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Original article

Prevalence and Behavioral Trends of Electronic Nicotine Delivery System Use Among Youth in Tripoli, Libya

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ABSTRACT

The rapid global increase in Electronic Nicotine Delivery Systems (ENDS) use among youth represents a critical public health challenge. However, there is a complete absence of city-level epidemiological data from Libya. This study aimed to determine the prevalence, patterns, and predictors of ENDS use among students in Tripoli. A cross-sectional online survey was administered to a sample of 420 students aged 15–25 years in Tripoli, Libya. Data were analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression in IBM SPSS version 28. The lifetime prevalence of ENDS use was 44.0% (95% CI: 39.3–48.9). The current (past 30-day) prevalence of use was 20.5% (95% CI: 16.8–24.6). Current use was significantly higher among males (31.3%) than among females (5.6%). Male was the sole strong independent demographic predictor (Adjusted Odds Ratio = 8.41, 95% CI: 4.07–17.37). The primary motivation for use was curiosity or experimentation (73.3%). While 82.6% of current users expressed a desire to quit, 33.7% reported physical difficulty abstaining for 24 hours. This first city-level study reveals alarmingly high ENDS use among youth in Tripoli, characterized by a pronounced gender disparity and primarily experimental motivations. These findings highlight an urgent need for targeted prevention, cessation support, and specific regulatory action in Libya.

Introduction

Over the past two decades, the use of electronic nicotine delivery systems (ENDS), commonly referred to as e-cigarettes or vaping devices, has increased substantially among adolescents and young adults worldwide. A recent meta-analysis, which included 4,189,145 school and university students from 53 countries, reported a pooled prevalence of 10.2% for current ENDS use and 22.0% for lifetime (ever) use [1], underscoring the widespread adoption of these products among youth populations. This rapid increase has raised significant public health concerns, particularly regarding nicotine dependence, the initiation of combustible tobacco use, and potential long-term health consequences [2]. Emerging evidence from the Middle East and North Africa (MENA) region suggests that youth vaping is following a similar pattern, although reliable epidemiological data remain scarce. Studies from neighboring Arab countries indicate increasing experimentation and use of ENDS among adolescents and university students, reflecting evolving nicotine consumption patterns within the region [2-4]. However, surveillance systems in MENA continue to focus predominantly on conventional tobacco products, resulting in limited region-specific data on ENDS use.

In Libya, available research on tobacco use among adolescents and young adults has largely concentrated on cigarette smoking and waterpipe use, with minimal attention given to ENDS. A school-based study conducted in Tripoli reported a current cigarette-smoking prevalence of 10.0% and an ever-smoking prevalence of 26.6% among students aged 10–18 years, with substantially higher rates observed among males [5]. Among university students, a cross-sectional study at Misurata University found that 8% of male smokers reported using electronic cigarettes alongside traditional cigarettes and waterpipe [6].

While these studies provide valuable insight into tobacco use patterns in Libya, they do not offer age-specific or city-level estimates of ENDS use among youth and young adults. Crucially, a critical gap exists in the literature regarding the prevalence and behavioral patterns of ENDS use among late adolescents and young adults in urban Libyan settings. The 15–25 age group represents a particularly critical population, as this period encompasses key developmental, educational, and social transitions that may influence health-risk behaviors, including nicotine use. To date, no peer-reviewed studies have systematically examined vaping behaviors within this age group in Tripoli, the country's largest urban center. Therefore, the present study aimed to assess the prevalence and patterns of ENDS use among youth aged 15–25 years in Tripoli, Libya.

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Methods

Study Design and Setting

A cross-sectional survey design was employed using an online, anonymous questionnaire. Data collection was conducted over nine weeks, allowing participants to complete the survey at their convenience while ensuring confidentiality.

Study Population

The study population comprised youth aged 15–25 years enrolled in high schools or undergraduate university programs in Tripoli, Libya. Eligibility criteria included being within the specified age range, currently registered in a high school or undergraduate program, and providing electronic informed consent. Exclusion criteria included individuals younger than 15 years or older than 25 years, as well as those unwilling or unable to complete the online questionnaire.

Sample Size

The sample size was calculated using the formula for prevalence studies:

$n=Z2 \cdot p(1-p)/d2$

Where:

- Z=1.96 for a 95% confidence interval
- p=0.10 (estimated prevalence of vaping among youth based on regional studies)
- d=0.03 (margin of error)

This yielded a minimum sample size of 385 participants. To account for an anticipated 10% non-response rate due to the online distribution format, the final target sample size was set at approximately 411 participants.

Sampling Technique

A convenience sampling strategy was adopted. The survey link was disseminated through official high school and university communication platforms (including email lists), as well as widely used social media applications such as WhatsApp, Facebook, and Telegram. Peer networks and student organizations were also engaged to enhance participation.

Data Collection Instrument

Data were collected using a structured, self-administered questionnaire adapted from previously validated surveys and contextualized to the Libyan setting. The instrument was anonymous and comprised sections addressing demographic characteristics, awareness and initiation of vaping, current patterns of use, perceptions and health effects, and addiction-related indicators, including future intentions. The questionnaire was pilot-tested with thirty participants to ensure clarity, reliability, and usability, and minor revisions were made prior to full-scale distribution.

To ensure reliability, the questionnaire was pilot-tested with thirty participants to assess clarity and usability. Internal consistency was evaluated using Cronbach's alpha, with values above 0.70 considered acceptable. Test–retest reliability was also assessed by re-administering the questionnaire to a subset of participants after two weeks, confirming the stability of responses. These procedures demonstrated that the instrument was reliable for capturing vaping awareness, behaviors, perceptions, and health effects among youth in Tripoli.

Data Collection Procedure

Participants accessed the survey via a secure online platform (Google Forms). An information sheet and electronic consent form were presented on the first page, outlining study objectives, voluntary participation, and assurances of anonymity. No personally identifiable information was collected. Responses were stored securely and accessible only to the research team.

Data Management and Analysis

Survey responses were exported to Microsoft Excel for initial cleaning, which included removal of incomplete or duplicate entries, verification of logical consistency, and creation of derived variables (e.g., age categories, frequency of use, educational levels). The cleaned dataset was then imported into IBM SPSS Statistics version 28 for analysis. Descriptive statistics were computed, with frequencies and percentages reported for categorical variables and means ± standard deviations for continuous variables. Associations between vaping behaviors (ever use and current use) and demographic or behavioral variables were examined using chi-square tests. Statistical significance was set at $p < 0.05$.

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Ethical Considerations

The study adhered to the principles of the Declaration of Helsinki and international ethical guidelines for research involving human participants. Ethical approval was obtained from the Faculty of Medicine, International Maaref University Ethics Committee. Participation was voluntary, and respondents could withdraw at any time. All responses were anonymous and confidential, ensuring privacy and data security.

Results

This study analysed data from 420 students. As detailed in Table 1, the lifetime (ever) use of ENDS was reported by 44.0% (185/420; 95% CI: 39.3–48.9) of participants. The current use, defined as use within the past 30 days, was reported by 20.5% (86/420; 95% CI: 16.8–24.6).

Table 1. Demographic Characteristics and Current ENDS Use Prevalence (N=420)

Characteristic	Total N (%)	Current Vapers, n (%)	Prevalence % (95% CI)	x^2 (p-value)
Total Sample	420 (100)	86	20.5 (16.8–24.6)	–
Sex				
Male	243 (57.9)	76	31.3 (25.6–37.4)	68.2 (<0.001)
Female	177 (42.1)	10	5.6 (2.7–10.1)	
Age Group				
≤ 18 years	92 (21.9)	18	19.6 (12.0–29.4)	0.28 (0.87)
19–21 years	209 (49.8)	45	21.5 (16.2–27.6)	
≥ 22 years	119 (28.3)	23	19.3 (12.7–27.5)	
Educational Stage				
Secondary School	51 (12.1)	11	21.6 (11.3–35.3)	0.05 (0.83)
University	369 (87.9)	75	20.3 (16.4–24.7)	
Institution Type				
Public	149 (35.5)	26	17.4 (11.7–24.5)	1.56 (0.21)
Private	271 (64.5)	60	22.1 (17.3–27.6)	

To identify independent predictors, a multivariable logistic regression was performed with current use as the outcome variable. The model, adjusted for educational stage and institution type, confirmed male sex as the sole strong independent demographic predictor (Table 2).

Table 2. Multivariable Logistic Regression for Predictors of Current ENDS Use

Predictor	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Male Sex	8.41	4.07 – 17.37	< 0.001
University Stage vs. Secondary	1.02	0.49 – 2.13	0.96
Private Institution vs. Public	1.35	0.81 – 2.25	0.25

Among current users (n=86), the most frequently cited motivations were curiosity or experimentation (73.3%, 63/86) and the variety of available flavours (24.4%, 21/86). A notable proportion endorsed the belief that ENDS are less harmful than combustible cigarettes (23.3%, 20/86) or used them to aid in quitting smoking (20.9%, 18/86). A majority of current users (82.6%, 71/86; 95% CI: 73.2–89.7) expressed a desire to quit vaping in the future. Despite this intention, a significant subset reported features of dependence (Figure 1), with 33.7% (29/86; 95% CI: 24.1–44.5) finding it "hard" or "very hard" to abstain from vaping for 24 hours of users (82.6%) indicated an intention to cease use in the future.

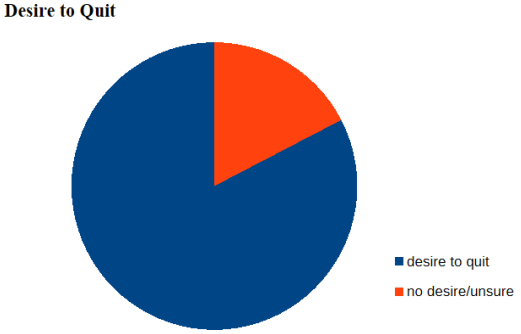

Figure 1: Proportion of current ENDS users expressing a desire to quit (n=86).

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Discussion

This study provides the first city-level epidemiological estimate of ENDS use among youth in Tripoli, Libya. The findings demonstrate a current ENDS use prevalence of 20.5% among students aged 15–25 years, highlighting vaping among adolescents and young adults as a significant and immediate public health concern. The observed pattern of use is marked by a pronounced gender disparity, predominantly experimental motivations, and operation within a regulatory context that requires urgent public health and policy attention.

The finding that 20.5% of youth in Tripoli are current users of ENDS places Libya within a concerning regional pattern of increasing vaping among young populations. This prevalence is consistent with recent multinational evidence indicating that ENDS use is emerging as a prominent form of tobacco consumption among young adults in the Arab world [9]. Notably, the prevalence observed in Tripoli is considerably higher than the limited data previously reported from other Libyan settings, such as the 8% rate of ENDS use among male smokers at Misurata University [6], and exceeds the global pooled prevalence of 10.2% reported among school and university students [1]. These findings suggest a potentially rapid uptake of ENDS in Libya's urban centers, mirroring global trends but possibly amplified by local contextual factors, including the absence of clear or enforced regulatory measures governing ENDS use [10].

The most striking demographic finding in this study is the pronounced sex disparity in ENDS use, with the prevalence among males (31.3%) being more than five times higher than that among females (5.6%). This pattern is consistent with well-established sociocultural norms that shape tobacco use behaviors across the MENA region. Multivariable analysis identified male sex as the only strong independent demographic predictor of current ENDS use (adjusted odds ratio [AOR] = 8.41, 95% CI: 4.07–17.37), in agreement with regional evidence that consistently reports male gender as a key risk factor for vaping [9]. Importantly, this disparity parallels the marked gender gap observed in conventional cigarette smoking in Libya, where national estimates indicate a prevalence of 45.8% among men compared with just 0.2% among women [10]. Together, these findings suggest that ENDS use in Libya largely follows existing gendered patterns of tobacco consumption, rather than altering established sociocultural norms.

The predominant motivations for ENDS use provide important insight into the behavioral dynamics underlying this emerging public health issue. Curiosity or experimentation was the main reason for use, reported by 73.3% of current users, whereas only 20.9% indicated using ENDS as a means to quit combustible cigarettes. This pattern is consistent with global evidence showing that youth initiation of ENDS is largely driven by curiosity rather than smoking cessation intentions [11]. This distinction has important implications for public health strategies. The high prevalence of curiosity-driven use, together with the finding that 33.7% of current users experience difficulty abstaining from ENDS for 24 hours, suggests a potential progression from initial experimentation to nicotine dependence.

A key finding of this study is the absence of significant differences in ENDS use prevalence across educational stages or types of institutions, indicating that vaping is widespread and socially normalized across diverse educational and socio-economic groups within Tripoli's youth population. This pervasive pattern should be interpreted in light of Libya's current policy environment, which lacks specific legislation governing the importation, marketing, or sale of e-cigarettes, effectively creating a regulatory vacuum [10]. Such an environment likely facilitates the easy availability and active promotion of ENDS to young people. The World Health Organization has warned that children and adolescents are particularly vulnerable to targeted marketing in unregulated settings [12]. Collectively, these findings highlight an urgent need for Libya to develop and implement comprehensive regulatory frameworks for ENDS to restrict youth access, regulate marketing practices, and mitigate the growing public health impact of vaping.

A major strength of this study lies in its novelty, as it provides the first peer-reviewed, city- level baseline data on ENDS use within a previously unstudied population. The study encompassed the critical 15–25-year age group and included both secondary school and university students, enabling a comprehensive assessment across key educational stages. Furthermore, the use of a standardized, anonymized online questionnaire supported the reliable collection of sensitive behavioral information. It enhanced the comparability of the findings with other studies employing similar methodological approaches.

The limitations of this study should be considered when interpreting the findings. Its cross-sectional design provides a snapshot in time, preventing any conclusions about causality or changes over time. The use of convenience sampling through online surveys, although practical, may restrict the generalizability of the results, likely under-representing youth with limited internet access and potentially influencing prevalence estimates. Additionally, as with all research on sensitive behaviors, the reliance on self-reported data introduces the possibility of recall errors and social desirability bias.

Conclusion

This study provides the first city-level evidence on ENDS use among youth in Tripoli, revealing a prevalence of 20.5% and a marked gender disparity, with males at significantly higher risk. Vaping in this population

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is largely driven by curiosity rather than smoking cessation, yet early signs of dependence highlight the potential progression to nicotine addiction. These findings underscore the urgent need for coordinated public health action, including stronger legislation to regulate sales and marketing, school- and university-based educational programs that address misconceptions, and clinical screening with age-appropriate cessation support. At the national level, systematic monitoring of ENDS use should be integrated into health surveys to inform long-term preventive strategies.

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Conflict of Interest
The authors declare that there are no conflicts of interest regarding the publication of this article.

Consent to participate
Informed consent was obtained electronically from all participants prior to data collection. The first page of the online questionnaire included an information sheet outlining the study objectives, the voluntary nature of participation, and assurances of anonymity and confidentiality. Participants indicated their willingness to take part by selecting the consent option before proceeding to the survey.

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