

Prevalence of Cigarette Smoking among Teenagers in Southeast Asia: A Systematic Review

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Abstract Background of the Study: Cigarette smoking is one of the most preventable causes of morbidity internationally, especially in low-income countries. It is more prevalent among youth as compared to adults, concluding that the age of initiation follows a decreasing shift. **Objective of the Study:** This study seeks to determine the prevalence and related risk factors of cigarette smoking among teenage individuals in Southeast Asian countries. **Materials and Methods:** Identification and selection of relevant studies from years 2011-2020 were from PubMed using an established syntax. A total of 849 articles were identified and screened against a predefined inclusion criteria: research article written in English, ISI or Scopus indexed journal published during 2011-2020, accessible full-text article, number of respondents is ≥ 50 aging from 13-19 years old, originated within Southeast Asia, and prevalence of cigarette smoking and related risk factors are reported. After screening and full-text eligibility assessment, 13 studies were included in the review. The extracted statistical findings from each study included the prevalence (in percentage) of cigarette smoking and its related risk factors (in odds ratio). Quality assessment was conducted using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross Sectional Studies. **Results and Discussion:** All 13 studies were considered to be low risk. The included studies presented that Malaysia has the highest prevalence of teenage smoking while Vietnam has the lowest. In line with this, there is a higher prevalence of smoking among males and older age groups. Furthermore, upon comparing the reported risk factors and odds ratio across all the included articles, the risk factors involved in teenage smoking were male sex, parental smoking, secondhand smoke (SHS) exposure, drug use, alcohol use, pro-tobacco advertisement exposure, and positive smoking-related beliefs. Alongside these, the protective factors were being exposed to anti-tobacco messages or advertisements, learning and having knowledge about the hazards or dangers of smoking, believing that smoking is harmful, and having a negative attitude toward smoking. **Conclusion:** In conclusion, teenagers that initiate conventional and electronic cigarette smoking have been increasing. Aside from male sex, where cigarette smoking prevalence was most common, other risk factors include secondhand smoking, parental smoking, concurrent substance abuse, and exposure to smoking ideals from the environment.

Keywords Cigarette smoking, Teenagers, Southeast Asia, Prevalence, Risk factor

1. Introduction

Cigarette smoking is defined as the inhalation and exhalation of smoke coming from a cigarette. This cigarette is made from folded tobacco leaves wrapped with thin paper containing about 600 different ingredients. Some of its notable ingredients are naphthalene, acetone, and the most known ingredient, nicotine. Across the globe, there are more than a billion smokers, wherein 80% reside in either low- or middle-income countries [1]. Furthermore, 19% of adults are current smokers in which 33% are men and 6% are women. While as for the youth who are aged 13-15 years old, there are approximately 24 million smokers globally. In both low-

and middle-income countries, the rise in the number of cigarette smokers is attributable to population growth and tobacco industry marketing [2].

According to the 2014 ASEAN Tobacco Control Report, 25 percent of the 1.2 billion adult smokers in the world come from the ASEAN population. From the 2013 ASEAN total adult tobacco smoker percentage distribution, with a population of 625,096,300 ASEAN citizens, Indonesia had the highest percentage of adult tobacco smokers (50.68%) taking up more than half of the population while Singapore had the lowest percentage (0.29%). Adults in this data were considered to be aged 15 and above [3].

There are several risk factors that are associated with smoking initiation among teenagers, such as male gender, parental smoking, friends smoking, socioeconomic status, perception of health hazards of smoking, mass media, spending more time away from home and single parents. The most common reported risk factor associated with smokers

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is having a family member and/or friend who smokes [4]. In addition to this, teenagers were found to have more pro-smoking behaviors when they were exposed to parental, sibling, and peer smoking. Parental smoking was also associated with the perceived safety of casual smoking and the desire to smoke in response to smoking-related cues like seeing someone else smoke [5]. Moreover, friends have a strong influence on each other and can promote experimentation when there is coercive pressure to engage in risky behaviors such as smoking [6].

According to the Centers for Disease Control and Prevention (CDC), cigarette smoking affects almost every organ in the human body. It causes various diseases and premature death to its affected users. Among the various diseases present in those that practice cigarette smoking, it majorly leads to respiratory diseases; specifically lung cancer and chronic obstructive pulmonary disease [7]. One of the evident diseases also associated with cigarette smoking are cardiovascular disease, mainly coronary heart disease [8]. Other health risks due to smoking include infertility for both men and women, pregnancy problems for women, cataract development in the eyes, type II diabetes, rheumatoid arthritis, and cancer of other organs [9].

People that do not directly smoke cigarettes, also known as passive smokers, are also affected by those that practice first hand smoking. Secondhand smokers (SHS) may develop the same diseases as those of first hand smokers because they indirectly inhale the same smoke inhaled by the latter [10]. These problems are not only the concern of adults, but also includes teenagers and children. The American Lung Association stated that people that smoke at an early age are most likely to develop an addiction to nicotine and pass away prematurely [11].

1.1. Objectives of the Study

1.1.1. General Objective

The main objective of this study is to determine the prevalence and related risk factors of cigarette smoking among teenage individuals in Southeast Asian countries.

1.1.2. Specific Objectives

1. To investigate relative studies on the prevalence and related risk factors of cigarette smoking using a specific inclusion criteria
2. To determine the prevalence of cigarette smoking during teenage years
3. To identify the odds ratios of risk factors and protective factors of cigarette smoking among teenage individuals in Southeast Asian countries
4. To combine and compare the differences and similarities in the reported prevalence and risk factors of the selected studies following the systematic review protocol
5. To assess the implications of the reported risk factors and protective factors

1.2. Significance of the Study

This study aims to determine the prevalence and risk factors related to cigarette smoking among teenage individuals. The results obtained from the study may benefit the following:

1.2.1. To the Department of Health

This research may be utilized to prompt the introduction of interventions and improve existing programs in the community implemented by the government and other concerned authorities, directed at regulating tobacco use, as well as discouraging individuals, especially teenagers, from smoking.

1.2.2. To the Community

The results of this study can help parents, in collaboration with school counselors, increase their awareness regarding the risk factors that influence cigarette smoking among teenagers, in order for them to effectively guide the teenagers.

1.2.3. To the Medical Professionals

The study shall demonstrate the prevalence of teenage smoking and will serve as a means for medical professionals to focus on discussing the harmful effects of smoking and its prevention among groups with a higher prevalence.

1.2.4. To the Future Researchers

This study seeks to be of aid to future researchers who are inclined to explore more on the topic of cigarette smoking among teenage individuals and its related risk factors.

2. Methodology

2.1. Research Design

The researchers utilized a systematic review, a method that involves systematic and comprehensive identification and selection of relevant studies against a predefined inclusion criteria, data extraction of necessary information from the included studies, and finally, data analysis in order to arrive at conclusions in relation to the provided formulated research question.

2.2. Search Strategy

The search strategy was established using the boolean operators “AND” and “OR.” Hence, the search for journal articles about prevalence and risk factors of adolescent cigarette smoking is done in the database PubMed using the statement “Adolescent OR youth OR teenage AND risk factors OR determinants OR associated factors AND initiation OR likelihood AND prevalence OR incidence OR epidemiology AND tobacco smoking OR cigarette smoking OR e-cigarettes OR electronic cigarettes AND Southeast Asia.” Duplicate titles are excluded, then an initial screening

through abstract review is done. Lastly, a full-text article assessment for eligibility is done to determine which studies are to be included in the systematic review using a predefined inclusion criteria.

2.3. Inclusion and Exclusion Criteria

Studies were included in the systematic review if they were written in the English language and its year of publication is during the years 2011-2020. Moreover, it should be a research article published in an ISI or Scopus indexed journal and its full-text article is available. As for the respondents involved, there must be a minimum of 50 respondents and their age range must strictly be from 13 to 19 years old. The country of origin of the research must be within Southeast Asia. Lastly, statistical findings on prevalence (in percentage) of cigarette smoking and its related risk factors (with odds ratio) are reported. Studies that lack any of the mentioned aspects were excluded.

2.4. Data Extraction

Data extraction was performed from the identified articles and reached an agreement as to which are to be included in the systematic review, wherein the following data are to be extracted from the screened journal articles and placed systematically in a spreadsheet:

- Title
- Author/s
- Year of publication
- Type of study
- Duration of the study
- Country where the study was conducted
- Age range and/or description of respondents
- Sample size
- Prevalence of Cigarette Smoking (expressed in percentage)
- Risk factors to Cigarette Smoking (with odds ratio)

2.5. Quality Assessment

Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross Sectional Studies was utilized to evaluate the methodological quality of included studies and determine degree to which a study has approached the risk of bias in terms of its design, conduct, and analysis, by employing the following criteria [12]:

- Criteria for inclusion in the sample clearly defined
- Study subjects and the setting described in detail
- Exposure measured in a valid and reliable way
- Objective, standard criteria used for measurement of the condition
- Confounding factors identified
- Strategies to deal with confounding factors stated
- Outcomes measured in a valid and reliable way
- Appropriate statistical analysis used

Studies that have a score of 50% and above were considered low-risk bias, while those studies with a score lower than 50% will be considered high-risk bias.

2.6. Data Synthesis

In a systematic review, qualitative methods were utilized in order to synthesize research outcomes drawn from the selected studies, in aim of pooling relevant data regarding prevalence rates of current smoking as well as reported risk and protective factors of smoking among the youth. All relevant data was initially tabularized for easier comparison, thereupon containing prevalence rates as well as identified and protective risk factors as established from pooled odds ratios (OR) and adjusted ratio (aOR) of correlates reported in raw data of the respective journals. Thereafter, general evaluation, commonalities and differences were descriptively discussed to further elaborate on the salient points of major outcomes.

3. Results and Discussion

3.1. Literature Search and Selection of Eligible Material

A total of 849 original articles were identified from the electronic database, PubMed upon input of the search syntax, “Adolescent OR youth OR teenage AND risk factors OR determinants OR associated factors AND initiation OR likelihood AND prevalence OR incidence OR epidemiology AND tobacco smoking OR cigarette smoking OR e-cigarettes OR electronic cigarettes AND Southeast Asia.”, then utilizing search filters by the publication date to be within 2011-2020, and text availability to be free full-text.

Out of all identified studies, duplicates were removed using the Remove Duplicates function of Microsoft Excel 2016. There were no duplicates observed. Out of the 849 studies, 782 were excluded as they did not confirm with the inclusion criteria. Out of the 67 studies, 54 were excluded after assessing the eligibility of the full-text article. The reasons for exclusion are the involvement of respondents outside the range of 13-19 years old, the study did not provide smoking prevalence and statistical findings on its risk factors (specifically odds ratio), the topic was irrelevant, and the full-text article was not accessible. Finally, 13 articles were utilized for systematic review. The process for the selection of studies to be included in the research is illustrated in Figure 1.

3.2. Characteristics of Included Studies

As shown in Table 1, 13 studies were conducted in Southeast Asian countries between 2011 and 2020. Of these, five were done in Malaysia, two in Vietnam, one in Thailand, one in Indonesia, one in Myanmar, one in Thailand, Vietnam, & South Korea, one in Thailand, Taiwan, & South Korea, and another one was in Cambodia & Vietnam. The data collected in countries that included South Korea and Taiwan were individually stated, hence, all data for South Korea and Taiwan were disregarded. All of the studies accessed through the search were cross-sectional. Sample sizes ranged from 300 to 25,507, wherein the overall sample size amounted to 101,906 respondents. As for the quality

assessment, all studies were evaluated to be low-risk bias.

3.3. Quality of Included Studies

In accordance with the JBI critical appraisal checklist for analytical cross-sectional studies, all of the included studies did not indicate any methodological defect as well as significant risk of bias for the reason that the studies scored 50% and above of the quality assessment criteria. Therefore, all 13 articles remain included and considered to be low-risk bias.

3.4. Major Outcomes of Included Studies

As shown in Table 2, the researchers have indicated the country of origin, year of publication prevalence of cigarette smoking, of the 13 remaining journals included in the study. The prevalence of cigarette smoking was divided into three aspects namely: the overall prevalence, prevalence of cigarette smoking in relation to the age, and in relation to the biological sex of the included studies. In addition, the researchers also collated the necessary statistical findings of the related risk and protective factors to cigarette smoking reported per journal article, specifically in odds ratio (OR) with 95% confidence interval.

The overall cigarette smoking prevalence ranged from 2.7% to 73%, with the highest overall cigarette smoking prevalence of 73% coming from Malaysia in the study of Nur Atikah *et al.* (2019), while one of the studies from Vietnam by Huong *et al.* (2016) had the lowest prevalence of 2.5% [13,14]. Based on the biological sex, males had a higher prevalence percentage compared to females in 10 out of the 13 studies, with the study of Nur Atikah *et al.*, (2019) having the highest percentage difference of 97.37% [13]. Furthermore, in eight out of the 13 studies that mentioned specific prevalence for the different age groups, there is a direct proportion whereas the age group increases the cigarette smoking prevalence increases. However, in one of the studies by Nur Atikah *et al.* (2019), the smoking prevalence decreases in 17 year olds compared to the 15 and 16 year olds [13]. Their study mentioned that the cause of this may possibly be the Sijil Pelajaran Malaysia public examination, which may lead to the 17 year olds to be more focused on their studies.

Among all of the reported risk factors, the commonly stated ones are male sex, parental smoking, SHS exposure, drug use, alcohol use, pro-tobacco advertisement exposure, and positive smoking-related beliefs.

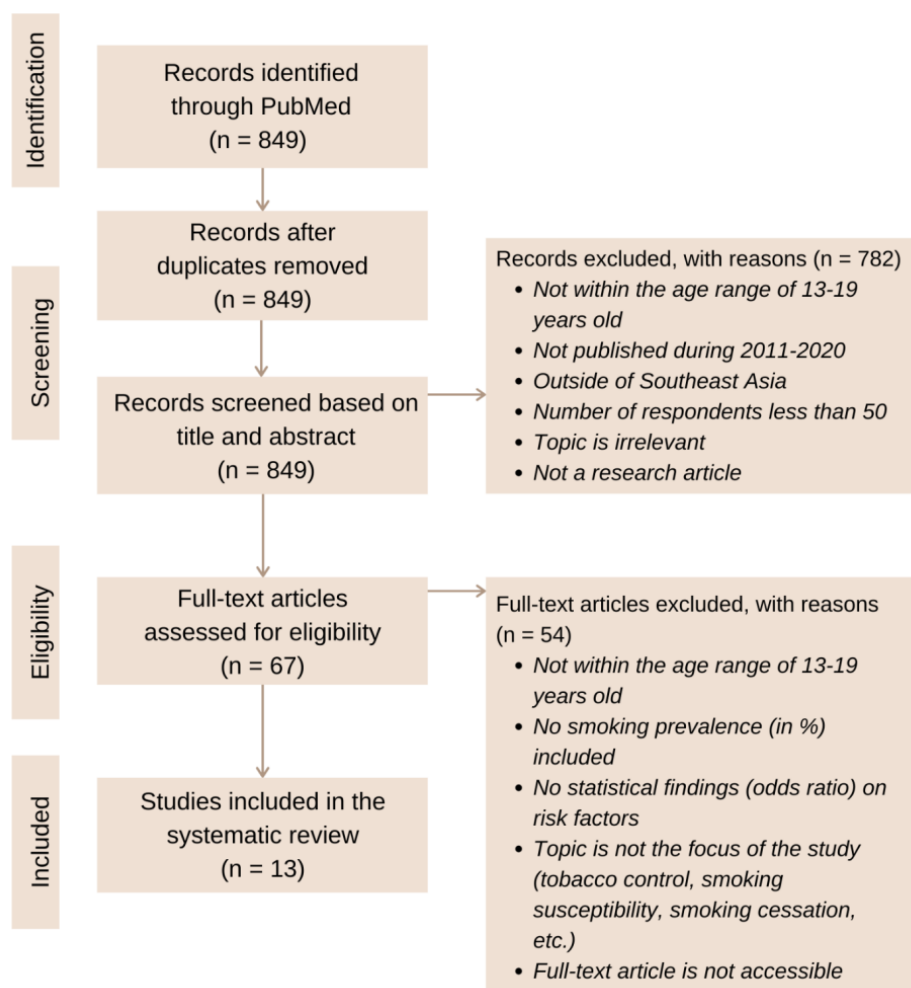


Figure 1. PRISMA 2009 Flow Diagram of the Study Selection Process for Systematic Review

Table 1. Characteristics of the Studies Included in the Systematic Review (n=13)

Journal No.: Author/Year	Study Area	Study Design	Sample Size	Quality
J1: Joung & Chung/2019	Vietnam	Cross-sectional	3,552	Low risk
	Thailand		1,872	
J2: Nur Atikah et al/2019	Malaysia	Cross-sectional	422	Low risk
J3: Htin Aung Myint et al/2019	Myanmar	Cross-sectional	300	Low risk
J4: Ling et al/2019	Malaysia	Cross-sectional	13,135	Low risk
J5: Bigwanto et al/2017	Indonesia	Cross-sectional	698	Low risk
J6: Peltzer & Pengpid/2017	Cambodia	Cross-sectional	3,325	Low risk
	Vietnam		3,198	
J7: Lee et al/2013	Thailand	Cross-sectional	15,420	Low risk
J8: Chotbenjamaporn et al/2017	Thailand	Cross-sectional	1,721	Low risk
J9: Huong et al/2016	Vietnam	Cross-sectional	3,430	Low risk
J10: Lim et al/2015	Malaysia	Cross-sectional	554	Low risk
J11: Van Minh et al/2011	Vietnam	Cross-sectional	15,610	Low risk
J12: Robert Lourdes et al/2019	Malaysia	Cross-sectional	13,162	Low risk
J13: Tee & Kaur/2014	Malaysia	Cross-sectional	25,507	Low risk
OVERALL SAMPLE SIZE		101,906		

As compared to females, the male population was reported to be a significant risk factor to cigarette smoking as reported by 11 out of the 13 studies selected, with the highest OR reported being 81.505 (95% CI = 8.554 - 776.570) and the lowest being 2.220 (95% CI = 1.005 - 4.900). As for parental smoking, six articles claimed that having either one parent or both parents smoke can increase smoking susceptibility. The highest OR reported for both parents smoking is 8.18 (95% CI = 5.94-11.28), while the lowest is 0.810 (95% CI = 0.040–16.256). On the other hand, the highest OR reported for only one parent smoking is 1.98 (95% CI = 1.81-2.17), while the lowest is 0.8 (95% CI = 0.6-1.1). In relation to parental smoking, SHS exposure was also reported as a risk factor in four articles, with the highest aOR being 4.685 (95% CI = 3.376 - 6.501) and the lowest OR being 1.054 (95% CI = 0.438–2.533). Three articles also stated that drug use and alcohol use are significant risk factors to cigarette smoking. For drug use, its highest OR and lowest aOR are 14.00 (95% CI = 11.56-16.97) and 2.972 (95% CI = 1.243 - 7.106). As for alcohol use, its highest OR and lowest aOR are 7.83 (95% CI = 5.83-10.52) and 2.337 (95% CI = 1.463 - 3.735). Focusing on pro-tobacco advertising, four articles claimed that exposure to advertisements which promote use of cigarettes and other tobacco products can increase the likelihood of adolescent smoking. Its highest reported OR is

1.7 (95% CI = 1.1-2.6) while the lowest is 1.05 (95% CI = 1.02-1.08). Lastly, according to three articles, having positive beliefs about smoking is also a risk factor, with the highest OR and lowest OR being 2.2 (95% CI = 1.38-3.49) and 1.074 (95% CI = 0.588–1.961) respectively.

Amidst the risks given by cigarette smoking, data regarding the most significant protective factors was collated and determined in the 13 included articles. In the study of Chotbenjamaporn P, et al. (2017), three protective factors were stated: exposure to anti-tobacco messages in the media (OR = 0.6, 95% CI = 0.4 - 0.9), knowledgeable regarding the bad effects of tobacco from school (OR = 0.6, 95% = CI 0.4 - 0.8), and belief the smoking is harmful to them (OR = 0.4, 95% CI = 0.2 - 0.6) [15]. Similarly, the ninth study by Huong, et al. (2016), presented data regarding the exposure of the participants to anti-tobacco advertisements (OR = 0.54, 95% CI = 0.31 - 0.93) [14]. Lastly, the tenth journal by Lim, et al. (2015), was the final study that included significant protective factors. It included data regarding the knowledge level of the participants on the hazards of smoking (aOR = 0.5, 95% CI = 0.37-0.72), and the negative attitude toward smoking (aOR = 0.67, 95% CI = 0.46-0.99) [16]. The only difference between this study and the first two is that it used adjusted odds ratios in presenting the statistics of their data.

Table 2. Major Outcomes on Prevalence, Risk Factors, and Protective Factors of the Included Studies

Journal No.: Author/Year	Country of Origin	Prevalence of Cigarette Smoking		Risk Factors			Protective Factors			
		Overall	Age	Biological Sex	Variable	OR (95% CI)	aOR (95% CI)	Variable	OR (95% CI)	aOR (95% CI)
J1: Joung & Chung/2019	Vietnam	2.8%	(13-15 years old) 7th Grade: 1.0% 8th Grade: 3.5% 9th Grade: 4.4%	Male: 5.4% Female: 0.3%	Sex	Male: 81.505 (8.554-776.570)				
					Parental Smoking	Anyone: 0.725 (0.396-1.327) Both: 0.810 (0.040-16.256)				
					SHS at home	Yes: 2.266 (1.216-4.222)				
					SHS in indoor public places	Yes: 1.054 (0.438-2.533)				
					SHS in school	Yes: 1.240 (0.634-2.427)				
					Myth that smoking is good for socializing	Yes: 1.089 (0.482-2.459)				
					Sex	Male: 3.484 (1.822- 6.660)				
					Parental Smoking	Anyone: 0.873 (0.581-1.314) Both: 1.944 (0.238-15.883)				
					SHS at home	Yes: 1.508 (0.707-3.217)				
					SHS in indoor public places	Yes: 1.054 (0.438-2.533)				
J2: Nur Atikah et al/2019	Thailand	10.9%	(13-15 years old) 7th Grade: 5.4% 8th Grade: 11.3% 9th Grade: 16.3%	Male: 16.8% Female: 4.8%	SHS in school	Yes: 1.240 (0.634-2.427)				
					Myth that smoking is good for socializing	Yes: 1.089 (0.482-2.459)				
					Biological Sex (Conventional Cigarette Smoking)	Male: 9.887 (2.737- 35.721)				
					Biological Sex (Electronic Cigarette Smoking)	Male: 2.220 (1.005- 4.900)				
					Sex	Male: 3.484 (1.822- 6.660)				
					Parental Smoking	Anyone: 0.873 (0.581-1.314) Both: 1.944 (0.238-15.883)				
					SHS at home	Yes: 1.508 (0.707-3.217)				
					SHS in indoor public places	Yes: 1.054 (0.438-2.533)				
					SHS in school	Yes: 1.240 (0.634-2.427)				
					Myth that smoking is good for socializing	Yes: 1.089 (0.482-2.459)				
J2: Nur Atikah et al/2019	Malaysia	73.0%	Sole CC users (27.01%): 13 years old: 5.26% 14 years old: 29.82% 15 years old: 31. 58% 16 years old: 27.19% 17 years old: 6.14% Sole EC users (42.18%): 13 years old: 10.67% 14 years old: 19.66% 15 years old: 10.11%	Sole CC users: Male: 97.37% Female: 2.63% Sole EC users: Male: 92.13% Female: 7.87% Dual users: Male: 81.54%	Biological Sex (Conventional Cigarette Smoking)	Male: 9.887 (2.737- 35.721)				
					Biological Sex (Electronic Cigarette Smoking)	Male: 2.220 (1.005- 4.900)				
					Sex	Male: 3.484 (1.822- 6.660)				
					Parental Smoking	Anyone: 0.873 (0.581-1.314) Both: 1.944 (0.238-15.883)				
					SHS at home	Yes: 1.508 (0.707-3.217)				
					SHS in indoor public places	Yes: 1.054 (0.438-2.533)				
					SHS in school	Yes: 1.240 (0.634-2.427)				
					Myth that smoking is good for socializing	Yes: 1.089 (0.482-2.459)				
					Biological Sex (Conventional Cigarette Smoking)	Male: 9.887 (2.737- 35.721)				
					Biological Sex (Electronic Cigarette Smoking)	Male: 2.220 (1.005- 4.900)				

[illegible]

J8: Chotbenjamaporn et al/2017	Thailand	14.0%	13-15 years old: prevalence for each age group is not stated	Male: 20.7% Female: 7.1%	Biological Sex	Male: 3.2 (2.0-4.9)	Male: 2.9 (1.8-4.8)	Exposed to anti-tobacco messages in media	Yes: 0.6 (0.4-0.9)	Yes: 0.6 (0.4-0.9)
					Parental Smoking	None: Ref One parent: 0.8 (0.6-1.1) Both parents: 2.1 (0.6-7.5)	None: Ref One parent: 0.8 (0.5-1.1) Both parents: 2.0 (0.7-6.0)	Learned about dangers of tobacco at school	Yes: 0.7 (0.5-0.9)	Yes: 0.6 (0.4-0.8)
					Exposed to secondhand smoke	Yes: 2.1 (1.5-2.9)	Yes: 2.2 (1.2-3.9)	Believe that people's smoking is harmful to them	Yes: 0.6 (0.3-1.1)	Yes: 0.4 (0.2-0.6)
					Exposed to advertisement of cigarettes or other tobacco products on the internet	Yes: 1.7 (1.2-2.4)	Yes: 1.4 (1.0-2.0)			
					Exposed to point-of-sale tobacco advertisement	Yes: 1.7 (1.1-2.6)	Yes: 1.5 (1.0-2.2)			
	Vietnam	2.5%	13-15 years old: prevalence for each age group is not stated	Male: 4.9% Female: 0.2%	Biological Sex	Male: 20.6 (7.50-56.45)	Male: 11.55 (4.13-32.35)	Exposure to anti-tobacco advertisement	0.54 (0.31-0.93)	
					Parental Smoking	Either: 1.78 (1.10-2.87) Both: 4.82 (1.95-11.9)				
	Malaysia	19.0%	13-16 years old: prevalence for each age group is not stated	Male: 35.8% Female: 3.1%	Biological Sex		Male: 6.6 (2.61-16.4)	Knowledge level on hazards of smoking	0.51 (0.37-0.72)	0.67 (0.46-0.99)
					Parental smoking	Father or Mother: 1.46 (1.18-1.82) Both Parents: 2.52 (1.57-4.05)		Negative attitude toward smoking		
	Vietnam	3.3%	13 years old: 2.2% (1.7-2.8) 14 years old:	Male: 5.9% (5.3-6.9) Female: 1.2%	Parental smoking					

J9: Huong et al/2016

J10: Lim et al/2015

J11: Van Minh et al/2011

						1.05 (1.02-1.08)	Proportion of students who were exposed to smoking ads					
J12: Robert Lourdes et al/2019	Malaysia	9.1%	13-15 years old: 11.3% (8.9-14.2) 16-19 years old: 13.0% (10.2-16.4)	Male: 16.0% (13.8-18.5) Female: 2.8% (1.9-4.1)		Male: 7.51 (6.23-8.93)	Biological sex	Male: 4.08 (3.36-4.95)				
J13: Tee & Kaur/2014	Malaysia	11.5%	12-13 years old: 6.8% (5.7- 8.0) 14 years old: 9.5% (7.7-11.7) 15 years old: 11.8% (10.1-13.9) 16 years old: 14.6% (12.7-16.7) 17 years old: 15.7% (13.1-18.7)	Male: 20.9% (18.9- 23.0) Female: 2.1% (1.8-2.6)	Biological sex		Biological sex	Male: 3.25 (1.87-4.98)				
					Parental Smoking			My father or male guardian: 1.023 (0.795- 1.317) My mother or female guardian: 0.882 (0.299- 2.601) Both: 4.782 (1.156- 19.772)				
					Secondhand smoke exposure			Yes: 4.685 (3.376- 6.501)				
					Drank alcohol in the past 30 days			Yes: 2.337 (1.463- 3.735)				
					Drug used at least once in the past 12 months			Yes: 2.972 (1.243- 7.106)				

3.5. Discussion

Cigarette smoking is known as one of the highest preventable causes of death globally wherein initiation often begins during one's youth. According to the WHO, the Southeast Asia Region consists of a third of the world's youth aged 13-15 years old that use various forms of tobacco. Knowing its danger to those who practice this and to those who are exposed to an environment of smoking, it is important to determine the prevalence and related risk factors of cigarette smoking among teenage individuals in Southeast Asian countries. Therefore, 13 published studies from an online database (PubMed) were reviewed and analyzed in order to differentiate and combine their varying findings.

Across the 13 journals, 11 studies (84.62%) were focused on one research locale. Malaysia was the most common research location as it was the country founded in five studies (38.46%), followed by Vietnam (15.38%) and Thailand (15.38%) with two studies respectively, and finally Myanmar (7.69%) and Indonesia (7.69%) with one study each. Aside from this, the remaining two journals by Kyoung H Joung & Sung S Chung (2019), and Peltzer K & Pengpid S (2017), focused on more than one research location (Vietnam and Thailand, and Vietnam and Cambodia respectively). From 2011 and 2013-2016, there was one included journal for each year while in 2017 there were three journals included, and finally five journals were included in the year of 2019. This then gives the study a timeline capable of analyzing the various findings regarding the topic throughout the years.

All included studies collated up to 101,906 participants. 11 journals had sample sizes greater than 500 with 25,507 participants as the highest sample size in the study of Guat Tee & Kaur (2014), while two journals had less than 500 participants with 300 participants as the lowest sample size in the study of Htin Aung Myint, et al. (2019) [17,18]. The participants in the included studies were the youth aged 13-19 years old. 38.46% of the studies consisted of 13-15 year olds while the remaining studies consisted of the varying 13-19 year old limitation. 92.31% of the studies included both male and female biological sex labels, but the study of Ling, et al. (2019) only included the male sex [19]. Generally, upon further review of the various data, cigarette smoking in Southeast Asia is more common for the male sex as compared to the female sex.

Smoking prevalence was most common in Malaysia, collectively, the prevalence of smokers in Malaysia ranged from 9% to 73%. The most notable data came from the study conducted by Nur Atikah et al. (2019) which stated that 73% of the sample study were electronic cigarette users aged 13-17 years old [13]. Opposing this, Vietnam had the lowest smoking prevalence ranging from 2.5-3.3%, wherein the journal of Huong, et al. (2016) was found to have the least number of smokers [14]. Majority of these smokers come from the male sex ranging from 1.1-97.37%, while the female sex included smokers ranging from 0.2-7.1%. Based

on the journal where the highest biological sex percentage was taken from, it was found that Asian males are more likely to smoke compared to females for the reason that it is prevalent in culture where it is more acceptable to be a male smoker compared to female smokers. Similar notions had been observed in a similar study conducted in Tunisia wherein the males had a significantly increased prevalence as compared to females, attributed by normative behavior to that of the male population [20].

As for the cigarette smoking prevalence in the different age groups, there is a direct proportion seen, as the age group increases the cigarette smoking prevalence percentage increases as well. This means that there is a higher risk of smoking in the older adolescents compared to those who were younger. This is specifically seen in the study of Bigwanto et al. (2017) where from the prevalence of 27.2% in the age range 15-17 years old, increased to 44.7% in the 18-19 years old range [21]. This finding was similar to one of the studies in Malaysia by Ling et al. (2019) where their study found that older male adolescents were more likely to be cigarette smokers as peer relationships become more important, hence they are more likely to smoke for social acceptance [19]. Consequently, multiple cross-sectional samples in the US followed a similar pattern, as an observed upward shift toward older age groups was reported, peaking thereafter at 18 years [22].

Smoking includes various risk factors and from the 13 articles that were reviewed, the common risk factors include male sex, parental smoking, SHS exposure, substance use, advertisement exposures, and beliefs. Among these, male sex was reported the most times. Based on the journal where the highest OR was taken from, male smoking is said to be a symbol of masculinity and is considered a social norm while female smoking is not [23]. Furthermore, most youth think that smoking makes boys appear more attractive, successful, and intelligent [24]. This is consistent with a study conducted in Hamadan City, west of Iran, by Barati et al (2015), wherein a typical male smoker was evaluated as less immature, more popular, more attractive, more self-confident, more independent, and less selfish by tobacco smokers [25].

In terms of parental smoking, the ORs of both parents smoking are higher than those of only one parent smoking, which means that the occurrence of smoking is more likely when both parents smoke than when only one parent smokes. According to Ling et al. (2019), teenagers who have parents as smokers have the tendency to imitate their parents' actions and think that smoking is not harmful. Moreover, the parents' behavior can be interpreted as an approval for them to start smoking [19]. Furthermore, cigarettes being easily available and accessible in their home can also be a reason [17]. This finding is similar to a study conducted in Boston, Massachusetts, by Mays et al (2014), wherein when parents are current, nicotine-dependent smokers, a longer period of exposure to parental smoking increases the likelihood that their children will follow in their footsteps and become a heavy smoker [26].

Alongside parental smoking, SHS exposure is considered a potent smoking stimulus due to the nicotine inhalation and olfactory stimulation it causes [17]. This finding had also been highlighted in the study conducted in the greater Montreal area, by McGrath et al (2018), in which exposure to airborne nicotine via second hand smoking is a potential risk factor for smoking initiation throughout adolescence. It was also stated that pharmacological exposure to nicotine in the air was linked to smoking expectancies, which are known to trigger smoking initiation [27].

As for drug and alcohol use, Tee & Kaur (2014) mentioned that those teenagers that engage in one health-risk behavior are anticipated to take part in more health-risk behaviors [17]. This is further strengthened in a study conducted in four Pacific Islands in Oceania wherein prevalence of smoking is claimed to be concurrent with both alcohol and drug use among the respondents [28].

In relation to pro-tobacco advertising exposure, these advertisements include pro-smoking media campaigns and point of sale display, as well as indirect ones like being offered a free tobacco product by a tobacco company sales representative. Given the consequences of such, one of the provisions of the new Tobacco Product Control Act in Thailand is total ban on advertising [15]. Similar streams of causation was mentioned in a study conducted in the United States, by Agaku & Ayo-Yusuf (2014), wherein adolescents who are exposed to pro-tobacco advertisements are more likely to try new tobacco products [29].

Finally, positive smoking-related beliefs include: people

who smoke have more friends, smoking makes people more attractive, and smoking helps people feel comfortable during social events [14]. Anent to this, a study conducted in Madinah City, Al Madinah Region, Saudi Arabia, by Kasim et al (2016), stated that the belief that smokers were more attractive, especially if they were of the opposite sex, as well as the belief that they were more comfortable in social gatherings, increased the probability of adolescents becoming smokers [30].

Alongside the risk factors are the protective factors, and the significant ones that were reported are: being exposed to anti-tobacco messages or advertisements, learning and having knowledge about the hazards or dangers of smoking, believing that smoking is harmful, and having a negative attitude toward smoking. As mentioned by Strecher and Rosenstock's Health Belief Model which was cited by Lim et al. (2015), changes in behaviors happen whenever the perceived threats of a certain behavior outweigh its perceived benefits. In this case, the likelihood of developing cancer prevents the individual from engaging in a health-risk behavior like smoking [16]. In line with this, a study conducted in California, United States of America, by Leas et al (2015), stated that anti-tobacco advertisements with visceral and personal messages may be recalled by a higher percentage of smokers and have a stronger impact on smoking cessation [31].

The summary of generalized qualitative findings from the included articles according to country can be seen in Table 3 below.

Table 3. Summary of Qualitative Findings According to Country

Country	Summary of Findings
Malaysia	<ul style="list-style-type: none"> • Six journals (journals 2, 4, 10, 12, 13) were included with the year of publication ranging from 2014 to 2019 • Overall cigarette smoking prevalence ranged from 9.1% to 73% • Cigarette smoking prevalence among males ranged from 16% to 81.54% • Cigarette smoking prevalence among females ranged from 2.1% to 18.46% • Cigarette smoking prevalence among the highest age groups ranged from 13% to 25.2% • Cigarette smoking prevalence among the lowest age groups ranged from 6.8% to 20.6% • Reported risk factors are male sex, parental smoking, SHS exposure, alcohol use, drug use • Reported protective factors are knowledge on hazards of smoking and negative attitude towards smoking
Thailand	<ul style="list-style-type: none"> • Three journals (journals 1, 7, 8) were included with the year of publication ranging from 2013 to 2019 • Overall cigarette smoking prevalence ranged from 10.9% to 14% • Cigarette smoking prevalence among males ranged from 16.8% to 20.7% • Cigarette smoking prevalence among females ranged from 4.8% to 7.1% • Cigarette smoking prevalence among the highest age group is 16.3% • Cigarette smoking prevalence among the lowest age group is 5.4% • Reported risk factors are male sex, parental smoking, SHS exposure, pro-tobacco advertisement exposure, and positive smoking-related beliefs • Reported protective factors are exposure to anti-tobacco messages in media, learning about the dangers of tobacco at school, and believing that smoking is harmful
Vietnam	<ul style="list-style-type: none"> • Four journals (journals 1, 6, 9, 11) were included with the year of publication ranging from 2011 to 2019 • Overall cigarette smoking prevalence ranged from 2.5% to 4.7% • Cigarette smoking prevalence among males ranged from 4.9% to 5.9% • Cigarette smoking prevalence among females ranged from 0.2% to 1.2% • Cigarette smoking prevalence among the highest age groups ranged from 4.4% to 5.5% • Cigarette smoking prevalence among the lowest age groups ranged from 1% to 2.2%

Country	Summary of Findings
	<ul style="list-style-type: none"> Reported risk factors are male sex, parental smoking, SHS exposure, alcohol use, drug use, pro-tobacco advertisement exposure, and positive smoking-related beliefs Reported protective factor is exposure to anti-tobacco advertisement
Myanmar	<ul style="list-style-type: none"> Only one journal (journal 3) was included with the year of publication being 2019 Overall cigarette smoking prevalence is 34.7% Cigarette smoking prevalence among males is 65.3% Cigarette smoking prevalence among females is 4% Reported risk factor is male sex
Indonesia	<ul style="list-style-type: none"> Only one journal (journal 5) was included with the year of publication being 2017 Overall cigarette smoking prevalence is 29.6% Cigarette smoking prevalence among males is 55.6% Cigarette smoking prevalence among females is 3.8% Cigarette smoking prevalence among the highest age group is 44.7% Cigarette smoking prevalence among the lowest age group is 27.2% Reported risk factors are male sex and pro-tobacco advertisement exposure
Cambodia	<ul style="list-style-type: none"> Only one journal (journal 6) was included with the year of publication being 2017 Overall cigarette smoking prevalence is 2.7% Cigarette smoking prevalence among males is 5.5% Cigarette smoking prevalence among females is 1.1% Cigarette smoking prevalence among the highest age group is 5.5% Cigarette smoking prevalence among the lowest age group is 1.8% Reported risk factors are male sex, SHS exposure, alcohol use, and drug use

Six out of 11 Southeast Asian countries were covered in this study. Myanmar, Indonesia, and Cambodia only had one article each. On the other hand, Malaysia, Thailand, and Vietnam had three articles and above. From the presented overall prevalence of cigarette smoking, Malaysia, Thailand, Myanmar, and Indonesia have a high prevalence, while Vietnam and Cambodia have a low prevalence. However, such findings cannot be used to generalize the said countries, since not all of them have the same number of studies to base the conclusion on, and the studies themselves have limitations which will be later discussed. In terms of prevalence based on biological sex, males consistently have a higher prevalence of cigarette of smoking than females across all six countries. Similarly, in terms of age group, those from higher groups also consistently have a higher prevalence of cigarette smoking than those from lower age groups. As for the risk factors that were listed previously, they are scattered among the six countries, which gives the impression that they are all relevant issues in a number of countries in Southeast Asia. Meanwhile, the protective factors are only reported in three countries, as not all included articles had data about it.

Despite the results of each study, the studies have its limitations which may cause discrepancies in the outcomes of the study. Listed in Table 4 are the factors affecting each study included in the review.

Table 4. Summary of Factors that May Affect Each Study According to the Limitations of the Included Studies

Author	Factors that may affect each study
Joung & Choung (2019)	<ul style="list-style-type: none"> School-based sample

Nur Atikah et.al. (2019)	<ul style="list-style-type: none"> Population of study is represented by only one state in Malaysia EC use was not validated
Htin Aung Myint et.al. (2019)	<ul style="list-style-type: none"> Small sample size No interventional study by pre and post test in proper assessment of variables
Ling et.al. (2019)	<ul style="list-style-type: none"> Self-reported data No verification tool for smoking status
Bigwanto et.al. (2017)	<ul style="list-style-type: none"> School-based sample Self-reported data
Peltzer & Pengpid (2017)	<ul style="list-style-type: none"> Self-reported data
Lee et.al. (2013)	<ul style="list-style-type: none"> Self-reported data School-based sample
Chotbenjamaporn et.al. (2017)	<ul style="list-style-type: none"> Self-reported data School-based sample
Huong et.al. (2016)	<ul style="list-style-type: none"> School-based sample
Lim et.al. (2015)	<ul style="list-style-type: none"> Causality was not inferred between dependent and independent variables Self-reported data
Van Minh et.al. (2011)	<ul style="list-style-type: none"> GYTS self-reported data School-based sample
Robert Lourdes et.al. (2019)	<ul style="list-style-type: none"> Factors that may influence e-cigarette use were not explored well Unable to determine the prevalence of cigarette smoking among students who switched to e-cigarette usage and vice versa No measure of frequent or persistent use of e-cigarette was explored
Tee & Kaur (2014)	<ul style="list-style-type: none"> Self-reported No biomarker studies were carried out

With regards to the research locale, a more inclusive sample would result in proper comprehension of risk factors, representative of each country since six studies were conducted solely in school-based settings. As cited by Chotbenjamaporn et.al. (2017), neglecting the percentage of those who do not attend school may not constitute for the whole teenage population [15]. Similarly, a small sample size confined in one region may not be generalizable to the representative country [18].

The accuracy of participants' responses to survey items may also be affected by biases, as well as limitations related to self-reported smoking among teenagers. Smoking behavior is underreported more frequently among younger adolescents and in circumstances where social desirability is strongest, such as at school [24]. This statement has been further supported by Bigwanto et al., (2017), wherein prevalence may be underreported among collection of data performed in schools [21]. Thus, a validation tool or intervening study may be useful to minimize bias and yield more accurate results since it lacked among four of the selected studies [18].

Aside from the limitations found, the researchers concluded that there were research gaps present in the study. The systematic review focused only on teenage individuals aged 13-19 years old, studies from Southeast Asia and, the prevalence, risk factors and protective factors in the different studies regarding cigarette smoking. Based on the main variables of the study, there is limited knowledge regarding other articles that may be of aid in improving the entire topic. It was found that not all countries in Southeast Asia were properly represented in the systematic review. Due to the inclusion criteria, six out of the eleven countries were the only ones included with less than four studies varying from the six. Additionally, there was difficulty in finding related literature for the study to ensure that there was literature for each of the eleven countries. This might have been due to the language used in the paper, the inaccessibility of the study, the participants in the study & etc. The different included studies mostly used crude odds ratio only while the other studies used adjusted odds ratio in presenting their risk factors and protective factors. Although there are protective factors shown in the results of the research, not all studies included have provided significant protective factors.

4. Conclusions

Based on the collated and analyzed data from the 13 journals used in the systematic review, the following statements have been concluded: The prevalence of smokers was found to be more common in the male sex compared to the female sex. The youth that has been practicing electronic and conventional cigarette smoking has been increasing. The common risk factors include the male sex, secondhand smoking, parental smoking, concurrent substance abuse, and exposure to smoking ideals from the environment. In order to mitigate the mentioned risk factors, protective factors were

also stated in order to solve the long growing problem of cigarette smoking. Research gaps were also present in the study due to inaccessibility of studies online, comprehension of different languages, type of participants in the study, and incomplete representation of all Southeast Asian countries.

The researchers recommend that more studies must be published regarding this topic as all countries in Southeast Asia are not well represented. Although some countries may use this study as a comparison towards their own protocols regarding smoking. It is also recommended that other online electronic platforms are used to have a broader spectrum of included studies. Lastly, performing a meta-analysis on this study should be taken into consideration for more specific findings.

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