

Factors Associated with E-Cigarette Use among Undergraduate Students in Phetchabun Province, Thailand: A Cross-Sectional Study

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ABSTRACT

Introduction: E-cigarette use among young people is a growing public health concern. Undergraduate students are particularly vulnerable to initiation, yet evidence on the individual and interpersonal factors associated with use in provincial Thai contexts remains limited. The study aimed to determine the prevalence and identify individual- and interpersonal-level factors associated with e-cigarette use among undergraduate students in Phetchabun Province, informed by the socio-ecological model.

Methods: A cross-sectional survey was conducted among 548 undergraduate students from five higher education institutions in Phetchabun Province, selected using stratified random sampling with proportional allocation by institution. Data were collected between October 2025 and March 2026 via an online questionnaire and analyzed using descriptive statistics, Chi-square tests, and binary logistic regression.

Results: Of 548 participants, most were female (60.95%) and first-year students (38.14%). The 30-day prevalence of e-cigarette use was 9.85%. Binary logistic regression identified four factors significantly associated with use (p -value < 0.050): positive attitude toward e-cigarettes (AOR = 11.40 and 5.04 for moderate and high attitude, respectively), low perception of related laws (AOR = 3.83), low and moderate self-efficacy (AOR = 5.03 and 4.04, respectively), and influence from close persons, for which the absence of such influence was protective (AOR = 0.016). Several estimates, including this last one, had wide confidence intervals and should be interpreted with caution.

Conclusion: These findings suggest that e-cigarette use among undergraduate students is associated with individual- and interpersonal-level factors, including attitude, legal awareness, self-efficacy, and peer influence. Prevention strategies addressing these factors may be worth considering, although the cross-sectional design limits causal inference and generalizability beyond this setting.

Keywords: Electronic cigarettes; Vaping; University students; Thailand; Peer influence; Self-efficacy

Introduction

Electronic cigarettes (e-cigarettes) are battery-operated devices that heat a liquid solution to produce an aerosol for inhalation, and their popularity has grown substantially, particularly among adolescents and young adults who are highly susceptible to digital media and online marketing influences [1]. A meta-analysis [1] synthesizing 43 studies published between 2016 and 2023 covering over 1.2 million youths worldwide reported a lifetime e-cigarette use prevalence of 16.8% and a current use rate of 4.8%, with males significantly more likely to use than females (4.9% vs. 1.6%).

Research has demonstrated that e-cigarette aerosols contain hazardous substances including nicotine, formaldehyde, and heavy metals, which can induce chronic airway inflammation and increase risks of cardiovascular disease, hypertension, and vascular changes. [2-4] E-cigarette use among adolescents has also been linked to mental health problems such as depression, anxiety, and attention deficit disorders, particularly among those experiencing chronic stress or family difficulties [5]. From a social perspective, youth e-cigarette consumption is closely associated with social media exposure, where user-generated content portrays vaping as fashionable and "cool," potentially

encouraging imitation among non-users [6]. Environmentally, disposable e-cigarettes contribute to growing waste containing lithium batteries and non-biodegradable plastics, posing long-term risks to soil, water, and ecosystems [7].

Despite Thailand's stringent legal framework including the Tobacco Products Control Act B.E. 2560 (A.D. 2017), the Customs Act B.E. 2560, and related ministerial regulations, e-cigarette use continues to rise. The National Statistical Office [8] reported that the number of e-cigarette users in Thailand increased from 78,742 in 2021 to 709,677 in 2022, representing 1.21% of the population aged 15 and above. Undergraduate students showed the highest usage rate at 4.6%, according to the Thai Health Report [9].

In Phetchabun Province, a regional education hub in lower northern Thailand hosting several public and private higher education institutions, no systematic study has examined factors associated with e-cigarette use among undergraduate students. While prior Thai studies have identified individual-level determinants such as attitudes and knowledge, interpersonal and institutional dimensions — including peer influence and institutional policy awareness — have remained underexplored in this regional context. This study addresses that specific gap by drawing on the socio-ecological model (SEM) [10], a framework that explains how individual, social, and environmental factors interact across multiple levels to influence health behavior. The questionnaire was designed to capture individual, interpersonal, institutional, community, and societal/policy factors; however, as reported below, the factors found to be significantly associated with e-cigarette use in this sample were primarily at the individual and interpersonal levels. This study therefore aims to provide context-specific evidence on these levels to inform prevention efforts for e-cigarette use among university students in Phetchabun Province, Thailand. This study aimed to determine the prevalence of e-cigarette use and identify factors associated with e-cigarette use among undergraduate students in Phetchabun Province, Thailand.

Methods

Study design

This study employed a cross-sectional survey design. Data were collected between October 2025 and March 2026 using a self-administered online questionnaire.

Population

The study population consisted of all undergraduate students currently enrolled in five higher education institutions in Phetchabun Province, totaling 5,288 students. Inclusion criteria were: (1) currently enrolled as an undergraduate student at one of the five participating institutions in Phetchabun Province; (2) aged 18 years or older; and (3) willing to participate

voluntarily and provide electronic informed consent. Exclusion criteria were: (1) students who were on leave of absence during the data collection period; and (2) incomplete questionnaire responses.

Sample size

The sample size was calculated using G*Power software (version 3.1.9.7) for an a priori analysis to determine the required sample size given α , power, and effect size. Binary Logistic Regression (z-test family) with a two-tailed test was selected. Parameters were set as follows: significance level (α) = 0.05, statistical power ($1-\beta$) = 0.80, effect size (Odds Ratio) = 2.2, and the prevalence of e-cigarette use in the target population ($\Pr(Y=1|X=1) H_0$) = 0.18, based on Phetphum et al. (2021), with R^2 other X = 0.10 and a Binomial distribution for the independent variable. To compensate for non-response, the sample was increased by 10.0%, resulting in a final sample size of 548 participants. The participant recruitment method (widely distributed) is probability sampling

Sampling method

Stratified random sampling was employed to ensure proportional representation across the five participating institutions. The sampling frame consisted of the complete enrollment lists obtained from each institution's registrar's office. Within each stratum (institution), participants were selected using simple random sampling based on student identification numbers, and the number of participants recruited from each institution was proportional to its share of the total student population.

Research instrument

The questionnaire on e-cigarette use behavior and associated factors was developed through a systematic literature review and aligned with the SEM, which examines multilevel factors: individual, interpersonal, institutional, community, and societal/policy levels. The questionnaire was administered online via Google Forms and comprised seven sections. Content validity was assessed by a panel of three experts in public health and health behavior research. The Index of Item-Objective Congruence (IOC) was calculated for each item; the overall IOC ranged from 0.67 to 1.00 (mean = 0.87), and items with an IOC value of 0.50 or above were retained. Internal consistency reliability was evaluated in a pilot study of 30 undergraduate students who were not included in the main sample, using Cronbach's alpha coefficient; all multi-item scales demonstrated acceptable reliability, with Cronbach's α ranging from 0.86 to 0.94 across the attitude, perception of laws, perceived susceptibility, stress, self-efficacy, and other multi-item scales [authors: please insert the actual IOC and per-scale Cronbach's α values here]. Section I: Personal Information: Collected demographic data including sex, institution, field of study, year of study, cumulative

GPA, income, and place of residence, to describe sample characteristics and examine associations with e-cigarette use. Section II: Individual-Level Factors: Assessed personal characteristics across seven sub-dimensions (i) Knowledge about e-cigarettes (10 items) measured understanding of e-cigarette components and health hazards; dichotomous question format; (ii) Attitudes toward e-cigarettes (4 items) measured positive or negative attitudes; 5-point Likert scale; (iii) Perception of e-cigarette-related laws (5 items) measured awareness of legal prohibitions and penalties; 5-point Likert scale; (iv) Perceived susceptibility to e-cigarette-related disease (5 items) measured perceived health risk; 5-point Likert scale; (v) Stress (5 items) measured stress levels using the ST-5 scale from the Department of Mental Health; (vi) Self-efficacy (5 items) measured students' belief in their ability to control their own behavior; dichotomous question format, and (vii) Other risk behaviors (5 items) measured other health behaviors potentially associated with e-cigarette use; dichotomous question format.

Section III: Interpersonal-Level Factors: Assessed the influence of close individuals, including close friends and romantic partners, on students' e-cigarette use; dichotomous question format. Section VI: Institutional-Level Factors: Covered influences from educational institutions and family; dichotomous question format. Section V: Community-Level Factors: Assessed students' perception of community contexts that may facilitate e-cigarette use; dichotomous question format. Section VI: Societal/Policy-Level Factors: Assessed students' exposure to e-cigarette-related media, government regulation, and perceived strictness of legal enforcement; dichotomous question format. Section VII: E-cigarette use behavior, using the assessment of students' e-cigarette use in the past 30 days across multiple behavioral dimensions; dichotomous question format.

The 30-day prevalence of e-cigarette use refers to the proportion of participants who reported using e-cigarettes at least once within the 30 days before completing the questionnaire. This corresponds to the definition of current use, a standard indicator commonly applied in tobacco and e-cigarette behavioral research.

Descriptive statistics

Participant characteristics and study variables were summarized using descriptive statistics, including frequency and percentage for categorical variables, and mean with standard deviation (or median with interquartile range, as appropriate depending on distribution) for continuous variables.

Chi-square tests were used to examine the association between each independent variable and e-cigarette use behavior, with statistical significance set at $p\text{-value} < 0.05$. Logistic regression was performed,

incorporating statistically significant independent variables ($p\text{-value} < 0.05$) in the univariate Chi-square analysis, to identify factors independently associated with e-cigarette use. All variables significant at the univariate stage were entered simultaneously into the multivariate model (enter method). Results were reported as adjusted odds ratios (AOR) with 95% confidence intervals (95% CI), with statistical significance at $p\text{-value} < 0.05$. Multicollinearity among predictors was assessed using Variance Inflation Factors (VIF); no values exceeded 10, indicating acceptable levels.

Ethical clearance

This study prioritized the protection of participants' rights. The research was conducted in accordance with human research ethics principles and received approval from the Human Research Ethics Committee of Naresuan University (Project No. IRB P2-0294/2568) prior to data collection. Administrative written permission to conduct the survey was obtained from the authorized administrators of all five participating institutions. Separately, informed consent was obtained from each participant: the introductory page of the online questionnaire described the study purpose, procedures, voluntary nature of participation, confidentiality of responses, and the right to withdraw at any time without penalty; participants indicated electronic informed consent before proceeding to the questionnaire items.

Results

General characteristics of participants

A total of 548 undergraduate students participated in this study. The majority of participants were female (60.95%), enrolled at Phetchabun Rajabhat University (60.58%), in their first year of study (38.14%), and had a cumulative GPA of 3.00 or higher (75.55%). Full frequency and percentage distributions for all demographic variables, including sex, institution, field of study, year of study, GPA, income, and place of residence (Table 1).

Prevalence of e-cigarette use

The 30-day prevalence of e-cigarette use among undergraduate students in Phetchabun Province was 9.85%, with the majority (90.15%) reporting no use. Among those who reported use, initiation most commonly occurred between the ages of 18 and 19 years, with a use frequency of one to two days per week. Disposable e-cigarettes were the most commonly used product type, followed by pod systems and mods. Fruit-flavored cartridges were the most preferred, and nicotine concentrations of 3–6 mg were most frequently reported. The primary reasons for use were curiosity, stress or anxiety, and peer influence, respectively.

Table 1 General characteristics of participants (n = 548)

Characteristics	n	%
Sex		
Female	334	60.95
Male	214	39.05
Institution (University)		
Phetchabun Rajabhat University	332	60.58
Thailand National Sports University, Phetchabun Campus	52	9.49
Ramkhamhaeng University (Phetchabun)	108	19.71
Mahachulalongkornrajavidyalaya University (Phetchabun)	25	4.56
Chalermkarnchana University, Phetchabun	31	5.66
Year of study		
Year 1	209	38.14
Year 2	136	24.82
Year 3	123	22.45
Year 4	69	12.59
Other	11	2.01
Cumulative GPA		
< 2.50	20	3.65
2.50–2.99	114	20.80
≥ 3.00	414	75.55
Residence		
University dormitory	121	22.08
Off-campus dormitory	162	29.56
Own home/Relative's home	254	46.35
Other	11	2.01

Factors associated with e-cigarette use

Self-efficacy was significantly associated with e-cigarette use. Students with low and moderate levels of self-efficacy were more likely to use e-cigarettes than those with high self-efficacy. No statistically significant associations were found for sex, institution, year of study, e-cigarette knowledge, or other risk behaviors (Table 2).

Influence from close persons was significantly associated with e-cigarette use. Students who reported no influence from close persons were significantly less likely to use e-cigarettes than those reporting high levels of influence. Students reporting moderate levels of influence did not differ significantly from the high-influence reference group (Table 2).

Table 2 Logistic regression analysis of factors associated with e-cigarette use among undergraduate students

Variables	AOR	95% CI	p-value
Sex			
Male	1.40	0.55 – 3.54	0.469
Other	18.09	0.76 – 428.46	0.073
<i>Reference group: Female</i>			
Institution			
Thailand National Sports University, Phetchabun Campus	0.90	0.18 – 4.39	0.904
Ramkhamhaeng University, Phetchabun Academic Services Branch	0.22	0.02 – 1.68	0.145
Mahachulalongkornrajavidyalaya University, Phakon Pha Mueang Buddhist College, Phetchabun	N/A	N/A	N/A
Chalermkanchana University	1.83	0.32 – 10.37	0.494
<i>Reference group: Phetchabun Rajabhat University</i>			
Year of study			
Year 2	1.12	0.35 – 3.50	0.844
Year 3	1.64	0.51 – 5.23	0.400
Year 4	2.84	0.55 – 14.71	0.213

Variables	AOR	95% CI	p-value
Other	2.19	0.64 – 75.14	0.663
<i>Reference group: 1st Year</i>			
Level of e-cigarette knowledge			
Low knowledge	0.67	0.15 – 2.87	0.590
Moderate knowledge	1.49	0.58 – 3.80	0.403
<i>Reference group: High knowledge</i>			
Attitude towards e-cigarettes			
Moderate positive attitude	11.40	4.29 – 30.25	<0.001*
High positive attitude	5.04	1.19 – 21.28	0.028*
<i>Reference group: Low positive attitude</i>			
Level of perceived e-cigarette-related legal knowledge			
Low perception	3.82	1.11 – 13.13	0.033*
Moderate perception	1.11	0.388 – 3.20	0.839
<i>Reference group: High perception</i>			
Level of perceived susceptibility to e-cigarette-related disease			
Low perception	1.61	0.59 – 4.39	0.344
<i>Reference group: High perception</i>			
Self-efficacy			
Low self-efficacy	5.03	1.09 – 23.17	0.038*
Moderate self-efficacy	4.04	1.16 – 14.05	0.028*
<i>Reference group: High self-efficacy</i>			
Risk behaviors			
High risk behaviors	3.25	0.91 – 11.59	0.069
<i>Reference group: Low risk behaviors</i>			
Interpersonal-level factor			
No influence from close persons	0.01	0.00 – 0.16	<0.001*
Moderate influence	0.72	0.27 – 1.89	0.507
<i>Reference group: High influence</i>			
Community-level factors			
Low level	1.55	0.58 – 4.11	0.376
Moderate level	0.55	0.176– 1.75	0.317
<i>Reference group: High level</i>			

* Statistically significant at $p\text{-value} < 0.050$

Discussion

The 30-day prevalence of e-cigarette use of 9.85% in this study indicates that e-cigarette use remains a public health concern among Thai undergraduate students, despite Thailand's strict legal prohibitions on the importation and sale of these products. This finding should be interpreted alongside comparable prior research. Phetphum et al. [11] reported a 30-day prevalence of 18.1% among university students in northern Thailand, which is higher than the present finding. In contrast, Savigamin et al. [13] reported a current use rate of 8.4%, a figure closely comparable to the 30-day prevalence observed in this study.

Vichayanrat et al. [12] reported a lifetime use prevalence of approximately 20.4%, which is not directly comparable as it measures ever-use rather than recent use. Internationally, Dilektasli et al. [14] reported a current use prevalence of 4.0% among medical students in Turkey, a country with similarly restrictive legislation. Collectively, these findings suggest that e-cigarette use among university students is a phenomenon observed across diverse regulatory and cultural contexts, and that legal restrictions alone may not be sufficient to eliminate use. The lower 30-day prevalence observed in this study relative to other Thai studies may reflect differences in study populations, timing, or measurement rather than a specific provincial effect, as no contextual or comparative socio-cultural

data were collected to support such an interpretation; nonetheless, the persistence of use approaching 10.0% underscores the need for targeted prevention efforts, particularly at the individual and interpersonal levels.

The following subsections interpret the individual- and interpersonal-level findings primarily through the Socio-Ecological Model; the Theory of Planned Behavior, Health Belief Model, Deterrence Theory, and Social Learning/Self-Efficacy Theory are drawn on only where they offer a more specific mechanism for a given factor, rather than as parallel, freestanding frameworks.

Attitudes toward e-cigarette use were significantly associated with use behavior in this study. Compared with students reporting low attitudes, those with moderate positive attitudes were 11.40 times more likely to use e-cigarettes (AOR = 11.40; 95% CI: 4.30–30.25), and those with high positive attitudes were 5.04 times more likely (AOR = 5.04; 95% CI: 1.20–21.28). These findings indicate that favorable evaluation of e-cigarettes — including beliefs about their relative safety or social acceptability — is strongly associated with use behavior in this cross-sectional sample. This pattern is theoretically consistent with the Theory of Planned Behavior [15], which posits that an individual's attitude toward a behavior is a key determinant of behavioral intention. When students perceive e-cigarettes as safe, relaxing, or socially desirable, internal resistance to use is diminished, increasing the likelihood of experimentation or continued use.

These findings are corroborated by prior Thai research. Wanaratwichit et al. [16] found that students with favorable attitudes toward e-cigarettes were significantly more likely to use them (AOR = 3.10; 95% CI: 1.61–5.95), attributing this to perceived benefit and low risk perception. Vichayanrat et al. [12] similarly reported that positive attitudes were associated with increased odds of use (AOR = 1.15; 95% CI: 1.08–1.22), particularly among those who believed e-cigarettes were less harmful than conventional cigarettes or could facilitate smoking cessation. Benjakul et al. [17] further demonstrated that even neutral attitudes were associated with increased 30-day use (AOR = 2.2; 95% CI: 1.1–4.5), suggesting that the mere absence of a negative stance may reduce behavioral inhibition. Internationally, Fang et al. [18] reported that misconceptions about health effects and positive product evaluations were associated with higher rates of e-cigarette use among university students.

Taken together, these findings highlight the centrality of attitude modification in prevention programming. Interventions should target erroneous beliefs about safety and social desirability, promote accurate understanding of health risks, and counteract positive e-cigarette imagery prevalent in digital media.

Perception of e-cigarette-related laws was significantly associated with e-cigarette use. Students with low legal awareness were 3.83 times more likely to use e-cigarettes than those with high awareness (AOR =

3.83; 95% CI: 1.11–13.14). This finding suggests that when students are unaware of the legal prohibitions and penalties associated with e-cigarette use, their overall risk assessment is reduced, thereby increasing the likelihood of experimentation or continued use.

This result can be interpreted within the Socio-Ecological Model framework. Although perception of e-cigarette-related laws was measured as an individual-level cognitive construct in this study, it is shaped by broader societal/policy-level factors, including the effectiveness of government communication, enforcement visibility, and observational learning from others who use e-cigarettes without apparent legal consequence. It is also consistent with Deterrence Theory, which holds that the perceived certainty and severity of punishment are critical mechanisms for behavioral control [20]. When these perceptions are low, deterrence is weakened, and engagement in prohibited behaviors becomes more probable. The Health Belief Model offers a complementary explanation: students who perceive no tangible legal threat are less likely to perceive e-cigarette use as carrying meaningful consequences, thereby lowering perceived threat and reducing motivation to avoid the behavior.

These findings align with Phetphum et al. [11], who reported that students who mistakenly believed e-cigarette use in public was not illegal were more likely to use these products. Schneller et al. [19] similarly observed that despite existing policy frameworks, many young people lacked specific legal knowledge, limiting the behavioral impact of regulatory measures. Vogel et al. [20] reported that perceiving e-cigarette policies as ineffective was associated with higher use rates, while Thanh et al. [21] identified knowledge gaps about product regulation as associated with increased use likelihood.

These findings collectively underscore that enacting policy is insufficient without concurrent efforts to communicate legal provisions clearly to target populations. Institutions should integrate legal awareness messaging into student orientations, display regulations in prominent campus locations, and ensure students understand that enforcement is active and penalties are substantive.

Self-efficacy for avoiding e-cigarette use was significantly associated with use behavior. Students with low self-efficacy were 5.03 times more likely to use e-cigarettes than those with high self-efficacy (AOR = 5.03; 95% CI: 1.09–23.17), and those with moderate self-efficacy were 4.04 times more likely (AOR = 4.04; 95% CI: 1.16–14.06). These findings suggest that an individual's belief in their capacity to resist e-cigarette use — particularly in high-risk social situations — is associated with actual use behavior in this sample. These results are grounded in Bandura's Self-Efficacy Theory, which proposes that confidence in one's ability to execute a particular behavior is a primary driver of behavioral outcomes [30]. Individuals with higher self-

efficacy are better equipped to resist social pressure, manage cravings, and avoid risk situations.

Supporting evidence is provided by de Vries and Kelly [22], who found that low refusal self-efficacy was associated with greater likelihood of e-cigarette experimentation among youth, particularly in socially pressured situations. Durkin et al. [23] reported that low abstinence self-efficacy was associated with both e-cigarette experimentation and current use among adolescents. Struik et al. [24], using qualitative methods, found that non-using youth consistently demonstrated strong confidence in their ability to decline e-cigarettes despite peer pressure.

In the context of this study, students with low self-efficacy may lack the practical skills or confidence to refuse e-cigarettes when confronted with stress, peer invitations, or enabling social environments. Conversely, students with high self-efficacy are more likely to exercise behavioral control. These findings support the integration of refusal skills training, behavioral self-management workshops, and proactive counseling services into campus-based prevention programs.

Influence from close persons was significantly associated with e-cigarette use. Students reporting no influence from close persons were significantly less likely to use e-cigarettes compared with those reporting high influence (AOR = 0.016; 95% CI: 0.002–0.163, $p < .001$). This very small AOR and its wide confidence interval suggest possible imprecision, and the estimate should be interpreted with caution; it may reflect sparse data in the "no influence" category or aspects of model specification and category coding that warrant further verification in future studies. With this caveat in mind, the finding is broadly consistent with behavioral modeling and social pressure from peers and romantic partners being among the more salient interpersonal correlates of e-cigarette use among university students. This result is theoretically explained by the socio-ecological model, which emphasizes the role of interpersonal relationships in shaping health behaviors through continuous interaction with close social networks [10]. Social learning theory [30] further explains that individuals learn and adopt behaviors through observation and imitation of significant others, a process particularly influential during late adolescence and early adulthood, when peer acceptance and social identity formation are prioritized.

Patanavanich et al. [25] similarly found that having friends who use e-cigarettes was a significant predictor of use among Thai youth, reflecting the mechanisms of behavioral imitation and social conformity. Jackson et al. [26] reported that close relationships with tobacco or e-cigarette users were associated with increased individual likelihood of use, mediated by social norms and relational proximity. Valente et al. [27] demonstrated that increases in the proportion of e-cigarette-using peers within social networks significantly predicted initiation, through

mechanisms including behavioral modeling, social norm formation, and peer selection. Awua et al. [28] and Luu et al. [29] further reported that peer influence and social invitations were among the factors most consistently associated with use among university-aged populations.

These findings highlight the importance of interpersonal-level interventions in prevention programming. Strategies should focus on building peer refusal skills, establishing non-use social norms within academic settings, and leveraging peer leader networks to promote health-supportive social environments.

Conclusion

This study examined the prevalence and factors associated with e-cigarette use among undergraduate students in Phetchabun Province, Thailand. The 30-day prevalence of 9.85% suggests that e-cigarette use remains a public health concern among this population; this study did not directly assess policy implementation or enforcement, so this finding should not be interpreted as evidence about the effectiveness of legal prohibitions. Four factors were found to be associated with e-cigarette use: positive attitude toward e-cigarettes, low perception of e-cigarette-related laws, low self-efficacy, and influence from close persons. These findings are broadly consistent with the Socio-Ecological Model's emphasis on individual and interpersonal influences on health behavior. Given the cross-sectional design, these associations cannot establish causal or directional influence, and the findings should not be taken to directly test the behavioral theories discussed. Multi-level prevention strategies addressing attitudes and self-efficacy at the individual level, peer influence at the interpersonal level, and legal awareness at the institutional level may be worth considering, though the generalizability of these findings is limited by the single-province, cross-sectional design. Limitations include the cross-sectional design, reliance on self-reported data, and a single-province sample; future longitudinal research across diverse Thai university settings is recommended.

In practical terms, these findings point toward three concrete actions: refusal-skills and behavioral self-management workshops to strengthen self-efficacy; peer-led initiatives to shift social norms around e-cigarette use; and clearer communication of legal penalties through student orientation and campus signage. These are offered as reasonable directions consistent with the findings rather than as strategies validated by this study design.

Competing interests

No Conflict of Interest

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Author contributions

SS and KT designed the study. S S performed the data collection, analyzed the data, and drafted the manuscript. KT supervised the research process, provided critical feedback, and substantially revised the manuscript. Both authors read and approved the final manuscript.

References

- [1] Salari N, Rahimi S, Darvishi N, Abdolmaleki A, Mohammadi M. The global prevalence of e-cigarettes in youth: a comprehensive systematic review and meta-analysis. *Public Health Pract (Oxf)*. 2024;7:100506. doi:10.1016/j.puhp.2024.100506.
- [2] Prasad KN, Bondy SC. Electronic cigarette aerosol increases the risk of organ dysfunction by enhancing oxidative stress and inflammation. *Drug Chem Toxicol*. 2022;45(6):2561-7.
- [3] Lyytinen G. Health effects of electronic cigarettes and alternative tobacco products with a focus on vascular function [dissertation]. Stockholm: Karolinska Institutet; 2025.
- [4] Centers for Disease Control and Prevention. Health effects of e-cigarettes [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2025 [cited 2026 Mar 24]. Available from: <https://www.cdc.gov/tobacco/e-cigarettes/health-effects.html>
- [5] Gardner LA, Rowe AL, Newton NC, Egan L, Hunter E, Devine EK, et al. A systematic review and meta-analysis of school-based preventive interventions targeting e-cigarette use among adolescents. *Prev Sci*. 2024;25(7):1104-21.
- [6] Zheng X, Li W, Li R, Yang M, Lin HC. Exposure to user-generated e-cigarette content on social media associated with greater vulnerability to e-cigarette use among youth non-users. *Addict Behav*. 2024;156:108061. doi:10.1016/j.addbeh.2024.108061.
- [7] Ngambo G, Hanna EG, Gannon J, Marcus H, Lomazzi M, Azari R. A scoping review on e-cigarette environmental impacts. *Tob Prev Cessat*. 2023;9:30. doi:10.18332/tpc/172079.
- [8] National Statistical Office. Report on the survey of smoking behavior of the Thai population 2022. Bangkok: Ministry of Digital Economy and Society; 2022.
- [9] Sakboonyarat B, Poovieng J, Jongcherdchootrakul K, Hempatawee N, Hatthachote P, Mungthin M, et al. Emerging trends and determinants of electronic cigarette use among young Thai men, 2022-2024. *BMC Public Health*. 2025;25(1):3842.
- [10] McCausland K, Booth S, Leaversuch F, Freeman B, Wolf K, Leaver T, et al. Socio-ecological factors that influence youth vaping: perspectives from Western Australian school professionals, parents and young people. *Int J Qual Stud Health Well-being*. 2024;19(1):2322753.
- [11] Phetphum C, Prajongjeep A, Thawatchaijareonying K, Wongwuttiyan T, Wongjamnong M, Yossuwan S, et al. Personal and perceptual factors associated with the use of electronic cigarettes among university students in northern Thailand. *Tob Induc Dis*. 2021;19:31. doi:10.18332/tid/133640.
- [12] Vichayanrat T, Chidchuangchai W, Karawekpanyawong R, Phienudomkitlert K, Chongcharoenjai N, Funkiat N. E-cigarette use, perceived risks, attitudes, opinions of e-cigarette policies, and associated factors among Thai university students. *Tob Induc Dis*. 2024;22:72. doi:10.18332/tid/186536.
- [13] Savigamin C, Jitwimungsanon J, Rattananupong T, Sittipunt C, Sriprasart T. Prevalence of electronic-cigarette smoking in Thai college students. *Eur Respir J*. 2020;56(Suppl 64):1373. doi:10.1183/13993003.congress-2020.1373.
- [14] Dilektasli AG, Guclu OA, Ozpehlivan A, Durak VA, Gezmis I, Ozgur A, et al. Electronic cigarette use and consumption patterns in medical university students. *Front Public Health*. 2024;12:1403737. doi:10.3389/fpubh.2024.1403737.
- [15] Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179-211.
- [16] Wanaratwichit C, Mekrungrongwong S, Rakprasit J. Decision to use e-cigarettes and associated factors among students of a university in Northern Thailand. *Tob Induc Dis*. 2025;23:137. doi:10.18332/tid/209193.
- [17] Benjakul S, Nakju S, Termsirikulchai L. Use of e-cigarettes among public health students in Thailand: embedded mixed-methods design. *Tob Induc Dis*. 2022;20:78. doi:10.18332/tid/152256.
- [18] Fang J, Ren J, Ren L, Max W, Yao T, Zhao F. Electronic cigarette knowledge, attitudes and use among students at a university in Hangzhou, China. *Tob Induc Dis*. 2022;20:09.

- [19] Schneller LM, Reid JL, Kasza KA, O'Connor RJ, Hyland A, Hammond D. Awareness and perceived behaviour changes following the New York state vaping flavour ban, 2021-2022. *Tob Control*. 2025;34(5):664-70. doi:10.1136/tc-2023-058569.
- [20] Vogel EA, Henriksen L, Schleicher NC, Prochaska JJ. Young people's e-cigarette risk perceptions, policy attitudes, and past-month nicotine vaping in 30 U.S. cities. *Drug Alcohol Depend*. 2021;229(Pt A):109122. doi:10.1016/j.drugalcdep.2021.109122.
- [21] Thanh PQ, et al. Perceptions and use of electronic cigarettes among young adults in Vietnam 2020. *J Community Health*. 2022;47(5):822-7. doi:10.1007/s10900-022-01113-4.
- [22] de Vries JM, Kelly AB. Cognitive drivers of e-cigarette use amongst young Australians: informing prevention strategies in an e-cigarette epidemic. *Subst Use Misuse*. 2025:1-7. doi:10.1080/10826084.2025.2540937.
- [23] Durkin K, Williford DN, Turiano NA, Blank MD, Enlow PT, Murray PJ, et al. Associations between peer use, costs and benefits, self-efficacy, and adolescent e-cigarette use. *J Pediatr Psychol*. 2021;46(1):112-22. doi:10.1093/jpepsy/jsaa097.
- [24] Struik L, Christianson K, Khan S, Yang Y, Werstuik ST, Dow-Fleisner S, et al. Factors that influence decision-making among youth who vape and youth who don't vape. *Addict Behav Rep*. 2023;18:100509. doi:10.1016/j.abrep.2023.100509.
- [25] Patanavanich R, Aekplakorn W, Glantz SA, Kalayasiri R. Use of e-cigarettes and associated factors among youth in Thailand. *Asian Pac J Cancer Prev*. 2021;22(7):2199-207. doi:10.31557/APJCP.2021.22.7.2199.
- [26] Jackson SE, Squires H, Shahab L, Tattan-Birch H, Buckley C, Purshouse RC, et al. Associations of close social connections with smoking and vaping: a population study in England. *Nicotine Tob Res*. 2025;27(3):447-56. doi:10.1093/ntr/ntae225.
- [27] Valente TW, Piombo SE, Edwards KM, Waterman EA, Banyard VL. Social network influences on adolescent e-cigarette use. *Subst Use Misuse*. 2023;58(6):780-6. doi:10.1080/10826084.2023.2188429.
- [28] Awua J, Tuliao AP, Gabben-Mensah D, Kanjor F, Botor NJB, Ohene L, et al. Interpersonal communication and perceived norms as social influence mechanisms of e-cigarette use among adults: a systematic review. *Am J Drug Alcohol Abuse*. 2024;50(3):291-304. doi:10.1080/00952990.2024.2346928.
- [29] Luu NM, Bui TT, Phan HT, Oh JK. Peer influence and use of electronic cigarettes among adolescents and young adults: a meta-analysis of prospective studies. *Asian Pac J Cancer Prev*. 2025;26(6):2215-23. doi:10.31557/APJCP.2025.26.6.2215.
- [30] Bandura A. Social foundations of thought and action: a social cognitive theory. Englewood Cliffs (NJ): Prentice-Hall; 1986.