ORIGINAL ARTICLE

Oral health knowledge and associated factors among office workers who use electronic cigarettes: a cross-sectional study

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ABSTRACT

Introduction: The prevalence of electronic cigarette use is increasing; however, public understanding of their ingredients and associated health risks remains inconsistent. Persistent misconceptions contribute to inaccurate perceptions of product safety, especially regarding oral health. This study aimed to analyze oral health knowledge and associated factors among office workers who use electronic cigarettes. **Methods**: An analytical cross-sectional study was conducted among 100 office workers who used electronic cigarettes at a state-owned enterprise in Jakarta, Indonesia, between September and October 2025. Participants were recruited using purposive sampling. Data were collected using a structured questionnaire assessing respondents' demographic characteristics and knowledge of electronic cigarette contents and their oral health effects. Data were analyzed using descriptive statistics, cross-tabulation, and the chi-square test. **Results:** Overall, 58% of respondents demonstrated good knowledge of oral health, whereas 42% had poor knowledge. High levels of awareness were observed regarding nicotine content (86%) and the addictive potential of electronic cigarettes (65%), while misconceptions persisted regarding carbon monoxide, tooth discoloration, and halitosis. Knowledge level was significantly associated with gender, with female respondents demonstrating higher knowledge than male respondents ($p=0.014$). No significant associations were observed between knowledge level and education level, smoking status, motivation for electronic cigarette use, or duration of use (all $p>0.05$). **Conclusion**: Although most electronic cigarette users demonstrated good overall oral health knowledge, important misconceptions remained regarding carbon monoxide production, tooth discoloration, and halitosis. These findings highlight the need for targeted oral health education focusing on specific misconceptions related to the oral health effects of electronic cigarettes.

KEYWORDS

Electronic cigarettes, oral health, health knowledge, cross-sectional studies

INTRODUCTION

Smoking remains a major public health problem in Indonesia and worldwide. According to the World Health Organization (WHO), approximately 1.2 billion people worldwide use tobacco products, with nearly 80% living in low- and middle-income countries. Indonesia continues to have one of the highest numbers of tobacco users globally and the largest tobacco-consuming population in Southeast Asia, making tobacco use a major public health concern.[1] According to the WHO Report on the Global Tobacco Epidemic 2025, the prevalence of current tobacco use among Indonesian adults aged ≥15 years was 30.8%, with current tobacco smoking accounting for 29.5%. Tobacco use was substantially higher among men (57.9%) than women (3.3%). In addition, electronic cigarette use has emerged as a growing public health concern, with 1.0% of Indonesian adults and 12.4% of adolescents aged 13–17 years reported as current users. These findings highlight

the continuing burden of tobacco consumption and the increasing popularity of electronic cigarettes in Indonesia, emphasizing the need for evidence-based public health interventions and oral health education.[2]

Indonesia also ranks third worldwide in the number of smokers, according to the Ministry of Health (Kemenkes RI).[3] Cigarettes contain substances that are harmful to human health.[4] Research shows that smoking increases the risk of stroke, cardiovascular disease, coronary heart disease, and lung cancer.[4–6] In the mouth, smoking harms oral hygiene, lowers salivary pH, and may cause periodontal disease.[7,8] Tobacco in cigarettes damages periodontal ligament cells, accelerates alveolar bone loss, and disrupts bone remodeling.[8] In recent years, tobacco use patterns have expanded to include Electronic Nicotine Delivery Systems (ENDS).[9]

The use of electronic cigarettes has increased substantially in Indonesia over the past decade. According to the Global Adult Tobacco Survey (GATS) Indonesia 2021, the prevalence of current electronic cigarette use increased tenfold, from 0.3% in 2011 to 3.0% in 2021, representing more than six million users. More recent data from the 2023 Indonesian Health Survey (SKI), reported in the WHO Report on the Global Tobacco Epidemic 2025, estimated that 1.0% of adults aged ≥15 years and 12.4% of adolescents aged 13–17 years were current electronic cigarette users, highlighting the growing popularity of these products, particularly among younger populations.[10]

Electronic cigarettes, or vapes, consist of a battery, heating element, e-liquid storage chamber, and mouthpiece.[11,12] These devices heat e-liquid, a mixture of glycerol, propylene glycol, nicotine, and flavorings, into an aerosol for inhalation without tobacco combustion.[12,13] The aerosol generated by e-cigarettes contains water particles derived from the heated e-liquid and other chemical constituents that dissipate more rapidly at room temperature than conventional cigarette smoke, as the particles in conventional cigarette smoke are more stable and persist in the air for longer periods.[14] Electronic cigarettes are often promoted as alternatives to conventional cigarettes. Media and the internet promote them as safer and less harmful than tobacco cigarettes, and as tools for quitting smoking.[12,15,16]

The use of electronic cigarettes has increased rapidly, particularly among adolescents and young adults. According to the WHO Report on the Global Tobacco Epidemic 2025, 12.4% of Indonesian adolescents aged 13–17 years were current electronic cigarette users, while the prevalence among adults aged ≥15 years was 1.0%. As these younger users transition into adulthood and the workforce, electronic cigarette use is increasingly observed among working-age adults. Young adults are often attracted to electronic cigarettes because of their wide variety of flavors, perceived lower health risks than conventional cigarettes, and the belief that they may facilitate smoking cessation. These factors make office workers an important population for assessing knowledge regarding the oral health effects of electronic cigarette use.[15,17] Young individuals may be attracted to electronic cigarettes because of their wide variety of flavors and the opportunity to try new products, and they may continue to use these products despite their higher cost compared with conventional cigarettes.[15,17,18]

Common reasons for use include the belief that they are safer than regular cigarettes and help with quitting. Other motivations are better taste, trendiness, and curiosity. The health effects and their value for quitting smoking remain uncertain.[19–21] Recent studies show that electronic cigarettes have adverse effects on the respiratory tract. Propylene glycol and glycerol may irritate the airways, and electronic cigarette use has been associated with asthma.[22] Nicotine intake from electronic cigarettes is similar to that of traditional cigarettes.[23] Electronic cigarette use has been associated with alterations in the oral environment through several biological mechanisms. Exposure to aerosol constituents, including nicotine, propylene glycol, vegetable glycerin, and flavoring chemicals, can reduce salivary flow, induce oxidative stress, and stimulate the release of pro-

inflammatory cytokines. These changes disrupt the balance of the oral microbiome, promoting dysbiosis characterized by increased pathogenic bacterial and fungal colonization while impairing local immune responses.[16,25]

Consequently, electronic cigarette users may experience an increased risk of periodontal inflammation, periodontal disease, and other oral mucosal conditions. Despite growing evidence regarding these adverse oral effects, public knowledge of the potential oral health consequences of electronic cigarette use remains limited. Therefore, assessing oral health knowledge among electronic cigarette users, particularly office workers, is important to support targeted oral health education and preventive interventions.[24] Given the ongoing debate regarding the use of electronic cigarettes as smoking cessation aids, with recommendations varying because of limited safety and efficacy data, assessing oral health knowledge among electronic cigarette users may provide additional insight into their understanding of the potential oral health effects of these products.[16,25]

Indonesia continues to face a substantial burden of tobacco and electronic cigarette use. According to the 2023 Indonesian Health Survey, 30.8% of adults aged ≥15 years currently use tobacco, while the prevalence of tobacco use was 57.9% among men. In addition, electronic cigarette use has increased markedly over the past decade. The 2021 Global Adult Tobacco Survey (GATS) reported a tenfold increase in e-cigarette use among Indonesian adults, from 0.3% in 2011 to 3.0% in 2021. The increase is particularly evident among younger populations, with 7.5% of individuals aged 15–24 years using e-cigarettes in 2021, while the 2023 Global School-based Student Health Survey found that 12.4% of adolescents aged 13–17 years were current e-cigarette users. These trends underscore the continuing need to assess oral health knowledge and its associated factors among Indonesian adults who use electronic cigarettes.

Despite this growing trend, awareness of the adverse oral health effects of electronic cigarettes remains limited, and evidence regarding users' oral health knowledge in Indonesia is scarce. As young adults increasingly enter the workforce, office workers represent an important population for evaluating oral health knowledge because they constitute a productive age group with increasing exposure to electronic cigarette use. Understanding their level of knowledge may help inform targeted oral health promotion strategies and preventive public health interventions in Indonesia.[1,10]

The Food and Drug Administration (FDA) has not approved electronic cigarettes as smoking cessation products, and leading respiratory organizations have advised against their use.[15] Previous studies have investigated electronic cigarettes from various perspectives, including users' perceptions, health risks, attitudes, smoking behaviors, and the effects of electronic cigarettes on oral health.[26,27] These studies have shown that many users perceive electronic cigarettes as safer than conventional cigarettes despite accumulating evidence of their adverse oral and systemic health effects.[28,29] However, limited research has specifically examined oral health knowledge among adult electronic cigarette users, particularly in occupational settings.

In Indonesia, evidence on oral health knowledge among electronic cigarette users remains scarce despite the increasing prevalence of electronic cigarette use. Adult office workers represent an important target population because they are part of the productive workforce, are increasingly exposed to electronic cigarette use, and may influence health-related behaviors within their families and workplaces.[30-32] Understanding their level of oral health knowledge is essential for identifying misconceptions, developing targeted oral health education, and supporting workplace-based health promotion strategies. Furthermore, examining the association between users' characteristics and oral health knowledge may help identify population subgroups requiring more focused educational interventions.

By focusing on an understudied population in Indonesia, this study provides evidence to support targeted oral health promotion and preventive public health strategies. The novelty of this research lies in its focus on assessing oral health

knowledge among office workers who use electronic cigarettes and examining its association with user characteristics.

This approach provides additional insight into knowledge gaps related to oral health risks in a specific population that is frequently exposed to lifestyle-related health behaviors. Therefore, this study aimed to analyze oral health knowledge and its associated factors among office workers who use electronic cigarettes.

METHODS

This study employed an analytical cross-sectional design to assess the level of oral health knowledge among electronic cigarette users and to examine its association with respondent characteristics. The study was conducted from September to October 2025 at a state-owned enterprise office in Jakarta, Indonesia.

This setting was selected because it provided access to a stable population of adult office workers within the productive age group, among whom electronic cigarette use has become increasingly common. In addition, the workplace offered a well-defined organizational structure that facilitated participant recruitment and standardized data collection procedures. Therefore, this setting was considered appropriate for investigating oral health knowledge among adult electronic cigarette users and examining the association between users' characteristics and their level of oral health knowledge.

Eligibility was confirmed using a screening section at the beginning of the online questionnaire, which verified participants' age (25–54 years), current electronic cigarette use, employment status, and willingness to participate. This study focused on adults aged 25–54 years because this age group represents the core productive workforce and constitutes a substantial proportion of office employees in Indonesia. Individuals in this age range may experience occupational stress, workplace social interactions, and lifestyle factors that may influence electronic cigarette use.

Moreover, maintaining oral health is essential at this stage of life for long-term well-being, work productivity, and quality of life. Although previous studies have predominantly examined adolescents, university students, or the general population, evidence regarding oral health knowledge among working-age adult electronic cigarette users remains limited, particularly in Indonesia.

Individuals who did not meet the inclusion criteria or declined to provide informed consent were excluded from the study. Although purposive sampling may introduce selection bias and limit the generalizability of the findings, standardized eligibility criteria and a uniform recruitment process were applied to minimize potential bias and ensure that all participants represented the target population. Participants were recruited during the study period using purposive sampling until the predetermined target of 100 eligible respondents was achieved.

The minimum required sample size was calculated using a formula for comparing two independent proportions, as the primary objective was to examine the association between respondents' characteristics and oral health knowledge using the chi-square test. Assuming a 95% confidence level, 80% statistical power, and the expected proportions derived from previous studies, the minimum required sample size was 96 participants.

Data were collected using a structured closed-ended questionnaire developed to measure respondents' knowledge regarding electronic cigarette contents and their effects on oral and dental health. The questionnaire consisted of sections covering demographic characteristics (age, gender, and education level), smoking status, which was categorized into three groups: (1) exclusive electronic cigarette users, defined as participants who currently used only electronic cigarettes; (2) dual users, defined as participants who concurrently used both electronic and conventional cigarettes; and (3) former conventional cigarette smokers, defined as participants who had previously smoked conventional cigarettes but had

switched exclusively to electronic cigarettes at the time of the study. The questionnaire also included knowledge-related questions about the composition and potential oral health effects of electronic cigarettes.

The questionnaire used in this study was adopted from a previously published instrument designed to assess knowledge regarding electronic cigarettes and their health effects.[26] In the original study, the instrument underwent validity and reliability testing, and all items were found to be valid. Reliability assessment demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.82. According to the commonly accepted criterion, a Cronbach's alpha value of ≥0.70 indicates acceptable internal consistency, whereas values ≥0.80 indicate good reliability.

Therefore, the questionnaire demonstrated good reliability for assessing oral health knowledge. Because the questionnaire was adopted from a previously validated instrument and used without modification, additional validity and reliability testing in the present study was not performed. Data collection was conducted online using a digital form distributed to eligible participants. Participation was voluntary and respondents provided informed consent before completing the questionnaire.

The knowledge section consisted of 10 items. Each correct response was scored as 1 and each incorrect response as 0, yielding a total score ranging from 0 to 10. The knowledge questionnaire included both positively and negatively worded statements to assess respondents' understanding of common misconceptions regarding electronic cigarettes and their effects on oral health. Negatively worded items, including "Electronic cigarettes produce carbon monoxide smoke" and "Electronic cigarettes do not affect periodontal disease," were included to assess their ability to recognize scientifically inaccurate statements. For these items, the correct response was "False" and was assigned a score of 1, whereas incorrect responses were assigned a score of 0. This scoring approach was applied consistently to all negatively worded items.

Knowledge scores were converted into percentages, and respondents scoring more than 50% (>5 correct responses) were classified as having good knowledge, whereas those scoring 50% or less (≤5 correct responses) were classified as having poor knowledge. A 50% cut-off was adopted to provide a simple dichotomous classification distinguishing respondents with predominantly correct knowledge from those with predominantly incorrect knowledge, thereby facilitating the planned bivariate analysis.

Knowledge scores were converted into percentages. Because no universally accepted or previously validated cut-off point for categorizing knowledge levels using this questionnaire was available in the literature, a 50% threshold was applied to classify respondents into two groups. Participants scoring more than 50% were classified as having good knowledge, whereas those scoring 50% or less were classified as having poor knowledge. This dichotomization was performed to facilitate the planned bivariate analysis using the chi-square test.

Data analysis was performed using descriptive and inferential statistical methods. Descriptive statistics were used to summarize respondent characteristics and the distribution of knowledge levels. Crosstabulation analysis was conducted to examine the distribution of knowledge levels according to independent variables, including gender, education level, electronic cigarette use status, reasons for use, and duration of use. The Chi-square test was used to assess the association between independent variables and knowledge level. Statistical significance was determined at $p<0.05$. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

RESULTS

The study included 100 respondents who used electronic cigarettes. Data analysis focused on describing respondent characteristics, assessing knowledge levels, and examining associations between variables.

Table 1. Demographic characteristics and smoking-related profile of electronic cigarette users (n=100)

	n	%
Gender		
Male	61	61
Female	39	39
Education		
High School	34	34
Diploma	13	13
Bachelor's or higher	53	53
Electronic cigarette use status		
Dual user (electronic and conventional cigarettes_	37	37
Exclusive electronic cigarette user	33	33
Former conventional cigarette smoker	30	30
Motivation for using electronic cigarettes		
Flavor variety	62	62
Smoking cessation	25	25
Lifestyle	13	13
Duration of electronic cigarette use		
Less than one year	53	53
1-3 years	32	32
More than 3 years	15	15

Males comprised 61% of the sample, while females represented 39%. Regarding education level, respondents were grouped into three categories: high school (34.0%), diploma (13.0%), and bachelor's degree or higher (53.0%). Regarding smoking status, 37% of respondents were dual users of electronic and conventional cigarettes, 33% were exclusive electronic cigarette users, and 30% were former conventional cigarette smokers who had switched to electronic cigarettes. The primary motivation for electronic cigarette use was flavor variety (62%), followed by smoking cessation (25%) and lifestyle factors (13%). Most respondents had used electronic cigarettes for less than one year (53%), while 32% reported use for 1–3 years and 15% for more than three years (Table 1).

Table 2. Respondent answers regarding knowledge of electronic cigarettes and their effects on oral and dental health.

Statement	Correct Answer	Incorrect Answer
Electronic cigarettes contain nicotine	86%	14%
Electronic cigarettes are tobacco products	74%	26%
Electronic cigarettes do not affect periodontal disease	66%	34%
Electronic cigarettes cause addiction	65%	35%
Electronic cigarettes increase saliva production	59%	41%
Electronic cigarettes can cause changes in taste perception	59%	41%
Electronic cigarettes may contain higher levels of carcinogenic substances than conventional cigarettes, increasing cancer risk	52%	48%
Electronic cigarettes produce carbon monoxide smoke	49%	51%
Electronic cigarettes cause tooth discoloration	37%	63%
Electronic cigarettes containing flavoring additives may prevent halitosis (bad breath)	33%	67%

Table 2 shows that respondents demonstrated the highest level of knowledge regarding the nicotine content of electronic cigarettes (86%), followed by knowledge that electronic cigarettes are tobacco products (74%). In contrast, the lowest proportions of correct responses were observed for statements regarding flavoring additives preventing halitosis (33%) and electronic cigarettes causing tooth discoloration (37%). These findings indicate that respondents were generally knowledgeable about the basic characteristics of electronic cigarettes but had limited knowledge regarding their specific effects on oral health. Table 3 presents the distribution of oral health knowledge among electronic cigarette users.

Table 3. Distribution of knowledge regarding electronic cigarettes and oral and dental health.

Knowledge Score Category	n	%
Good	58	58
Poor	42	42
Total	100	100

Overall, the majority of respondents demonstrated a good level of knowledge (58%; 58 respondents), while 42% (42 respondents) demonstrated a poor level of knowledge. Crosstabulation analysis was conducted to examine the distribution of knowledge levels according to respondent characteristics.

The chi-square test was used to evaluate the association between respondent characteristics and knowledge level. Table 4 indicates that only gender was statistically significantly associated with knowledge level ($p < 0.05$), with female respondents exhibiting a higher level of knowledge than male respondents. Education level, electronic cigarette use characteristics, reasons for use, and duration of use were not significantly associated with knowledge level ($p > 0.05$).

Table 4. Chi-square test results for the association between independent variables and knowledge level.

Variable	Category	Poor knowledge n(%)	Good knowledge n(%)	Total	p-value
Gender	Male	32(52.5)	29(47.5)	61	0.014*
	Female	10(25.6)	29(74.4)	39	
Education level	High school	16(47.1)	18(52.9)	34	0.381
	Diploma	7(53.8)	6(46.2)	12	
	Bachelor's degree or higher	19(35.8)	34(64.2)	53	
Smoking status	Former conventional cigarette smoker	12(40)	18(60)	30	0.545
	Exclusive electronic cigarette user	13(39.4)	20(60.6)	33	
	Dual user	17(45.9)	20(54.1)	37	
Reason for using e-cigarettes	Flavor variety	28(45.2)	34(54.8)	62	0.846
	Smoking cessation	10(40)	15(60)	25	
	Lifestyle	4(30.8)	9(69.2)	13	
Duration of e-cigarette use	<1 year	21(39.6)	32(60.4)	53	0.260
	1-3 years	14(43.8)	18(56.2)	32	
	>3 years	7(46.7)	8(53.3)	15	

*Significance criteria: $p \leq 0.05$

DISCUSSION

The demographic distribution reveals a distinct male predominance at 61% (n=61), a trend consistent with global and regional epidemiological data on alternative tobacco product use (Table 1) This disparity aligns with recent cross-sectional findings by Syawqie A et al. which identified urban males with high social mobility as the primary demographic for vaping.[33] Sociodemographic analysis by Kierstead et al. further attributes this gap to peer-group dynamics and gendered social acceptability surrounding novel nicotine delivery devices.[34]

Regarding educational attainment, the findings indicate that 53% of respondents held a bachelor's degree or higher, suggesting that e-cigarette adoption is concentrated among highly educated populations. These results correspond with Turan Ayşe et al.'s data, which established a positive correlation between advanced formal education and the early adoption of technological innovations in consumer tobacco alternatives.[35]

A significant clinical concern arises from the behavioral distribution shown in Table 1, where dual users represent the largest segment (37%), followed by exclusive e-cigarette users (33%) and former conventional smokers (30%). According to a large-scale population study of Kasza K et al., dual-use typology often indicates a prolonged, incomplete transition between conventional and

electronic cigarette use rather than complete smoking cessation, thereby exposing individuals to concurrent, heterogeneous toxicological hazards.[36]

Furthermore, Table 1 shows that 53% of the sample reported a duration of electronic cigarette use of less than one year, indicating a substantial influx of recent adopters. This rapid uptake resonates with findings from Joanne T Chang et al.'s study, which linked short-term spikes in e-cigarette initiation to targeted digital marketing frameworks that capture new consumer demographics within an abbreviated timeframe.[37]

Flavor variety was the primary reported motivation for e-cigarette use (62%), substantially exceeding therapeutic motivations such as smoking cessation (25%) and lifestyle factors (13%) (Table 1). This finding suggests that sensory and palatability characteristics are important factors influencing product use. This behavioral mechanism is supported by a contemporary multi-cohort study by Farsalinos K et al. which identified non-tobacco flavor formulations as an important predictor for product initiation among young adults.[38] Similarly, an analysis by Farsalinos K et al. indicate that over 80% of current users prioritize flavor profiles during device selection.[39] Consequently, the low prevalence of cessation motivation (25%) in Table 1 supports arguments raised by the CDC Foundation (2026) that modern electronic nicotine delivery systems may function predominantly as commercial vehicles that promote new or continued nicotine dependence through customized palatability, rather than functioning primarily as effective clinical cessation aids.[40]

Respondents demonstrated relatively good knowledge regarding nicotine content (86%) and the addictive potential of electronic cigarettes (65%), indicating that these health messages have become widely recognized (Table 2). This finding is comparable to that of Al-Hamdani et al., who reported that 83.5% of participants correctly identified that electronic cigarettes contain nicotine, while 68.9% recognized their addictive potential.[41] However, misconceptions regarding carbon monoxide production, periodontal disease, tooth discoloration, and halitosis remained common in the present study. Similarly, Beard C. et al. reported that 97.9% of health sciences students recognized that electronic cigarettes affect general health and 91.2% acknowledged their addictive potential.

Despite this high awareness, only 58.5% correctly associated electronic cigarette use with periodontal disease and 51.3% with dental caries, indicating that knowledge of general health risks does not necessarily translate into adequate understanding of oral health consequences.[42] This pattern is consistent with the findings of the present study. Misconceptions regarding carbon monoxide production, periodontal disease, tooth discoloration, and halitosis were also evident in the present study. The negatively worded questionnaire items revealed that many respondents were unable to distinguish common misconceptions from scientifically established evidence. Electronic cigarettes generate aerosol rather than smoke and do not produce carbon monoxide through tobacco combustion in the same manner as conventional cigarettes.

However, growing evidence indicates that electronic cigarette use may adversely affect periodontal tissues through inflammatory and immunological mechanisms. Likewise, exposure to electronic cigarette aerosols has been associated with alterations in the oral microbiome and other adverse oral health effects.[43-46] These findings suggest that misperceptions shaped by commercial advertising and social media, together with the widespread perception that electronic cigarettes are harmless, continue to influence users' understanding of their health effects. Marketing messages frequently portray electronic cigarettes as safer alternatives to conventional cigarettes, effective smoking cessation aids, or products with minimal health risks because they do not involve tobacco combustion.

Similarly, social media platforms often promote flavored electronic cigarettes and user-generated content that emphasizes lifestyle appeal while underrepresenting potential health consequences. Repeated exposure to these

messages may reinforce the perception that electronic cigarettes are relatively harmless, thereby reducing users' awareness of their adverse effects on oral health. Previous studies have shown that exposure to electronic cigarette advertising and social media content is associated with more favorable perceptions of electronic cigarettes, lower perceived health risks, and greater intention to use these products, particularly among young adults and current users.[1,10]

Overall, 58% of respondents demonstrated good oral health knowledge; however, several important misconceptions persisted (Table 3). The lowest proportions of correct responses were observed for the belief that flavoring additives in electronic cigarettes can prevent halitosis (33%) and recognizing that electronic cigarettes may cause tooth discoloration (37%). In addition, nearly half of the respondents were unaware of the potential carcinogenic constituents and carbon monoxide production associated with electronic cigarette use. Similar findings have been reported by Martell et al., who found that young adult electronic cigarette users showed low knowledge scores (mean 2.9 ± 1.7) and limited familiarity with the oral health effects of vaping (mean 2.7 ± 1.7), despite expressing interest in receiving oral health information from dental professionals.[26] Likewise, a recent study among health sciences students found that although 97.9% recognized that electronic cigarettes affect general health and 91.2% knew they are addictive, only 58.5% correctly associated vaping with gum disease, 51.3% linked it to dental caries, and 44% reported being unfamiliar with scientific evidence regarding its oral health effects.[16] These findings are consistent with the present study, indicating that awareness of general health risks does not necessarily translate into adequate knowledge of the specific oral consequences of electronic cigarette use.

These findings suggest that respondents were generally familiar with the basic characteristics of electronic cigarettes, such as their nicotine content and addictive potential, but had limited knowledge regarding their specific oral health effects.

This pattern may reflect the widespread marketing of electronic cigarettes as safer alternatives to conventional cigarettes, the influence of social media and commercial advertising, and the limited availability of evidence-based oral health education specifically addressing electronic cigarette use. These findings suggest that while general awareness of electronic cigarettes is increasing, gaps remain in knowledge of their specific oral health consequences. Similar findings were reported by Abo-Elkheir OI and Sobh E, who found that public knowledge regarding electronic cigarettes and perceptions of their safety were influenced by the information available about these products, with electronic cigarettes often perceived as safer alternatives to conventional cigarettes.[15]

The crosstabulation and inferential analysis presented in Table 4 showed that gender was the only variable significantly associated with knowledge level. Female respondents demonstrated higher levels of knowledge than male respondents. This finding is consistent with several public health studies indicating that women often exhibit higher health awareness and are more likely to seek health-related information. Women may also show greater concern regarding preventive health behaviors, which could contribute to their higher knowledge scores in this study.[47]

No significant associations were observed between knowledge level and education level, smoking status, motivation for electronic cigarette use, or duration of electronic cigarette use (Table 4). This finding is consistent with previous studies. For example, Al-Hamdani et al. reported no significant association between knowledge of electronic cigarettes and respondents' educational level or smoking status ($p > 0.05$), suggesting that information about electronic cigarettes is widely accessible through mass media and social media regardless of educational background.[41] Similarly, Kendrich and Sinaga evaluated smoking knowledge and behaviors among college students. The researchers found that higher educational attainment does not translate into comprehensive awareness of tobacco health hazards uniformly.

Their findings indicated that many highly educated students still held misconceptions or underestimate the mortality rates associated with smoking-related diseases. This suggests that the accumulation of formal years of education is not a strong predictor of comprehensive knowledge regarding smoking hazards unless accompanied by a specific intervention curriculum.[48] Although respondents with higher educational attainment and those who had used electronic cigarettes for less than one year tended to demonstrate better knowledge descriptively, these differences were not statistically significant. This finding may reflect the Indonesian context, where information about electronic cigarettes is widely disseminated through social media, online platforms, and commercial marketing rather than formal educational channels. Consequently, individuals with different educational backgrounds or smoking histories may have similar levels of knowledge, which could contribute to the absence of significant differences across these characteristics.

Similar findings have been reported in previous studies, suggesting that knowledge regarding electronic cigarettes is influenced not only by formal education or user experience but also by exposure to media information, peer influence, and evolving public health messages.[49-51] These findings highlight the need for targeted oral health education to address persistent misconceptions regarding electronic cigarettes, particularly their effects on carbon monoxide production, periodontal disease, tooth discoloration, and halitosis. Evidence-based educational interventions should be integrated into tobacco control and oral health promotion programs through collaboration among the Ministry of Health, dental professionals, workplaces, and educational institutions. In addition, accurate information should be disseminated through digital and social media platforms to counter misinformation and improve public awareness of the oral health risks associated with electronic cigarette use.[52-54]

This study has several limitations. First, the cross-sectional design limits the ability to establish temporal or causal relationships between respondents' characteristics and oral health knowledge. Second, the use of self-reported data may have introduced recall and social desirability bias. The study was conducted among office workers in a single state-owned enterprise in Jakarta, which may limit the generalizability of the findings to other occupational groups or regions in Indonesia. Third, the use of purposive sampling and recruitment from a single workplace may have limited the representativeness of the study population, thereby reducing the external validity and generalizability of the findings. Fourth, although the questionnaire was adopted from a previously validated instrument and used without modification, it was not subjected to additional validity and reliability testing in the present study population; therefore, measurement bias cannot be entirely excluded.

Finally, only bivariate analyses were performed. Consequently, the magnitude of associations was not estimated using odds ratios or assessed after adjustment for potential confounding variables. Future studies with larger sample sizes are recommended to perform multivariable logistic regression to quantify the strength of these associations.

These findings have important implications for oral health promotion and public health practice. Educational interventions should specifically target adult electronic cigarette users, particularly office workers, as well as adolescents and young adults who are at increased risk of initiating or regularly using electronic cigarettes. These groups are important because they represent the productive workforce and future adult population, and misconceptions established at an early stage may influence long-term oral health behaviors. Evidence-based educational programs delivered through smoking cessation services, workplace health promotion initiatives, dental healthcare providers, and digital media campaigns may improve oral health literacy, correct misinformation, and support informed decision-making regarding electronic cigarette use.

CONCLUSION

Most respondents demonstrated a generally good level of knowledge regarding electronic cigarettes, although important misconceptions persisted regarding several oral health effects, including carbon monoxide production, tooth discoloration, and halitosis. Among the examined variables, gender was the only characteristic associated with knowledge level, while education level, electronic cigarette use status, motivation for use, and duration of use were not associated with knowledge level.

These findings have implications for oral health promotion and tobacco control. Public health education should not only target current electronic cigarette users but also adolescents, young adults, and other individuals who have not yet initiated electronic cigarette use. Early, evidence-based educational interventions are needed to improve awareness of the potential oral health risks associated with electronic cigarettes, correct common misconceptions, and discourage initiation. For current users, oral health promotion should be integrated into smoking cessation services, workplace health programs, and routine dental care to support informed decision-making and healthier behaviors.

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