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Original Article

Knowledge, Attitude, and Practices regarding E-cigarette use among Undergraduate Medical Students at a Tertiary-care Medical College in India

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Abstract

Background: Despite increasing e-cigarette use among young adults, data on medical students' knowledge, attitudes, and practices (KAP) remain limited. This study assessed KAP regarding e-cigarettes and examined the influence of sociodemographic factors on their use.

Methodology: A cross-sectional study was conducted among 311 MBBS students at RUHS College of Medical Sciences, Jaipur. A validated 37-item questionnaire assessed sociodemographic details and KAP. Responses were recorded on a 5-point Likert scale. Data were analyzed using SPSS version 26 with descriptive statistics, independent t-tests, ANOVA, and chi-square tests. Subgroup analysis compared ever-users and never-users.

Results: Among ever-users, the majority were male (74%) and aged 19–23 years (78%). Knowledge gaps were evident, with 23% unaware of e-cigarette types and 63% perceiving them as less harmful than conventional cigarettes. While most participants recognized nicotine-related harms (91%), awareness of regulatory measures was lower, including the national ban (61.6%) and prior taxation (57.5%). Over half (58.9%) considered e-cigarettes not cost-effective. Ever-users demonstrated relatively more favorable attitudes (43.8%); however, most rejected perceived social benefits (75.3%) and supported regulatory bans (56.2%). Overall use was low, with 76.5% reporting no lifetime use; among ever-users, occasional use predominated (43%).

Conclusion: Medical students displayed partial awareness and permissive attitudes, but ever-users showed inconsistent cessation behaviors. These findings underscore the need for targeted education and structured cessation support to address rising e-cigarette use in this vulnerable group.

Keywords: e-cigarette - electronic nicotine delivery system - nicotine - smoking - vape

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Quick Response Code:

Introduction

Young adults in India are using e-cigarettes (ECs) more frequently. These battery-operated devices vaporise a nicotine-infused liquid containing propylene glycol, vegetable glycerin, and flavourings. Invented in 2003 by Chinese pharmacist Hon Lik as a smoking cessation aid, ECs are marketed as a safer alternative to traditional cigarettes.[1] EC use weakens the immune system, thereby increasing the lungs' susceptibility to infections.[2] The Government of India imposed a ban on ECs in September 2019, citing public health concerns. Prior restrictions had already limited their use for both recreation and smoking cessation. However, illicit markets persist, hampering tobacco control efforts.[3]The rise in EC use is driven by its perceived effectiveness for cessation, increased youth exposure to advertisements, and the appeal of flavoured products due to their taste and aroma.[4-5] The World Health Organization (WHO) warns of EC-related health risks, stating that ECs can trigger inflammatory responses similar to conventional smoking. ECs are often used where smoking is banned and may deliver higher nicotine levels than cigarettes, raising addiction risks among youth. [6-7] Medical students play a crucial role in promoting tobacco cessation and educating patients about smoking risks. However, data on their knowledge, attitudes, and practices (KAP) regarding ECs remain unexplored. As future healthcare professionals, assessing their use and perceptions of ECs is essential. To the best of our knowledge, this is among the first studies in India to explore KAP among medical students regarding EC consumption.

Materials & Methods

Study Design: This observational study was conducted at the RUHS College of Medical Sciences, Jaipur, Rajasthan. Approval was obtained from the Institutional Research Review Board and the Institutional Ethics Committee (EC-P-40-24) before initiating the study. The study was also registered with the Clinical Trial Registry of India (CTRI/2025/03/082305). Written informed consent was obtained from all participants before their inclusion in the study.

Study Population: The study population consisted of undergraduate MBBS students from various academic batches. A total of 900 students who provided written informed consent were eligible to participate, of whom 311 students completed the survey. The study was conducted from February to March 2025, with fifteen days allocated for data collection and one month for data analysis.

Sampling approach:

All undergraduate MBBS students from first to fifth year who were eligible and provided informed consent were invited to participate (census-based invitation). The survey link (Google Forms) was disseminated through official student communication channels, and participation was voluntary. Thus, the final sample comprises voluntary responses from those invited.

Response rate and implications: Of approximately 900 eligible students, 311 completed the questionnaire, yielding a response rate of 34.6%. While this response rate is acceptable for online surveys, it may affect representativeness and warrants cautious interpretation of prevalence estimates.

Inclusion and Exclusion Criteria: Undergraduate MBBS students from first to fifth year who provided written informed consent were included in the study. Participants who did not complete the questionnaire or provide incomplete data were excluded. For the purpose of analysis, participants were categorized as **"ever-users"** if they reported having used an e-cigarette at least once in their lifetime, and **"never-users"** if they reported no lifetime use.

Data Collection: A validated 37-item online questionnaire was used to collect data, divided into four sections (A, B, C, and D).[6]

The internal consistency reliability of the questionnaire was evaluated using Cronbach's alpha (α). The questionnaire demonstrated excellent reliability, with Cronbach's alpha values exceeding 0.9 across all domains, indicating very high internal consistency and strong instrument reliability for assessing knowledge, attitudes, and practices related to e-cigarette use.

The questionnaire assessed demographic and socioeconomic data and participants' KAP regarding EC use. The survey was distributed via Google Forms, and responses were collected over a period of two months.

Scoring System and Thresholds

The knowledge and practice domains were assessed using a 5-point Likert scale (score range: 1–5). For each participant, mean domain scores were calculated. Based on established KAP methodology, mean scores were categorized as poor (1.00–2.49), average (2.50–3.49), and good (3.50–5.00). This categorization has been widely used in prior KAP studies to facilitate the interpretation of awareness levels and behavioral practices.[6]

The attitude domain employed a binary response format (agree/disagree), consistent with the original validated questionnaire. This approach was chosen to minimize ambiguity among respondents, reduce central-tendency bias, and facilitate clearer interpretation of attitudinal positions, particularly in public-health KAP studies, where decisional clarity is preferred over graded opinion scales.

Section A: Sociodemographic Details: The survey included 9 questions on socio-demographic details, such as age, gender, year of MBBS completion, place of residence, and family income.

Section B: Knowledge about E-cigarettes: 10 questions assessed participants' knowledge.

Section C: Attitude towards use of E-cigarettes: 6 questions assessed attitudes using a binary scale (agree/disagree).

Section D: Practices Regarding E-Cigarette Use: The final section comprised 12 questions that evaluated practices related to EC use. Inquiries encompassed current EC use, frequency and duration of smoking, the volume of cartridge, and willingness to quit or participate in a tobacco cessation programme.

The study was conducted from February to March 2025. The active data collection period lasted 15 days, during which the online questionnaire was accessible to participants. The overall two-month duration included survey dissemination, follow-up reminders, data cleaning, and statistical analysis.

Statistical Analysis: The collected data were analyzed using SPSS 26. Descriptive statistics, including mean and standard deviation, were calculated for quantitative variables. Graphs and tables were generated wherever necessary. Statistical tests, such as independent t-tests, ANOVA, and chi-square tests, were applied to evaluate the effect of sociodemographic factors on EC use. Additionally, a subgroup analysis was conducted to compare ever-users and never-users of ECs.

Results: Figure 1: Sociodemographic Variables of study participants

A total of 311 undergraduate medical students participated in the study. Most participants were aged 19–23 years (79.1%), with males constituting 65.3%. The majority were in their fourth (37.9%) or fifth (32.8%) year of the MBBS, and over half were day scholars (55.9%). Nearly two-fifths belonged to high-income families (≥₹2,13,814/month; 43.1%). Most participants' parents had professional or honours-level education (52.4%) and were employed in professional or managerial occupations (74.6%). The majority of students identified as non-smokers (84.2%), while smaller proportions reported traditional cigarette use (8.7%), dual use (4.2%), transition from smoking to e-cigarettes (1.3%), or exclusive e-cigarette use (1.6%).

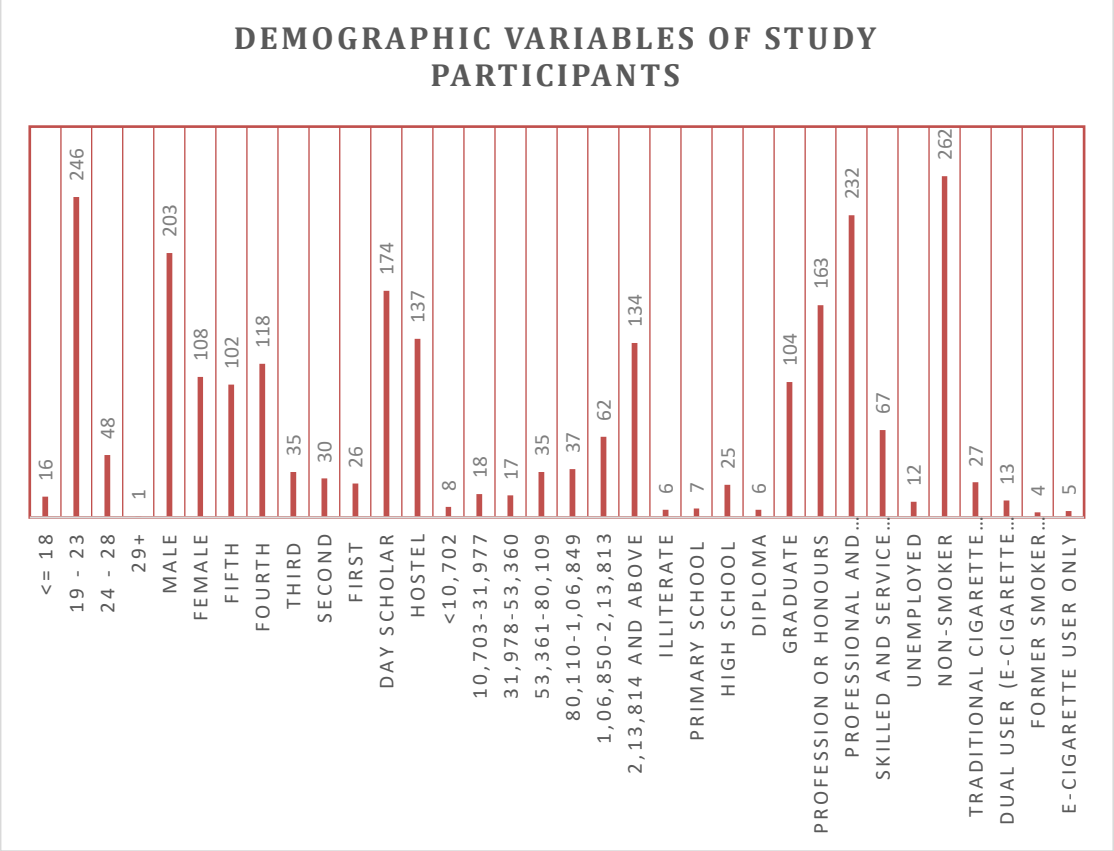

Table 1. Distribution of knowledge regarding e-cigarettes among study participants

Question	Response	Ever Users (n=73)	Never Users (n=238)	p- value
What kind of e-cigarettes do you know about?	Containing nicotine	47 (64.0%)	70 (29.0%)	0.430
	Nicotine free	13 (18.0%)	54 (23.0%)	0.522
	Containing tobacco	18 (25.0%)	43 (18.0%)	0.426
	Not aware	17 (23.0%)	137 (58.0%)	0.431
Which, according to you, is less harmful?	Traditional cigarette	46 (63.0%)	170 (71.4%)	0.627
	E-cigarette	27 (37.0%)	68 (28.6%)	0.729
Are you aware of the ill effects of nicotine on the human body?	Yes	67 (91.0%)	221 (92.9%)	0.745
	No	6 (8.0%)	17 (7.1%)	0.729
Are you aware that e-cigarettes are banned under Indian law?	Yes	45 (61.6%)	102 (42.9%)	0.205
	No	28 (38.4%)	136 (57.1%)	0.170
Were you aware of any taxation or excise duties applicable to e-cigarettes in India?	Yes	42 (57.5%)	115 (48.3%)	0.100
	No	31 (42.5%)	123 (51.7%)	0.160
Can E-cigarettes be used in smoke-free places?	Yes	20 (27.4%)	65 (27.3%)	0.954
	No	53 (72.6%)	173 (72.7%)	0.860
Do you think e-cigarettes are cost-effective compared to conventional cigarettes?	Yes	30 (41.1%)	72 (30.3%)	0.967
	No	43 (58.9%)	166 (69.7%)	0.958

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Question	Response	Ever Users (n=73)	Never Users (n=238)	p- value
Are you aware of nicotine replacement (alternatives) for the substitution of e-cigarettes?	Yes	49 (67.1%)	110 (46.2%)	0.392
	No	24 (32.9%)	128 (53.8%)	0.402
Are you aware that passive smoking from e-cigarettes causes any adverse effects on?	Yes	41 (56.2%)	136 (57.1%)	0.442
	No	32 (43.8%)	102 (42.9%)	0.402
Are e-cigarette emissions less offensive to bystanders than conventional cigarette smoke?	Yes	43 (58.9%)	93 (39.1%)	0.666
	No	30 (41.1%)	145 (60.9%)	0.673

Knowledge of e-cigarettes was moderate, with no statistically significant differences between ever-users and never-users across most domains ($P > 0.05$). Awareness of nicotine-related health risks was high among participants (>90%). However, knowledge gaps persisted regarding regulatory aspects, with awareness of the national ban and taxation policies remaining below two-thirds of participants. Ever-users showed higher awareness of nicotine-containing e-cigarettes and nicotine replacement alternatives compared to never-users, though these differences were associated with small effect sizes. Misperception of reduced harm of e-cigarettes compared to conventional cigarettes was reported by approximately one-third of participants, indicating persistent knowledge deficits despite medical training.

Table 2. Attitudes toward e-cigarette use among study participants

Question	Response	Ever Users (n=73)	Never Users (n=238)	P value
If I use e-cigarettes, I will gain superiority among my friends	Agree	18 (24.7%)	33 (13.9%)	0.308
	Disagree	55 (75.3%)	205 (86.1%)	0.305
Do you consider encouraging others as your responsibility to quit using e-cigarettes?	Agree	47 (64.4%)	181 (76.1%)	0.761
	Disagree	26 (35.6%)	57 (23.9%)	0.773
E-cigarettes should be banned in India	Agree	41 (56.2%)	201 (84.5%)	0.155
	Disagree	32 (43.8%)	37 (15.5%)	0.148
E-cigarettes give pleasure during their usage	Agree	28 (38.3%)	14 (5.9%)	0.021
	Disagree	18 (24.7%)	32 (13.4%)	0.021
	Not aware	27 (37.0%)	192 (80.7%)	0.507
E-cigarettes release stress after their usage	Agree	23 (31.5%)	17 (7.1%)	0.461
	Disagree	22 (30.1%)	38 (16.0%)	0.437
	Not aware	28 (38.4%)	183 (76.9%)	0.346
I want to quit E-cigarette use	Agree	48 (65.7%)	0 (0.0%)	0.724
	Disagree	25 (34.3%)	0 (0.0%)	0.718

Participants held mixed attitudes toward e-cigarette use. Most students rejected the belief that e-cigarette use confers social superiority, with 75.3% of ever-users and 86.1% of never-users disagreeing. A substantial proportion supported regulatory control, with 56.2% of ever-users and 84.5% of never-users favouring a nationwide ban. Ever-users were significantly more likely to perceive e-cigarettes as pleasurable compared

to never-users (38.3% vs. 5.9%, $P = 0.021$). Similarly, perceptions of stress relief were more common among ever-users. Despite these attitudes, a majority of ever-users (65.7%) expressed willingness to quit e-cigarette use, indicating conflicting behavioural perceptions.

Table 3. Practices regarding e-cigarette use among study participants

Questions	Responses	Ever Users (n=73)	Never Users (n=238)	p value
How often do you currently use e-cigarettes?	Occasionally	31 (43.0%)	0 (0.0%)	0.484
	Daily	10 (14.0%)	0 (0.0%)	0.5
	> twice a week	3 (4.0%)	0 (0.0%)	0.864
	Monthly	1 (1.0%)	0 (0.0%)	0.837
	Don't use	28 (38.0%)	238 (100.0%)	0.847
What volume of cartridge do you use in your e-cigarette mostly?	1 ml	7 (9.6%)	0 (0.0%)	0.957
	2 ml	12 (16.4%)	0 (0.0%)	0.987
	5 ml	9 (12.3%)	0 (0.0%)	0.964
	10 ml	4 (5.5%)	0 (0.0%)	0.879
	Don't use	41 (56.2%)	238 (100.0%)	0.919
What is the frequency of e-cigarette usage?	<2	15 (21.0%)	0 (0.0%)	0.035
	3-5	9 (12.0%)	0 (0.0%)	0.029
	Don’t use	49 (67.0%)	238 (100.0%)	0.963
How long have you been using e-cigarettes?	< 1 month	5 (6.8%)	0 (0.0%)	0.351
	1-6 months	8 (11.0%)	0 (0.00%)	0.405
	1-2 years	9 (12.0%)	0 (0.0%)	0.39
	More than 2 years	10 (14.0%)	0 (0.0%)	0.308
	Don’t use	41 (56.2%)	238 (100.0%)	0.406
When did you start smoking e-cigarettes?	Middle school	11 (15.0%)	0 (0.0%)	0.69
	High school	15 (21.0%)	0 (0.0%)	0.68
	Medical college	41(56.0%)	0 (0.0%)	0.682
	Internship	6 (8.0%)	0 (0.0%)	0.691
	Don’t use	0 (0.0%)	238 (100.0%)	0.685
What led you to start smoking e-cigarettes?	Friends	43 (58.9%)	0 (0.0%)	0.944
	Curiosity	24 (32.8%)	0 (0.0%)	0.948
	Social media	10 (13.7%)	0 (0.0%)	0.899
	Smoking cessation	6 (8.2%)	0 (0.0%)	0.95
	Stress	5(5.4%)	0 (0.0%)	0.987
	Don’t use	0 (0.0%)	238 (100.0%)	0.887
Have e-cigarettes caused any changes in breathing?	Yes	47 (64.4%)	0 (0.0%)	0.117
	No	26 (35.6%)	0 (0.0%)	0.078
	Don’t use	0 (0.0%)	238 (100.0%)	0.084
Have e-cigarettes caused dryness in the mouth?	Yes	45 (61.6%)	0 (0.0%)	0.907
	No	28 (38.4%)	0 (0.0%)	0.906
	Don’t use	0 (0.0%)	238 (100.0%)	0.908
Are you willing to quit smoking e-cigarettes?	Yes	49 (67.0%)	0 (0.0%)	0.631
	No	24 (33.0%)	0 (0.0%)	0.638
	Don’t use	0 (0.0%)	238 (100.0%)	0.487
	Yes	51 (70.0%)	0 (0.0%)	0.52

Questions	Responses	Ever Users (n=73)	Never Users (n=238)	p value
Have you ever tried to quit e-cigarettes?	No	22 (30.0%)	0 (0.0%)	0.497
	Don't use	0 (0.0%)	238 (100.0%)	0.791
Do you want to participate in any e-cigarette cessation program?	Yes	26 (36.0%)	0 (0.0%)	0.052
	No	47 (64.0%)	0 (0.0%)	0.056
	Don't use	0 (0.0%)	238 (100.0%)	0.049

Practice patterns showed that more than half of users reported occasional use, with initiation commonly occurring during medical college and largely influenced by peers. More than three-fourths rejected perceived social advantages, and a substantial proportion reported respiratory or oral discomfort. Although over two-thirds expressed willingness to quit and many had attempted cessation, participation in structured cessation programmes remained comparatively low, and overall associations between use status and practice patterns were weak.

Table 5: Association between composite knowledge, attitude, and practice scores and e-cigarette use status among study participants

Domain	**Use Status**	**Poor n (%)**	**Average n (%)**	**Good n (%)**	**Total**	**P value**
Knowledge	Ever users	2 (2.7%)	42 (57.5%)	29 (39.7%)	73	0.443
Knowledge	Never users	16 (6.7%)	132 (55.5%)	90 (37.8%)	238	
Attitude	Ever users	7 (9.6%)	34 (46.6%)	32 (43.8%)	73	0.185
Attitude	Never users	21 (8.8%)	139 (58.4%)	78 (32.8%)	238	
Practice	Ever users	17 (23.3%)	39 (53.4%)	17 (23.3%)	73	0.946
Practice	Never users	54 (22.7%)	124 (52.1%)	60 (25.2%)	238	

Values expressed as n (%). P values derived from the chi-square test. Associations between KAP domains and e-cigarette use status were not statistically significant.

Analysis of composite KAP scores demonstrated comparable distribution patterns between ever-users and never-users. More than half of the participants in both groups demonstrated average knowledge and practice levels, while approximately one-third showed good knowledge scores. Ever-users showed a slightly higher proportion of favourable attitude scores compared to never-users; however, this difference did not reach statistical significance. Chi-square analysis across knowledge, attitude, and practice domains showed no significant association with e-cigarette use status. Effect size estimates indicated negligible to small associations, suggesting that although minor differences were observed between groups, e-cigarette use was not strongly associated with the overall distribution of KAP scores in the study population.

Discussion

The present study assessed the knowledge, attitudes, and practices regarding e-cigarette use among undergraduate medical students in an Indian tertiary-care setting. The key findings were that approximately one-fourth of students reported ever using e-cigarettes; overall knowledge levels were average, with notable gaps in awareness of regulatory provisions; ever-users demonstrated relatively more permissive attitudes toward e-cigarettes; and cessation intent was common, although participation in structured cessation programmes was limited.

The prevalence of ever-use observed in our cohort is lower than that reported among medical students in Saudi Arabia[7], the United States[8], and the United Kingdom[9], where substantially higher usage rates have been documented. This difference may reflect India's stringent regulatory framework and nationwide ban on e-cigarettes. Similar to findings reported by Hinderaker et al [10] and Afzal et al [11], a considerable proportion of students in our study perceived e-cigarettes as less harmful than conventional cigarettes, despite acknowledging the adverse effects of nicotine. This highlights a persistent gap between general awareness of harm and nuanced understanding of emerging nicotine products.

Knowledge regarding the legal status of e-cigarettes in India was incomplete, with a substantial proportion of students unaware of the national ban. Comparable gaps in regulatory awareness among medical students have been reported in studies from the United States and the Middle East[12], suggesting that formal medical curricula may not adequately address newer tobacco and nicotine delivery systems. Year-wise differences in knowledge were statistically significant, with younger students achieving higher scores than senior cohorts. This trend likely reflects the influence of evolving public health discourse and recent curriculum updates that place greater emphasis on emerging health issues. Nevertheless, students exhibited limited awareness of electronic cigarette regulatory frameworks and taxation policies, a gap that mirrors observations reported in studies from the United States.[10] Importantly, overall knowledge scores did not differ significantly between ever-users and never-users, indicating that use was not necessarily associated with poorer awareness. These results were similar to those reported in previous studies.[13-14]

Attitudinal differences between ever-users and never-users followed expected patterns, with ever-users exhibiting more favourable perceptions toward e-cigarettes. However, a majority of students—across both groups—supported a ban on e-cigarettes and expressed a sense of responsibility toward tobacco cessation, consistent with findings from previous studies.[13-14] among health-professional students. These findings suggest alignment with public health principles despite some students' personal experimentation. Findings in the attitude domain indicated that a majority of students supported a ban on electronic cigarettes and expressed a willingness to quit, consistent with observations by Alhajj et al. [14]. This favorable attitude toward regulation likely reflects heightened concern about the potential health risks of EC use. Furthermore, most participants perceived ECs as less cost-effective than conventional cigarettes, a finding that contrasts with the report by Alshanberi et al. [15], who identified ECs as a cost-effective alternative. These differences may be attributable to variations in economic context, taxation policies, and accessibility across regions.

Practice-related findings showed that most ever-users reported occasional rather than regular use, and a majority expressed willingness to quit. However, interest in participating in formal cessation programmes was limited. Similar patterns have been observed in other studies [6,13] among medical and dental students, in which motivation to quit did not consistently translate into engagement with structured interventions.

Among sociodemographic factors, residence status emerged as a significant correlate, with day scholars demonstrating higher knowledge and practice scores than hostel residents. While the effect sizes were small, this finding aligns with prior studies [16-18] suggesting that environmental and supervisory contexts may influence health-related behaviours among students. Other variables, such as gender, income, and

academic year, showed no statistically significant associations, indicating relatively uniform KAP patterns across these subgroups, similar to previous studies.[17-18]

However, concerns over EC addiction highlight the need for vaping cessation support. Growing dependence on ECs mirrors patterns seen with tobacco addiction, necessitating interventions such as pharmacological treatments like cytisine and behavioural therapy, as revealed by the ORCA-V1 trial. These findings emphasise the urgency of vaping cessation strategies alongside established tobacco control efforts.[19,20] ECs are increasingly recognised as a potential nicotine replacement therapy (NRT), with clinical trials supporting their role in smoking cessation.[21] Moreover, research shows that nicotine-containing ECs, combined with behavioural support, resulted in higher quit rates than conventional NRT.[22-23]

The findings of this study have important public health implications. As future healthcare providers, medical students play a critical role in tobacco and nicotine cessation counselling. The presence of permissive attitudes and experimentation with e-cigarettes, despite awareness of nicotine-related harms and existing legal restrictions, underscores the need for structured education on emerging tobacco products within the medical curriculum. Strengthening undergraduate training on nicotine addiction, regulatory frameworks, and cessation strategies may enhance students' ability to model healthy behaviors and effectively counsel patients, thereby supporting broader tobacco control efforts in India.

Limitations:

The reliance on self-reported data introduces potential biases related to memory recall and social desirability. The study's focus on a single institution may limit generalisability, and online data collection could reduce participant engagement, potentially introducing selection bias. Because participation was voluntary and data were collected online, non-response bias cannot be excluded. Students with prior exposure to e-cigarettes, stronger attitudes toward vaping, or greater interest in tobacco-related topics may have been more likely to respond, potentially leading to selection bias. Conversely, students concerned about disclosure or those less engaged online may have been underrepresented. Therefore, the findings—particularly estimates of ever-use—should be interpreted cautiously and may not fully generalize to all MBBS students at the institution or to other medical colleges.

Conclusion:

The study demonstrates significant variation in knowledge and attitudes toward electronic cigarettes among medical students, with younger cohorts showing higher knowledge levels. While support for an electronic cigarette ban and willingness to quit were high, notable gaps persisted in understanding regulatory policies and taxation. These findings highlight the need for targeted educational interventions within the medical curriculum to address identified knowledge gaps and reinforce informed attitudes toward tobacco and electronic cigarette use.

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