom5	0.084	1299	< 0.001
ADom6	0.071	1299	< 0.001
PDom9	0.111	1299	< 0.001
PDom10	0.394	1299	< 0.001

Table 4.11 shows the Spearman's correlation coefficient between KAP domains. As shown in the table, the correlations between each of the domains were low.

Table 4.11: Correlation coefficients among KAP domains

	KDom1	KDom2	KDom3	KDom4	ADom5	ADom6	PDom9	PDom10
Cigarette content (KDom1)	1.00							
Treatment for smokers (KDom2)	0.24	1.00						
Distal effects of smoking on other systems (KDom3)	0.27	0.30	1.00					
Direct effects of smoking on mouth, nose, throat, and lungs (KDom4)	0.29	0.32	0.22	1.00				
Anti-smoking attitudes (ADom5)	0.16	-0.04	-0.06	0.10	1.00			
Positive perceptions about smoking (ADom6)	0.04	-0.12	0.07	-0.05	0.16	1.00		
Positive preventive practice (PDom9)	-0.06	-0.04	-0.004	-0.04	0.17	-0.03	1.00	
Negative practice (PDom10)	0.18	-0.13	0.05	0.02	0.32	0.47	-0.29	1.00

4.2.3 Descriptive Statistic of Knowledge, Attitudes and Practice toward smoking

According to the result of EFA for KAP domains, there were 17 questions of smoking-related knowledge domains, 16 questions of smoking-related attitude domains, and 11 questions of smoking-related practice domains will be used for the subsequent analysis.

4.2.3.1 Knowledge toward smoking

The results as shown in Table 4.12 present the percentage of students who answered each question about knowledge regarding smoking. Among them, 59.7% could answer correctly the statement number 7 “Switching to smokeless tobacco can help to reduce smoking”. There were 4 out of 17 statements on knowledge about smoking that showed more than 95% of students answered correctly. These are statement number 2 “A cigarette contains 40 materials that can cause cancer”, 95.5%; statement number 3 “Smoking can cause lung cancer”, 97.5%; statement number 5 “Inhaling cigarette smoke from other smokers can affect one’s health”, 97.9%, and statement number 6 “Carbon monoxide is harmful to the body”, 96.8%.

Table 4.12: Response to knowledge toward smoking

No.	Statements	Correct answer n (%)
	Cigarette content (KDom1)	
1	Tar level in cigarettes is a factor that influences lung cancer incidence.	1228 (94.5)
2	A cigarette contains 40 materials that can cause cancer.	**1240 (95.5)**
3	Smoking can cause lung cancer.	**1266 (97.5)**
4	Tar is harmful to the body.	1225 (94.3)
5	Inhaling cigarette smoke from other smokers can affect the health.	**1272 (97.9)**
6	Carbon Monoxide is harmful to the body.	**1257 (96.8)**
	Treatment for smokers (KDom2)	
7	Switching to smokeless tobacco can help to reduce smoking.	776 (59.7)
8	Nicotine replacement therapy can be effective to reduce smoking.	947 (72.9)
9	Having more anti-smoking campaign can influence smokers to quit smoking.	1011 (77.8)
10	Smoking can cause stroke.	1139 (87.7)
	Distal effects of smoking on other systems (KDom3)	
11	Pregnant women who smoke can cause complications to her pregnancy.	1187 (91.4)
12	Nicotine is harmful to the body.	1154 (88.8)
13	Smoking cigarettes can cause health disorders.	1194 (91.9)
14	Smoking can cause premature birth.	1013 (78.0)
	Direct effects of smoking on mouth, nose, throat, and lungs (KDom4)	
15	Smoking can cause throat cancer.	1205 (92.8)
16	Smoking can cause oral cancer.	1211 (93.2)
17	Smoking can cause a person to cough and get rhinorrhoea.	1045 (80.5)

4.2.3.2 Attitude toward smoking

Smoking-related attitude was measured with 16 questions. If it was a negative question, scoring was performed in reverse order prior to analysis. All the responses were categorized into three groups according to Bloom's classification (Mondal et al., 2014).

- Not inclined to smoking (> 80% of the value) : 6 – 7
- Neutral (60 – 80% of the value) : 4 – 5
- Inclined to smoking (< 60% of the value) : 1 – 3

The results as shown in Table 4.13 stated the percentage of students' attitude toward each question regarding smoking. There were 6 out of 16 statements that revealed over 50% of the students were not inclined to smoking. These were statement number 4 "Chemical in cigarette can increase the chances of getting cancer (e.g. tar and nicotine)", 63.0%; statement number 10 "Smoking helps to increase concentration in studies", 55.7%; statement number 12 "Smoking is a way to express individual independence", 53.0%; statement number 13 "Smoking a few cigarettes will not damage my health condition", 53.7%; statement number 15 "Smoking makes people look more grown-up and mature", 62.0%, and statement number 16 "Many of my friends encouraged me to try smoking (e.g. peers, classmates)", 75.4%.

Table 4.13: Response to attitude toward smoking

No.	Statements	Not inclined to smoking n (%)	Neutral n (%)	Inclined to smoking n (%)
	Anti-smoking attitudes (ADom5)			
1	Cigarette and tobacco should not be sold in Thailand for the next 10 years.	541 (41.6)	513 (39.5)	245 (18.9)
2	There should be fewer places where cigarettes and tobacco can be sold.	641 (49.3)	438 (33.7)	220 (16.9)
3	Tobacco companies should not be allowed to promote cigarettes and tobacco with cool-looking packaging.	610 (47.0)	436 (33.6)	253 (19.5)
4	Chemical in cigarette can increase the chances of getting cancer (e.g. tar and nicotine).	**818 (63.0)**	297 (22.9)	184 (14.2)
5	Cigarette and tobacco should be made more expensive so that children and young people cannot afford it.	617 (47.5)	434 (33.4)	248 (19.1)
6	I want to live in a country where no one smokes.	551 (42.4)	477 (36.7)	271 (20.9)
7	Smoking should be banned in all outdoor places where young people frequently go.	633 (48.7)	394 (30.3)	272 (20.9)
8	Some religion forbids smoking.	327 (25.2)	670 (51.6)	302 (23.2)
	Positive perceptions about smoking (ADom6)			
9	Smoking helps people to relax.	475 (36.6)	532 (41.0)	292 (22.5)
10	Smoking helps to increase concentration in studies.	**723 (55.7)**	454 (34.9)	122 (9.4)
11	Smoking helps people forget their worries.	513 (39.5)	494 (38.0)	292 (22.5)
12	Smoking is a way to express individual independence.	**688 (53.0)**	456 (35.1)	155 (11.9)
13	Smoking a few cigarettes will not damage my health condition.	**698 (53.7)**	405 (31.2)	196 (15.1)
14	Smoking does not influence my grades/CGPA.	491 (37.8)	497 (38.3)	311 (23.9)
15	Smoking makes people look more grown-up and mature.	**805 (62.0)**	359 (27.6)	135 (10.4)
16	Many of my friends encouraged me to try smoking (e.g. peers, classmates).	**979 (75.4)**	236 (18.2)	84 (6.5)

4.2.3.3 Practice toward smoking

There were 11 questions that examined the respondents' preventive practice on smoking. If it was a negative question, scoring was performed in reverse order prior to analysis. All the responses were categorized into three groups according to Bloom's classification (Mondal et al., 2014).

- Good practice (> 80% of the value) : 6 – 7
- Moderate practice (60 – 80% of the value) : 4 – 5
- Poor practice (< 60% of the value) : 1 – 3

The results as shown in Table 4.14 present the percentage of students' practice toward each question regarding smoking. There were 2 out of 11 statements revealed over 70% of the students have good preventive practice toward smoking. These are statement number 10 "I offer cigarettes as a gift", 84.1% and statement number 11 "I liked the smell of cigarette and thought the taste would be a pleasant experience", 78.0%. However, more than 70% of the students have a poor preventive practice toward smoking on 4 out of 11 statements related to practice. There are statement number 6 "I advise smokers to seek physician advise to quit smoking.", 72.7%; statement number 7 "I participate as a volunteer in one of the "no-smoking" programme", 79.1%; statements number 8 "I am involved in training and helping people to quit smoking", 79.8%, and statement number 9 "I am coaxing teachers to quit smoking", 82.4%

Table 4.14: Response to practice toward smoking

No.	Statements	Poor		Moderate		Good	
		n	(%)	n	(%)	n	(%)
	Positive preventive practice (PDom9)						
1	I encourage smokers to quit smoking as soon as possible.	738	(56.8)	357	(27.5)	204	(15.7)
2	I advise my family and friends not to start smoking	761	(58.6)	310	(23.9)	228	(17.6)
3	I talked to and shared with others about smoking hazards.	744	(57.3)	385	(29.6)	170	(13.1)
4	I am urging parents to quit smoking.	810	(62.4)	264	(20.3)	225	(17.3)
5	I recommend smokers to reduce the number of cigarettes they smoke.	754	(58.0)	378	(29.1)	167	(12.9)
6	I advise smokers to seek physician advice to quit smoking.	**945**	**(72.7)**	251	(19.3)	103	(7.9)
7	I participate as a volunteer in any of the "no-smoking" programme.	**1027**	**(79.1)**	212	(16.3)	60	(4.6)
8	I am involved in training and helping people to quit smoking.	**1036**	**(79.8)**	197	(15.2)	66	(5.1)
9	I am coaxing teachers to quit smoking.	**1070**	**(82.4)**	174	(13.4)	55	(4.2)
	Negative practice (PDom10)						
10	I offer cigarettes as a gift.	53	(4.1)	153	(11.8)	**1093**	**(84.1)**
11	I liked the smell of cigarette and thought the taste would be a pleasant experience.	80	(6.2)	206	(15.9)	**1013**	**(78.0)**

4.2.3.4 Overall Level of Knowledge, Attitude, and Practice toward smoking

The total score of knowledge has the possible minimum of 0 – 17 and the scores were categorized into three groups according to Bloom's classification (Mondal et al., 2014).

- Good knowledge (> 80% of the value) : 14 – 17
- Average knowledge (60 – 80% of the value) : 11 – 13
- Poor knowledge (< 60% of the value) : 0 – 10

The total score of attitude has the possible minimum of 1 – 112 and the scores were categorized into three groups according to Bloom's classification.

- Not inclined to smoking (> 80% of the value) : 91 – 112
- Neutral (60 – 80% of the value) : 67 – 90
- Inclined to smoking (< 60% of the value) : 1 – 66

The total score of practice has the possible minimum of 1 – 77 and the scores were categorized into three groups according to Bloom's classification.

- Good practice (> 80% of the value) : 62 – 77
- Moderate practice (60 – 80% of the value) : 47 – 61
- Poor practice (< 60% of the value) : 1 – 46

Research objective 2: To examine the general level of knowledge, attitude and practice with regards to smoking among university students in Thailand.

To answer the research objective 2, Table 4.15 shows the overall percentage and mean score of knowledge, attitude, and practice toward smoking. 75.3% of students had a high knowledge about smoking and the mean score was 14.91. 49.5% had neutral attitude toward smoking and the mean score was 81.19. 79.0% of students had poor preventive practice toward smoking and the mean score was 37.19.

Table 4.15: Summary of knowledge, attitude and practice toward smoking (n=1,299)

Domain	Total		Mean (SD)
	n	(%)	
Knowledge			14.91 (2.17)
Low	47	(3.6)	
Average	274	(21.1)	
High	978	(75.3)	
Attitude			81.19 (15.03)
Not inclined to smoking	408	(31.4)	
Neutral	643	(49.5)	
Inclined to smoking	248	(19.1)	
Practice			37.19 (12.08)
Poor	1026	(79.0)	
Moderate	222	(17.1)	
Good	51	(3.9)	

4.3 Associations between Demographic characteristics, Socioeconomic status, Smoking history of Family members and Friend, and Smoking status

Table 4.16 presents the association between smoking status and selected variables. The results revealed that gender, age groups, field of study, place of residence, family member smokes, friend smokes, and attitude toward smoking were significantly associated with smoking status.

Table 4.16: Association between selected variables and smoking status

Selected variables	Smokers		Non-smokers		p-value
	n	(%)	n	(%)	
Overall	366	(28.2)	933	(71.8)	
Gender					**< 0.001**[b]
Male	280	(76.5)	361	(38.7)	
Female	86	(23.5)	572	(61.3)	
Age groups (years)					**< 0.001**[a]
18 – 20	215	(58.7)	653	(70.0)	
21 – 22	116	(31.7)	237	(25.4)	
≥ 23	35	(9.6)	43	(4.6)	
Field of study					**< 0.001**[b]
Science	194	(53.0)	593	(63.6)	
Non-science	172	(47.0)	340	(36.4)	
Place of residence					**< 0.001**[b]
On campus	107	(29.2)	385	(41.3)	
Off campus	259	(70.8)	548	(58.7)	
Original place of residence					1.000[b]
Rural	198	(54.1)	505	(54.1)	
Urban	168	(45.9)	428	(45.9)	
Father's education level					0.831[a]
No formal education	15	(1.4)	41	(4.4)	
Primary school	58	(15.8)	167	(17.9)	
Secondary school	137	(37.4)	339	(36.3)	
College/university	156	(42.6)	386	(41.4)	
Mother's education level					0.782[a]
No formal education	13	(3.6)	32	(3.4)	
Primary school	71	(19.4)	205	(22.0)	
Secondary school	134	(36.6)	326	(34.9)	
College/university	148	(40.4)	370	(39.7)	
Father's occupation					0.617[a]
Not working	21	(5.7)	67	(7.2)	
Government	79	(21.6)	183	(19.6)	
Private	75	(20.5)	184	(19.7)	
Self-employed	150	(41.0)	410	(43.9)	
Other	41	(11.2)	89	(9.5)	

Table 4.16, continued

Selected variables	Smokers		Non-smokers		p-value
	n	(%)	n	(7%)	
Mother's occupation					0.266[a]
Not working	48	(13.1)	109	(11.7)	
Government	51	(13.9)	178	(19.1)	
Private	67	(18.3)	160	(17.1)	
Self-employed	171	(46.7)	423	(45.3)	
Other	29	(7.9)	63	(6.8)	
Monthly household income (Thai baht)					0.207[a]
≤ 15,000	61	(16.7)	177	(19.0)	
15,001 – 30,000	120	(32.8)	337	(36.1)	
30,001 – 50,000	101	(27.6)	248	(26.6)	
≥ 50,001	84	(23.0)	171	(18.3)	
Family member smokes					**< 0.001[b]**
No	165	(45.1)	592	(63.5)	
Yes	201	(54.9)	341	(36.5)	
Friend smokes					**< 0.001[b]**
No	59	(16.1)	537	(57.6)	
Yes	307	(83.9)	396	(42.4)	
Knowledge					0.276[a]
Low	18	(4.9)	29	(3.1)	
Average	74	(20.2)	200	(21.4)	
High	274	(74.9)	704	(75.5)	
Attitude					**< 0.001[a]**
Not inclined to smoking	43	(11.7)	365	(39.1)	
Neutral	179	(48.9)	464	(49.7)	
Inclined to smoking	144	(39.3)	104	(11.1)	
Practice					
Poor	309	(84.4)	717	(76.8)	**0.007[a]**
Moderate	49	(13.4)	173	(18.5)	
Good	8	(2.2)	43	(4.6)	

Note: [a] Pearson's chi-square test, [b]Fisher's exact test.

4.4 Multiple Logistic Regression Analysis

Research objective 3: To identify factors associated with smoking status among university students in Thailand.

For the third research objective, the researcher aimed to find the relationship between the demographic characteristics, socioeconomic status, smoking history of family and friend, and smoking status. The relationship between the smoking status and

the selected independent variables were examined though multiple logistic regression. Since all the selected independent variables were categorical variables, the dummy variables were created as shown in Table 4.17–4.20

Table 4.17: Dummy variable demographic characteristics

Variable	Dummy variable	Parameter Code	
		1	2
Gender	Female (Ref.)	0	
	Male	1	
Age groups (years)	18 – 20 (Ref.)	0	0
	21 – 22	1	0
	≥ 23	0	1
Field of study	Science (Ref.)	0	
	Non-science	1	
Place of Residence	On campus (Ref.)	0	
	Off campus	1	
Original place of residence	Rural (Ref.)	0	
	Urban	1	

Table 4.18: Dummy variable socioeconomic status

Variable	Dummy variable	Parameter Code			
		1	2	3	4
Father's education level	No formal education (Ref.)	0	0	0	
	Primary school	1	0	0	
	Secondary school	0	1	0	
	College / university	0	0	1	
Mother's education level	No formal education (Ref.)	0	0	0	
	Primary school	1	0	0	
	Secondary school	0	1	0	
	College / university	0	0	1	
Father's occupation	Other (Ref.)	0	0	0	0
	Not working	1	0	0	0
	Government	0	1	0	0
	Private	0	0	1	0
	Self-employed	0	0	0	1
Mother's occupation	Other (Ref.)	0	0	0	0
	Not working	1	0	0	0
	Government	0	1	0	0
	Private	0	0	1	0
	Self-employed	0	0	0	1
Monthly household income (Thai baht)	≤ 15,000 (Ref.)	0	0	0	
	15,001 – 30,000	1	0	0	
	30,001 – 50,000	0	1	0	
	≥ 50,001	0	0	1	

Table 4.19: Dummy variable smoking history of family members and friend

Variable	Dummy variable	Parameter Code	
		1	2
Family members smokes	No (Ref.)	0	
	Yes	1	
Friend smokes	No (Ref.)	0	
	Yes	1	

Table 4.20: Dummy variable knowledge and attitude toward smoking

Variable	Dummy variable	Parameter Code	
		1	2
Knowledge	Low (Ref.)	0	0
	Average	1	0
	High	0	1
Attitude	Not inclined to smoking (Ref.)	0	0
	Neutral	1	0
	Inclined to smoking	0	1

All the factors above were included in the multiple logistic regression model. The factors were selected to the reduced model using a backward elimination method. The results of final multiple logistic regression model are also presented as a graph of 95% confidence intervals using weighted sum contrasts to compare each proportion with overall proportion rather than with a specified reference group.

4.4.1 Multiple Logistic Regression Analysis of Factors Associated with Smoking

Table 4.21 presents the results of final multiple logistic regression model. Males were 3.58 (95% CI=2.61-4.92) times more likely to be smokers than females. Students who were aged between 21-22 years and aged 23 years and above were 1.47 (95% CI=1.06-2.05) times and 1.78 (95% CI=1.01-3.15) times more likely to be smokers than those aged less than 21 years. Compared to science students, those who were enrolled in the other fields were 1.35 (95% CI=1.00-1.81) times more likely to be smokes. Students living outside campus were 1.37 (95% CI=1.00-1.87) times more likely to be smokers

compared to those living inside campus. Students who had a family member (OR=2.02; 95% CI=1.50-2.71) or friend (OR=4.01; 95% CI=2.86-5.62) who smoked were more likely to be smokers. Finally, students who were inclined to smoking (OR=7.02; 95% CI=4.48-10.99) or had neutral attitude toward smoking (OR=2.17; 95% CI=1.46-3.22) were more likely to be smokers than those who were not inclined to smoking.

Table 4.21: Final Multiple Logistic Regression of Smoking status

Variables	β	SE	Adjusted odds ratio	95% CI	Wald test (p-value)
Constant	-4.251	0.268			< 0.001
Gender					
(Ref.= Female)					
Male	1.275	0.162	3.58	(2.61 – 4.92)	< 0.001
Age groups (years)					
(Ref.=18 – 20)					
21 – 22	0.387	0.169	1.47	(1.06 – 2.05)	0.022
≥ 23	0.576	0.291	1.78	(1.01 – 3.15)	0.047
Field of study					
(Ref.= Science)					
Non-science	0.299	0.151	1.35	(1.00 – 1.81)	0.048
Place of Residence					
(Ref.= On campus)					
Off campus	0.316	0.159	1.37	(1.00 – 1.87)	0.046
Family member smokes					
(Ref.= No)					
Yes	0.701	0.151	2.02	(1.50 – 2.71)	< 0.001
Friend smokes					
(Ref.= No)					
Yes	1.388	0.172	4.01	(2.86 – 5.62)	< 0.001
Attitude					
(Ref.= Not inclined to smoking)					
Neutral	0.775	0.201	2.17	(1.46 – 3.22)	< 0.001
Inclined to smoking	1.949	0.229	7.02	(4.48 – 10.99)	< 0.001

In the model diagnostic test (Table 4.22), Nagelkerke R^2 showed the percentage of variation in the outcome variable (smoking status) that was explained by the models was 39.4%. The p-value of Hosmer and Lemeshow (H-L) goodness of fit test for the model was more than 5% level, thus suggests the model is a good fit to the data. In

addition, the overall classification accuracy of the model showed 80.2% of the cases were correctly classified by the model. The tolerance values ranged from 0.93 to 0.98, which are greater than 0.10, and the Variance Inflation Factor (VIF) values ranged from 1.02 to 1.07, which are less than 10.0. Both of these measures indicated that there is no multicollinearity existence among the independent variables include in the regression model (Menard, 1995).

Table 4.22: Model Diagnostic Results of Final Multiple Logistic Regression

Statistical Test	Value of Test Statistic	df	p-value
Nagelkerke R^2	0.394		
Hosmer and Lemesshow test	11.833	8	0.159
Overall classification	80.2%		

Figure 4.1 shows the receiver operation characteristic (ROC) curves for the logistic model. The ROC curves for model with nine independent dummy variables were drawn in the black line. The diagonal line represents the null model. The other nine lines represent the ROC curves for model with each independent dummy variable. The ROC curve examines the predictive ability of the fitted model. For a fitted model to be accepted as having predictive power, the area under the ROC curve (AUC) must be higher than 0.50 (Hosmer et al., 2013).

The model with nine independent dummy variables gave an AUC of 0.83 which indicates that the model offers moderate predictive ability. The AUC of model with gender as a determinant was 0.38, the AUC of model with age group (21-22 years) as a determinant was 0.06, the AUC of model with age group (≥ 23 years) as a determinant was 0.50, and the AUC of model with field of study as a determinant was 0.11. The AUC of models with place of residence as a determinant was 0.12, the AUC of models with family member smokes as a determinant was 0.18, and the AUC of model with

friend smokes as a determinant was 0.41. The AUC of models with attitude (favorable) as a determinant was 0.29 and the AUC of models with attitude (equivocal) as a determinant was 0.008.

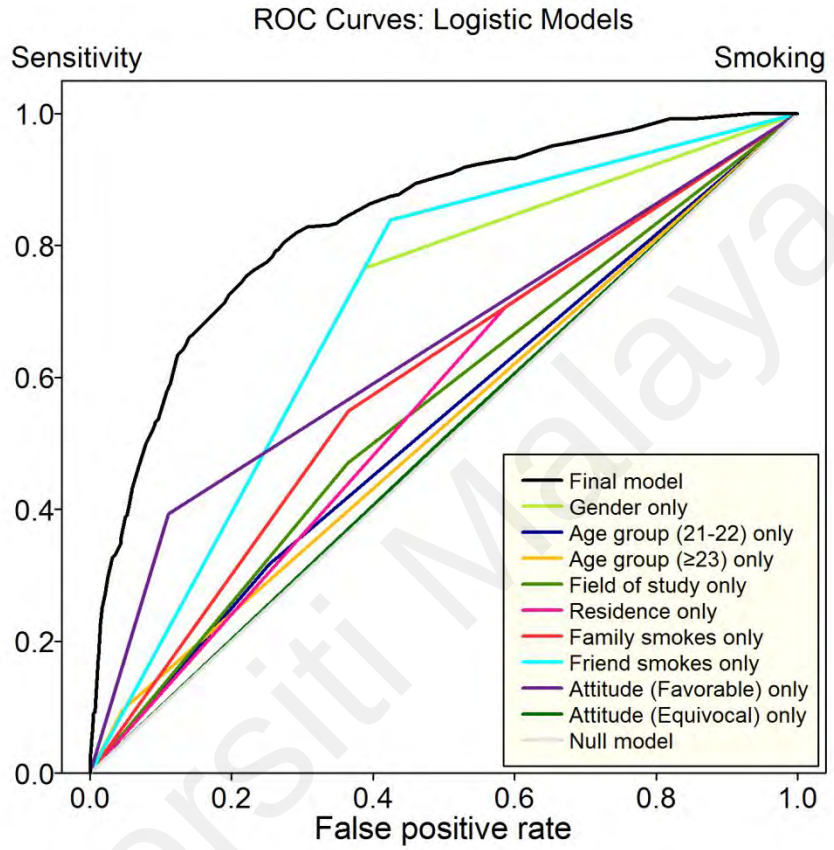

Figure 4.1: ROC curve for reduce model of smoking among respondents

Figure 4.2 displays a plot of the crude and adjusted smoking rates for each of factors after fitting the final multiple logistic regression model based on weighted sum contrasts. This method was used particularly to compare each proportion with the overall proportion rather than with a specified reference group (Tongkumchum & McNeil, 2009). The horizontal line defines the overall smoking rate (28.2%). The CI above or below the horizontal line represents groups that are greater than or lower than the overall smoking rate. In contrast, a CI that crosses the horizontal line indicates that there is no significant difference from the overall smoking rate. The results showed that

male students, students aged between 21-22 years, those majoring in non-science, staying outside campus, having a family or friend who smoked, and those being inclined to smoking had a significantly higher smoking rate compared to overall smoking rate.

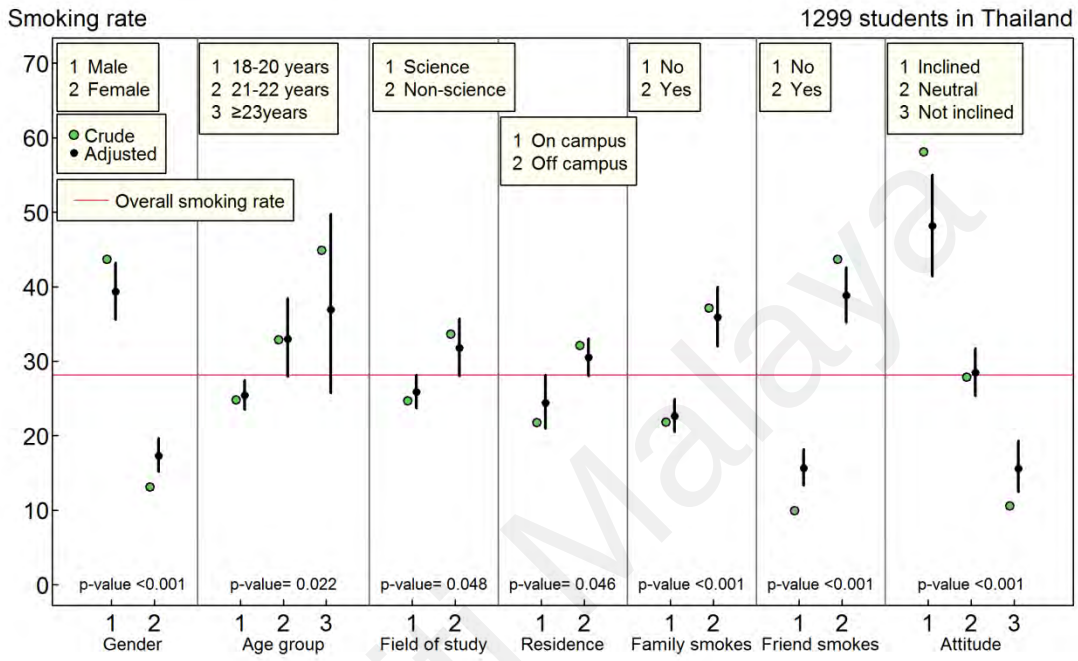

Figure 4.2: Crude percent of smoking and adjusted with 95% confidence intervals of smoking rate among 1,299 respondents

4.5 Associations between Demographic characteristics, Socioeconomic status, Smoking history of Family members and Friend, and Current smoking status

Table 4.23 presents the association between current smoking status and selected variables. The results revealed that gender, age groups, field of study, place of residence, family member smokes, friend smokes, attitude toward smoking, and practice toward smoking were significantly associated with current smoking status.

Table 4.23: Association between selected variables and current smoking status

Selected variables	Current smokers		Non-smokers		p-value
	n	(%)	n	(%)	
Overall	225	(17.3)	1074	(82.7)	
Gender					**< 0.001**[b]
Male	186	(82.7)	455	(42.4)	
Female	39	(17.3)	619	(57.6)	
Age groups (years)					**< 0.001**[a]
18 – 20	129	(57.3)	739	(68.8)	
21 – 22	71	(31.6)	282	(26.3)	
≥ 23	25	(11.1)	53	(4.9)	
Field of study					**0.007**[b]
Science	118	(52.4)	669	(62.3)	
Non-science	107	(47.6)	405	(37.7)	
Place of residence					**< 0.001**[b]
On campus	62	(27.6)	430	(40)	
Off campus	163	(72.4)	644	(60)	
Original place of residence					0.378[b]
Rural	128	(56.9)	575	(53.5)	
Urban	97	(43.1)	499	(46.5)	
Father's education level					0.589[a]
No formal education	12	(5.3)	44	(4.1)	
Primary school	35	(15.6)	190	(17.7)	
Secondary school	78	(34.7)	398	(37.1)	
College/university	100	(44.4)	442	(41.2)	
Mother's education level					0.187[a]
No formal education	13	(5.8)	32	(3.0)	
Primary school	43	(19.1)	233	(21.7)	
Secondary school	79	(35.1)	381	(35.5)	
College/university	90	(40)	428	(39.9)	
Father's occupation					0.931[a]
Not working	13	(5.8)	75	(7.0)	
Government	44	(19.6)	218	(20.3)	
Private	44	(19.6)	215	(20.0)	
Self-employed	99	(44.0)	461	(42.9)	
Other	25	(11.1)	105	(9.8)	
Mother's occupation					0.086[a]
Not working	26	(11.6)	131	(12.2)	
Government	28	(12.4)	201	(18.7)	
Private	37	(16.4)	190	(17.7)	
Self-employed	112	(49.8)	482	(44.9)	
Other	22	(9.8)	70	(6.5)	
Monthly household income (Thai baht)					0.732[a]
≤ 15,000	36	(16)	202	(18.8)	
15,001 – 30,000	83	(36.9)	374	(34.8)	
30,001 – 50,000	59	(26.2)	290	(27.0)	
≥ 50,001	47	(20.9)	208	(19.4)	
Family member smokes					**< 0.001**[b]
No	93	(41.3)	664	(61.8)	
Yes	132	(58.7)	410	(38.2)	

Table 4.23, continued

Selected variables	Current smokers n	(%)	Non-smokers n	(%)	p-value
Friend smokes					**< 0.001**[b]
No	21	(9.3)	575	(53.5)	
Yes	204	(90.7)	499	(46.5)	
Knowledge					0.504[a]
Low	11	(4.9)	36	(3.4)	
Average	45	(20.0)	229	(21.3)	
High	169	(75.1)	809	(75.3)	
Attitude					**< 0.001**[a]
Not inclined to smoking	117	(52.0)	131	(12.2)	
Neutral	99	(44.0)	544	(50.7)	
Inclined to smoking	9	(4.0)	399	(37.2)	
Practice					
Poor	195	(86.7)	831	(77.4)	**0.004**[a]
Moderate	27	(12.0)	195	(18.2)	
Good	3	(1.3)	48	(4.5)	

Note: [a] Pearson's chi-square test, [b]Fisher's exact test.

4.5.1 Multiple Logistic Regression Analysis of Factors Associated with Current smoking status

Table 4.24 presents the results of final multiple logistic regression model. Males were 4.41 (95% CI=2.71-6.31) times more likely to be smokers than females. Students whose mother was not working (OR=0.28; 95% CI=0.12-0.63) or employed in the government sector (OR=0.28; 95% CI=0.13-0.61) or private sector (OR=0.33; 95% CI=0.16-0.69) or was self-employed (OR=0.45; 95% CI=0.23-0.87) were less likely to be current smokers than those whose mother with other occupation categories. Students who had a family member (OR=2.10; 95% CI=1.47-3.01) or friend (OR=6.18; 95% CI=3.71-10.29) who smoked were more likely to be current smokers. Finally, students who had a favorable (OR=27.38; 95% CI=4.48-10.99) or equivocal attitude (OR=5.54; 95% CI=4.48-10.99) toward smoking were more likely to be current smokers than those who had an unfavorable attitude.

Table 4.24: Final Multiple Logistic Regression of Current smoking

Variables	β	SE	Adjusted odds ratio	95% CI	Wald test (p-value)
Constant	-5.184	0.503			
Gender					
(Ref.= Female)					
Male	1.420	0.215	4.14	(2.71 – 6.31)	< 0.001
Mother's occupation					
(Ref.= Other)					
Not working	-1.276	0.413	0.28	(0.12 – 0.63)	0.002
Government	-1.266	0.395	0.28	(0.13 – 0.61)	0.001
Private	-1.104	0.375	0.33	(0.16 – 0.69)	0.003
Self-employed	-0.800	0.337	0.45	(0.23 – 0.87)	0.017
Family member smokes					
(Ref.= No)					
Yes	0.743	0.183	2.10	(1.47 – 3.01)	< 0.001
Friend smokes					
(Ref.= No)					
Yes	1.821	0.260	6.18	(3.71 – 10.29)	< 0.001
Attitude					
(Ref.= Not inclined to smoking)					
Neutral	3.310	0.379	5.54	(1.46 – 3.22)	< 0.001
Inclined to smoking	1.711	0.367	27.38	(4.48 – 10.99)	< 0.001

In the model diagnostic test (Table 4.25), Nagelkerke R^2 showed the percentage of variation in the outcome variable (current smoking status) that was explained by the models was 44.8%. The p-value of Hosmer and Lemeshow (H-L) goodness of fit test for the model was more than 5% level, thus suggests the model is a good fit to the data. In addition, the overall classification accuracy of the model showed 86.9% of the cases were correctly classified by the model.

Table 4.25: Model Diagnostic Results of Final Multiple Logistic Regression

Statistical Test	Value of Test Statistic	df	p-value
Nagelkerke R^2	0.448		
Hosmer and Lemesshow test	3.243	8	0.918
Overall classification	86.9%		

Figure 4.3 displays a plot of the crude and adjusted current smoking rates for each of factors after fitting the final multiple logistic regression model based on weighted sum contrasts. The horizontal line defines the overall current smoking rate (17.3%). The results showed that male students, students whose mother with other occupation categories, having a family or friend who smoked, and those being inclined to smoking had a significantly higher current smoking rate compared to overall current smoking rate.

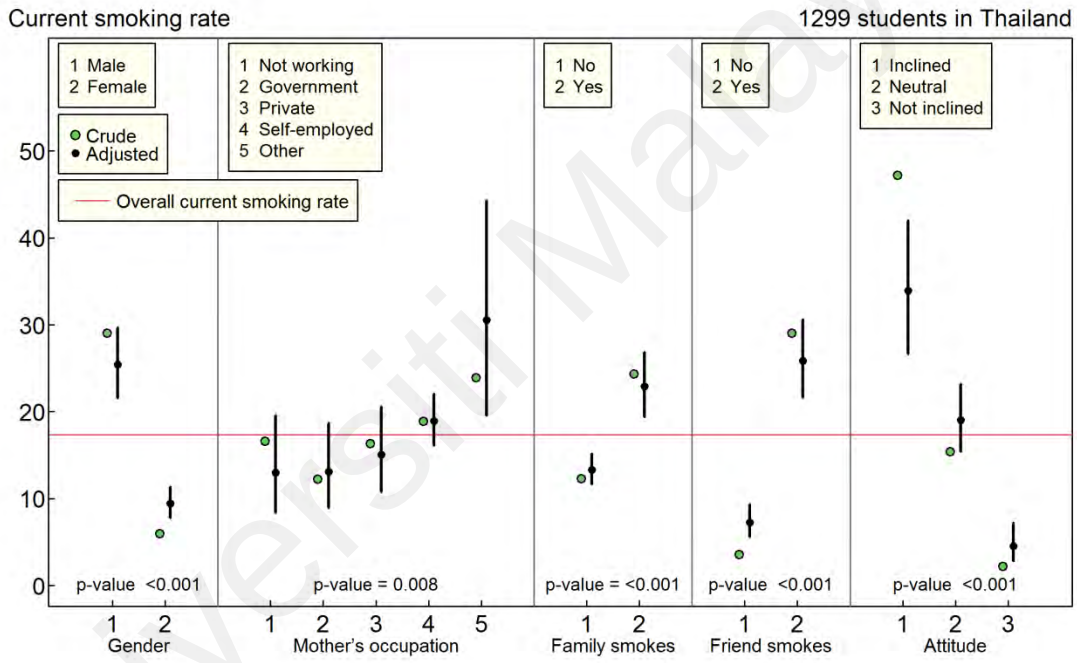

Figure 4.3: Crude percent of current smoking and adjusted with 95% confidence intervals of current smoking rate among 1,299 respondents

4.6 Comparative Analysis of Knowledge, Attitude and Practice (KAP Domains)

According to the result of EFA for KAP domains, eight factors for KAP domains were used for the subsequent analysis (see Section 4.2). Table 4.26 shows the summary of the overall mean score for each of the domains.

Table 4.26: Summary of the overall mean score for each of the domains

Domains	Min	Max	Mean	SD
KDom1	0	100	96.07	11.44
KDom2	0	100	74.54	27.94
KDom3	0	100	87.53	22.04
KDom4	0	100	88.81	21.49
ADom5	14.29	100	70.13	19.85
ADom6	14.29	100	39.43	17.17
PDom9	14.29	100	38.87	20.11
PDom10	14.29	100	23.56	16.80

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom5=Anti-smoking attitude, ADom6=Positive perceptions about smoking, PDom9=Positive preventive practice, PDom10=Negative practice

To investigate the relationship between selected independent variables and KAP domains, non-parametric tests were used to examine the differences between KAP domains across the demographic characteristics, socioeconomic status and smoking history of family member and friend, using Mann-Whitney U test for variables with two categories, and Kruskal-Wallis H test for variables with more than two categories.

4.6.1 Difference in Knowledge domains across demographic characteristics, socioeconomic status, and smoking history of family members and friend

Table 4.27 shows the comparison of mean score on four knowledge domains across demographic characteristic. Age group shows significant difference in knowledge about cigarette content. Students who were aged 23 years and above had lower mean score of knowledge about cigarette content compared to the other age groups. Additionally, there was a significant difference between males and females on

knowledge about treatment for smokers, where males were more knowledgeable with a higher mean score than females. In addition, field of study shows significant difference in knowledge about the distal effects of smoking on other systems, students who were studying science had a higher mean score of knowledge compared to non-science students.

Table 4.27: Knowledge domains across demographic characteristics

Demographic variables	KDom1 Mean (SD)	KDom2 Mean (SD)	KDom3 Mean (SD)	KDom4 Mean (SD)
Gender				
Male	95.22 (13.20)	76.64 (26.50)	86.12 (23.93)	88.56 (21.75)
Female	96.91 (9.36)	72.49 (29.15)	88.91 (19.95)	89.06 (21.25)
p-value	*0.072*	***0.019***	*0.127*	*0.636*
Age groups (years)				
18 – 20	96.66 (10.61)	73.96 (27.96)	88.31 (20.62)	88.10 (22.05)
21 – 22	95.37 (12.33)	75.28 (27.89)	86.90 (23.69)	90.18 (20.52)
≥ 23	92.74 (15.10)	77.56 (28.09)	81.73 (28.11)	90.6 (19.29)
p-value	***0.003***	*0.387*	*0.246*	*0.198*
Field of study				
Science	95.96 (11.69)	73.25 (28.50)	88.72 (20.78)	88.78 (21.33)
Non-science	96.26 (11.06)	76.51 (26.98)	85.69 (23.75)	88.87 (21.77)
p-value	*0.799*	*0.056*	***0.029***	*0.734*
Place of residence				
On campus	96.48 (10.80)	75.15 (27.43)	86.59 (23.78)	88.28 (22.12)
Off campus	95.83 (11.82)	74.16 (28.26)	88.10 (20.90)	89.14 (21.11)
p-value	*0.687*	*0.599*	*0.839*	*0.447*
Original place of residence				
Rural	96.35 (10.90)	75.00 (27.51)	87.87 (21.51)	89.00 (21.84)
Urban	95.75 (12.05)	73.99 (28.46)	87.12 (22.66)	88.59 (21.09)
p-value	*0.518*	*0.619*	*0.757*	*0.381*

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs

The results of the relationship between socioeconomic status with four knowledge domains are presented in Table 4.28. Only mother's occupation shows significant difference in knowledge about distal effects of smoking on other systems, students whose mother was employed in the private sector had a significantly lowest mean score of knowledge about distal effects of smoking on other systems, while those whose mother was self-employed reported the highest mean score. Students who had a father

with a college or university education had a significantly lower mean score of knowledge about direct effects of smoking on mouth, nose, throat, and lungs compared to other education groups.

Table 4.28: Knowledge domains across socioeconomic status

Demographic variables	KDom1 Mean (SD)	KDom2 Mean (SD)	KDom3 Mean (SD)	KDom4 Mean (SD)
Father's education level				
No formal education	95.83 (11.57)	75.00 (30.53)	79.02 (32.25)	94.64 (13.89)
Primary school	95.48 (12.72)	74.00 (29.72)	87.11 (20.88)	88.15 (21.54)
Secondary school	97.41 (8.25)	75.32 (28.05)	87.39 (23.54)	89.92 (21.22)
College / university	95.17 (13.09)	74.03 (26.85)	88.70 (19.59)	87.52 (22.25)
p-value	*0.070*	*0.707*	*0.205*	***0.031***
Mother's education level				
No formal education	97.78 (9.13)	76.67 (30.80)	77.22 (34.47)	92.59 (17.25)
Primary school	95.71 (12.26)	73.10 (29.05)	85.69 (23.43)	88.04 (22.34)
Secondary school	97.21 (8.45)	74.57 (28.10)	88.70 (20.48)	89.93 (21.05)
College / university	95.11 (13.26)	75.1 (26.98)	88.37 (21.00)	87.9 (21.73)
p-value	*0.081*	*0.734*	*0.104*	*0.158*
Father's occupation				
Not working	97.16 (8.08)	74.43 (28.36)	86.65 (23.04)	85.23 (26.68)
Government	94.78 (13.06)	74.62 (26.80)	87.12 (21.96)	88.68 (21.12)
Private	97.17 (9.19)	77.32 (27.39)	84.46 (27.00)	90.35 (19.61)
Self-employed	95.95 (12.02)	73.93 (28.00)	89.42 (19.40)	88.63 (22.02)
Other	96.28 (11.23)	71.54 (30.62)	86.92 (20.70)	89.23 (19.56)
p-value	*0.153*	*0.398*	*0.368*	*0.715*
Mother's occupation				
Not working	96.50 (9.99)	69.75 (29.56)	89.01 (20.67)	88.11 (23.27)
Government	95.92 (11.49)	76.20 (25.78)	88.10 (22.77)	88.36 (20.00)
Private	96.62 (10.08)	76.21 (28.44)	82.05 (28.02)	89.13 (21.71)
Self-employed	95.48 (12.72)	73.95 (27.93)	89.31 (18.80)	89.06 (21.60)
Other	98.19 (7.19)	78.26 (28.52)	85.60 (23.21)	88.77 (21.13)
p-value	*0.368*	*0.074*	***0.026***	*0.870*
Monthly household income (Thai baht)				
≤ 15,000	96.86 (8.49)	74.23 (28.49)	86.51 (22.91)	89.77 (20.81)
15,001 – 30,000	96.46 (11.21)	75.55 (28.24)	86.16 (24.19)	88.77 (21.52)
30,001 – 50,000	95.89 (11.54)	75.5 (27.88)	87.89 (21.57)	89.78 (20.39)
≥ 50,001	94.97 (13.78)	72.25 (26.76)	90.39 (17.06)	86.27 (23.64)
p-value	*0.707*	*0.209*	*0.325*	*0.177*

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs

Table 4.29 presents the mean score of four knowledge domains by smoking history of family members and friend. Only friend smoking status shows significant

difference in knowledge about treatment for smokers, having friend who smoked had a significantly higher mean score compared to those who did not.

Table 4.29: Knowledge domains across smoking history of family members and friend

Demographic variables	KDom1 Mean (SD)	KDom2 Mean (SD)	KDom3 Mean (SD)	KDom4 Mean (SD)
Family members smokes				
No	95.97 (11.92)	75.17 (28.30)	87.98 (21.73)	89.52 (20.47)
Yes	96.22 (10.75)	73.66 (27.43)	86.90 (22.47)	87.82 (22.83)
p-value	*0.781*	*0.189*	*0.255*	*0.292*
Friend smokes				
No	95.89 (11.69)	72.32 (28.83)	88.38 (20.40)	87.86 (22.37)
Yes	96.23 (11.24)	76.42 (27.05)	86.81 (23.33)	89.62 (20.70)
p-value	*0.328*	***0.012***	*0.542*	*0.181*

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs

4.6.2 Difference in Attitude domains across demographic characteristics, socioeconomic status, and smoking history of family members and friend

Table 4.30 shows the comparison of mean score on three attitude domains across demographic characteristics. Female students had a higher mean score of anti-smoking attitude compared to males. In contrast, males had a significantly higher mean score of positive beliefs toward smoking compared to females. Non-science students had a significantly higher mean score of positive beliefs about smoking compared to science students. Students who were living inside campus had a significantly higher mean score of anti-smoking attitude compared to those students living outside campus. Likewise, students who came from rural areas had a significantly higher mean score of anti-smoking attitude compared to those students came from urban areas.

Table 4.30: Attitude domains across demographic characteristics

Demographic variables	ADom5 Mean (SD)	ADom6 Mean (SD)
Gender		
Male	67.42 (20.32)	44.19 (17.68)
Female	72.76 (19.02)	34.79 (15.29)
p-value	***< 0.001***	***< 0.001***
Age groups (years)		
18 – 20	70.56 (19.30)	38.74 (17.02)
21 – 22	69.67 (20.74)	40.55 (17.45)
≥ 23	67.35 (21.61)	42.03 (17.11)
p-value	*0.539*	*0.060*
Field of study		
Science	71.04 (19.24)	38.51 (16.99)
Non-science	68.72 (20.69)	40.84 (17.35)
p-value	*0.062*	***0.012***
Place of residence		
On campus	72.84 (18.15)	39.15 (16.64)
Off campus	68.47 (20.65)	39.6 (17.49)
p-value	***< 0.001***	*0.644*
Original place of residence		
Rural	71.43 (19.22)	39.11 (16.97)
Urban	68.80 (20.39)	40.04 (17.32)
p-value	***0.018***	*0.291*

Note: ADom5=Anti-smoking attitudes, ADom6=Positive perceptions about smoking

The results of the relationship between socioeconomic status with two attitude domains are presented in Table 4.31. Students having a father with no formal education had a significantly higher mean score of anti-smoking attitude, while those having a father with college or university education level reported the lower mean score of anti-smoking attitude. Mother's education level shows significant difference on anti-smoking attitude and positive beliefs about smoking. The results revealed that students who had a mother with a primary education level had a significantly higher mean score on anti-smoking attitude whereas those who had a mother with a college or university education levels reveals the lower mean score. In contrast, students who had a mother with no formal education had a higher mean score of positive perceptions about smoking, while those who had a mother with a primary education level had a lower mean score of positive perceptions about smoking. Students whose father was employed in the private sector had a significantly higher mean score of both anti-smoking attitude

and positive perceptions about smoking. Likewise, students whose mother was not working had a significantly lower mean score of anti-smoking attitude. Monthly family income shows significant difference on anti-smoking attitude and positive perceptions about smoking. Students with a family income of ≤15,000 baht had significantly higher mean scores of anti-smoking attitude, while students with a family income of 30,001 baht to 50,000 baht had a significantly higher mean score of positive perceptions about smoking.

Table 4.31: Attitude domains across socioeconomic status

Demographic variables	ADom5 Mean (SD)	ADom6 Mean (SD)
Father's education level		
No formal education	73.53 (18.80)	41.52 (18.59)
Primary school	72.88 (18.85)	36.84 (15.84)
Secondary school	72.97 (18.74)	39.63 (17.35)
College / university	66.13 (20.65)	40.11 (17.31)
p-value	***< 0.001***	*0.097*
Mother's education level		
No formal education	72.02 (19.69)	43.13 (19.60)
Primary school	72.52 (19.22)	36.88 (16.54)
Secondary school	72.09 (18.28)	40.04 (16.87)
College / university	66.94 (21.12)	39.93 (17.43)
p-value	***< 0.001***	***0.037***
Father's occupation		
Not working	70.58 (21.82)	39.08 (17.75)
Government	67.40 (20.97)	39.34 (17.31)
Private	73.71 (17.60)	41.80 (15.53)
Self-employed	68.98 (20.22)	39.02 (18.05)
Other	73.12 (17.53)	36.91 (15.29)
p-value	***0.005***	***0.027***
Mother's occupation		
Not working	68.59 (19.64)	41.09 (19.06)
Government	70.06 (21.39)	39.14 (17.23)
Private	72.12 (19.40)	40.27 (14.88)
Self-employed	69.14 (19.80)	38.82 (17.56)
Other	74.38 (16.86)	39.23 (16.38)
p-value	***0.038***	*0.415*
Monthly household income (Thai baht)		
≤ 15,000	72.02 (19.94)	35.70 (16.49)
15,001 – 30,000	71.33 (19.37)	40.71 (16.75)
30,001 – 50,000	68.77 (20.47)	41.29 (18.64)
≥ 50,001	68.05 (19.54)	38.08 (15.80)
p-value	***0.020***	***< 0.001***

Note: ADom5=Anti-smoking attitudes, ADom6=Positive perceptions about smoking

Table 4.32 shows the relationship between two attitude domains and smoking history of family members and friends. Students who had a family member that smoked had a significantly higher mean score of positive perceptions about smoking compared to those who did not. Students who had a friend that smoked had a significantly lower mean score of anti-smoking attitude compared to those who did not. On the contrary, students who had a friend that smoked had a significantly higher mean score of positive perceptions about smoking compared to those who did not.

Table 4.32: Attitude domains across smoking history of family members and friend

Demographic variables	ADom5 Mean (SD)	ADom6 Mean (SD)
Family member smokes		
No	69.87 (19.89)	38.17 (16.48)
Yes	70.48 (19.81)	41.19 (17.94)
p-value	*0.464*	***0.005***
Friend smokes		
No	71.96 (20.29)	33.17 (14.75)
Yes	68.57 (19.34)	44.74 (17.29)
p-value	***< 0.001***	***< 0.001***

Note: ADom5=Anti-smoking attitudes, ADom6=Positive perceptions about smoking

4.6.3 Difference in Practice domains across demographic characteristics, socioeconomic status, and smoking history of family members and friend

Table 4.33 shows the difference in two practice domains across demographic characteristics. Gender shows significance difference in both practice domains. The results revealed that females had a significantly higher mean score for positive preventive practice compared to males. In contrast, males had a significantly higher mean score of negative practice compared to females. Students aged 23 years or above had a significantly higher mean score of negative practice compared to other age groups. Fields of study shows a significant difference toward positive preventive practice and negative practice. Science students had a higher mean score for positive

prevention practice and had a lower mean score of negative practice compared to non-science students. Students who lived outside campus had a significantly higher means score of negative practice compared to those lived inside campus. In addition, students who came from rural areas had a significantly higher mean score of positive preventive practice compared to those came from urban areas.

Table 4.33: Practice domains across demographic characteristics

Demographic variables	PDom9 Mean (SD)	PDom10 Mean (SD)
Gender		
Male	37.27 (19.55)	26.65 (18.32)
Female	40.44 (20.52)	20.54 (14.57)
p-value	***0.006***	***< 0.001***
Age groups (years)		
18 – 20	39.08 (20.63)	23.22 (17.37)
21 – 22	38.37 (19.33)	23.85 (15.54)
≥ 23	38.90 (17.61)	25.92 (15.83)
p-value	*0.898*	***0.009***
Field of study		
Science	39.65 (19.97)	22.53 (15.71)
Non-science	37.68 (20.27)	25.13 (18.25)
p-value	***0.034***	***0.004***
Place of residence		
On campus	38.14 (20.03)	21.56 (15.65)
Off campus	39.32 (20.15)	24.77 (17.36)
p-value	*0.265*	***< 0.001***
Original place of residence		
Rural	40.74 (21.37)	22.94 (16.41)
Urban	36.80 (18.19)	24.23 (17.09)
p-value	***0.006***	*0.066*

Note: PDom9=Positive preventive practice, PDom10=Negative practice

The mean score of two practice domains by socioeconomic status is presented in Table 4.34. Students who had a father or a mother with a college or university education had a significantly higher mean score of negative practice. Students whose mother was employed in the government sector had a lower mean score for positive preventive practice. Lastly, students with a family income of ≤ 15,000 baht had significantly higher mean score for positive preventive practice compared to those students with a family income of 15,001 baht and above.

Table 4.34: Practice domains across socioeconomic status

Demographic variables	PDom9 Mean (SD)	PDom10 Mean (SD)
Father's education level		
No formal education	41.01 (21.72)	22.45 (17.31)
Primary school	41.23 (21.05)	20.95 (14.40)
Secondary school	39.43 (20.29)	22.61 (15.77)
College / university	37.19 (19.26)	25.58 (18.29)
p-value	*0.079*	***0.008***
Mother's education level		
No formal education	35.34 (18.77)	24.13 (18.61)
Primary school	41.99 (21.79)	21.30 (14.33)
Secondary school	38.76 (19.98)	22.33 (15.98)
College / university	37.63 (19.24)	25.80 (18.28)
p-value	*0.056*	***< 0.001***
Father's occupation		
Not working	41.02 (20.96)	22.48 (15.94)
Government	36.89 (19.65)	25.11 (18.09)
Private	38.45 (18.25)	23.30 (15.38)
Self-employed	38.86 (20.73)	23.57 (17.32)
Other	42.32 (20.92)	21.59 (14.95)
p-value	*0.126*	*0.294*
Mother's occupation		
Not working	37.33 (19.45)	24.29 (17.12)
Government	35.62 (19.74)	23.02 (17.28)
Private	36.31 (18.24)	22.44 (15.01)
Self-employed	40.94 (20.67)	23.98 (17.21)
Other	42.60 (20.98)	23.68 (16.74)
p-value	***< 0.001***	*0.896*
Monthly household income (Thai baht)		
≤ 15,000	42.29 (21.80)	22.18 (16.69)
15,001 – 30,000	40.02 (19.24)	23.35 (15.75)
30,001 – 50,000	35.74 (19.13)	24.07 (16.85)
≥ 50,001	37.92 (20.69)	24.51 (18.57)
p-value	***< 0.001***	*0.114*

Note: PDom9=Positive preventive practice, PDom10=Negative practice

The difference in two practice domains across smoking history of family members and friend is presented in Table 4.35. Students who had a family member that smoked had a significantly higher mean score for positive preventive practice and negative practice compared to those who did not. Students who had a friend that smoked had a significantly higher mean score of negative practice compared to those who did not.

Table 4.35: Practice domains across smoking history of family members and friend

Demographic variables	PDom9 Mean (SD)	PDom10 Mean (SD)
Family member smokes		
No	37.42 (20.24)	23.33 (17.50)
Yes	40.90 (19.76)	23.87 (15.77)
p-value	***< 0.001***	***0.043***
Friend smokes		
No	38.47 (20.75)	20.09 (14.13)
Yes	39.21 (19.55)	26.50 (18.27)
p-value	*0.282*	***< 0.001***

Note: PDom9=Positive preventive practice, PDom10=Negative practice

Table 4.36 summarizes the significant variables of the non-parametric test difference of scores on KAP domains between selected variables. Data in the table clearly showed the significance differences simultaneously across demographic characteristics, socioeconomic status and smoking history of family members and friend. Only knowledge about cigarette content (KDom1) and knowledge about direct effects of smoking on mouth, nose, throat, and lungs (KDom4) that had only one significant factor.

Table 4.36: The Summary of Non-Parametric Tests

Variables	KDom1	KDom2	KDom3	KDom4	ADom5	ADom6	PDom9	PDom10
Demographic characteristics								
Gender	0.072	***0.019***	0.127	0.636	***< 0.001***	***< 0.001***	***0.006***	***< 0.001***
Age groups (years)	***0.003***	0.387	0.246	0.198	0.539	0.060	0.898	***0.009***
Field of study	0.799	0.056	***0.029***	0.734	0.062	***0.012***	***0.034***	***0.004***
Place of Residence	0.687	0.599	0.839	0.447	***< 0.001***	0.644	0.265	***< 0.001***
Original place of residence	0.518	0.619	0.757	0.381	***0.018***	0.291	***0.006***	0.066
Socioeconomic status								
Father's education level	0.070	0.707	0.205	***0.031***	***< 0.001***	0.097	0.079	***0.008***
Mother's education level	0.081	0.734	0.104	0.158	***< 0.001***	0.037	0.056	***< 0.001***
Father's occupation	0.153	0.398	0.368	0.715	***0.005***	***0.027***	0.126	0.294
Mother's occupation	0.368	0.074	***0.026***	0.870	***0.038***	0.415	***< 0.001***	0.896
Monthly household income	0.707	0.209	0.325	0.177	***0.020***	***< 0.001***	***< 0.001***	0.114
Smoking status of family members and friends								
Family member smokes	0.781	0.189	0.255	0.292	0.464	***0.005***	***< 0.001***	***0.043***
Friend smokes	0.328	***0.012***	0.542	0.181	***< 0.001***	***< 0.001***	0.282	***< 0.001***

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom5=Anti-smoking attitude, ADom6=Positive perceptions about smoking, PDom9=Positive preventive practice, PDom10=Negative practice

4.7 Relationship between Demographic characteristics, Socioeconomic status, Smoking history of family members and friend, Knowledge, Attitude and Practice

Research objective 4: To identify factors associated with KAP domains among university students in Thailand.

To answer the fourth research objective, this section will address the association between demographic characteristics, socioeconomic status, smoking history of family member and friend, and KAP toward smoking. The relationship between the dependent and independent variables were examined through multiple linear regression analysis. To identify the significant independent variables of the model, the variables were selected to the reduced model using stepwise method.

Since all the selected independent variables are categorical variables, dummy variables were created as shown in Table 4.37-4.39.

Table 4.37: Dummy variable Demographic characteristics

Variable	Dummy variable	Parameter Code	
		1	2
Gender	Female (Ref.)	0	
	Male	1	
Age groups (years)	18 – 20 (Ref.)	0	0
	21 – 22	1	0
	≥ 23	0	1
Field of study	Science (Ref.)	0	
	Non-science	1	
Place of Residence	On campus (Ref.)	0	
	Off campus	1	
Original place of residence	Rural (Ref.)	0	
	Urban	1	

Table 4.38: Dummy variable Socioeconomic status

Variable	Dummy variable	Parameter Code			
		1	2	3	4
Father's education level	No formal education (Ref.)	0	0	0	
	Primary school	1	0	0	
	Secondary school	0	1	0	
	College / university	0	0	1	
Mother's education level	No formal education (Ref.)	0	0	0	
	Primary school	1	0	0	
	Secondary school	0	1	0	
	College / university	0	0	1	
Father's occupation	Not working (Ref.)	0	0	0	0
	Government	1	0	0	0
	Private	0	1	0	0
	Self-employed	0	0	1	0
	Other	0	0	0	1
Mother's occupation	Not working (Ref.)	0	0	0	0
	Government	1	0	0	0
	Private	0	1	0	0
	Self-employed	0	0	1	0
	Other	0	0	0	1
Monthly household income (Thai baht)	≤ 15,000 (Ref.)	0	0	0	
	15,001 – 30,000	1	0	0	
	30,001 – 50,000	0	1	0	
	≥ 50,001	0	0	1	

Table 4.39: Dummy variable Smoking history of family members and friend

Variable	Dummy variable	Parameter Code	
		1	2
Family member smokes	No (Ref.)	0	
	Yes	1	
Friend smokes	No (Ref.)	0	
	Yes	1	

Table 4.40 – 4.47 presents the coefficients (β), standard errors (SE), *p-value* for all the parameters obtained from final multiple linear regression model. Figure 4.4 – 4.7, 4.10, 4.13, 4.16, and 4.19 presents a graph of crude and adjusted score with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. Sum contrasts were used to compare

each mean score with the overall mean score rather than with a specified reference group.

4.7.1 Multiple Linear Regression Analysis of Knowledge domains

For knowledge domains, the score of each knowledge domain has the possible minimum of 0 and maximum of 100. From Table 4.40, the final regression model shows that gender, age group, father's education, and mother's occupation were significantly associated with knowledge about cigarette content. Males had a negative coefficient (β=-1.542), which indicates that males have on average lower knowledge score than females. Students who were aged 23 years or above had a negative coefficient (β=-3.041) compared to those who were aged between 18–20 years. This indicates that students aged 23 years or above have on average lower knowledge score. Students who had a father with a secondary education level (β=2.169) have on average higher knowledge score compared to those who had a father with no formal education. Compared to students whose mother were not working, student whose mother was self-employed (β=-1.333) have on average lower knowledge score.

Table 4.40: Multiple linear regression of knowledge about cigarette content by associated factors

Variables	β	SE	*p-value*
Constant	96.832	0.578	< 0.001
Gender (Ref.= Female)			
Male	-1.542	0.632	0.015
Age group (Ref. = 18 – 20)			
21 – 22 years	-1.425	0.740	0.055
≥ 23 years	-3.041	1.331	0.022
Father's education level (Ref. = No formal education)			
Primary school	0.689	1.982	0.728
Secondary school	2.169	0.659	< 0.001
College / university	1.445	1.997	0.470
Mother's occupation (Ref. = Not working)			
Government	1.229	1.330	0.356
Private	0.638	1.242	0.607
Self-employed	-1.333	0.638	0.037
Other	2.313	1.725	0.180

R-squared: 0.021, Adjusted R-squared: 0.017

Figure 4.4 presents a graph of crude and adjusted score with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The horizontal line denotes the overall mean score of knowledge about cigarette content (96.07). The CI above or below the horizontal line represents groups that are greater than or lower than the overall mean score. If the CI crossed the horizontal line, then there is no significant difference from the overall mean score. Females had a higher score of knowledge about cigarette content while males had a lower score compared to overall mean score. Students aged 18-20 years had a significantly higher knowledge score when compared to overall mean score. In contrast, students aged 23 years or above had a significantly lower knowledge score. Students who had a father with a secondary education level had a significantly higher knowledge score whereas students who had a father with a college or university education level had a significantly lower knowledge score compared to overall mean score.

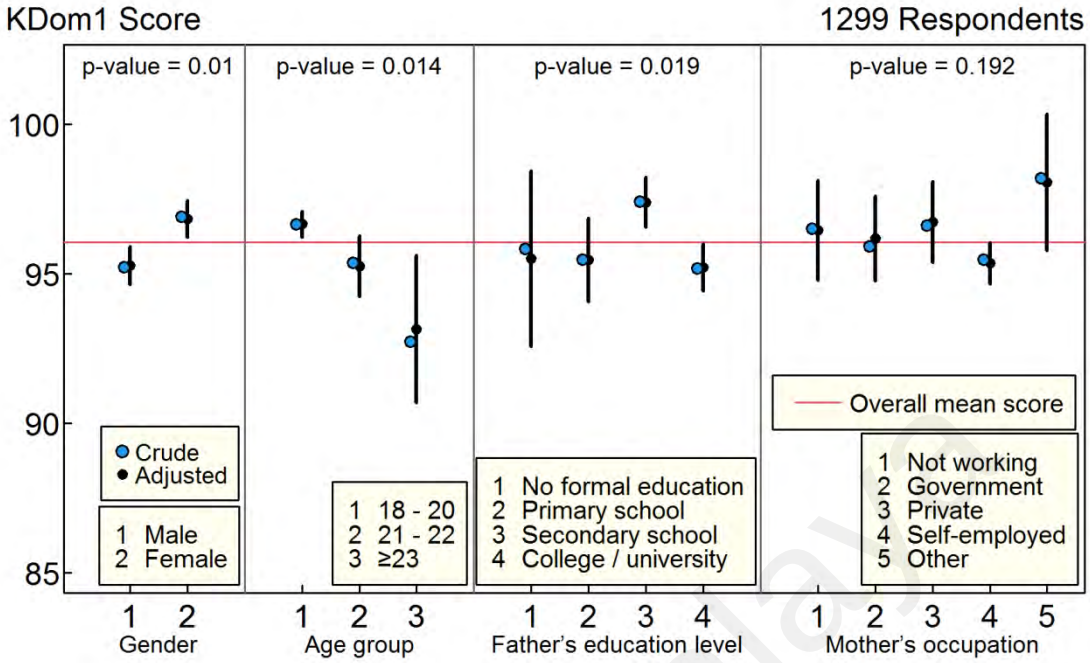

Figure 4.4: Confidence interval plots of knowledge about cigarette content by associated factors

Regarding knowledge about treatment for smokers, two independent variables were significant with the variation of the independent variables as shown in Table 4.41. These variables were gender and field of study. Males (β=4.162) have on average higher knowledge score than females. Students from non-science field (β=3.283) have on average higher knowledge score compared to science students.

Table 4.41: Multiple linear regression of knowledge about treatment for smokers by associated factors

Variables	β	SE	*p-value*
Constant	71.190	1.253	<0.001
Gender (Ref.= Female)			
Male	4.162	1.545	0.007
Field of study (Ref. = Science)			
Non-science	3.283	1.581	0.038

R-squared: 0.009, Adjusted R-squared: 0.007

Figure 4.5 shows a graph of crude and adjusted scores with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The horizontal lines indicate the overall mean score of knowledge about treatment for smokers (74.54). Males had a significantly higher knowledge score while females had a lower knowledge score compared to overall mean score. Students from non-science field had a significantly higher knowledge score while those from science field had a significantly lower knowledge score compared to overall mean score.

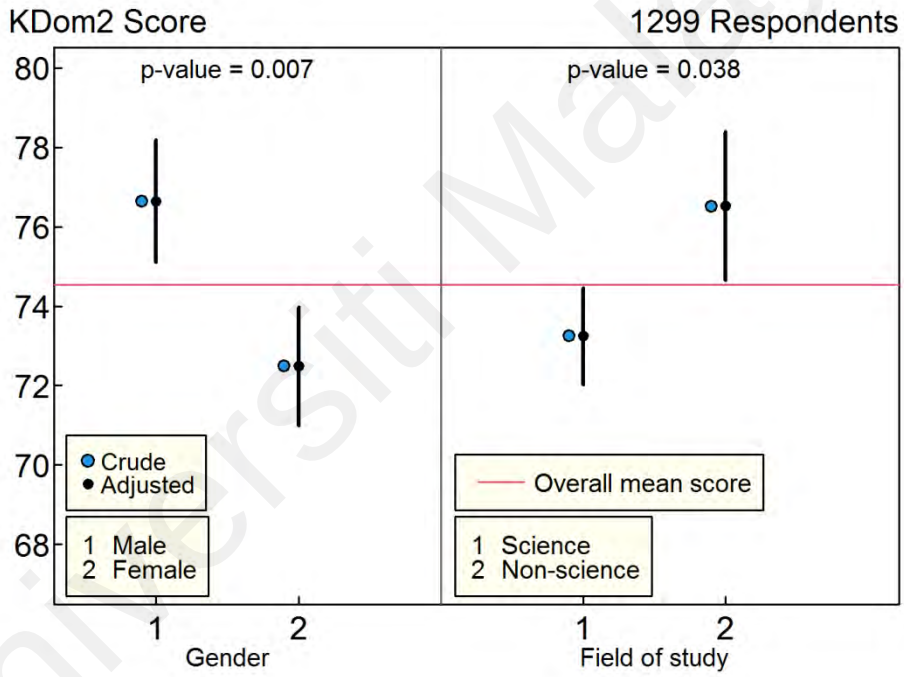

Figure 4.5: Confidence interval plots of knowledge about treatment for smokers by associated factors

As shown in Table 4.42, five independent variables were significantly associated with knowledge about distal effects of smoking on other systems. The final model shows that students aged 23 years or above (β=-6.692) have on average lower knowledge than those who were aged between 18-20 years. Students majoring in non-science subjects (β=-2.728) have on average lower knowledge than those majoring in

science. Students who had a mother with a secondary school level of education (β=2.755) had higher knowledge than those whose mother had no formal education. Students whose mother was employed in the private sector (β=-6.991) have on average lower knowledge than those whose mother did not work. Lastly, students with a family income of 50,001 baht or above (β=4.429) have on average higher knowledge than those students had a family income of 15,000 baht or less.

Table 4.42: Multiple linear regression of knowledge about distal effects of smoking on other systems by associated factors

Variables	β	SE	*p-value*
Constant	88.382	1.008	< 0.001
Age group (Ref. = 18 – 20 years)			
21 – 22 years	-1.057	1.415	0.455
≥ 23 years	-6.692	2.547	0.009
Field of study (Ref. = Science)			
Non-science	-2.728	1.237	0.028
Mother's education level (Ref. = No formal education)			
Primary school	4.250	4.067	0.296
Secondary school	2.755	1.287	0.032
College / university	7.574	4.145	0.068
Mother's occupation (Ref. = Not working)			
Government	-2.433	2.543	0.339
Private	-6.991	1.596	< 0.001
Self-employed	-0.741	2.063	0.719
Other	-1.996	3.296	0.545
Monthly household income (Ref. = ≤ 15,000 Baht)			
15,001 – 30,000 Baht	-0.473	1.870	0.800
30,001 – 50,000 Baht	0.422	2.172	0.846
≥ 50,001 Baht	4.429	1.548	0.004

R-squared: 0.030, Adjusted R-squared: 0.026

Figure 4.6 shows a graph of crude and adjusted knowledge scores with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The overall mean knowledge score about distal effects of smoking on other systems was 87.53. Students who were aged 23

years or above, from a non-science field, those who had a mother with no formal education had a significantly lower knowledge score compared to overall mean score. Lastly, students whose mother was employed in the private sector had a significantly lower knowledge score compared to overall mean score while students whose mother was self-employed had a significantly higher knowledge score compared to overall mean score.

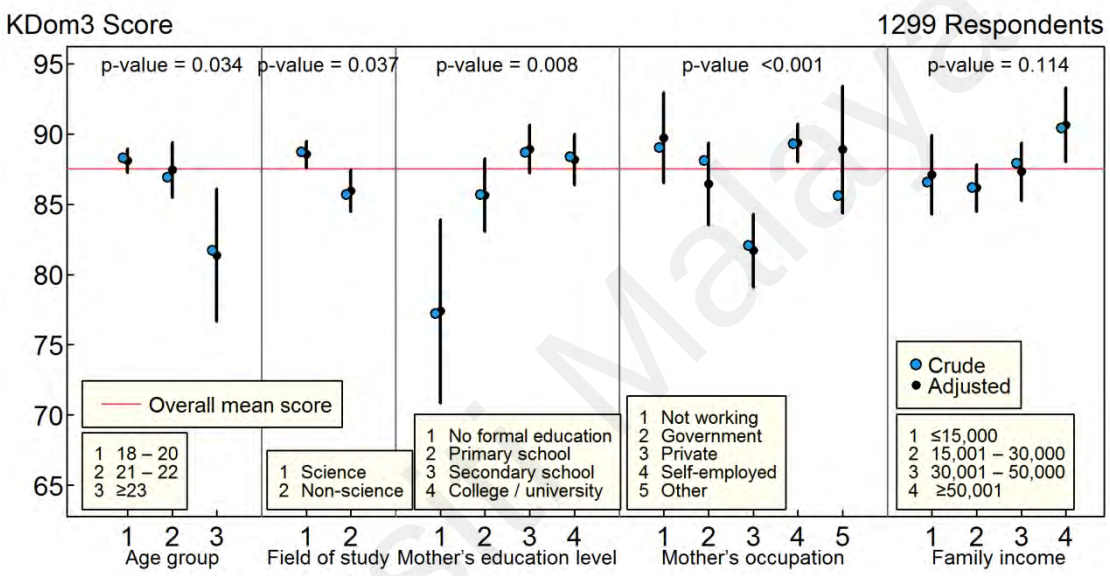

Figure 4.6: Confidence interval plots of knowledge about distal effects of smoking on other systems by associated factors

From the Table 4.43, the final regression model shows that only family income was significantly associated with knowledge about direct effects of smoking on mouth, nose, throat, and lungs by associated factor scores. Students with a family income of 50,001 baht or above have on average lower knowledge than students with a family income of 15,000 baht or less.

Table 4.43: Multiple linear regression of knowledge about direct effects of smoking on mouth, nose, throat, and lungs by associated factors

Variables	β	SE	*p-value*
Constant	89.432	0.664	< 0.001
Monthly household income			
(Ref. = ≤ 15,000 Baht)			
15,001 – 30,000 Baht	-2.554	1.847	0.167
30,001 – 50,000 Baht	-1.216	2.146	0.571
≥ 50,001 Baht	-3.157	1.499	0.035

R-squared: 0.003, Adjusted R-squared: 0.003

Figure 4.7 presents a graph of crude and adjusted knowledge scores with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The overall mean score was 88.81. The adjusted mean score of knowledge for students with a family income of 50,001 baht or above was significantly lower than the overall mean score.

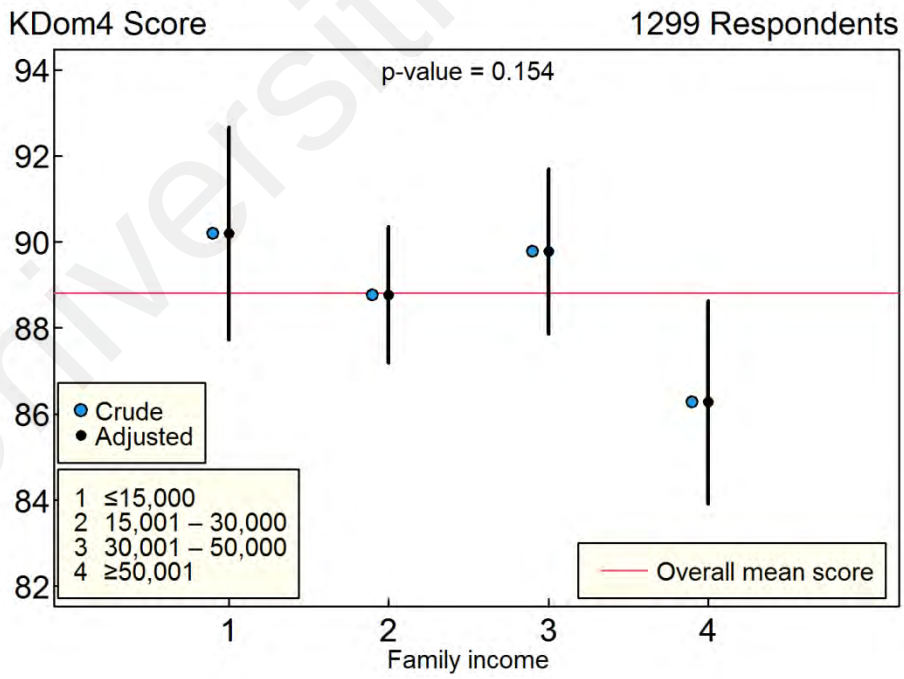

Figure 4.7: Confidence interval plots of knowledge about direct effects of smoking on mouth, nose, throat, and lungs by associated factors

4.7.2 Multiple Linear Regression Analysis of Attitude domains

As regard to attitude domains, the score of each attitude domain has a possible minimum of 0 and maximum of 100. The multiple regression analysis was also conducted to determine the significant factors that influenced the attitude domains. Table 4.44 presents the final model fitted to the data. There were six independent variables that were significantly associated with anti-smoking attitude. Males (β=-4.717) had a lower anti-smoking attitude score compared to females. Students from a non-science field (β=-2.927) had a lower attitude score than those from science field. Students who were living outside campus (β=-3.530) had a lower attitude score compared to those were living inside campus. Students who had a father with a college or university education had a lower attitude score than those whose father had no formal education. Compared to students whose parents did not work, students whose father was employed in private sector (β=3.437) had a higher attitude score whereas those whose mother was self-employed (β=-2.518) had a lower attitude score. Figure 4.8 shows the p-p plot of standardized residuals from the linear regression model, most of the residuals lie on the diagonal line. Figure 4.9 shows the histogram of standardized residuals which appear to be approximately normally distributed. Mean is 0 and standard deviation very is close to 1. The assumption of approximate normality was met.

Table 4.44: Multiple linear regression of anti-smoking attitude by associated factors

Variables	β	SE	*p-value*
Constant	79.130	1.376	< 0.001
Gender (Ref.= Female)			
Male	-4.717	1.072	< 0.001
Field of study (Ref. = Science)			
Non-science	-2.927	1.094	0.008
Place of residence (Ref. = On campus)			
Off campus	-3.530	1.104	0.001
Father's education level (Ref. = No formal education)			
Primary school	-1.228	3.360	0.715
Secondary school	-1.616	3.224	0.616
College / university	-6.865	1.108	< 0.001
Father's occupation (Ref. = Not working)			
Government	-1.114	2.600	0.668
Private	3.437	1.386	0.013
Self-employed	-1.201	2.392	0.616
Other	0.935	2.908	0.748
Mother's occupation (Ref. = Not working)			
Government	4.310	2.255	0.056
Private	3.106	2.104	0.140
Self-employed	-2.518	1.129	0.026
Other	2.904	2.923	0.321

R-squared:0.068, Adjusted R-squared: 0.063

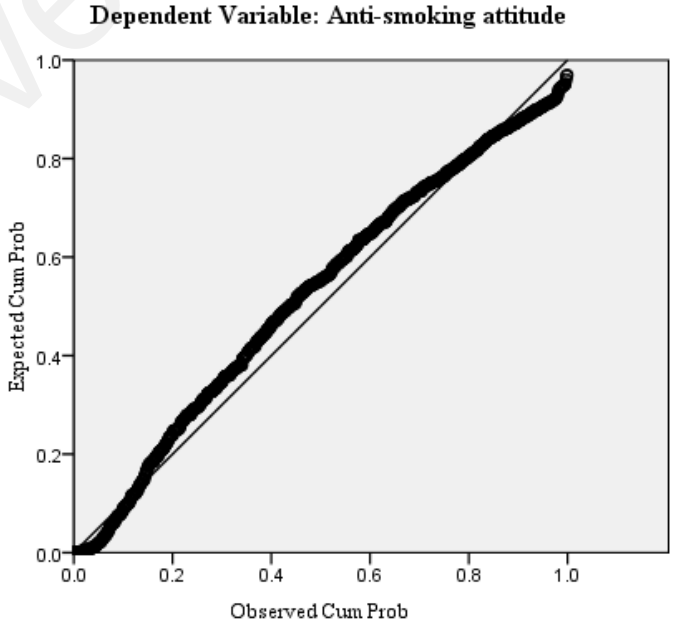

Figure 4.8: Normal P-P Plot of Regression Standardized Residual (Anti-smoking attitude)

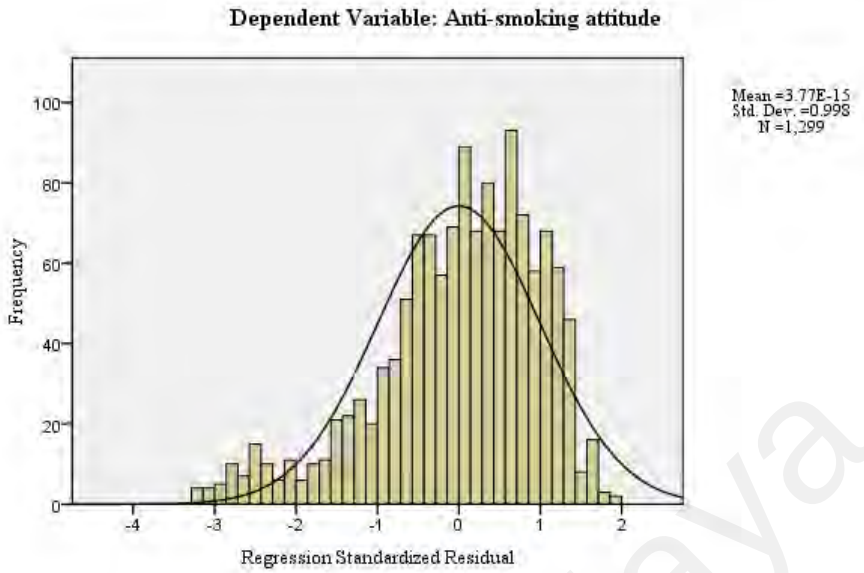

Figure 4.9: Histogram of Standardized Residuals (Anti-smoking attitude)

Figure 4.10 presents a graph of crude and adjusted score with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The overall mean score of anti-smoking attitude was 70.13. A higher attitude score was found for females while males had a lower attitude score compared to overall mean score. Students majoring in science had a significantly higher attitude score while those majoring in non-science had a lower attitude score compared to overall mean score. Regarding students' residence, students who were staying inside campus had a significantly higher attitude score while those who were staying outside campus had a lower attitude score compared to overall mean score. Students who had a father with a primary or secondary school education had a significantly higher attitude score compared to overall mean score. In contrast, students who had a father with a college or university education had a significantly lower attitude score compared to overall mean score.

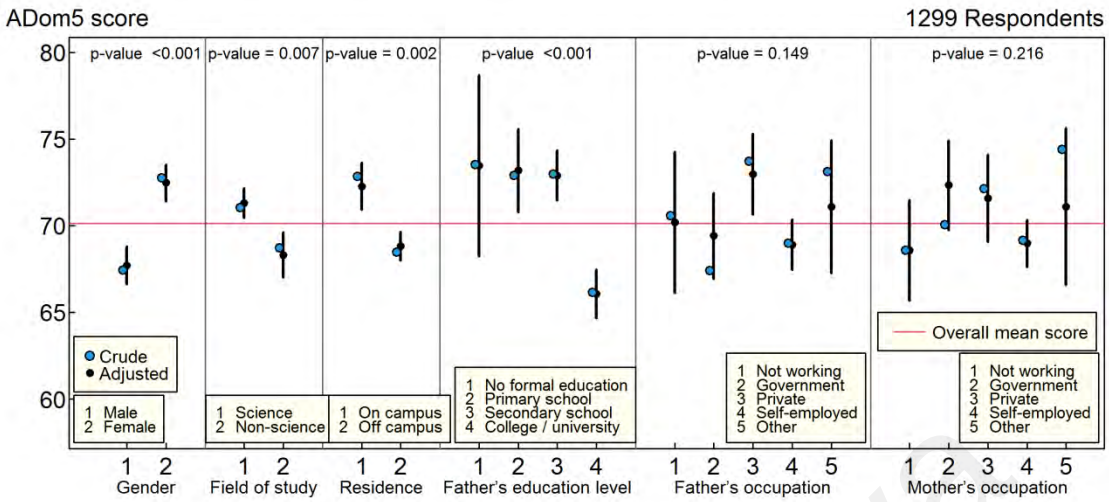

Figure 4.10: Confidence interval plots of anti-smoking attitude by associated factors

Table 4.45 revealed that gender, monthly household income, having family members who smoked and having friends who smoked were significantly associated with positive perceptions about smoking. Students with a monthly family income of 15,001 baht to 30,000 baht (β=3.358) or 30,001 baht to 50,000 baht (β=4.213) had a higher positive perceptions score compared to those students with a monthly family income of 15,000 baht or less, and having at least one family member (β=1.945) or friend (β =9.205) who smoked had a higher positive perceptions score than those who did not. Figure 4.11 shows the p-p plot of standardized residuals, most of the residuals follow the diagonal line. Figure 4.12 shows the histogram of standardized residuals which appear to be approximately normally distributed. Mean is 0 and standard deviation very is close to 1. The assumption of approximate normality was met.

Table 4.45: Multiple linear regression of positive perceptions about smoking by associated factors

Variables	β	SE	*p-value*
Constant	28.097	0.961	< 0.001
Gender (Ref.= Female)			
Male	6.540	0.922	< 0.001
Monthly household income (Ref. = ≤ 15,000 Baht)			
15,001 – 30,000 Baht	3.358	1.025	0.001
30,001 – 50,000 Baht	4.213	1.105	< 0.001
≥ 50,001 Baht	0.752	1.736	0.665
Family member smokes (Ref.= No)			
Yes	1.945	0.902	0.031
Friend smokes (Ref.= No)			
Yes	9.205	0.935	< 0.001

R-squared: 0.159, Adjusted R-squared: 0.156

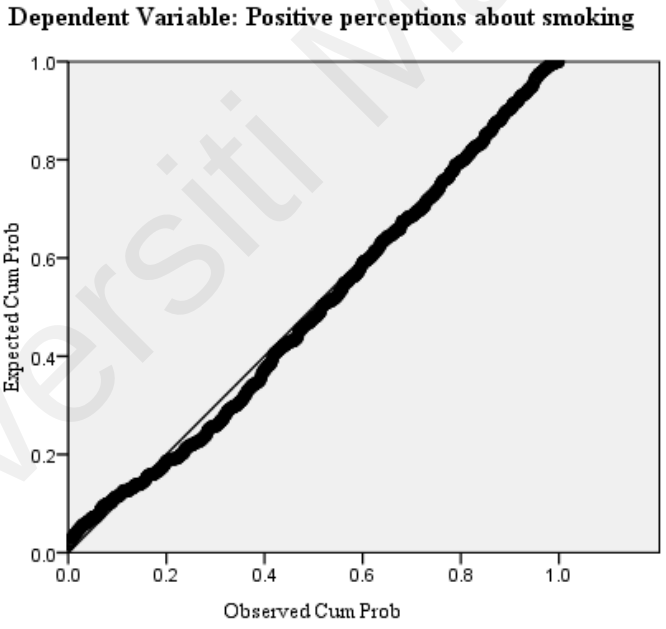

Figure 4.11: Normal P-P Plot of Regression Standardized Residual (Positive perceptions about smoking)

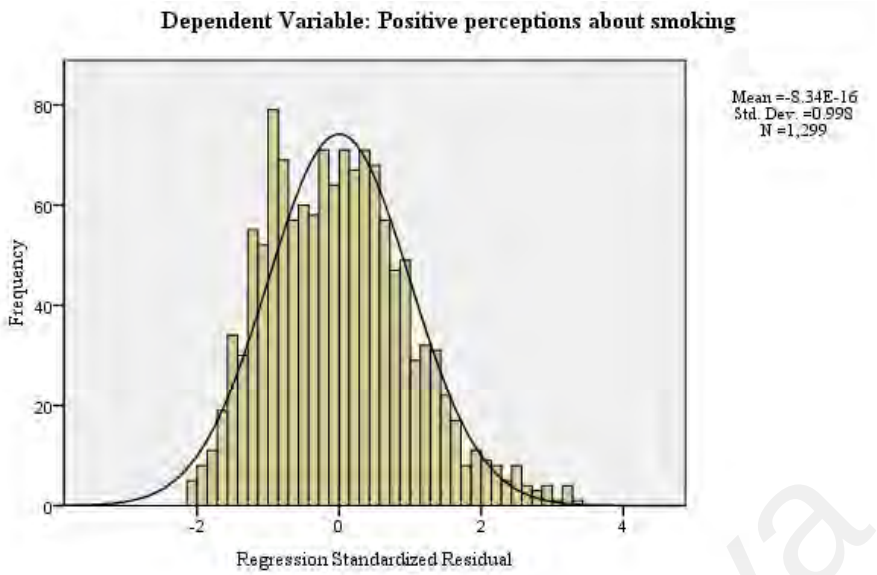

Figure 4.12: Histogram of Standardized Residuals (Positive perceptions about smoking)

Figure 4.13 shows a graph of crude and adjusted positive perception scores with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The overall mean score of positive perceptions about smoking was 39.43. Males had a significantly higher positive perception score than females and overall mean score. Students with a monthly family income of 30,001-50,000 baht had a significant higher positive perception score compared to overall mean score. In contrast students with a monthly family income of 15,000 baht or less had a significantly lower positive perception score compared to overall mean score. Students who reported that their family members or their friend who smoked had a significantly higher positive perception about smoking score compared to overall mean score.

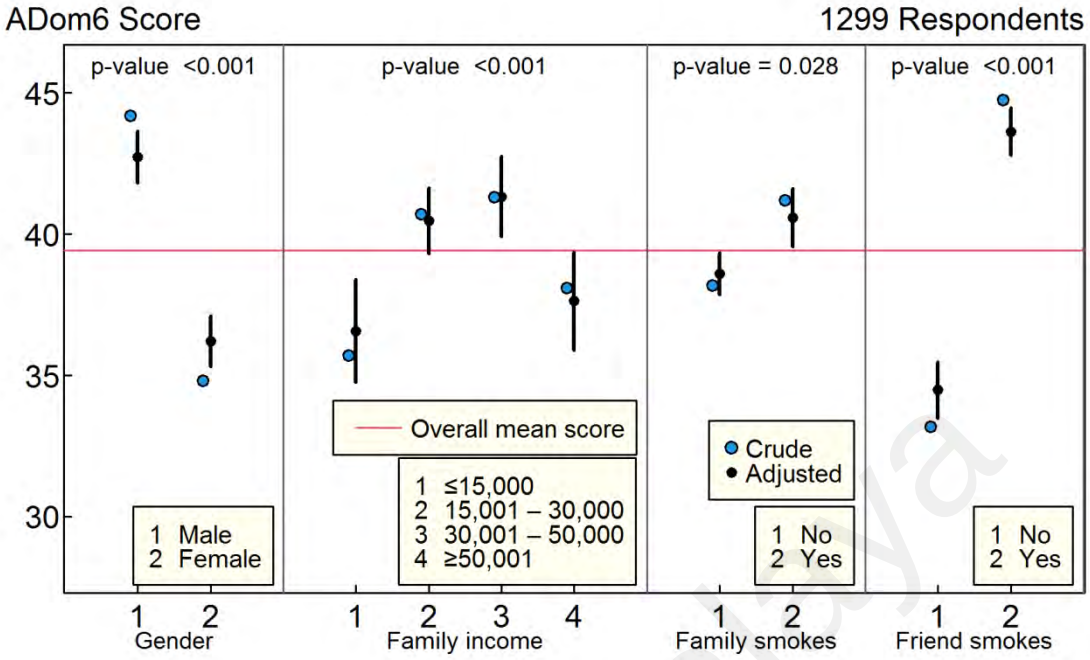

Figure 4.13: Confidence interval plots of positive perceptions about smoking by associated factors

4.7.3 Multiple Linear Regression Analysis of Practice domains

Multiple linear regression analysis was conducted to identify the factors that influence the practice on smoking of the respondents. The score of each practice domain has a possible minimum of 0 and maximum of 100. Based on Table 4.46, gender, original place of residence, parent's occupation, monthly household income and having family member who smoked were significantly associated with positive preventive practice. Males (β=-3.134) had a lower positive preventive practice score than females. Likewise, students from urban areas (β=-3.178) had a lower positive preventive practice score than those from rural areas. Compared to students whose father or mother was not working, students whose father was self-employed (β=-2.869) had a lower positive preventive practice score while those whose mother was self-employed (β=4.637) had a higher positive preventive practice score. Students with a family income of 30,001 baht to 50,000 baht (β=-3.227) had a lower positive preventive practice score than those

students with a family income of 15,000 baht or less, and having at least one family member who smoked (β=3.167) had a higher positive preventive practice score than those who did not. Figure 4.14 shows the p-p plot of standardized residuals, most of the residuals lie on the diagonal line. Figure 4.15 shows the histogram of standardized residuals which appear to be approximately normally distributed. Mean is very close to 0 and standard deviation is very close to 1. The normality assumption was met.

Table 4.46: Multiple linear regression of positive preventive practice by associated factors

Variables	β	SE	*p-value*
Constant	40.541	1.260	
Gender (Ref.= Female)			
Male	-3.134	1.099	0.004
Original place of residence (Ref. = Rural)			
Urban	-3.178	1.121	0.005
Father's occupation (Ref. = Not working)			
Government	-1.853	2.666	0.487
Private	-1.139	2.626	0.665
Self-employed	-2.869	1.295	0.027
Other	-1.056	2.982	0.723
Mother's occupation (Ref. = Not working)			
Government	-1.036	2.312	0.654
Private	-0.880	2.157	0.683
Self-employed	4.637	1.291	< 0.001
Other	3.717	2.997	0.215
Monthly household income (Ref. = ≤ 15,000 Baht)			
15,001 – 30,000 Baht	-0.727	1.700	0.669
30,001 – 50,000 Baht	-3.227	1.256	0.010
≥ 50,001 Baht	-2.241	2.172	0.302
Family member smokes (Ref.= No)			
Yes	3.167	1.115	0.005

R-squared: 0.038, Adjusted R-squared: 0.034

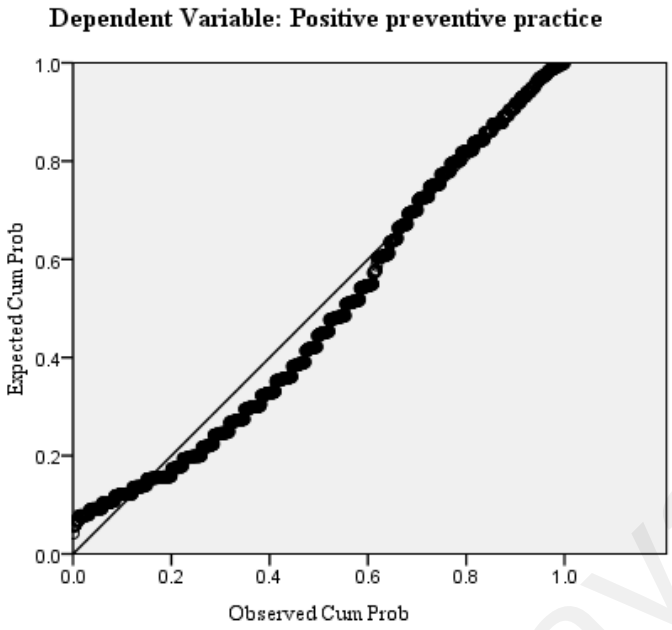

Figure 4.14: Normal P-P Plot of Regression Standardized Residual (Positive preventive practice)

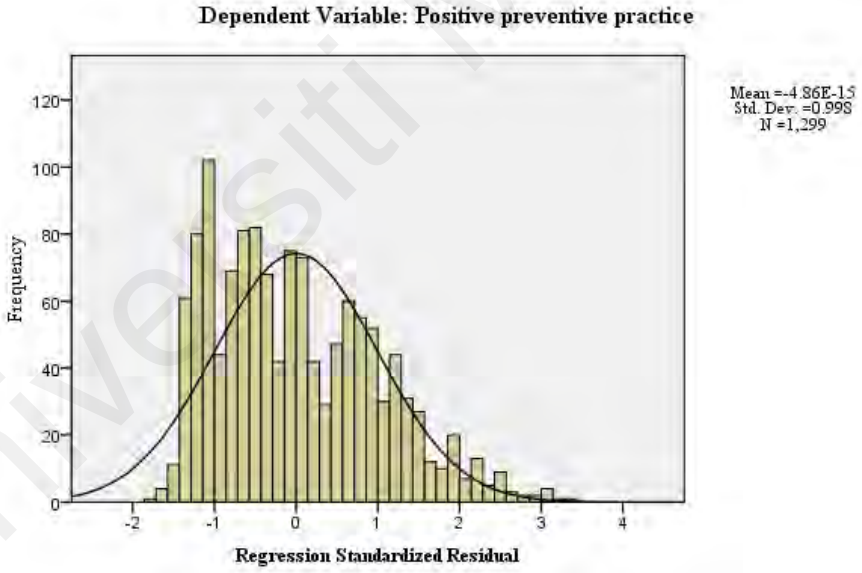

Figure 4.15: Histogram of Standardized Residuals (Positive preventive practice)

Figure 4.16 shows a graph of crude and adjusted positive preventive practice scores with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The overall mean score was 38.87. Females and students whose mother was self-employed had a significantly

higher positive preventive practice score compared to overall mean score. In contrast, students who had a mother was employed in the private sector and those from urban areas had a significantly lower positive preventive practice scores compared to overall mean score. Students who had a family member that smoked had a significantly higher positive preventive practice score compared to overall mean score, while those who had no family members who smoked had a significantly lower positive preventive practice score compared to overall mean score.

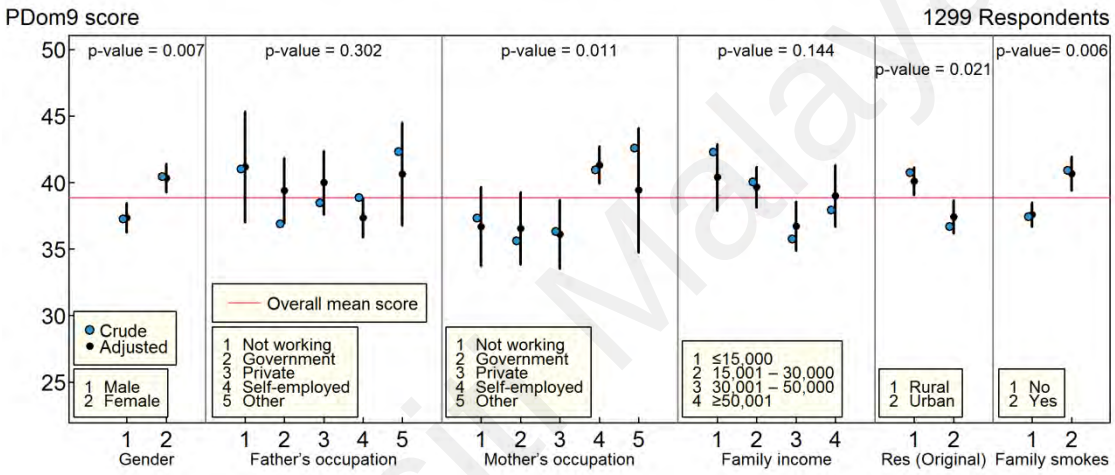

Figure 4.16: Confidence interval plots of positive preventive practice by associated factors

Table 4.47 presents the results of the final multiple linear regression model assessing the association of all determinants with negative practice domain. Six independent variables were significantly associated with negative practice. Males (β=4.509) had a higher negative practice than females. Students from a non-science field (β=2.289) had a higher negative practice compared to students from science field. Students living outside campus (β=2.472) had a higher negative practice than those living inside campus. Students who had a mother with a college or university education (β=4.531) had a higher negative practice than those who had a mother with no formal education. Compared to students whose mother was not working, students whose

mother was employed in the government (β=-3.318) or private (β=-3.201) sectors had a lower negative practice. Furthermore, students who had a friend who smoked (β=4.506) had a higher negative practice than those who did not. Figure 4.15 shows the p-p plot of standardized residuals. Although the residuals are not aligned perfectly along the diagonal line, they are close enough. Figure 4.16 shows the histogram of standardized residuals which appear to be approximately normally distributed. Mean is very close to 0 and standard deviation is very close to 1. The normality assumption was met.

Table 4.47: Multiple linear regression of negative practice by associated factors

Variables	β	SE	*p-value*
Constant	15.792	1.037	< 0.001
Gender (Ref.= Female)			
Male	4.509	0.948	< 0.001
Field of study (Ref.= Science)			
Non-science	2.289	0.926	0.014
Place of residence (Ref. = On campus)			
Off campus	2.472	0.929	0.008
Mother's education level			
(Ref. = No formal education)			
Primary school	-0.815	3.037	0.789
Secondary school	-1.292	2.977	0.664
College / university	4.531	1.041	< 0.001
Mother's occupation (Ref. = Not working)			
Government	-3.318	1.371	0.016
Private	-3.201	1.223	0.009
Self-employed	0.307	1.541	0.842
Other	2.478	2.462	0.314
Friend smokes (Ref.= No)			
Yes	4.506	0.959	< 0.001

R-squared: 0.079, Adjusted R-squared: 0.074

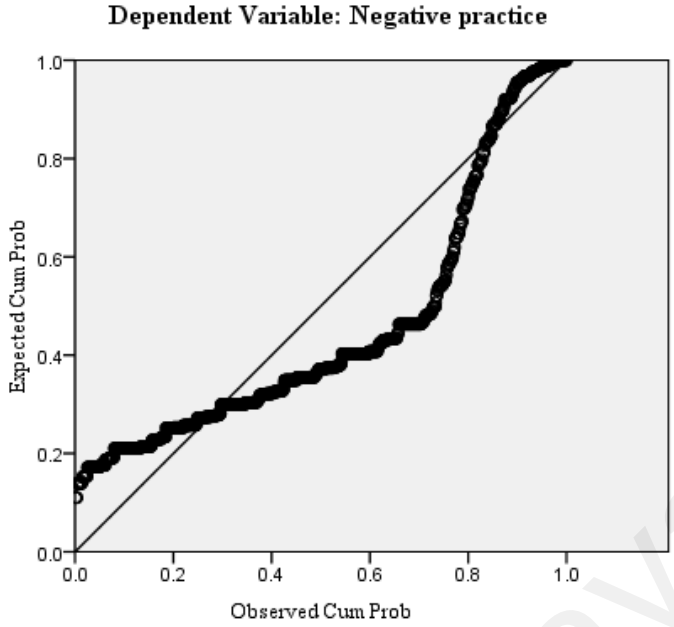

Figure 4.17: Normal P-P Plot of Regression Standardized Residual (Negative practice)

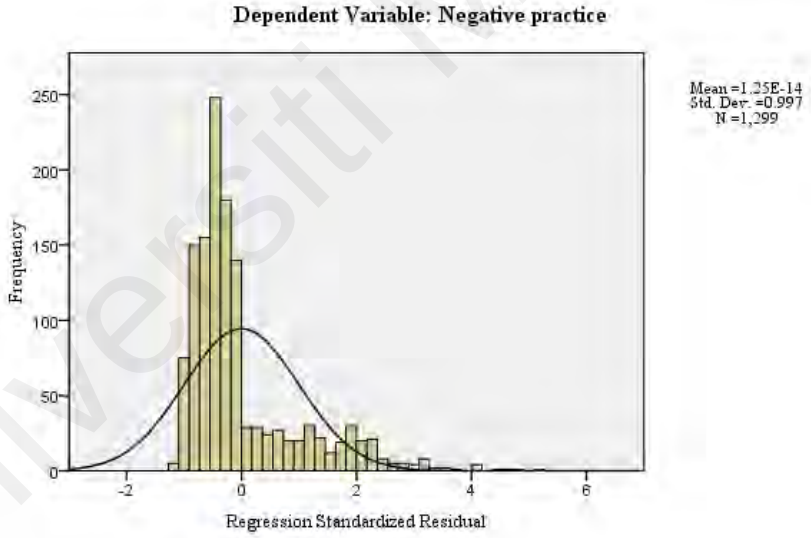

Figure 4.18: Histogram of Standardized Residuals (Negative practice)

Figure 4.19 shows a graph of crude and adjusted score with 95% confidence intervals using weighted sum contrasts for each significant independent variable after fitting the final regression model. The overall mean negative practice score was 23.56. Males, students majoring in non-science, staying outside campus, having a mother with a college or university education, students whose mother was self-employed, and

students who had a friend who smoked had a significantly higher negative practice score than overall mean score.

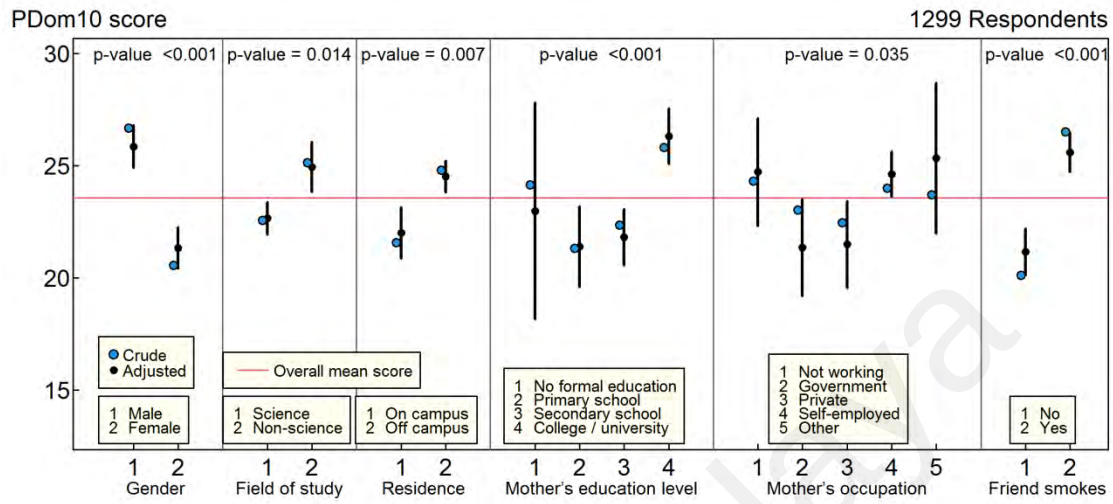

Figure 4.19: Confidence interval plots of negative practice by associated factors

The measure R-square is called the coefficient of determination which is an estimate of how much variation in a dependent variable is explained by independent variables. Our results all had small values of R-square (0.003-0.156). In general, a higher R-squared shows that the model fits the data better. However, a large value of R-square does not necessarily indicate that the fitted model is a useful one whereas a low value of R-square does not imply that the fitted model is a useless one (King, 1986; Kutner et al., 2005; Wooldridge, 2012). R-square near zero does not mean that independent variables and outcome variables are not related (Kutner et al., 2005). In addition, low R-square values are not uncommon in the social science field as these studies are usually very difficult to predict individual behavior, especially for a cross-sectional analysis (Wooldridge, 2012). Therefore, to examine the effectiveness of a factor, the size of R-squared does not matter. The coefficients of explanatory variable remain statistical significantly which indicated that the regression model has statistically significant explanatory power (Kutner et al., 2005).

4.8 Mediation Analysis

Research objective 5: To investigate whether attitude domains mediate the relationship between knowledge domains and practice domains.

To answer the fifth research objective, mediation analysis was used. From the proposed model of KAP (Figure 3.1), it can be identified that the attitude domain is the key mediating variable of the framework. For establishment of the mediation model, the Baron and Kenny (1986) approach was used to test the mediation of the attitude domain between knowledge domains and practice domains. To identify the statistical significance of the mediator, the 95% confidence interval bootstrap percentiles with 5000 simulations was used (Shrout & Bolger, 2002).

Table 4.48: Summary of mediation analysis

Sections	Mediation analysis
4.8.1 Mediating effect of anti-smoking attitude domain in the relationship between knowledge domains and positive preventive practice domain	1) KDom1 → ADom5 → PDom9 2) KDom2 → ADom5 → PDom9 3) KDom3 → ADom5 → PDom9 4) KDom4 → ADom5 → PDom9
4.8.2 Mediating effect of anti-smoking attitude domain in the relationship between knowledge domains and negative preventive domain	1) KDom1 → ADom5 → PDom10 2) KDom2 → ADom5 → PDom10 3) KDom3 → ADom5 → PDom10 4) KDom4 → ADom5 → PDom10
4.8.3 Mediating effect of positive perceptions about smoking domain in the relationship between knowledge domains and positive preventive practice domain	1) KDom1 → ADom6 → PDom9 2) KDom2 → ADom6 → PDom9 3) KDom3 → ADom6 → PDom9 4) KDom4 → ADom6 → PDom9
4.8.4 Mediating effect of positive perceptions about smoking domain in the relationship between knowledge domains and negative preventive domain	1) KDom1 → ADom6 → PDom10 2) KDom2 → ADom6 → PDom10 3) KDom3 → ADom6 → PDom10 4) KDom4 → ADom6 → PDom10

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom5=Anti-smoking attitude, ADom6=Positive perceptions about smoking, PDom9=Positive preventive practice, PDom10=Negative practice

The independent mediator model, with the attitude domains as the mediator between knowledge domains and practice domains was tested and the results are presented in Tables 4.49 – 4.52.

4.8.1 Mediating effect of Anti-smoking attitude domain on the relationship between Knowledge domains and Positive preventive practice domain

Table 4.49 shows the result on the effect of anti-smoking attitude domain towards the relationship between the knowledge domains and positive preventive practice domain.

Table 4.49: Estimated Coefficient between Knowledge domains with Anti-smoking attitude domain and Positive preventive practice domain

Tests of Mediation				Estimated	SE	p-value	Bootstrap 95%CI		Type of mediation
							LL	UL	
KDom1 → ADom5 → PDom9									Partial mediation
Step 1	Simple	KDom1→ PDom9	c	-0.126	0.049	0.010	-0.210	-0.034	
Step 2	Regression	KDom1→ ADom5	a	0.290	0.047	< 0.001	0.193	0.392	
Step 3	Multiple Regression	KDom1→ PDom9	c′	-0.190	0.048	< 0.001	-0.269	-0.105	
		ADom5→ PDom9	b	0.223	0.028	< 0.001	0.173	0.273	
		Indirect effect	ab	0.065	0.014	< 0.001	0.040	0.095	
KDom2 → ADom5 → PDom9									No mediation
Step 1	Simple	KDom2→ PDom9	c	-0.023	0.020	0.243	-0.061	0.015	
Step 2	Regression	KDom2→ ADom5	a	-0.034	0.020	0.081	-0.072	0.003	
Step 3	Multiple Regression	K Dom2→ PDom9	c′	-0.016	0.020	0.406	-0.053	0.022	
		ADom5→ PDom9	b	0.203	0.028	< 0.001	0.153	0.253	
		Indirect effect	ab	-0.007	0.004	0.084	-0.015	0.001	
KDom3 → ADom5 → PDom9									full mediation
Step 1	Simple	KDom3→ PDom9	c	0.018	0.025	0.478	-0.029	0.063	
Step 2	Regression	KDom3→ ADom5	a	-0.085	0.025	0.001	-0.130	-0.037	
Step 3	Multiple Regression	KDom3→ PDom9	c′	0.036	0.025	0.152	-0.012	0.081	
		ADom5→ PDom9	b	0.208	0.028	< 0.001	0.158	0.259	
		Indirect effect	ab	-0.018	0.005	0001	-0.029	-0.007	
KDom4 → ADom5 → PDom9									full mediation
Step 1	Simple	KDom4→ PDom9	c	-0.007	0.026	0.790	-0.062	0.046	
Step 2	Regression	KDom4→ ADom5	a	0.079	0.025	0.002	0.028	0.131	
Step 3	Multiple Regression	KDom4→ PDom9	c′	-0.023	0.026	0.363	-0.077	0.028	
		ADom5→ PDom9	b	0.207	0.028	< 0.001	0.157	0.256	
		Indirect effect	ab	0.016	0.006	0.006	0.006	0.029	

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom5=Anti-smoking attitude, PDom9=Positive preventive practice

Investigating the effect of anti-smoking attitude domain towards the relationship between knowledge about cigarette content and positive preventive practice found that the direct effect of knowledge about cigarette content on anti-smoking attitude was significant (a=0.290, p-value<0.05). Knowledge about cigarette content (c=-0.126, *p-value*<0.05) and anti-smoking attitude (b=0.223, *p-value*<0.05) had significant effects on positive preventive practice. However, the pattern of mediation observed is what MacKinnon et al. (2007) termed as "inconsistent mediation" was found. Inconsistent mediation effect arises when at least one indirect effect has a different sign than the direct effect (or another indirect effect). In such a case, the direct effect and indirect effects might tend to cancel each other out, resulting in non-significance of the total effect and in some case the direct effect larger than the total effect (MacKinnon et al., 2000). In this situation the direct effect of knowledge about cigarette content on positive preventive practice after adjusting for anti-smoking attitude (c′=-0.190) and indirect effect (ab=0.065) had opposite signs. Thus, the absolute value of direct effects of knowledge about cigarette content on positive preventive practice was not reduced when anti-smoking attitude is in the model. Meanwhile, the indirect effect yielded a significant result using the bootstrapping 95% confident interval method. This shows that anti-smoking attitude had a significant partial mediating effect on the relationship between knowledge about cigarette content and positive preventive practice.

With regards to the examination of whether anti-smoking attitude mediates the relationship between knowledge about treatment for smokers and positive preventive practice, it was found that the first condition of mediation was not fulfilled as knowledge about treatment for smokers did not significantly influence on anti-smoking attitude (a=-0.034, *p-value*=0.085). In addition, the bootstrapping 95% confidence interval of the indirect effect contained zero. Therefore, anti-smoking attitude domain

did not mediate the relationship between knowledge about treatment for smokers and positive preventive practice.

With regards to the examination of whether anti-smoking attitude mediates the relationship between knowledge about distal effects of smoking on other systems and positive preventive practice found that the direct effect of knowledge about distal effects of smoking on other systems on anti-smoking attitude was significant (a=-0.085, *p-value*<0.05). Anti-smoking attitude had significant direct effect on positive preventive practice (b=0.208, *p-value*<0.05). However, an inconsistent mediation effect was found. Since the direct effect of knowledge about distal effects of smoking on other systems on positive preventive practice after adjusting for anti-smoking attitude (c′=0.036) and indirect effect (ab=-0.018) had opposite signs, thus the total effect of knowledge about distal effects of smoking on other systems on positive preventive practice was not significant (c=0.018, *p-value*=0.478) (MacKinnon et al., 2007). However, the bootstrapping 95% confidence interval of the indirect effect did not contain zero and the direct effect was non-significant. Therefore, anti-smoking attitude had a significant full mediating effect on the relationship between knowledge about distal effects of smoking on other systems and positive preventive practice.

With regards to the examination of whether anti-smoking attitude mediates the relationship between knowledge about direct effects of smoking on mouth, nose, throat, and lungs and positive preventive practice, the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on anti-smoking attitude was significant (a=0.079, *p-value*<0.05). Anti-smoking attitude had significant direct effect on positive preventive practice (b=0.207, *p-value*<0.05). However, an inconsistent mediation effect was found. As the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on positive preventive practice after

adjusting for anti-smoking attitude (c′=-0.023) and indirect effect (ab=0.016) had opposite signs. Thus, the total effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on positive preventive practice was not significant (c=-0.007, *p-value*=0.790) (MacKinnon et al., 2007). However, the bootstrapping 95% confidence interval of the indirect effect did not contain zero and the direct effect was non-significant. Therefore, anti-smoking attitude had a significant full mediating effect on the relationship between knowledge about direct effects of smoking on mouth, nose, throat, and lungs and positive preventive practice.

4.8.2 Mediating effect of Anti-smoking attitude domain on the relationship between Knowledge domains and Negative practice domain

Table 4.50 shows the result on the effect of anti-smoking attitude domain towards the relationship between the knowledge domains and negative practice domain.

Table 4.50: Estimated Coefficient between Knowledge domains with Anti-smoking attitude domain and Negative practice domain

Tests of Mediation				Estimated	SE	p-value	Bootstrap 95%CI		Type of mediation
							LL	UL	
KDom1 → ADom5 → PDom10									Partial mediation
Step 1	Simple	KDom1→ PDom10	c	-0.319	0.040	< 0.001	-0.415	-0.222	
Step 2	Regression	KDom1→ ADom5	a	0.290	0.047	< 0.001	0.193	0.392	
Step 3	Multiple Regression	KDom1→ PDom10	c′	-0.270	0.040	< 0.001	-0.370	-0.167	
		ADom5→ PDom10	b	-0.169	0.023	< 0.001	-0.219	-0.124	
		Indirect effect	ab	-0.049	0.011	< 0.001	-0.072	-0.030	
KDom2 → ADom5 → PDom10									No mediation
Step 1	Simple	KDom2→ PDom10	c	0.068	0.017	< 0.001	0.036	0.099	
Step 2	Regression	KDom2→ ADom5	a	-0.034	0.020	0.085	-0.072	0.003	
Step 3	Multiple Regression	KDom2→ PDom10	c′	0.061	0.016	0.002	0.031	0.092	
		ADom5→ PDom10	b	-0.190	0.023	< 0.001	-0.240	-0.144	
		Indirect effect	ab	0.007	0.004	0.075	-0.001	0.014	
KDom3 → ADom5 → PDom10									full mediation
Step 1	Simple	KDom3→ PDom10	c	-0.017	0.021	0.414	-0.056	0.022	
Step 2	Regression	KDom3→ ADom5	a	-0.085	0.025	< 0.001	-0.130	-0.037	
Step 3	Multiple Regression	KDom3→ PDom10	c′	-0.034	0.021	0.099	-0.072	0.004	
		ADom5→ PDom10	b	-0.198	0.023	< 0.001	-0.248	-0.153	
		Indirect effect	ab	0.017	0.005	0.001	0.007	0.027	
KDom4 → ADom5 → PDom10									full mediation
Step 1	Simple	KDom4→ PDom10	c	-0.007	0.022	0.755	-0.052	0.035	
Step 2	Regression	KDom4→ ADom5	a	0.079	0.026	0.002	0.028	0.131	
Step 3	Multiple Regression	KDom4→ PDom10	c′	0.008	0.021	0.683	-0.037	0.052	
		ADom5→ PDom10	b	-0.195	0.023	< 0.001	-0.245	-0.150	
		Indirect effect	ab	-0.015	0.006	0.005	-0.027	-0.005	

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom5=Anti-smoking attitude, PDom10=Negative practice

With regards to the examination of whether anti-smoking attitude mediates the relationship between knowledge about cigarette content and negative practice, it was found that the direct effect of knowledge about cigarette content on anti-smoking attitude was significant (a=0.290, *p-value*<0.05). Knowledge about cigarette content (c=-0.319, *p-value*<0.05) and anti-smoking attitude (b=-0.169, *p-value*<0.05) had significant effect on negative practice. The absolute value of direct effect of knowledge about cigarette content on negative practice reduced after adjusting for anti-smoking attitude (c=-0.319 to c′=-0.270) and remains statistically significant (*p-value*<0.05). Moreover, the bootstrapping 95% confidence interval of the indirect effect did not contain zero. Thus, anti-smoking attitude had a significant partial mediating effect on the relationship between knowledge about cigarette content and negative practice.

With regards to the examination of whether anti-smoking attitude mediates the relationship between knowledge about treatment for smokers and negative practice found that the first condition of mediation was not fulfilled as knowledge about treatment for smokers did not significantly influence on anti-smoking attitude (a=-0.034, *p-value*=0.085). In addition, the bootstrapping 95% confidence interval of the indirect effect contained zero. Therefore, anti-smoking attitude did not mediate the relationship between knowledge about treatment for smokers and negative practice.

With regards to the examination of whether anti-smoking attitude mediates the relationship between knowledge about distal effects of smoking on other systems and negative practices, the direct effect of knowledge about distal effects of smoking on other systems on anti-smoking attitude was significant (a=-0.085, *p-value*<0.05). An inconsistent mediation effect was found. As the direct effect of knowledge about distal effects of smoking on other systems on negative practice after adjusting for anti-smoking attitude (c′=-0.034) and indirect effect (ab=0.017) had opposite signs. Thus,

the total effect of knowledge about distal effects of smoking on other systems on negative practice was not significant (c=-0.017, *p-value*=0.414) (MacKinnon et al., 2007). Meanwhile, the bootstrapping 95% confidence interval of the indirect effect did not contain zero and the direct effect was non-significant. Therefore, anti-smoking attitude had a significant full mediating effect on the relationship between knowledge about distal effects of smoking on other systems and negative practice.

Investigating mediating effect toward the relationship between knowledge about direct effects of smoking on mouth, nose, throat, and lungs and negative practice found that the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on anti-smoking attitude was significant (a=0.079, *p-value*<0.05). An inconsistent mediation effect was found. As the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on negative practice after adjusting for anti-smoking attitude (c′=0.008) and indirect effect (ab=-0.015) had opposite signs. Thus, the total effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on negative practice was not significant (c=-0.007, *p-value*=0.755) (MacKinnon et al., 2007). However, the bootstrapping 95% confidence interval of the indirect effect did not contain zero and the direct effect was non-significant. Therefore, anti-smoking attitude had a significant full mediating effect on the relationship between knowledge about direct effects of smoking on mouth, nose, throat, and lungs and negative practice.

4.8.3 Mediating effect of Positive perceptions about smoking domain on the relationship between Knowledge domains and Positive preventive practice domain

Table 4.51 shows the result on the effect of positive beliefs about smoking domain towards the relationship between the knowledge domains and preventive practice domain.

Table 4.51: Estimated Coefficient between Knowledge domains with Positive perceptions about smoking domain and Positive preventive practice domain

Tests of Mediation				Estimated	SE	p-value	Bootstrap 95%CI		Type of mediation
							LL	UL	
KDom1 → ADom6 → PDom9									No mediation
Step 1	Simple Regression	KDom1→ PDom9	c	-0.126	0.049	0.009	-0.210	-0.034	
Step 2		KDom1→ ADom6	a	-0.106	0.042	0.010	-0.197	-0.009	
Step 3	Multiple Regression	KDom1→ PDom9	c′	-0.124	0.049	0.011	-0.209	-0.033	
		ADom6→ PDom9	b	0.017	0.033	0.596	-0.056	0.087	
		Indirect effect	ab	-0.002	0.004	0.672	-0.012	0.007	
KDom2 → ADom6 → PDom9									No mediation
Step 1	Simple Regression	KDom2→ PDom9	c	-0.023	0.020	0.243	-0.061	0.015	
Step 2		KDom2→ ADom6	a	0.067	0.017	< 0.001	0.032	0.100	
Step 3	Multiple Regression	KDom2→ PDom9	c′	-0.025	0.020	0.211	-0.063	0.014	
		ADom6→ PDom9	b	0.028	0.033	0.400	-0.047	0.100	
		Indirect effect	ab	0.002	0.003	0.492	-0.003	0.008	
KDom3 → ADom6 → PDom9									No mediation
Step 1	Simple Regression	KDom3→ PDom9	c	0.018	0.025	0.478	-0.029	0.063	
Step 2		KDom3→ ADom6	a	-0.070	0.022	0.001	-0.107	-0.032	
Step 3	Multiple Regression	KDom3→ PDom9	c′	0.020	0.025	0.437	-0.027	0.065	
		ADom6→ PDom9	b	0.025	0.033	0.437	-0.049	0.097	
		Indirect effect	ab	-0.002	0.003	0.518	-0.008	0.004	
KDom4 → ADom6 → PDom9									No mediation
Step 1	Simple Regression	KDom4→ PDom9	c	-0.007	0.026	0.790	-0.062	0.046	
Step 2		KDom4→ ADom6	a	0.047	0.022	0.032	0.007	0.090	
Step 3	Multiple Regression	KDom4→ PDom9	c′	-0.008	0.026	0.758	-0.063	0.045	
		ADom6→ PDom9	b	0.024	0.033	0.467	-0.051	0.094	
		Indirect effect	ab	0.001	0.002	0.567	-0.003	0.005	

Note: KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom6=Positive perceptions about smoking, PDom9=Positive preventive practice

With regards to the examination of whether positive perceptions about smoking mediates the relationship between knowledge about cigarette content and positive preventive practice, the direct effect of knowledge about cigarette content on positive perceptions about smoking was significant (a=-0.106, *p-value*<0.05), but the direct effect of positive perceptions about smoking on positive preventive practice was not significant (b=0.017, *p-value*=0.596) after adjusting for knowledge about cigarette content. Then the second condition of mediation was not fulfilled. Moreover, the bootstrapping 95% confidence interval of the indirect effect contained zero. Therefore, there was no mediation effect exists.

With regards to the examination of whether positive perceptions about smoking mediates the relationship between knowledge about treatment for smokers and positive preventive practice, the result shown that the direct effect of knowledge about treatment for smokers on positive perceptions about smoking was significant (a=0.067, *p-value*<0.05), but the direct effect of positive perceptions about smoking on positive preventive practice was not significant (b=0.028, *p-value*=0.400) after adjusting for knowledge about treatment for smokers. Then the second condition of mediation was not fulfilled. Moreover, the bootstrapping 95% confidence interval of the indirect effect contained zero. Therefore, there was no mediation effect exists.

Similarly, investigating on knowledge about distal effects of smoking on other systems as the dependent variable found that the direct effect of knowledge about distal effects of smoking on other systems on positive perceptions about smoking was significant (a=-0.070, *p-value*<0.05), but the direct effect of positive perceptions about smoking on positive preventive practice was not significant (b=0.025, *p-value*=0.437) after adjusting for knowledge about distal effects of smoking on other systems. Then the second condition of mediation was not fulfilled. In addition, the bootstrapping 95% confidence interval of the indirect effect contained zero. Therefore, there was no

mediation effect exists.

Likewise, investigating on knowledge about direct effects of smoking on mouth, nose, throat, and lungs as the dependent variable found that the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on positive perceptions about smoking was significant (a=0.047, *p-value*<0.05), but the direct effect of positive perceptions about smoking on positive preventive practice was not significant (b=0.024, *p-value*=0.467) after adjusting for knowledge about direct effects of smoking on mouth, nose, throat, and lungs. Then the second condition of mediation was not fulfilled. Furthermore, the bootstrapping 95% confidence interval of the indirect effect contained zero. Therefore, there was no mediation effect exists.

4.8.4 Mediating effect of Positive perceptions about smoking domain on the relationship between Knowledge domains and Negative practice domain

Table 4.52 shows the result on the effect of positive beliefs about smoking domain towards the relationship between the knowledge domains and encourage smoking domain.

Table 4.52: Estimated Coefficient between Knowledge domains with Positive perceptions about smoking domain and Negative practice domain

Tests of Mediation				Estimated	SE	p-value	Bootstrap 95%CI		Type of mediation
							LL	UL	
KDom1 → ADom6 → PDom10									Partial mediation
Step 1	Simple	KDom1→ PDom10	c	-0.319	0.040	< 0.001	-0.415	-0.222	
Step 2	Regression	KDom1→ ADom6	a	-0.107	0.042	0.011	-0.197	-0.009	
Step 3	Multiple Regression	KDom1→ PDom10	c′	-0.271	0.035	< 0.001	-0.353	-0.192	
		ADom6→ PDom10	b	0.454	0.023	< 0.001	0.398	0.511	
		Indirect effect	ab	-0.048	0.022	0.027	-0.090	-0.004	
KDom2 → ADom6 → PDom10									Partial mediation
Step 1	Simple	KDom2→ PDom10	c	0.067	0.017	< 0.001	0.036	0.099	
Step 2	Regression	KDom2→ ADom6	a	0.067	0.017	< 0.001	0.032	0.101	
Step 3	Multiple Regression	KDom2→ PDom10	c′	0.037	0.015	0.012	0.009	0.065	
		ADom6→ PDom10	b	0.461	0.024	< 0.001	0.403	0.517	
		Indirect effect	ab	0.031	0.008	< 0.001	0.015	0.047	
KDom3 → ADom6 → PDom10									full mediation
Step 1	Simple	KDom3→ PDom10	c	-0.017	0.021	0.414	-0.056	0.022	
Step 2	Regression	KDom3→ ADom6	a	-0.070	0.022	0.001	-0.108	-0.032	
Step 3	Multiple Regression	KDom3→ PDom10	c′	0.016	0.019	0.310	-0.020	0.051	
		ADom6→ PDom10	b	0.469	0.024	< 0.001	0.412	0.525	
		Indirect effect	ab	-0.033	0.009	< 0.001	-0.052	-0.015	
KDom4 → ADom6 → PDom10									full mediation
Step 1	Simple	KDom4→ PDom10	c	-0.007	0.022	0.755	-0.051	0.035	
Step 2	Regression	KDom4→ ADom6	a	0.047	0.022	0.032	0.007	0.090	
Step 3	Multiple Regression	KDom4→ PDom10	c′	-0.029	0.019	0.128	-0.068	0.008	
		ADom6→ PDom10	b	0.470	0.024	< 0.001	0.412	0.526	
		Indirect effect	ab	0.022	0.010	0.026	0.003	0.042	

KDom1=Cigarette content, KDom2=Treatment for smokers, KDom3=Distal effects of smoking on other systems, KDom4=Direct effects of smoking on mouth, nose, throat, and lungs, ADom6=Positive perceptions about smoking, PDom10=Negative practice

With regards to the examination of whether positive perceptions about smoking mediates the relationship between knowledge about cigarette content and negative practices, the direct effect of knowledge about cigarette content on positive perceptions about smoking was significant (a=-0.107, *p-value*<0.05). Knowledge about cigarette content (c=-0.319, *p-value*<0.05) and positive beliefs about smoking (b=0.454, *p-value*<0.05) had significant effects on negative practices. The absolute value of direct effect of knowledge about cigarette content on negative practices reduced after adjusting for positive perceptions about smoking (c=-0.319 to c′=-0.271) and remains statistically significant (*p-value*<0.05). In addition, the indirect effect yielded a significant result using the bootstrapping 95% confident interval method. Therefore, positive perceptions about smoking had a significant partial mediating effect on the relationship between knowledge about cigarette content and negative practice.

Investigating on knowledge about treatment for smokers as the dependent variable found that the direct effect of knowledge about treatment for smokers on positive perceptions about smoking was significant (a=0.067, *p-value*<0.05). Knowledge about treatment for smokers (c=0.067, *p-value*<0.05) and positive perceptions about smoking (b=0.461, *p-value*<0.05) had a significant effect on negative practices. The direct effect of knowledge about treatment for smokers on negative practices reduced after adjusting for positive perceptions about smoking (c=0.067 to c′=0.037) and it remained statistically significant (*p-value*<0.05). In addition, the indirect effect yielded a significant result using the bootstrapping 95% confident interval method. Therefore, positive perceptions about smoking had a significant partial mediating effect on the relationship between knowledge about treatment for smokers and negative practices.

Investigating on knowledge about distal effects of smoking on other systems as the dependent variable found that the direct effect of knowledge about distal effects of

smoking on other systems on positive perceptions about smoking was significant (a=-0.070, *p-value*<0.05). However, an inconsistent mediation effect was found. As the direct effect of knowledge about distal effects of smoking on other systems on negative practices after adjusting for positive perceptions about smoking (c′=0.016) and indirect effect (ab=-0.033) had opposite signs. Thus, the total effect of knowledge about distal effects of smoking on other systems on negative practices was not significant (c=-0.017, *p-value*=0.414) (MacKinnon et al., 2007). However, the bootstrapping 95% confidence interval of the indirect effect did not contain zero and the direct effect was non-significant. Therefore, positive perceptions about smoking had a significant full mediating effect on the relationship between knowledge about distal effects of smoking on other systems and negative practices.

Investigating on knowledge about direct effects of smoking on mouth, nose, throat, and lungs as the dependent variable found that the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on positive perceptions about smoking was significant (a=0.047, *p-value*<0.05). However, an inconsistent mediation was found. As the direct effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on negative practices after adjusting for positive perceptions about smoking (c′=-0.029) and indirect effect (ab=0.022) had opposite signs. Thus, the total effect of knowledge about direct effects of smoking on mouth, nose, throat, and lungs on negative practices was not significant (c=-0.007, *p-value*=0.755) (MacKinnon et al., 2007). However, the bootstrapping 95% confidence interval of the indirect effect did not contain zero and the direct effect was non-significant. Therefore, positive perceptions about smoking had a significant full mediating effect on the relationship between knowledge about direct effects of smoking on mouth, nose, throat, and lungs and negative practices.

4.9 Chapter Summary

This chapter first reported the findings of the preliminary data analysis. Descriptive statistics showed that there were 1,299 respondents included in the study. The prevalence of smoking was 28.2%; of these 61.5% were current smokers and 38.5% were former smokers. There were 10 factors extracted from the 52-item questionnaire for KAP domains, two factors were dropped due to the low Cronbach's alpha. Therefore, there were eight factors of KAP domains used for the subsequent analysis.

The results of the final logistic regression analysis revealed that being male, aged between 21-22 years, aged 23 years or above, majoring in non-science, living off campus, having a family member or friend who smoked, and having an equivocal or favorable attitude toward smoking were significantly associated with being a smoker. Multiple linear regression was used to determine associated factors of KAP domains. Being male, aged 23 years or above and having a father with a college or university education had a significantly lower knowledge about cigarette content score compared to overall mean score. Females and students who were studying in a science field had significantly lower knowledge about treatment for smokers compared to the overall mean. Students who were aged 23 years or above, studying in non-science, having a mother with no formal education, and having a mother who was employed in the private sector had significantly lower knowledge about distal effects of smoking on other systems score compared to overall mean score.

Regarding attitude domains, females, students who majored in science, those who live on campus, and those who had a father with a primary or secondary education level had a significantly higher anti-smoking attitude compared to the overall mean. In addition, males, students with a family income of 30,001-50,000 baht, and those having

at least one family member or friend who smoked had significantly higher positive perceptions about smoking compared to the overall mean.

Multiple linear regression analysis was conducted to identify the factors that influenced the practice toward smoking. The results revealed that females, students whose mother was self-employed, students who came from rural areas, and those having at least one family member who smoked had a significantly higher positive preventive practice compared to overall mean. Lastly, males, students majoring in non-science, living outside campus, having a mother with college or university education level, student whose mother was self-employed, and those having friends who smoked had a significantly higher negative practice compared to overall mean.

Based on the mediation analysis, knowledge about cigarette content domain, knowledge about distal effects of smoking on other systems domain, and knowledge about direct effects of smoking on mouth, nose, throat, and lungs domain has significantly influence the positive preventive practice domain and are mediated by anti-smoking attitude domain. Similarly, knowledge about cigarette content domain, knowledge about distal effects of smoking on other systems domain, and knowledge about direct effects of smoking on mouth, nose, throat, and lungs domain significantly influenced negative smoking practices domain and were mediated by anti-smoking attitudes domain. The results also revealed that positive perceptions about smoking domain mediated the relationship between all knowledge domain and negative practice domain.

CHAPTER 5: DISCUSSION AND CONCLUSION

This final chapter provides the discussion and conclusion of the study. The chapter begins with discussion of the findings in Section 5.1. It then presents implications of the study in Section 5.2. This is followed by limitations of research and future recommendations of the study in Sections 5.3 and 5.4, respectively. Finally, the conclusion of the study is presented in Section 5.5.

5.1 Discussion of the Findings

According to the analysis in Chapter 4, the sections below will discuss the findings of the five research objectives.

5.1.1 Discussion of Findings – Research objective one

Based on the results of the analysis in the preceding chapter, the first objective of this study was to determine the prevalence of smoking among university students in Thailand. The overall prevalence of smoking among university students in this study was 28.2%. This figure is higher than the national smoking prevalence in Thailand, 19.1% (Tan & Dorotheo, 2018). It is also slightly higher than the smoking prevalence reported among students attending other universities such as the Sukhothai Thammathirat Open University in Thailand which was 27.7% (Pachanee et al., 2011), Chongqing University Town, China, 21.9% (Xu, Leung et al., 2015), Internationnal Islamic University Malaysia, 19.3% (Elkalmi et al., 2016), University of Malaya, 22.4% (Chirtkiatsakul et al., 2019), the Ahi Evran University College of Health and Physical Education and Sports, 23.7% (Babaoğlu et al., 2017) and Artvin Çoruh University in Turkey, 27.9% (Karadoğan et al., 2018). However, this finding on the smoking prevalence is lower than that reported among students attending the Management and Science University, Malaysia which was 29% (Al-Naggar et al., 2011), the Assiut

university, Egypt, 36.0% (Abou-Faddan & Ahmed, 2018), two public universities in the Sylhet Division (Hassan et al., 2018) and Patuakhali Science and Technology University (Ahmed et al., 2020), in Bangladesh, 37.0% and 32.6% respectively and universities in New Zealand, 49.8% (Wamamili et al., 2019). The possible justification for the difference of smoking prevalence in each study could be due to the population's norms and sociocultural values, and religious beliefs (Koenig, 2001; Prabhu et al., 2013).

In this study, 62.0% of smokers started smoking before the age of 18 years. This finding was also aligned with a previous study conducted among Thai university students where it was found that around 38.2% of smokers started smoking when they were in senior high school and 68.3% of smokers started smoking before they attended university (Pachanee et al., 2011). This study revealed that the average age of students when they started smoking was 16 years. Similarly, a study from Turkey showed that the average age at initiation of smoking was 16.6 years (Babaoğlu et al., 2017). This figure suggests that the age of smoking initiation has become decreased. This may be due to the fact that access to tobacco products is becoming easier, particularly for minors.

5.1.2 Discussion of Findings – Research objective two

The second research objective was to examine the general level of knowledge, attitude and practice with regards to smoking among university students in Thailand. The findings indicated that nearly 76% of students had a high level of knowledge about smoking, half of the students had neutral attitude towards smoking, whereas almost 80% had poor preventive practice towards smoking. An explanation for the high percentage of good knowledge could be that many universities in Thailand have implemented a smoke-free university policy since 2014, thus universities may have

been providing several smoking prevention resources to increase student's knowledge. Many studies showed that having good knowledge does not necessarily translate into good practice (Demaio et al., 2014; Fazey et al., 2014; Selvarajoo et al., 2020; Xu, Liu, et al., 2015). The stumbling block is the behaviour which is not easily changed or improved. This suggests that although most students had good knowledge of the harmful effects and negative impact of smoking, practices towards smoking were poor. Therefore, it is recommended that university-based preventive education and health promotion are still needed to inculcate healthy behaviour and increase the awareness and preventive practice of smoking.

5.1.3 Discussion of Findings – Research objective three

The third research objective was to identify factors associated with smoking status among university students in Thailand. Multiple logistic regression analysis was performed. The results showed that male gender, students aged 21-22 years or 23 years and above, majoring in non-science, living outside campus, having at least one family members or friend who smoked and having an equivocal and favorable attitude towards smoking were associated with smoking status.

Male students had a significantly higher smoking prevalence than females. Similar findings have been documented in China, Malaysia, and various parts of the world to confirm that higher smoking rate are recorded in males (Al-Naggar et al., 2011; Babaoğlu et al., 2017; Chirtkiatsakul et al., 2019; Jafari et al., 2014; Karadoğan et al., 2018; Mandil et al., 2010; Sarıoğlu et al., 2016; Xu, Leung et al., 2015). This may be due to the fact that female smoking is not well accepted in Thai society (Parkinson et al., 2009). Another possibility is that tobacco use among males is a more common way of socializing with friends compared to females. Tsai et al. (2008) reported that males tend to use tobacco in more socially relevant situations than females. This study

demonstrated a significant relationship between student's age and smoking status. A similar finding was noted in Cameroon, Vietnam, and New Zealand whereby the prevalence of smoking increased with increasing age (Huong et al., 2017; Ngahane et al., 2015; Wamamili et al., 2019). The smoking prevalence was higher among students who were not majoring in science. This finding aligned with previous studies which indicated type of education has an effect on smoking behaviour (Jafari et al., 2014; Mandil et al., 2010; Musmar, 2012; Tucktuck et al., 2018). This was probably due to the fact that there is higher awareness about smoking hazards among the health science or science professional students compared to non-science students. Students with more knowledge on science or health science have better access to resources that can help them maintain better health. Students who live outside campus were more likely to smoke. One possibility might be that those students lived away from home with influence from peer off-campus (Maroof et al., 2013; Peltzer & Pengpid, 2014) and they were more independent.

Having family members or friends who smoked in this study were the most important factors associated with smoking status. Students with at least one family member who smoked was a significant risk factor for smoking. These findings were similar to a previous research study, which found that having sibling who smoked increased the risk of smoking (Sarıoğlu et al., 2016), students whose parents were smokers had a significantly higher smoking rate than those who did not (Rosen et al., 2018), and family members are powerful influences for smoking (Karadoğan et al., 2018). It is possible that parents who smoked may also allow their children to smoke in the house. We also found that having friends who smoke had a significantly higher smoking rate than those without any smoking friends. This finding is consistent with the results of other studies carried out in Bangladesh (Ahmed et al., 2020; Hassan et al., 2018), Cameroon (Ngahane et al., 2015), Turkey (Sarıoğlu et al., 2016). A possible

explanation is that most university students spend more time with their friends and they might want to be accepted by them. A previous study revealed that students with perceived social acceptability of smoking are influential on their decision to smoke (Long & Valente, 2019). These findings suggest the impact that family and social environments have on these individuals may have contributed to the development of harmful habits. In this study, having a favorable attitude towards smoking had a significantly higher smoking rate. This finding is supported by a study in China (Xu, Leung et al., 2015) which found that students who smoked were more likely to believe that smoking helps them to relax, makes them look strong or helps them to study better. These results are also consistent with a study by Alves, Precioso and Becoña (2020) where students who showed favorable attitudes toward smoking were found to be more likely to be a former smoker or current smoker as compared to a non-smoker.

5.1.4 Discussion of Findings – Research objective four

The research objective four was to identify factors associated with KAP domains among university students in Thailand. According to the result of EFA for KAP domains, there were four factors related to the knowledge domains, two factors related to the attitude domains, and two factors related to the practice domains. Several multiple linear regression models were used to determine associated factors of each domain. With regard to knowledge domains, this study found that knowledge about cigarette content score was low among male students, those aged 23 years and above, and those who had a father with a college or university education level. Likewise, students aged 23 years and above, majoring in non-science, whose mother had no formal education, and whose mother was employed in the private sector were also associated with low knowledge about distal effects of smoking on other systems scores. This finding is important since it identified the key factors associated with low knowledge about

tobacco product content and its effects on health. University health practitioners should focus on these factors for developing and conducting programs to increase students' knowledge on the harmful effects of smoking. In addition, previous studies indicated that an increasing knowledge about the health effects of smoking are strongly associated with reduction in smoking prevalence and increases the intention to quit smoking (Dawood et al., 2016; Yang et al., 2009).

In terms of the attitude domains, female students reported a higher anti-smoking attitude than male students, a result that aligns with previous studies in India and Indonesia (Nagarajappa et al., 2013; Prasetya & Utami, 2018). Students who were studying in a non-science major had low anti-smoking attitude scores, a finding consistent with another study in China (Han et al., 2012). A possible explanation is that science and health science professional students have more chance to access resources that are related to the effects of tobacco smoke, which may in turn influence their attitude toward smoking. The study results also demonstrate that anti-smoking attitude scores were low among students who were residing off-campus. This could be related to the increased restriction of smoking on campus than off campus and students living off campus have a greater chance to live in an unhealthy environment, which might change their anti-smoking attitude from a positive to a negative one. Students having a father with a high educational level had lower attitude scores than those having a father with a low education level. Having an educated father does not mean that an individual has a good anti-smoking attitude. The highly educated people spend more time at work, which means they have less time to teach their children. In addition, Sherman et al. (2009) found that implicit attitudes toward smoking were transmitted intergenerationally from parents to their children. With regard to the factors associated with positive perceptions about smoking, the scores of positive perceptions about smoking were high among male students, a finding consistent with other studies (Al-

Shami et al., 2018; Haddad & Malak, 2002), indicating that males have less concern about the negative consequences of smoking. A significant association was found between positive perceptions about smoking and monthly family income. This is probably because the students with a high family income are more likely to be a smoker (Lee et al., 2020) and they might be provided with a larger amount of pocket money, which was associated with increased risk of tobacco products purchasing by adolescent smokers (Scragg et al., 2003). Thus, they may be less concerned about their health due to the fact that they have more opportunities to access health care services. We also found that students who had at least one family member or friend who smoked were more likely to express positive perceptions toward smoking, a similar finding also seen in a previous study (Resen, 2018). A possible explanation is that parents and friends can be crucial role models in the home environment. Lagerweij et al. (2019) found a significant association between positive beliefs about smoking and observing others who smoke, especially parents and friends. In addition, some parents who smoke at home are less likely to be aware of the risks of children's exposure to smoking substances (Rosen et al., 2018).

Observing the associated factors of practice domains, findings indicated that male students had lower positive preventive practice scores compared to females, a finding that is aligned with a previous study in Malaysia (Mahdi et al., 2020). A possible explanation is due to the social acceptability belief of male smoking; Thai males are more likely to believe that parents would allow them to smoke (Parkinson et al., 2009). Students from urban areas had lower positive preventive practice scores. This may be due to the different lifestyle behaviour between urban and rural areas. A previous study identified that urbanisation is a major driver of unhealthy lifestyle behaviors (Candib, 2007). However, this finding contrasts with a study from Vietnam which revealed living in a rural area correlated with lower practice against second-hand smoke (Vu et al.,

2020). Moreover, students whose mother was self-employed had high positive preventive practice scores. This could be due to the fact that self-employed mothers may have more time to take care of their children and provide advice to them concerning healthy practices since they were young. We also found that students who had a family member that smoked had higher positive preventive practice scores than those who did not. One possible explanation is that those students were directly affected by smoking behaviors of their parents or siblings, and they may worry about the health of their family. Another explanation could be that those students may feel more comfortable talking to their family about quitting smoking. Thus, this could be the starting point for their anti-smoking behavior. However, this finding is inconsistent with the results of a study done by Sadeghi et al. (2019) which found that having a father who smoked hookah led to less preventing smoking. With regard to the factors associated with negative practice, the scores of negative practices were high among male students. This might be because males tend to use tobacco in more socially relevant situations than females (Tsai et al., 2008). This study also reported that students who were majoring in a non-science major had higher negative practice scores compared to those who were majoring in science. This could be due to the strong effect of education about the health risk of smoking among science or heath science students. Living off campus is a factor influencing negative practice towards smoking. One explanation for such behaviour is that students living outside university and they may be living away from home could be gaining more negative behavior because of changes in their lifestyle. Living away from the restrictions of parental control may result in the adoption of unhealthy lifestyle practices. Students who had friends who smoked were more likely to have a negative behavior of smoking. This could be because of social acceptance. This may be particularly applicable for socially anxious university students, being faced with many new social situations and having the desire to be accepted socially by their peers. To be

accepted as one of their gang members, tobacco smoking is one of the behaviours for social acceptance (Ahmed et al., 2011; Lopez et al., 2017; Syme & Alcalay, 1982). This study also found that students whose mothers had a higher level of education were more likely to have a negative practice towards smoking. This could be due to the family's lack of communication about health behavior and healthcare. Highly educated mothers may fill position with more work responsibilities and more in paid employment. Thus, they might spend less time at home with their children during childhood (Behrman & Rosenzweig, 2002; Saucedo & Aluoch, 2018).

5.1.5 Discussion of Findings – Research objective five

The fifth objective aimed to investigate whether attitude domains mediate the relationship between knowledge domains and practice domains. Based on earlier findings, the research framework consists of the knowledge domains as an independent variable, attitude domains as a mediating variable, and practice domains as a dependent variable. The knowledge domains consist of four dimensions: (1) cigarette content; (2) treatment for smokers; (3) distal effects of smoking on other systems, and (4) direct effects of smoking on mouth, nose, throat, and lung. The attitude domains consist of two dimensions: (1) anti-smoking attitude and (2) positive perceptions about smoking. The practice domains consist of two dimensions: (1) positive preventive practice and (2) negative practice.

Table 4.49 depicts the mediating role of anti-smoking attitude between the four domains of knowledge and positive preventive practice. The result reveals that the three domains of knowledge significantly affected the positive preventive practice through anti-smoking attitude domain. This finding suggested that promoting preventive practice towards smoking would require promoting both knowledge regarding smoking and anti-smoking attitude. Consistent with evidence that anti-smoking attitude

correlated with practice towards prevention of smoking. Knowledge was also correlated with anti-smoking attitude and practice towards prevention of smoking (Izzati et al., 2016). Moreover, Blake et al. (2009) revealed that having high knowledge about smoking was associated with having a better attitude, thus leading to effective tobacco control. The study results are also consistent with the findings of Mahdi et al. (2020) in which a low level of satisfactory attitude towards secondhand smoke explained the low level of satisfactory preventive practices.

The results in Table 4.50 indicate that anti-smoking attitude mediates the relationship between the three domains of knowledge and negative practice. This finding implies that an increase in knowledge about smoking leads to an increase in anti-smoking attitude, which in turn leads to a decrease in negative smoking practice. One possible explanation is that students with better knowledge regarding smoking hazards might have a better anti-smoking attitude, which could be translated into good action. Our results are in line with a previous study, which found that higher levels of awareness is strongly associated with increases in targeted anti-tobacco attitudes as well as reduced intentions to smoke over time (Vallone et al., 2018).

In terms of positive perceptions about smoking, our study also found that positive perceptions about smoking act as a mediator between the four domains of knowledge and negative practice. This finding suggests that having poor knowledge about smoking leads to having smoking-related positive beliefs about the benefits of smoking, which would then have an impact on increasing the negative smoking behaviour. Previous studies indicated that positive attitudes involving smoking lead to intention to smoke, which in turn leads to smoking (Azjen & Fishbein, 1980; Hanson, 1997). Mohammadpoorasl et al. (2012) and Osuh et al. (2020) found that having a positive attitude toward smoking was associated with a greater likelihood of intention to smoke.

In this research, a model made up of three domains was designed to pave the way to understanding the mediating role of attitude in the relationship between knowledge and practice. Findings of this study support the proposed KAP model which was discussed in Chapter 2, Section 2.9.4. Both knowledge domains and attitude domains are associated with the practice domains, while attitude domains act as the mediator between the knowledge domains and practice domains. In order to improve the preventive practice towards smoking, it is necessary to enhance anti-smoking attitudes by increasing knowledge about the health risks of smoking.

5.2 Implication of the Study

The findings from this study furthers the understanding on the smoking behavior, knowledge, attitudes, and practices regarding smoking from the viewpoints of tertiary students in Thailand. The implications of the findings, with regard to methodological, practical, and policy were explored, and presented in the following sections.

5.2.1 Methodological Implications

This thesis has expanded the applications of statistical techniques, thus contributing to the methodological approach. Most of the previous studies on tobacco smoking employed binary logistic regression modelling based on the treatment contrasts when the outcome is dichotomous (Abou-Faddan & Ahmed, 2018; Ahmed et al., 2020; Al-Badri et al., 2017; Chotbenjamaporn et al., 2017; Karadoğan et al., 2018; Lee et al., 2020; Ngahane et al., 2012; Oktay et al., 2013; Omotehinwa et al., 2018; Tucktuck et al., 2018; Urrutia et al., 2017). The results from fitting logistic regression models can be presented as a graph of confidence intervals, to compare the proportion in each group with a specified reference group. This study considered a different technique, whereby the logistic regression model based on the weighted sum contrasts was used and the results from fitting the model were presented as a graph to compare the proportion in

each group with the overall proportion. Similarly, linear regression analysis using the weighted sum contrasts was utilized. The graph of confidence intervals for comparing each mean of KAP scores with the overall mean of KAP scores rather than with a specified reference group (Amirah et al., 2021; Baig et al., 2020; Hallit et al., 2020; Sa'adeh et al., 2018; Samosir et al., 2018) are produced. Therefore, the benefit of using weighted sum contrasts is that we can compare each proportion (or mean) with the overall proportion (or mean) rather than with a specified reference group, the choice of which is often arbitrary. The graph of confidence intervals based on the weighted sum contrasts provide a way of classifying the levels of each factor into three groups according to whether each corresponding confidence interval exceeds, crosses, or is below the overall proportion (or mean) (Kongchouy & Sampantarak, 2010).

Furthermore, as far as we are aware, there are limited studies evaluating the indirect effect of smoking-related knowledge on practice towards smoking via attitude regarding smoking among university students in Thailand. The KAP model was adapted to assess whether the preventive smoking behavior could be determined by the student's knowledge and attitude towards smoking and the results of this study supports this KAP theory regarding the direct and indirect effect of knowledge on practice via attitude.

5.2.2 Practical Implications

This research provides some implications for practices based on examinations and analysis conducted to answer the five research objectives. First, this study showed that more than half of smokers started smoking before the age of 18 years or they initiated smoking before they attended university. This indicates that education regarding smoking, emphasizing on its negative consequences, should begin early in the primary schools or secondary schools. It should be an integral part of the school curriculum in Thailand.

Second, the university health practitioners may build up advocates of smoke-free campaigns by recruiting the help from groups of university student volunteers. These university student volunteers can then build up the next generation of younger advocates within the secondary schools student. Eventually both will be living as children and emerging as adults into the mainstream communities in the future. If they have been inspired and equipped to do advocacy work on smoke-free campaigns, then it is anticipated that they can be the agents of change and an influential force in smoke-free efforts in the future.

Third, this study provides a better understanding of the factors affecting smoking uptake among university students in Thailand based on scientific evidence and not based on mere personal intuitions and judgements. Evidence from this study suggests specific attention should be given to the male students with several other profiles. Males entering the study institution, those aged between 21-22 years, particularly, those studying in a non-science major, living off campus, who have a family or friend who smokes or a favorable attitude about smoking should be screened for smoking and be given the appropriate interventions. Parents and teachers can play an important role in closely monitoring their youths' behavior to prevent them from starting the habit of smoking, particularly, to reduce the smoking behaviour due to influence from their smoker peers. Meanwhile, the smoking behavior of parents and other siblings were also identified as the vital influencing factors contributing to smoking behaviour, which implies that health practitioners should increase the awareness among parents or guardians about the harmful effects of tobacco smoking. The interventions targeted at parents who are smoking may be more fruitful, not only to prevent their children from smoking, but can have the potential additional benefit of decreasing other family members from smoking. In addition, teachers and staff should not be allowed to smoke on campus as students can imitate them.

Fourth, the results of this study also provide insights to a better understanding of the overall level of knowledge, attitude, and practice towards smoking among Thai university students. Some of the factors associated with low knowledge, high positive attitude and high negative practice towards smoking also have been identified. University health practitioners could use these results to screen the students who need to improve their KAP through training, education, and communication programs.

Fifth, the mediation role of the anti-smoking attitude and positive perceptions about smoking is also highlighted in the KAP model. Based on the results presented in Section 4.7.1, it can be claimed that anti-smoking attitudes act as a mediator between the three dimensions of knowledge (i.e., 1. cigarette content, 2. distal effects of smoking on other systems, and 3. direct effects of smoking on mouth, nose, throat, and lungs) and positive preventive practices. Furthermore, anti-smoking attitudes also can acts as a mediator between the three dimensions of knowledge (i.e., 1. cigarette content, 2. distal effects of smoking on other systems, and 3. direct effects of smoking on mouth, nose, throat, and lungs) and negative practices towards smoking. Positive perceptions about smoking can also acts as the mediator between all knowledge domains and negative practice toward smoking. According to this, university health practitioners can start planning to promote preventive practices towards smoking. If the objective is the enhancement of preventive practice toward smoking, and university health practitioners should take the level of student knowledge about smoking into consideration. By analysing students' level of knowledge on smoking, the right interventions can be proposed to change the students' attitude about anti-smoking and hence, hindering positive perceptions about smoking, which, consequently will result in an increase in smoking preventive behavior. In addition, campaigns should target the students with low level of knowledge about the health effects of smoking to improve health equity

and reduce health disparities. The Centers for Disease control and Prevention (2015) indicates that eliminating demographic disparities in tobacco use is a priority.

Sixth, the university health practitioner should promote healthy lifestyle to discourage smoking among university students by offering healthy activities such as promoting physical activities, promoting various sports, and providing a place for sport and exercise. These can motivate the students to keep away from smoking and other substance use.

Finally, although smoking behaviour among students in each university could be different, these findings could provide a useful baseline information on student smoking behaviour and that it can be used as a comparison basis with future research.

5.2.3 Policy Implications

Thailand has country-specific tobacco control laws and policies, and has also signed the WHO Framework Convention on Tobacco Control (WHO FCTC) in 2005. In addition, many universities in Thailand have initiated a smoke-free university policy since 2014. In support of the laws and policies, this study suggested some guidelines for policy-makers. First, to acknowledge the impact of smoking, changing the positive perceptions about smoking and encouraging smoking preventive practices, all university and school curricula should include and emphasize tobacco smoking preventions, its consequences, tobacco control and smoking cessation. Second, schools and universities should provide smoking cessation services and the service should be promoted to students to encourage them and help them to quit smoking and also to reduce the mortality rate of non-communicable disease. The use of effective smoking cessation programs such as individual consultation, peer group support, and empowerment programs should be considered and implemented. Third, The Division of Student

Affairs, should develop policy support for preventing new smokers, eliminating exposure to secondhand smoke, and building up new social norms. Fourth, a smoking ban should be extended to cover entrance and exit points of the campuses. Fifth, to make it more difficult for minors to purchase tobacco products, the government should consider increasing the taxes on all tobacco products.

Sixth, the study revealed that about half of smokers smoked normal cigarettes and about two-thirds also used electronic cigarettes. Thai laws state that electronic cigarettes are illegal. Thailand issued a Notification of the Ministry of Commerce Prohibition of importing Hookah and Electronic Hookah or Electronic cigarette into Thailand B.E.2557 in 2014 (Ministry of Commerce, 2014). In 2015, a consumer Protection Board Order (No.9/2015) was published prohibiting the sale and services of e-cigarettes is (Board of Consumer Protection, 2015). In 2017, the Tobacco Products Control Act of A.D. 2017 amended the definition of tobacco product as: "Tobacco Products shall mean products derived from the tobacco leaf, or from [other parts of] the plant nicotiana tabacum, and shall further include any product containing nicotine as an ingredient for consumption by smoking, sucking, sniffing, chewing, eating, burning, or snuffing into the mouth or nose, or by any other means to achieve the same purpose, but excluding items regulated by the drug laws" (Ministry of Public Health, 2017) However, Thai laws still have no specific measure to control electronic cigarettes. A previous study found that electronic cigarettes are less toxic and safer to use compared to conventional cigarettes (Shahab et al., 2017). Kochsiripong and Pitirattanaworranat (2021) found that the Thai undergraduate students had misperceptions about electronic cigarettes in terms of health impacts, addiction, appearance, and effectiveness as a smoking cessation tool. This may be the reason for the increasing number of university students who smoked electronic cigarette despite being illegal. Therefore, it is important that the Thai

government should make a clear policy and execute legal measures to control the use and sales of e-cigarettes.

The study revealed that more than half of university students are not aware that their university is a smoke-free campus and approximately 28% did not know the comprehensiveness of the smoke-free policy on campus. Although many universities have been implementing the smoke-free policy on their campuses for several years, not many university students knew about it. This finding confirms the need to strongly promote the implementation of a smoke-free policy and related campaigns in their campus. Enforcements are critical for the effective implementation of a smoke-free policy. When smoke-free policies are poorly enforced on university campuses, people tend to deliberately ignore them (Russette et al., 2014). Therefore, strict and high-quality enforcement of the smoke-free policy needs to be maintained. The regulations should be enforced, potentially by campus security and there should be a punishment for those who violate the laws.

5.3 Limitations of the Study

This study has some limitations which should be acknowledged. First, the findings are based on students' self-reports, which may be affected by respondent bias. Second, some students may have been reluctant to report their smoking status due to fear that their parents or university administration would find out. Furthermore, social norms in Thailand, particularly among women smokers since smoking is not accepted among women in Thailand, may have affected responses. Third, since all students in this study were from public universities, the current findings may not be generalizable to the whole population of university students in Thailand.

5.4 Recommendations for Further Research

Although this study had some limitations, its finding can guide future practice and research work. First, further research need to include interviews of participants. A qualitative study would be useful for supplementing a better understanding of smoking behavior and the reasons behind this complex issue of smoking among the university students. Second, further studies are needed to examine some other important factors that might be associated with smoking behaviour such as drinking, drug abuse, stress level, CGPA, and internet use. Third, this study only investigates students from public universities in Thailand. Further studies are needed to determine the possible factors contributing to differences in smoking prevalence between public and private university students and assess the difference in knowledge, attitude, and practice regarding smoking in both types of universities. Fourth, in the part of the analysis, the use of different types of tobacco products were not analyzed separately, therefore the results did not show the factors which contribute to smoking in each type of tobacco product, such as cigarettes, electronic cigarettes, and water-pipes. Future research could examine the factors related to smoking of each type of tobacco products and researchers may focus on alternative tobacco products used and how they influence students' attitudes, beliefs, and perceptions. Fifth, further interventional studies are needed to determine what methods are more effective for reducing the prevalence of smoking. Clinical assessment for quit smoking is also required for further research. Lastly, further studies could use a quality assessment rubric to select articles and sort out good from poor quality articles for literature reviews chapter.

5.5 Conclusions

The findings from this study highlight the importance of research into smoking behaviour and KAP towards smoking among university students in Thailand. This study

revealed that nearly one third of students were smokers. More than half of them started smoking before 18 years old, indicating that knowledge on tobacco smoking and its health effect should be instilled right from the primary and secondary school levels where many students had initiated their habits. Although most of the students showed high overall knowledge about smoking, increasing the students' awareness of the health risks of smoking and promoting the good practices towards smoking are still very much needed. Importantly, the smoking behaviour of parents, siblings, and friends was significantly related to students smoking behaviours. In addition, such profile of university students entering the study institution like males, those studying in a non-science major, those living off campus, and those who have a favorable attitude toward smoking are those that should be screened for smoking for appropriate interventions to be provided.

This study demonstrated an interesting pattern in the KAP toward smoking among university students in Thailand. Exploring the KAP domains and its associated factors will help policymakers better understand the university community and the related needs, as well as to promote better practice habits to reduce the prevalence of smoking in the future. Additionally, it was discovered that anti-smoking attitude is a mediating factor between all three domains of knowledge, positive preventive practice and negative practice. Positive perception about smoking is a mediating factor between all knowledge domains and negative practice.

As many universities in Thailand have initiated a smoke-free policy since 2014, findings from this study should be very useful to motivate the *smoke-free campuses* campaigns. The university health practitioners should start developing, improving, and conducting programs to monitor the smoking behaviors, prevent smoking and promote smoking cessation among university students. Raising such awareness and the

enforcement of the smoke-free policy are the foundation to sustain a long-term smoke-free campus environment.

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