



PREVALENCE AND FACTORS ASSOCIATED WITH ELECTRONIC CIGARETTE USE AMONG SECONDARY SCHOOL STUDENTS IN PHAYAO PROVINCE, THAILAND

PRASIT WONGSUPA¹, WUTTIPONG YODKHAM¹, JENJIRA NAMWONG¹, DEBDAS GHOSH², AND CHAWALIT CHANINTONSONGKHLA^{3,*}

¹Phayao Provincial Public Health Office, Phayao, Thailand

²Department of Mathematical Sciences, Indian Institute of Technology, Banaras Hindu University, Varanasi, 221 005, India

³School of Dentistry, University of Phayao, Phayao, Thailand

ABSTRACT. Electronic cigarette (e-cigarette) use among adolescents is increasing in Thailand despite a legal prohibition on sales and importation. Data on prevalence and associated factors among secondary school students in Phayao Province are lacking. A cross-sectional survey was conducted among 528 students in Grades 7-12 (Mathayom 1-6) from schools in Phayao Province during the 2024 academic year, selected through multistage random sampling. Data were collected using a validated online questionnaire and analyzed with chi-square tests, independent t-tests, and logistic regression. The prevalence of e-cigarette use was 21.97% (116/528). Four factors were independently associated with e-cigarette use: below-average academic performance (Adjusted OR = 3.69, 95% CI: 1.42-9.53), having close friends who use e-cigarettes (Adjusted OR = 3.11, 95% CI: 1.87-5.19), alcohol consumption more than five times per month (Adjusted OR = 2.63, 95% CI: 1.08-6.42), and lack of awareness of e-cigarette control laws (Adjusted OR = 2.27, 95% CI: 1.34-3.86). The design and attractiveness of e-cigarettes, as well as exposure to related media, may also play a role in use behavior, though these factors did not reach statistical significance. E-cigarette use among secondary school students in Phayao Province is common, and peer influence, academic performance, alcohol use, and legal awareness are the strongest associated factors. Health promotion programs should target these high-risk groups, and enforcement of existing e-cigarette control laws should be strengthened.

Keywords. Electronic cigarettes, secondary school students, risk behavior, risk factors, health promotion, Thailand.

© Journal of Decision Making and Healthcare

1. INTRODUCTION

Electronic cigarette (e-cigarette) use is increasingly prevalent among adolescents worldwide, particularly among secondary school students who are undergoing significant physical and psychological changes. E-cigarettes are often perceived as safer than conventional cigarettes, yet they contain nicotine, propylene glycol, glycerin, and flavoring agents that directly affect oral tissues, causing gingival inflammation, halitosis, and dry mouth, all of which are risk factors for periodontal disease and dental caries [1]. Exposure to e-cigarette aerosol can induce oxidative stress and damage oral epithelial cells [2], and e-cigarette users show alterations in the oral microbiome that may increase the long-term risk of periodontal disease [3]. Nicotine addiction from e-cigarettes may also serve as a pathway to conventional cigarette smoking.

In Thailand, e-cigarettes are classified as prohibited products. The Ministry of Commerce has prohibited their importation since December 27, 2014. Under Section 244 of the Customs Act B.E. 2560

*Corresponding author.

E-mail address: hippies.129@hotmail.com (P. Wongsupa), wuttipong.yodkham@gmail.com (W. Yodkham), jenjiranamwong61@gmail.com (J. Namwong), debdas.mat@iitbhu.ac.in (D. Ghosh), and chawalit.ch@up.ac.th (C. Chanintonsongkhla)

Received: July 3, 2026; Revised: July 12, 2026; Accepted: August 29, 2026.

2020 Mathematics Subject Classification: 62J12, 62P10, 92C60.

(2017), importing prohibited goods carries up to 10 years imprisonment, a fine of up to five times the goods' value, or both. The Office of the Consumer Protection Board (OCPB) issued Order No. 9/2015 prohibiting the sale of e-cigarettes and related products, with penalties of up to five years imprisonment, a fine of up to 500,000 baht, or both, with doubled penalties for manufacturers or importers [4]. Despite these measures, e-cigarettes enter Thailand through illegal sales on social media platforms.

A national survey found that males and younger adults were more likely to use e-cigarettes than females and older adults [5]. Among Thai youth aged 13-15 years, 4.7% of males and 1.9% of females reported e-cigarette use [6]. A survey of 945 upper secondary school students in Bangkok found that 30.2% had used e-cigarettes [7], with a mean age of first use of 16 years [8]. In Phayao Province, a study on conventional smoking among adolescents reported a prevalence of 31.1%, with males 3.8 times more likely to smoke than females, and smoking was associated with gender, attitudes, and peer influence [9]. A similar study in Chaiyaphum Province found 30.3% smoking prevalence, associated with knowledge and attitudes toward smoking [10].

E-cigarette use has become a public health concern comparable to conventional cigarette smoking, despite e-cigarettes being illegal in Thailand. Adolescents are in a developmental stage characterized by curiosity and experimentation, which may lead to risky behaviors including substance use and smoking. No study has examined e-cigarette use prevalence or associated factors among secondary school students in Phayao Province. Although legal measures exist, adolescent use continues to grow, and students may not fully understand the specific health risks or legal consequences. This study aimed to investigate the prevalence of e-cigarette use and identify factors associated with its use among secondary school students in Phayao Province, Thailand.

2. METHODS

2.1. Study design and participants. This study employed a cross-sectional survey design. The target population consisted of secondary school students in Phayao Province. The study sample included students from Grade 7 (Mathayom 1) and above in schools located in Phayao Province during the 2024 academic year. Participants were recruited through selected schools using a multistage random sampling technique. Permission was obtained from the selected schools, and students were invited to participate in the study. The research objectives and procedures were explained through an online platform, and informed consent was obtained prior to participation. Data were collected using an online questionnaire.

2.2. Instrument. The questionnaire consisted of four sections: smoking behavior, intention to smoke, knowledge and attitudes toward e-cigarettes, and general demographic information. The questionnaire was adapted from the International Tobacco Control Policy Survey (Thailand) conducted in 2009 by the Institute for Population and Social Research, Mahidol University. The quality of the research instrument was assessed using content validity. Three experts in public health and epidemiology reviewed the questionnaire and provided recommendations for improvement to ensure clarity and relevance to the research objectives. The Index of Item-Objective Congruence (IOC) was used to assess content validity, with acceptable values greater than 0.5.

2.3. Ethics approval. This study was approved by the Human Research Ethics Committee of the Phayao Provincial Public Health Office (Approval No. 062/2567, dated October 30, 2024).

2.4. Inclusion and exclusion criteria. Inclusion criteria were: students enrolled in Grade 7 or higher and willingness to participate and complete the online questionnaire. Exclusion criteria included students who refused to participate or were unable to complete the online questionnaire independently.

TABLE 1. General characteristics of the study participants ($n = 528$)

Variables	Number (n)	Percentage (%)
Prevalence of e-cigarette use		
E-cigarette users	116	21.97
Non-users	412	78.03
Gender		
Male	235	44.51
Female	293	55.49
Age (years), Mean $\pm$ SD	15.71 $\pm$ 1.84	
Monthly allowance (THB), Mean $\pm$ SD	2,457.34 $\pm$ 2,493.67	
Education level		
Lower secondary school	259	49.05
Upper secondary school	269	50.95
Living arrangement		
Both parents	305	57.77
Single parent	94	17.80
Relatives	68	12.88
Living alone	61	11.55

2.5. Sample size. The sample size was calculated based on a previous study on smoking behavior among early adolescents in Phayao Province by Chaikulwattana et al. (2017) [9] using a proportion estimation formula with an assumed prevalence of 0.40 and a precision of 0.10, yielding a required sample size of 576 participants.

2.6. Sampling procedure. Sampling was conducted using a multistage random sampling technique. In the first stage, stratified random sampling was used to select one school from each district in Phayao Province. In the second stage, six classrooms from Grades 7-12 were randomly selected, and 12 students were randomly selected from each classroom using simple random sampling based on student identification numbers. Students who met the inclusion criteria and were selected through this process were included as study participants.

2.7. Statistical analysis. Data analysis included descriptive statistics such as frequency and percentage to describe general characteristics. Inferential statistics included chi-square tests, independent t-tests, and logistic regression analysis. Statistical significance was set at $p < 0.05$.

3. MAIN RESULTS

A total of 528 students completed the questionnaire from the calculated sample size of 576 participants, resulting in a response rate of 91.67%. Among the respondents, 44.51% were male and 55.49% were female. The mean age of participants was 15.71 ± 1.84 years. The average monthly allowance was $2,457.34 \pm 2,493.67$ Thai Baht (THB). Most students lived with both parents (57.77%), as shown in Table 1.

A total of 116 participants (21.97%) reported using electronic cigarettes (Table 1). The mean age of e-cigarette users was 15.62 ± 1.92 years, with the youngest user aged 11.24 years. Regarding frequency of use, the majority of users reported occasional use (1-2 days per episode), accounting for 61.21%, while 5.17% reported daily use of e-cigarettes.

The analysis of associated factors showed that several variables were significantly related to e-cigarette use among the participants. These included academic performance, having siblings who use e-cigarettes, having close friends who use e-cigarettes, having a part-time job while studying, alcohol

TABLE 2. Comparison of general characteristics between e-cigarette non-users and users ($n = 528$)

Variables	Non-users (n=412)	Users (n=116)	p-value
Gender, n (%)			0.77
Male	182 (77.4%)	53 (22.6%)	
Female	230 (78.5%)	63 (21.5%)	
Age (years), Mean $\pm$ SD	15.67 $\pm$ 2.02	15.62 $\pm$ 1.92	0.79
Monthly allowance (THB), Mean $\pm$ SD	2,311.46 $\pm$ 1,879.27	2,700.95 $\pm$ 3,567.02	0.37
Education level, n (%)			0.81
Lower secondary school	201 (77.6%)	58 (22.4%)	
Upper secondary school	211 (78.4%)	58 (21.6%)	
Living arrangement, n (%)			0.51
Both parents	236 (77.4%)	69 (22.6%)	
Single parent	70 (74.5%)	24 (25.5%)	
Relatives	57 (83.8%)	11 (16.2%)	
Living alone	49 (80.3%)	12 (19.7%)	

consumption, knowledge about e-cigarettes, attitudes toward e-cigarettes, perceived harmfulness of e-cigarettes compared with other types of cigarettes, the attractiveness of e-cigarette design, the influence of media exposure on e-cigarette use, and awareness of e-cigarette control laws.

Logistic regression analysis showed that crude Odds Ratios (OR) for e-cigarette use were higher for all significantly associated variables compared with their reference categories ($p < 0.05$, Table 3).

Multiple logistic regression analysis of the 11 significant bivariate factors retained four independent predictors of e-cigarette use.

These factors included below-average academic performance (Adjusted OR = 3.69, 95% Confidence Interval (CI): 1.42-9.53), having close friends who use e-cigarettes (Adjusted OR = 3.11, 95% CI: 1.87-5.19), alcohol consumption more than five times per month (Adjusted OR = 2.63, 95% CI: 1.08-6.42), and lack of awareness of e-cigarette control laws (Adjusted OR = 2.27, 95% CI: 1.34-3.86).

The remaining variables showed higher odds ratios but did not reach statistical significance. Adolescents who had siblings who used e-cigarettes were 1.4 times more likely to use e-cigarettes than those without such exposure (Adjusted OR = 1.4, $p > 0.05$). Participants with limited knowledge about e-cigarettes, lower perceived harmfulness, and greater media exposure also showed elevated odds ratios (Table 4).

4. DISCUSSION

The prevalence of e-cigarette use among secondary school students in Phayao Province was 21.97% (116/528). A national survey conducted in 2018 among secondary school and university students reported that 44.00% of respondents had used e-cigarettes, and a Bangkok-based study found 30.2% prevalence among upper secondary students [7]. The prevalence in Phayao Province falls below these urban figures but remains substantial given that e-cigarettes are illegal in Thailand. The mean age of e-cigarette users in this study was 15.62 years, below the legal age of 20 years for tobacco consumption, indicating that adolescents continue to access these products despite legal prohibitions.

No significant difference was found between male and female students in e-cigarette use. Social Cognitive Theory posits that behavior results from the interaction between personal, environmental, and behavioral factors [11]. Curiosity and experimentation are commonly reported reasons for adolescent e-cigarette initiation, though motivations may differ by sex, with curiosity more frequently reported among females [12]. In this study, the absence of a gender difference may reflect changing social norms around e-cigarette use among Thai adolescents.

Peer influence was a strong predictor of e-cigarette use. Green and Kreuter [13] described peer influence as a key factor in maintaining health-related behaviors during adolescence. A narrative review by Romijnders et al. [14] identified social environment factors, including recommendations by friends

TABLE 3. Factors associated with e-cigarette smoking behaviors among youth ($n = 528$)

Associated Factors	Non-users (n=412)	Users (n=116)	COR	95% CI	p-value
Academic Performance (GPA)					
Above Average	71	10	ref		
Average	303	77	1.80	(0.89–3.66)	0.100
Below Average	38	29	5.42	(2.39–12.29)	< 0.001*
Siblings Using E-cigarettes					
No	375	97	ref		
Yes	37	19	1.99	(1.09–3.60)	0.024*
Close Friends Using E-cigarettes					
No	319	47	ref		
Yes	93	69	5.04	(3.25–7.79)	< 0.001*
Part-time Employment					
No	357	87	ref		
Yes	55	29	2.16	(1.30–3.59)	0.004*
Alcohol Consumption					
Never	298	47	ref		
1–5 times per month	95	52	3.47	(2.20–5.48)	< 0.001*
More than 5 times per month	19	17	5.67	(2.75–11.69)	< 0.001*
Knowledge of E-cigarettes					
High	385	103	ref		
Low	27	13	1.80	(0.89–3.61)	0.090
Attitudes Toward E-cigarettes					
Negative	397	100	ref		
Neutral or positive	15	16	4.23	(2.02–8.86)	< 0.001*
Perceived Harm (vs. Cigarettes)					
More harmful	255	69	ref		
Equally harmful	141	32	0.84	(0.52–1.34)	0.360
Less harmful	26	15	2.05	(1.03–4.08)	0.040*
Attractive Design					
No influence	296	62	ref		
Influential	116	54	2.22	(1.46–3.39)	< 0.001*
Media Influence					
No influence	63	14	ref		
Low influence	112	31	1.25	(0.62–2.51)	0.540
Moderate influence	208	55	1.19	(0.62–2.28)	0.600
High influence	29	16	2.48	(1.07–5.76)	0.034*
Awareness of Control Laws					
Aware	228	34	ref		
Unaware	184	82	2.99	(1.92–4.66)	< 0.001*

COR: Crude Odds Ratio; CI: Confidence Interval.

and peer pressure, as commonly reported reasons for e-cigarette use. In this study, students with close friends who used e-cigarettes were 3.11 times more likely to use them (Adjusted OR = 3.11, 95% CI: 1.87–5.19), and adolescents most frequently used e-cigarettes together with their close friends.

Living arrangements did not show a significant association with e-cigarette use. Adolescents living with parents or guardians had a similar likelihood of use compared with those in dormitories. The low visibility and minimal odor of e-cigarettes, combined with a perception that they are less harmful than conventional cigarettes, may reduce the effectiveness of parental supervision as a protective factor.

Media exposure and product design were associated with e-cigarette use. Cho et al. [15] identified internet advertising as a factor in adolescent e-cigarette uptake. Research by the Sasin Graduate Institute of Chulalongkorn University found that 35.24% of Thai adolescents learned about e-cigarettes through online media. In this study, adolescents exposed to e-cigarette media were 1.44 times more likely to use them (Adjusted OR = 1.44, $p > 0.05$). E-cigarette marketing strategies involving celebrity endorsements, attractive product designs, and flavored products may create positive perceptions among adolescents.

Positive attitudes toward e-cigarettes were associated with higher use. Rosenthal et al. [16] reported that adolescents often perceive e-cigarettes favorably due to sweet flavors, minimal odor, and perceived

TABLE 4. Predictors of e-cigarette smoking behaviors among youth using multiple logistic regression ($n = 528$)

Associated Factors	AOR	95% CI	p-value
Academic Performance (GPA)			
Above Average	ref		
Average	1.91	(0.87–4.19)	0.105
Below Average	3.69	(1.42–9.53)	0.007*
Siblings Using E-cigarettes			
No	ref		
Yes	1.49	(0.72–3.10)	0.280
Close Friends Using E-cigarettes			
No	ref		
Yes	3.11	(1.87–5.19)	< 0.001*
Part-time Employment			
No	ref		
Yes	1.36	(0.71–2.59)	0.353
Alcohol Consumption			
Never	ref		
1–5 times per month	2.34	(1.37–4.01)	0.002*
More than 5 times per month	2.63	(1.08–6.42)	0.033*
Knowledge of E-cigarettes			
High	ref		
Low	1.75	(0.74–4.14)	0.202
Attitudes Toward E-cigarettes			
Negative	ref		
Neutral or positive	1.50	(0.62–3.64)	0.372
Perceived Harm (vs. Cigarettes)			
More harmful	ref		
Equally harmful	0.59	(0.34–1.02)	0.058
Less harmful	1.64	(0.71–3.82)	0.248
Attractive Design			
No influence	ref		
Influential	1.37	(0.82–2.30)	0.227
Media Influence			
No influence	ref		
Low influence	0.91	(0.40–2.05)	0.816
Moderate influence	0.84	(0.38–1.83)	0.652
High influence	1.44	(0.53–3.96)	0.475
Awareness of Control Laws			
Aware	ref		
Unaware	2.27	(1.34–3.86)	0.002*

AOR: Adjusted Odds Ratio; CI: Confidence Interval.

social acceptability. In this study, adolescents with positive attitudes were 1.5 times more likely to use e-cigarettes (Adjusted OR = 1.5, $p > 0.05$). The belief that e-cigarettes are less harmful than conventional cigarettes may lower the perceived risk of experimentation.

4.1. Limitations. This study has several limitations. The cross-sectional design does not permit causal inferences between the associated factors and e-cigarette use. Self-reported e-cigarette use may be subject to social desirability bias, potentially underestimating the true prevalence. The study was conducted in a single province, limiting generalizability to other regions of Thailand. Data were collected through an online questionnaire, which may introduce selection bias if students without internet access were underrepresented.

5. CONCLUSION

E-cigarette use among secondary school students in Phayao Province was 21.97% (116/528), with four independent predictors: below-average academic performance (Adjusted OR = 3.69, 95% CI: 1.42–9.53), peer use (Adjusted OR = 3.11, 95% CI: 1.87–5.19), frequent alcohol consumption (Adjusted OR

= 2.63, 95% CI: 1.08-6.42), and lack of legal awareness (Adjusted OR = 2.27, 95% CI: 1.34-3.86). The cross-sectional design and single-province scope limit causal inference and generalizability. Targeted health literacy programs addressing e-cigarette risks should prioritize students with lower academic performance, peer exposure, and alcohol use. These findings support the need for integrated school-based prevention that combines health education with enforcement of existing e-cigarette control laws. Future longitudinal studies across multiple provinces are needed to establish temporal relationships and evaluate intervention effectiveness.

6. RECOMMENDATIONS

School-level interventions should focus on students with below-average academic performance (Adjusted OR = 3.69), the strongest predictor, through integrated health education within academic support programs. Peer-focused programs should address the influence of close friends (Adjusted OR = 3.11) by training peer health leaders and developing group-based prevention activities. Family-level collaboration should target alcohol consumption among adolescents (Adjusted OR = 2.63) through joint school-family awareness campaigns. Policy-level initiatives should improve adolescent awareness of e-cigarette control laws (Adjusted OR = 2.27) through educational programs, alongside stricter enforcement of existing regulations on illegal sales through social media platforms.

STATEMENTS AND DECLARATIONS

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

The authors acknowledge the participating schools in Phayao Province and all students who participated in this study.

REFERENCES

- [1] N. J. Leigh, R. I. Lawton, R. B. Hershow, and M. L. Goniewicz. Oral health risks associated with electronic cigarette use: a systematic review. *Tobacco Induced Diseases*, 18:Article ID 12, 2020.
- [2] I. K. Sundar, F. Javed, G. E. Romanos, and I. Rahman. E-cigarettes and flavorings induce inflammatory and pro-senescence responses in oral epithelial cells and periodontal fibroblasts. *Oncotarget*, 7:77196-77204, 2016.
- [3] M. Rouabhia, H. J. Park, A. Semlali, A. Zakrzewski, and W. Chmielewski. E-cigarette vapor induces changes in oral epithelial cell behavior and microbiota composition. *Toxicology Reports*, 7:998-1007, 2020.
- [4] J. Yusabai. Anti-tobacco network: ministry of Commerce maintains ban on e-cigarette imports [Internet]. *Matichon Online*, 2019 [cited 2024 Oct 15]. Available from: https://www.matichon.co.th/local/quality-life/news_1632910.
- [5] Sasin Graduate Institute of Business Administration of Chulalongkorn University. Study on the impact of electronic cigarettes on stakeholders in Thailand [Internet]. 2014 [cited 2024 Oct 15]. Available from: http://www.thaitobacco.or.th/th/wp-content/uploads/2015/07/140305_ECIG-Report-Template_V28.pdf.
- [6] Bureau of Tobacco Control. Fact sheet: Global Youth Tobacco Survey (GYTS) Thailand 2015 [Internet]. 2016 [cited 2024 Oct 15]. Available from: <http://btc.ddc.moph.go.th/th/upload/datacenter/59-04-26-FACT-SHEET-GYTS.pdf>.
- [7] S. Loysamut. New tobacco products in social media and the enforcement of tobacco product control laws. *Journal of Health Law and Public Health*, 5:13-29, 2019.
- [8] C. Areesantichai and U. Phuengpan. Cigarettes: a dangerous threat among adolescents [Internet]. 2016 [cited 2024 Oct 15]. Available from: <http://www.ashthailand.or.th/smartnews/post/detail/158>.
- [9] C. Chaikulwattana, P. Sutti, and W. Jaimalee. Smoking behavior and associated risk factors among early adolescents in Phayao Province. *Nursing Journal of the Ministry of Public Health*, 27:57-67, 2017.
- [10] C. Boonserm, P. Suttivanich, and W. Ravisannon. A survey of smoking behavior among youth in Chaiyaphum Province. *Journal of Health Science*, 3:6-14, 2009.
- [11] A. Bandura. *Social Foundations of Thought and Action: a Social Cognitive Theory*. Englewood Cliffs: Prentice-Hall, 1986.
- [12] F. Alam and P. Silveyra. Sex differences in e-cigarette use and related health effects. *International Journal of Environmental Research and Public Health*, 20:Article ID 7079, 2023.

- [13] L. W. Green and M. W. Kreuter. *Health Promotion Planning: an Educational and Ecological Approach*. 4th Edition, McGraw Hill, New York, 2005.
- [14] K. Romijnders, L. van Osch, H. de Vries, and R. Talhout. Perceptions and reasons regarding e-cigarette use among users and non-users: a narrative literature review. *International Journal of Environmental Research and Public Health*, 15:Article ID 1190, 2018.
- [15] J. H. Cho, E. Shin, and S. S. Moon. Electronic-cigarette smoking experience among adolescents. *Journal of Adolescent Health*, 49:542-546, 2011.
- [16] H. Rosenthal, N. Chow, S. Mehta, D. Pham, and R. Milanaik. Puff bars: a dangerous trend in adolescent disposable e-cigarette use. *Current Opinion in Pediatrics*, 34:288–294, 2022.