RESEARCH ARTICLE

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Use of Electronic Cigarettes and Associated Factors Among Public High School Students in Vietnam

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Abstract

Objective: The objective of this study was to assess the prevalence of electronic cigarette use (e-cigarette) and identify its associated factors among public high school students in Da Nang City, Vietnam. **Methods:** A cross-sectional study was conducted in 22 public high schools, involving 2504 students from grades 10-12. Students were selected using multistage cluster random sampling. Self-reported e-cigarette use was collected using the Global School-based Student Health Survey Questionnaire. A multivariable logistic regression model was used to examine predictors of e-cigarette use. **Result:** Of the 2504 students, 6.1% reported current e-cigarette use, with 95% confidence interval (CI): 5.2 to 7.1% (boys: 9.1%, 95% CI: 7.5-10.7; girls: 3.3%, 95% CI: 2.3-4.3). Peer and parental smoking was a key driver, with significant associations with e-cigarette use (Odd ratio, OR = 3.54, 95% CI: 2.34 - 5.38; 3.87, 95% CI: 2.66 - 5.63, respectively). In addition, being boy (OR = 2.74, 95% CI: 1.87 - 4.03), in the 11th-grade status (OR = 2.02, 95% CI: 1.31 - 3.12), having low academic achievement (OR = 2.89, 95% CI: 1.39 - 5.99); and currently smoking cigarette (OR = 7.68, 95% CI: 3.55 - 16.58) were also significantly associated with e-cigarette use. **Conclusion:** E-cigarette use is of growing concern among high school students in Da Nang. Current cigarette smoking, particularly influenced by peers and family, is the primary factor driving e-cigarette use. Intervention programs should prioritize reducing cigarette smoking to effectively prevent e-cigarette use among high school students.

Keywords: Electronic Cigarette- Students- Smoking- Public High Schools- Danang city.

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Introduction

The usage of e-cigarettes among adolescents has considerably increased in recent years [1], particularly those in high school [2]. E-cigarettes are known to be associated with various health consequences [3]. Particularly, nicotine exposure from vaping products can negatively impact brain development and cause addiction in children and adolescents [4]. Therefore, the rise of e-cigarette use has become a significant public health concern. Numerous studies report a prevalent trend of e-cigarette use in youth; for example, a meta-analysis showed about 4.8% (95% CI: 3 – 7.6) of young people globally engaged in using e-cigarettes [5]. In Vietnam, the prevalence of e-cigarette use among young adults was 2.4% in 2020 [6], while another study in the two largest cities revealed the rate of 7.4% [7]. Those who have ever used e-cigarettes tend to also smoke cigarettes in the future, according to 3 longitudinal waves, while smoking cigarettes was irrelevant to prospective e-cigarette use [8]. Additionally, using e-cigarettes increases the likelihood of e-cigarette addiction in adolescents over time, especially with the appealing advertisements of the pod mod style e-cigarettes containing high nicotine, which could potentially raise a smoking cigarette shift in adolescents similar to the pattern observed with older types of e-cigarettes, despite their previous intention to withdraw from cigarette smoking [9, 10]. Therefore, it is crucial to conduct research to monitor e-cigarette usage patterns among adolescents and to establish and enforce regulatory policies to limit access [11].

This trend appears to be significantly influenced by several factors, including targeted e-cigarette advertising via social media [12], attractive flavor options, affordable pricing, extensive accessibility, and subtle designs [13]. It is important to note that e-cigarettes have not demonstrated efficacy in aiding smoking cessation. In Vietnam, although the policy ban on cigarette advertisements

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has been incorporated into law, being exposed to either e-cigarette or smoking cigarette advertising on social media may contribute to the initial decision towards using in adolescents [9]. To date, limited research in Vietnam has comprehensively examined the factors influencing e-cigarette use across grades among high school students. A significant gap in the literature remains: a comprehensive understanding of how these factors interact and contribute to the initiation and prevalence of e-cigarette use within this demographic. While a ban on e-cigarettes was implemented early in 2025 in Vietnam, gaining insights into these factors affecting e-cigarette use behavior in adolescents will promote school programs for e-cigarette and tobacco control that are more practical and efficient for this targeted population. Additionally, recognizing this trend will support a new strategic orientation to formulate strategies to prevent health hazards, when there is a shift from using e-cigarettes to smoking cigarettes among current e-cigarette users. In summary, the objectives for the current study were to determine the prevalence of e-cigarette use and to explore the associated factors among public high school students in Vietnam.

Materials and Methods

Study design

A cross-sectional school-based study was conducted in twenty-two public high schools in Da Nang City, Vietnam, from April 2024 to July 2024. A self-administered questionnaire was completed by students.

Participants and sampling

A list of 22 high schools was compiled, from which one class each from grades 10, 11, and 12 was randomly selected, yielding a sample of 2,685 students. The present study included 2,504 individuals after removing inattentive questionnaires and people with missing demographic information. Participants and schools received a detailed description of the study, and written informed consent was obtained.

Questionnaire & Measurements

The Global School-based Student Health Survey (GSHS): The core questionnaire items were adapted based on the Vietnamese version of the GSHS [14]. In the present study, information related to e-cigarette users was collected based on the "tobacco use" module, which includes items such as know about e-cigarettes, sources of information about e-cigarettes, use of e-cigarettes, friendship relationships and the motivations for e-cigarette use, e-cigarette advertisements, and advice and cautions related to e-cigarettes [14].

Variables and measurements

Dependent variable

The dependent variables were current e-cigarette use and non-current e-cigarette use. Current e-cigarette use reports smoking at least one e-cigarette in the past 30 days. The question "Have you used electronic cigarettes in the last 30 days?" was used to assess current e-cigarette use and categorized as "yes" or "no" responses. The respondent was recognized as a current e-cigarette user if the response was "yes" [15, 16]. If a responder answered "no" to the question, it was determined that they did not use e-cigarettes currently [17, 18].

Independent variables

Independent variables included students' gender (Boys, Girls), grade level (10th, 11th, 12th), academic achievement (very good, good, and average) based on the grade point average (GPA) from the last semester, which was measured on a 0-10 scale, parental smoking (yes, no), highest education of either parent (junior school or lower, high school, college or higher), friends' smoking (yes, no), and cigarette smoking status (current, former, non-use). For cigarette smoking status, current users reported using cigarettes now and using at least one e-cigarette in the past 30 days. Former smokers had tried cigarettes but not smoked in 30 days; Non-smokers reported never trying a cigarette [15]. For individuals identified as current e-cigarette users, additional information was gathered on the following aspects: methods of accessing e-cigarettes (get from friends, buy in a store, others); primary reasons for use (curiosity, friend' encouragement, e-cigarettes are fashionable, e-cigarettes are less harmful, other reasons); sources of information about e-cigarettes (friends, social media, e-cigarette store, internet, television); awareness of the impact of e-cigarettes (yes, no); and visibility of health warnings on cigarette packages (yes, no).

Statistical analysis

Descriptive statistics summarized the sample, including current and non-current e-cigarette users. A Chi-square test was used to examine the independent variables and e-cigarette usage status. A multivariable logistic regression model (model 1) was used to examine e-cigarette use and independent factors. The backward stepwise selection method was employed to determine important independent variables in the multivariable logistic regression model (model 2), and OR along with 95% CI was calculated. A p-value of less than 0.05 was deemed statistically significant. Data analysis was conducted utilizing Stata version 13.1.

Results

Table 1 shows the characteristics of the participants. A total of 2,504 high school students were recruited from public high schools, including 36.5% in grade 10, 34.7% in grade 11, and 28.9% in grade 12.

Table 1 indicates the prevalence of e-cigarette use among different participant characteristics, representing 6.1% with a 95% confidence interval (95% CI: 5.2%-7.1%) of the study sample. Regarding sex group, 9.1%, 95% CI (7.5%-10.7%) of boys and 3.3%, 95% CI (2.3%-4.3%) of girls reported using e-cigarettes.

E-cigarette usage varied by grade level, with 4.6% of 10th graders, 7.5% of 11th graders, and 6.4% of 12th graders reporting e-cigarette use. The prevalence of e-cigarette use was higher among students with low (11.4%) and moderate (7.0%) academic achievement compared to those with high academic achievement

Table 1. Proportion of E-cigarette Use by Participant Characteristics (with 95% CI for Yes)

Characteristic	Category	Total n (%)	No n (%)	Yes n (%, 95% CI)
All sample		2.504	2351 (93.9%)	153 (6.1%, 5.2%-7.1%)
Sex	Boys	1224 (48.9%)	1113 (90.9%)	111 (9.1%, 7.5%-10.7%)
	Girls	1280 (51.1%)	1238 (96.7%)	42 (3.3%, 2.3%-4.3%)
Grade level	10th grade	913 (36.5%)	871 (95.4%)	42 (4.6%, 3.2%-6.0%)
	11th grade	868 (34.7%)	803 (92.5%)	65 (7.5%, 5.7%-9.2%)
	12th grade	723 (28.9%)	677 (93.6%)	46 (6.4%, 4.6%-8.1%)
Academic achievement	High	693 (27.7%)	673 (97.1%)	20 (2.9%, 1.6%-4.1%)
	Moderate	1653 (66.0%)	1538 (93.0%)	115 (7.0%, 5.7%-8.2%)
	Low	158 (6.3%)	140 (88.6%)	18 (11.4%, 6.4%-16.3%)
Parents' education	Junior or lower	339 (13.5%)	313 (92.3%)	26 (7.7%, 4.8%-10.5%)
	High school	918 (36.7%)	856 (93.2%)	62 (6.8%, 5.1%-8.4%)
	College or higher	1247 (49.8%)	1182 (94.8%)	65 (5.2%, 4.0%-6.4%)
Parental smoking	At least one smokes	751 (30.0%)	666 (88.7%)	85 (11.3%, 9.1%-13.6%)
	Neither smokes	1753 (70.0%)	1685 (96.1%)	68 (3.9%, 3.0%-4.8%)
Friends' smoking	No	2246 (89.7%)	2141 (95.3%)	105 (4.7%, 3.8%-5.5%)
	Yes	258 (10.3%)	210 (81.4%)	48 (18.6%, 13.9%-23.4%)
Cigarette smoking	Nonuse	2324 (92.8%)	2211 (95.1%)	113 (4.9%, 4.0%-5.7%)
	Former use	125 (5.0%)	97 (77.6%)	28 (22.4%, 15.1%-29.7%)
	Current use	55 (2.2%)	43 (78.2%)	12 (21.8%, 10.9%-32.7%)

(2.9%). Furthermore, 18.6% of students with friends who smoke reported e-cigarette use, while 4.7% of those with non-smoking friends used e-cigarettes. Regarding cigarette smoking, 4.9% of non-smokers, 22.4% of former smokers, and 21.8% of current cigarette smokers also used e-cigarettes.

Table 2 details the characteristics of the current e-cigarette users. Among these users, the predominant method of accessing e-cigarettes was through friends (47.1%), followed by purchasing from stores (22.9%) and other sources (30.1%). The primary motivations for e-cigarette use included curiosity (53.6%) and friend' encouragement (59.2%), with fewer participants citing e-cigarettes as fashionable (16.3%), influenced by advertisements that claim e-cigarettes are less harmful (10.5%), or other reasons (6.5%) (Figure 1).

Information about e-cigarettes was primarily obtained from friends or observing others (52.3%) and social media (49.0%), with lesser contributions from e-cigarette stores (8.5%) and other media such as the internet, television, and magazines (7.2%). A majority of participants (72.6%) were aware of the potential impacts of e-cigarettes, while 27.5% were not. Additionally, 86.6% had encountered health warnings on cigarette packages, compared to 13.4% who had not (Table 2).

Table 3 showed both crude and adjusted models. A multivariable logistic regression revealed predictors of e-cigarette use. Boys (OR = 2.74, 95% CI: 1.87 - 4.03,

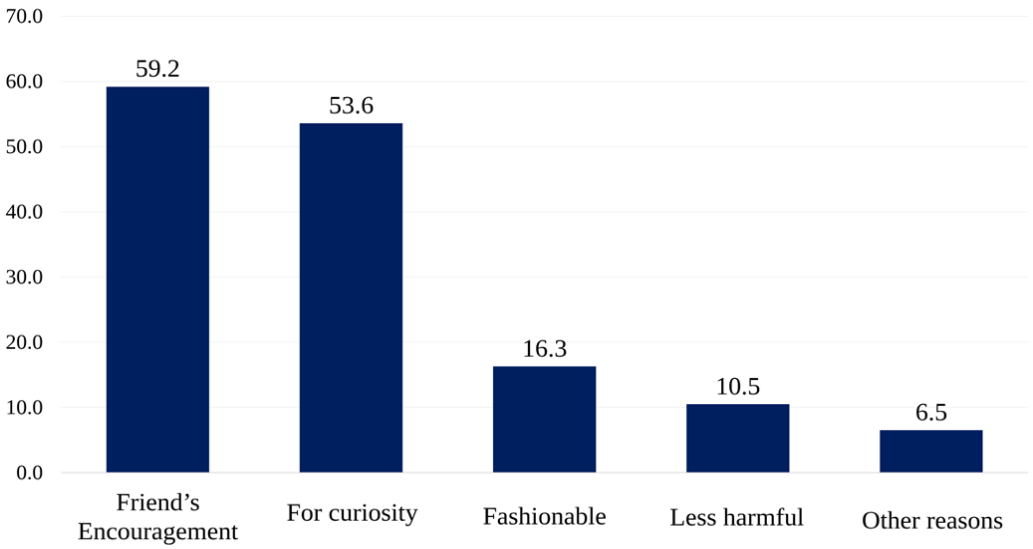

Figure 1. Primary reasons for electronic cigarette use (n=153)

Table 2. Descriptive Statistics of Participants Identified as Current E-Cigarette Users (n=153)

Characteristics	Current e-cigarette user (n=153; 6.11%)	Grade levels		
		Grade 10 (n=42;1.7%)	Grade 11 (n=65;2.6%)	Grade 12 (n=46;1.8%)
E-cigarette access method, n (%)				
Get from friends	72 (47.1)	15 (20.8)	36 (50.0)	21 (29.2)
Buy in a store	35 (22.9)	11 (31.4)	10 (28.6)	14 (40.0)
Others	46 (30.1)	12 (28.6)	25 (38.5)	9 (19.6)
The main reason to use an e-cigarette, n (%)				
Curiosity	82 (53.6)	25 (30.5)	31(37.8)	26 (31.7)
Friend's Encouragement	90 (59.2)	27 (30.0)	35 (38.9)	28 (31.1)
E-cigarettes are fashionable	25 (16.3)	6 (24.0)	5 (20.0)	14 (56.0)
E-cigarettes are less harmful	16 (10.5)	5 (31.3)	7 (43.8)	4 (25.0)
Other reasons	10 (6.5)	3 (20.0)	5 (60.0)	2 (20.0)
E-cigarette information source, n (%)				
Friends	80 (52.3)	27 (33.8)	30(37.5)	23 (28.8)
Social media	75 (49.0)	41 (54.7)	23(30.7)	11 (14.7)
E-cigarette store	13 (8.5)	3 (23.1)	6(46.2)	4 (30.8)
Internet, Television	11 (7.2)	5 (45.5)	4(36.4)	2 (18.2)
Hearing the impact of E-cigarettes, n (%)				
Yes	111 (72.6)	36 (36.0)	35(35.0)	40 (40.0)
No	42 (27.5)	22 (52.4)	10(24.8)	10 (24.8)
Seeing a health warning on cigarette packages, n (%)				
Yes	132 (86.6)	25 (18.9)	42(31.8)	65 (49.2)
No	21 (13.4)	10 (47.6)	8(38.1)	3 (14.3)

Table 3. Association between Sociodemographic Status and E-Cigarette Use

Characteristics	Model 1		Model 2	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Sex group				
Boys	1		1	
Girls	2.94 (2.04 - 4.23)	<0.0001	2.74 (1.87 - 4.03)	<0.0001
Grade level				
10th grade (15 years)	1		1	
11th grade (16 years)	1.68 (1.13 - 2.50)	0.011	2.02 (1.31 - 3.12)	0.002
12th grade (17 years)	1.41 (0.92 - 2.17)	0.118	1.62 (1.01 - 2.58)	0.043
Academic achievement				
High (very good)	1		1	
Middle (good)	2.52 (1.55 - 4.08)	<0.0001	2.32 (1.39 - 3.88)	0.001
Low (average)	4.33 (2.23 - 8.39)	<0.0001	2.89 (1.39 - 5.99)	0.004
Parental smoking				
No	1		1	
Yes	3.16 (2.27 - 4.41)	<0.0001	3.87 (2.66 - 5.63)	<0.0001
Friends' smoking				
No	1		1	
Yes	4.66 (3.22 - 6.75)	<0.0001	3.54 (2.34 - 5.38)	<0.0001
Cigarette smoking				
Never use	1		1	
Former use	5.65 (3.56 - 8.96)	<0.0001	6.98 (4.08 - 11.94)	<0.0001
Current use	5.46 (2.80 - 10.64)	<0.0001	7.68 (3.55 - 16.58)	<0.0001
R-squared, p-value			$R^2 = 0.19$, p = <0.001	

Abbreviations: OR, Odds ratio; CI, Confidence interval; Model 1: Univariable logistic regression; Model 2: Multivariable logistic regression

p < 0.0001), 11th graders (OR = 2.02, 95% CI: 1.31 - 3.12, p = 0.002), and 12th graders (OR = 1.62, 95% CI: 1.01 - 2.58, p = 0.043) had a significant association with e-cigarette use. Academics with middle (OR = 2.32, 95% CI: 1.39 - 3.88, p < 0.0001) and low achievement (OR = 2.89, 95% CI: 1.39 - 5.99, p = 0.004), showing a higher likelihood of e-cigarette use compared to the reference group. Parental smoking (OR = 3.87, 95% CI: 2.66 - 5.63, p < 0.0001) and friends' smoking (OR = 3.54, 95% CI: 2.34 - 5.38, p = < 0.0001), and former smokers (OR = 6.98, 95% CI: 4.08 - 11.94, p < 0.0001) and current cigarette smokers (OR = 3.95, 95% CI: 2.22 - 7.02, p < 0.0001) were found to be significant.

Discussion

The present study aimed to assess the prevalence of electronic cigarette (e-cigarette) use and identify its associated factors among public high school students in Da Nang City, Vietnam. The findings indicate a current e-cigarette use prevalence of 6.1% among these students. Several factors were significantly associated with e-cigarette use, including being boys, being in the 11th grade, having lower academic achievement, paternal smoking, friends' smoking, and being a current or former conventional cigarette smoker. These results offer crucial insights into the dynamics of adolescent smoking behaviors within a major Vietnamese urban center. This understanding is particularly pertinent given the evolving landscape of tobacco control policies and product regulation, not only in Vietnam but also across the broader Southeast Asian region, especially in light of Vietnam's impending nationwide ban on e-cigarettes.

The observed 6.1% current e-cigarette use prevalence among public high school students in Da Nang signifies a notable level of engagement with these products. This figure is considerably higher than the 2.6% (95% CI: 1.9-3.3) national prevalence reported by the World Health Organization (WHO) in 2019 for Vietnamese students aged 15-17 [19]. The disparity between the current findings in Da Nang and earlier national figures may suggest an increasing trend in e-cigarette use among Vietnamese adolescents over the past few years.

When contextualized within the Southeast Asian region, the 6.1% prevalence in Da Nang falls within the reported range of 3.3% to 11.8% for current e-cigarette use among adolescents in various Southeast Asian countries between 2012 and 2021 [20]. Specifically, this rate is higher than the 3.7% reported among Thai youth in 2019 and a more recent 3.5% among Thai youth aged 15-24 in a 2023 study [10]. This positions adolescent e-cigarette use in Vietnam, as indicated by the Da Nang data, at a moderate level compared to some regional neighbors, but the apparent increase from previous national figures suggests an upward trajectory.

Regarding associated factors, boy students comprised the dominant group of smokers, and 11th-grade students demonstrated the highest odds of e-cigarette use (aOR = 1.96), followed by 12th-grade students (aOR = 1.70), when compared to 10th-grade students. This aligns with broader adolescent development theories suggesting that mid-adolescence is often a period of heightened experimentation and susceptibility to peer influence [21]. The peak in 11th grade suggests this period may represent a critical window for the initiation and establishment of e-cigarette use, implying that preventive interventions could be strategically timed to preempt this rise, perhaps by intensifying efforts in late 10th grade or early 11th grade.

A strong inverse relationship was observed between academic achievement and e-cigarette use. Students with middle academic achievement (aOR = 3.10) and low academic achievement (aOR = 3.21) were significantly more likely to use e-cigarettes compared to those with high academic achievement. This finding is consistent with studies in other cultural contexts, such as research in China that has linked poor academic performance with an increased intention to smoke [22].

The social environment, encompassing both family and peer influences, emerged as a powerful determinant of e-cigarette use. Paternal smoking was strongly associated with adolescent e-cigarette use, with students whose fathers smoked having over three times the odds of using e-cigarettes. This aligns with a substantial body of literature demonstrating that parental smoking behavior can normalize smoking and enhance access to tobacco products within the household [20]. The influence of peers was also highly significant, with students whose friends smoked having more than double the odds of using e-cigarettes. The present study's data further elucidate some data that support this association. As data shows that "friend' encouragement" (59.2%) was a primary reason for use, "get from friends" (47.1%) was the predominant method of accessing e-cigarettes, and "friends or observing others" (52.3%) was a key source of information about these products. The combined presence of paternal smoking and friends' smoking likely creates a highly pro-smoking microenvironment for adolescents, synergistically increasing their risk of e-cigarette initiation and continued use [20].

A striking finding of this study is the extremely strong association between conventional cigarette smoking and e-cigarette use. Current conventional cigarette smokers had nearly four times the odds (aOR = 3.95), and former smokers nearly three times the odds (aOR = 2.86), of also using e-cigarettes compared to never-smokers. This indicates a significant overlap between these behaviors and is consistent with literature suggesting that e-cigarette use is common among adolescents who smoke conventional cigarettes [21]. The strength of the association suggests that e-cigarettes are heavily used by adolescents already initiated into tobacco use [8]. This strong link implies that efforts to prevent conventional cigarette smoking will likely have a concurrent positive impact on reducing e-cigarette uptake. Tobacco control interventions should therefore consider addressing nicotine addiction more broadly, rather than focusing solely on individual product types, and tackle the shared risk factors such as peer and family smoking influences.

A critical contextual factor for interpreting the findings of this study is the Vietnamese government's decision to implement a comprehensive ban on e-cigarettes, effective

from January 1, 2025. While this regulatory action aims to curb the rise of these products, the landscape of e-cigarette use gleaned from this pre-ban study remains highly relevant and significant for future e-cigarette and tobacco control efforts, owing to the anticipation and mitigation of potential unintended consequences of the ban. Furthermore, the current study's identification of key drivers of use shows how adolescents may respond to regulatory measures, and where to focus surveillance and enforcement efforts.

Crucially, a product ban primarily addresses the supply side of the issue. It does not inherently alter the underlying demand-side factors that drive initiation and use, which factors were identified as significant in this study. Therefore, the evidence provided by this study on why adolescents use e-cigarettes and the contexts that facilitate this use remains vital for designing and implementing comprehensive tobacco control strategies that focus on demand reduction.

This study possesses several strengths that contribute to its value. It utilized a representative sample of public high school students from Da Nang, a major city in Vietnam, enhancing the relevance of its findings for urban adolescent populations in the country. The use of a standardized questionnaire, adapted from the Global School-based Student Health Survey (GSHS), allows for some comparability with other national and international surveys. Furthermore, the study provides timely data on adolescent e-cigarette use and associated factors immediately preceding a significant national policy change the impending ban on e-cigarettes-making its findings particularly relevant for baseline assessments and future policy evaluation.

However, certain limitations must be acknowledged. The cross-sectional design of the study means that it can identify associations between variables but cannot establish causality or determine the temporal sequence of events. For example, while a strong association was found between conventional cigarette smoking and e-cigarette use, this design cannot definitively conclude whether one leads to the other (gateway effects) or if common underlying factors contribute to both. Beyond that, the findings are specific to public high school students in Da Nang and may not be generalizable to all adolescents in other areas in Vietnam.

A crucial area for future research will be the comprehensive impact assessment of Vietnam's e-cigarette ban, which was implemented early in 2025. This should include monitoring changes in the prevalence and patterns of overall youth tobacco use (e-cigarettes, conventional cigarettes, and other emerging products), investigating the emergence, scale, and characteristics of any illicit e-cigarette market [23], and assessing the effectiveness and challenges of enforcement efforts.

In conclusion, this study provides valuable insights into the prevalence of e-cigarette use and its associated factors among public high school students in Da Nang, Vietnam. The finding of a 6.1% current e-cigarette use prevalence, coupled with the significant influence of boys, 11th-grade status, lower academic achievement, paternal smoking, friends' smoking, and being a current or former conventional cigarette smoker, delineates a complex behavioral pattern among urban Vietnamese youth. These findings are of continued relevance and critical importance for informing comprehensive tobacco control strategies, guiding policy development, and shaping public health interventions in Vietnam. A multi-pronged approach that combines robust policy enforcement with evidence-based prevention and cessation strategies targeting these underlying drivers will be essential to protect the health and well-being of Vietnamese youth.

Author Contribution Statement

Phan Van Sang: Methodology, formal analysis, writing – original draft. Vo Duy Le: Supervision, project administration. Nguyen Thi Ngoc Ha]: Writing – review and editing. Hoang Huu Hai: Data analysis, writing – review and editing. Chau Hoa Nhung: Data collection, writing – review and editing. Ho Thi Thuy Duong: Data curation, validation, writing – review and editing. Tran Binh Thang: Conceptualization, methodology, formal analysis, writing – original draft. Data Availability: The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical restrictions but are available from the corresponding author upon reasonable request.

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Ethical Declaration

The Institutional Review Board of Danang Center for Disease Control (CDC) sanctioned all study procedures, which were executed in compliance with the established criteria on April 17, 2024. ID: TTKSBT/KHNV/620. Written informed consent was obtained from all participants, and for minors, additional consent was obtained from their homeroom teachers.

Conflict of Interest

The authors declare that they have no conflicts of interest related to this study.

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