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Knowledge, Attitudes and Practices of Vape Use among Secondary School Students: Bridging Awareness and Behaviour

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ABSTRACT

This study aims to investigate the knowledge, attitudes and practices (KAP) related to vaping among secondary school students in the Kuantan district, Pahang, Malaysia, considering the continued rise in usage and its health implications, despite widespread knowledge of the risks. A cross-sectional study was conducted from April to June 2024 in eight selected public secondary schools. A total of 431 students aged 13 to 17 completed a validated KAP questionnaire. Data were analysed using descriptive statistics, independent t-tests and Pearson correlation analysis in SPSS Version 21.0. 17.4% respondents reported being current vapers and 65.2% had family members who smoked. Vapers exhibited significantly higher knowledge scores compared to non-vapers, despite holding more positive attitudes towards vaping. The Pearson correlation showed a moderate positive relationship between knowledge and attitude, suggesting that higher knowledge does not equate to more negative attitudes. Despite high knowledge of vaping risks, positive attitudes toward vaping persist among vapers. This suggests that knowledge alone is insufficient to change behaviour.

1. Introduction

The rising prevalence of vaping among adolescents has become a global public health concern. Vaping, often perceived as a safer alternative to traditional cigarette smoking, has gained widespread popularity due to its variety of appealing flavours, sleek designs and the misconception that it poses fewer health risks [1]. However, emerging evidence shows that vaping is far from harmless, particularly for young users [2]. Studies have linked vaping to a range of adverse health outcomes, including respiratory damage [3,4], nicotine addiction [5,6] and potential long-term effects on

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cardiovascular and neurological health [7-11]. Despite these known risks, the adolescent vaping epidemic continues to expand, raising concerns about the effectiveness of public health messages in addressing this issue.

In Malaysia, vaping has followed a similar upward trajectory, with the vape products becoming increasingly accessible, particularly among adolescents [12]. Data from the School of Medical and Life Sciences at Sunway University indicate that many vape products sold locally contain high concentrations of nicotine, more than 1300 mg per tube of vape liquid [13], exceeding safe limits (20 mg/mL) and posing serious risks, especially for adolescents [14]. Furthermore, the use of psychoactive substances such as magic mushrooms and synthetic drugs in some vape liquids has escalated the dangers associated with vaping in Malaysia, potentially leading to addiction, mental health issues and other long-term consequences [15,16]. A study by Boccio *et al.,* [17] revealed that both nicotine vaping and dual-mode use (vaping and traditional smoking) are significantly associated with the use of a variety of illicit substances. Similarly, Grant *et al.,* [18] found that vape use among university students is significantly associated with other substance used such as alcohol and opiates and mental health issues like attention-deficit/hyperactivity disorder, posttraumatic stress disorder, gambling disorder and anxiety.

In response to these concerns, the Ministry of Health Malaysia, along with several non-governmental organizations, has advocated for stricter regulations on vape products [19]. However, enforcement remains inconsistent and vape products continue to be readily available. The combination of lenient regulation, peer pressure and the normalization of vaping within youth culture has created an environment where adolescent vaping thrives. This situation underscores the need for targeted interventions aimed at reshaping young people's attitudes toward vaping and addressing the underlying social dynamics that perpetuate this behaviour.

While knowledge of vaping's risks has increased in recent years, many adolescents remain unaware of or indifferent to the long-term health risks. The disconnect between knowledge and behaviour, where adolescents may be well-informed about the risks but continue to vape, suggests that factors beyond mere awareness are at play. Attitudes, social norms and perceived benefits (e.g., stress relief, social inclusion) likely play pivotal roles in sustaining vaping behaviour, despite high levels of awareness about the health risks involved. Most existing studies regarding smoking habits of vape or e-cigarettes in Malaysia largely focus on adults and college students [20-24], while research on adolescents and secondary school students remain limited and geographically restricted, with only a few studies conducted in selected regions [25-27]. Furthermore, many prior studies mainly report prevalence or general awareness and provide limited insight into the interrelationships between knowledge, attitudes, and practices (KAP) that shape adolescent vaping behaviour. This study addresses these gaps by assessing the knowledge, attitudes, and practices related to vaping among secondary school students in Kuantan district, Pahang, Malaysia. By examining the relationship between these factors, the study seeks to provide insights into why adolescents continue to vape, even when they are knowledgeable about its risks. Additionally, this study aims to identify key misconceptions and attitudinal barriers that may hinder effective behaviour change. Understanding these dynamics is critical for designing interventions that not only improve knowledge but also address the attitudinal and social influences that shape adolescent vaping behaviour.

2. Methodology

2.1 Study Design, Setting and Participants

This study employed a cross-sectional design to assess the knowledge, attitudes and practices (KAP) related to vaping among secondary school students. Data collection was conducted from April

to June 2024 in selected public secondary schools within the Kuantan district, Pahang, Malaysia. According to data provided by the Pahang State Education Department, there are 40 urban and 7 rural secondary schools in the district. From these, 8 schools (7 urban and 1 rural) were selected through stratified random sampling, to ensure representation from both urban and rural areas. Participants included secondary school students aged 13 to 17 years (Form 1 to Form 5).

An uncontrolled quota sampling method was employed, selecting a convenience sample based on quotas for the urban and rural categories. The final sample size consisted of 431 students, which was determined using the OpenEpi platform to meet the minimum requirement of 383 respondents (with a 5% nonresponse rate). The sample size was increased to 431 to enhance representative and account for potential incomplete responses. The combination utilization of stratified random sampling at the school level and quota-based convenience sampling at the student level was chosen to ensure representation of both urban and rural schools while accommodating logistical constraints in the school setting. This approach is commonly used in school-based cross-sectional surveys and was deemed appropriate for the study objectives. Although the use of convenience sampling may introduce selection bias, this was mitigated by including schools from both urban and rural settings and by recruiting participants across multiple age groups and school types. This approach is consistent with methods adopted in similar cross-sectional studies involving adolescent populations. The study obtained ethical approval from the International Islamic University Malaysia (IIUM) Research Ethics Committee (IREC) (Approval number: IREC 2024-188). Participation was voluntary and parental consent was obtained for students under 18. All participants were informed of the study's objectives, assured of anonymity and guaranteed confidentiality of their responses.

2.2 Study Instruments

A structured and validated questionnaire, written in Bahasa Malaysia, was used for data collection. The questionnaire comprised four sections:

- Section I: Sociodemographic characteristics (7 questions) covering students' age, gender, race, familial smoking status and known vapers within the student's social circle.
- Section II: Knowledge section consisting of 16 True/False questions covering health risks, harmful substances and potential for misuse with 7 reverse coded questions to ensure consistency in response patterns.
- Section III: Attitude section assessed with 16 items using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). It addresses perceptions of safety, regulation and social acceptability, with reverse coding applied to all but three items.
- Section IV: Practice section with 18 questions to gauge students' behaviour related to vape use, including frequency and context (e.g., at school). Reverse coding was used for 6 questions to ensure accuracy in interpreting negative behaviours.

The questionnaire sources were adapted from validated instruments used in previous studies by Doumi *et al.,* [28], Mat Salleh *et al.,* [29] and Wee *et al.,* [30]. It underwent face and content validity checks through consultation with four subject matter experts and their feedback was incorporated into the final version before obtaining ethic approval and conducting pilot testing.

Knowledge scores were calculated as the mean proportion of correct responses across 16 items, coded as 1 for correct and 0 for incorrect answers, with higher scores indicating greater knowledge of vaping-related risks. Attitude scores were derived by averaging responses across 16 items measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Reverse coding was applied where appropriate so that higher scores consistently reflected more positive attitudes toward vaping. Practice items were analysed descriptively to characterise patterns of vaping

behaviour, including frequency, duration, product type and context of use, rather than being combined into a composite score.

2.3 Data Collection and Analysis

Data collectors were trained on the study's objectives and data collection methods to ensure consistency and quality. Prior to data collection, informed consent was obtained from parents or guardians of all participating students. Printed, self-administered questionnaires were distributed to students during school hours, following a detailed briefing on the study's purpose. The questionnaires took approximately 10-15 minutes to complete and student received a small token of appreciation for their participation. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 21.0. Descriptive statistics, including frequencies and percentages, described the sociodemographic characteristics of the participants. Independent t-tests compared mean knowledge and attitude scores between vapers and non-vapers. Levene's test for equality of variances was used to determine whether equal variances could be assumed and results were reported accordingly. Pearson correlation analysis examined the relationship between knowledge and attitudes toward vaping, with statistical significance set at $p < 0.05$. Prior to conducting the analyses, the dataset was checked for missing values and outliers. All assumptions for parametric tests (e.g., normality, homogeneity of variance) were assessed, with appropriate adjustments made, as necessary. Any incomplete responses were excluded from the final analysis.

3. Results and Discussion

This section presents the findings from the 431 students who participated in the study, with a focus on the 75 students identified as active vapers (17.4%). The results are organized into key areas of sociodemographic characteristics, knowledge, attitudes and vaping practices. Each section provides insight into the students' background characteristics, their understanding of vaping risks, their perceptions and attitudes towards vaping and their actual vaping behaviours. The analysis also explores the correlation between knowledge and attitudes to understand how these cognitive and affective components influence vaping practices.

3.1 Sociodemographic Characteristics

The majority of students were male (71.2%), with a significant proportion aged 15 (24.1%) and 16 (19.5%) years old. Most respondents were Malay (91.4%), reflecting the predominant ethnic group in the study setting. Additionally, 65.2% of students had family members who smoked (Table 1). Out of the 431 students, 17.4% reported being active vapers, signalling that while vaping is not a widespread practice, it still poses a notable concern within the student population. Among the 75 students who vape, the gender disparity was more pronounced, with 94.7% being male (Table 2). The majority were aged 16-17 years old (65%), indicating that older students are more likely to engage in vaping. A significant proportion (84%) of these students came from families where members smoked, suggesting a strong correlation between household smoking and vaping behaviour [31]. The higher prevalence of vaping among males and older students suggests the need for targeted, gender- and age-specific interventions. Family smoking behaviour also appears to play a significant role in vaping initiation, underscoring the importance of family-based prevention strategies [32]. Schools with a high number of vapers may benefit from more focused anti-vaping campaigns and stricter enforcement of policies.

Table 1
Sociodemographic characteristics of participants

Sociodemographic characteristics	Frequency (n)	Percentage (%)
Age* (years)		15.03 (1.35)
13	73	16.9
14	89	20.6
15	104	24.1
16	84	19.5
17	81	18.8
Gender		
Male	307	71.2
Female	124	28.8
Ethnicity		
Malay	394	91.4
Chinese	18	4.2
Indian	14	3.2
Others	5	1.2
School location		
Rural	381	88.4
Urban	50	11.6
Vaping status		
Yes	75	17.4
No	356	82.6
Family smoking status		
Yes	281	65.2
No	150	34.8

Values shown are the frequency and percentage of each demographic parameter among 431 students. *Age is presented as mean ± standard deviation (SD).

Table 2
Characteristics of active vapers among participants

Sociodemographic characteristics	Frequency (n)	Percentage (%)
Age (years)		15.91 (1.03)
13	1	1.3
14	6	8.0
15	19	25.3
16	22	29.3
17	27	36.0
Gender		
Male	71	94.7
Female	4	5.3
Ethnicity		
Malay	73	97.3
Chinese	0	0.0
Indian	2	2.7
Others	0	0.0
School location		
Rural	61	81.3
Urban	14	18.7
Family smoking status		
Yes	63	84.0
No	12	16.0

Values shown are the frequency and percentage of each demographic parameter among 431 students. *Age is presented as mean ± standard deviation (SD).

3.2 Knowledge and Awareness of Vape Use

The knowledge scores among the 431 students were generally high, with 80.7% answering correctly on questions related to vaping (Figure 1). The highest correct responses were for questions about nicotine toxicity (93.0%) and heart function (93.3%), indicating strong awareness of the immediate risks, such as nicotine addiction and cardiovascular damage. However, there were notable gaps in areas such as the chemical content of vape products and their potential for drug misuse. For example, only 55.0% of students knew about the link between vaping and bladder cancer and 47.8% were aware of vaping as a potential vector for drug misuse. These gaps, as shown in Figure 1, highlight a limited understanding of long-term risks, suggesting that students might underestimate vaping's severe consequences.

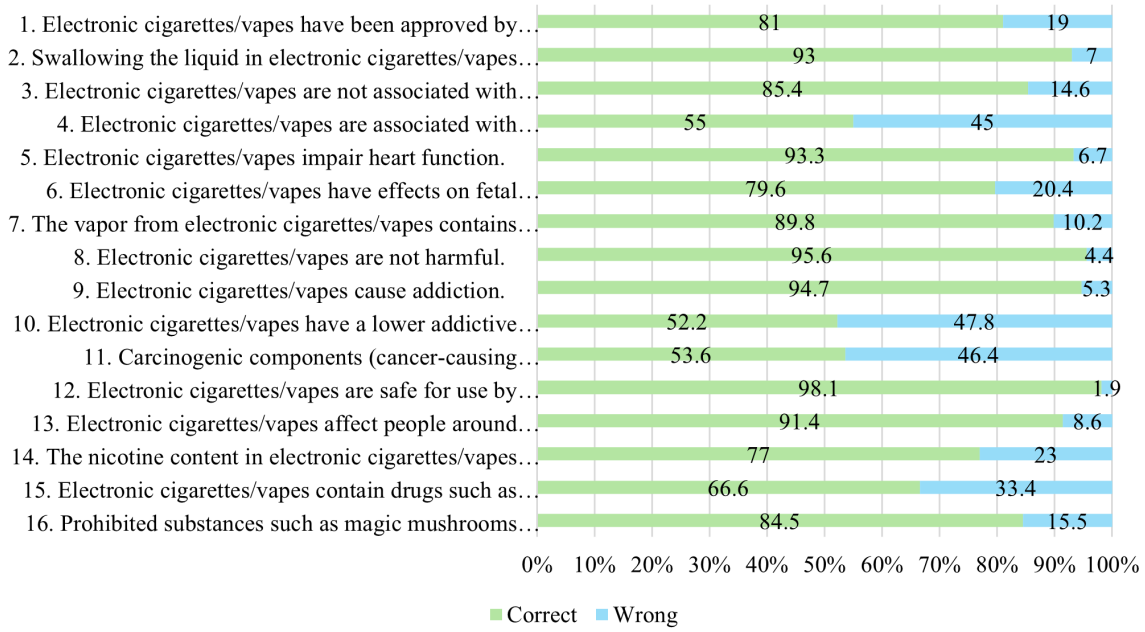

Fig. 1. Knowledge scores of students on vaping risks (general population, n = 431)

Among the 75 vaping students, knowledge levels were lower, with 70.1% answering correctly (Figure 2). The same trends observed in the broader group were present, with 94.7% correctly identified vaping's danger for pregnant women. However, misconceptions persisted in critical areas such as the presence of carcinogens in vape liquids and addiction potential. For example, only 45.3% of vaping students correctly identified the association between vaping and bladder cancer and 56.0% misunderstood the carcinogenic content of vape products compared to traditional cigarettes. Additionally, only 30.7% of students recognized that vaping has a high addictive potential, as shown in Figure 2. This further highlights the need for targeted education efforts to address these misconceptions. Similar misconceptions have been reported among young adults, as found in a study by Golan *et al.,* [33] and Yazidjoglou *et al.,* [34], where many participants underestimated the long-term risks of vaping, particularly regarding its association with cancer and drug misuse.

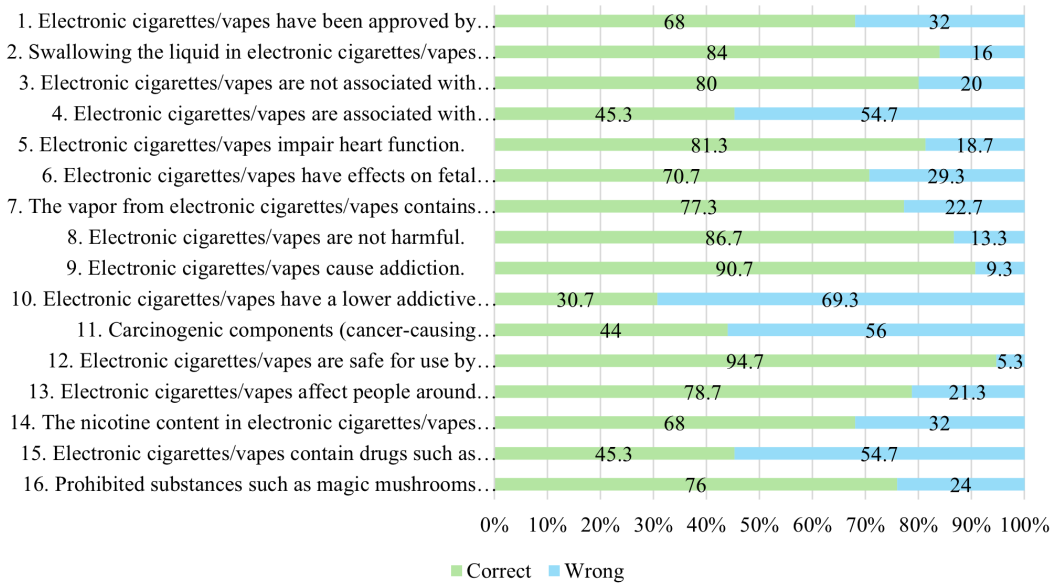

Fig. 2. Knowledge scores of vaping students on vaping risks (vapers only, n = 75)

3.3 Attitude toward Vape Use

In general, the students held negative attitudes toward vaping, as reflected by 56.8% of respondents who strongly disagreed that vaping should be recommended for people wanting to start smoking (mean = 1.64) (Figure 3). Similarly, 46.9% disagreed with allowing vaping in all public places (mean = 1.79). However, students were less certain about vaping's social acceptability, with 35.7% unsure whether vaping is more socially acceptable than smoking (mean = 2.35). This suggests that while most students are aware of vaping's health risks, they may still perceive it as more socially acceptable than traditional smoking. For the 75 vaping students, Figure 4 shows that attitudes were more mixed. While some saw vaping as beneficial for quitting smoking (44%, mean = 3.19), others recognized the need for government regulation (36%, mean = 2.93). The belief that vaping helps people reduce smoking habits (mean = 3.15) reflects a dangerous misconception, one that might justify continued vaping behaviour. Positive attitudes among adolescents, as seen in our study, are consistent with findings from Alexander *et al.,* [35] and Li *et al.,* [36], who demonstrated that adolescents view vaping as a safer alternative, which may lower their guard against the use of more harmful tobacco products. The fact that even vapers show some support for regulation suggests a partial recognition of vaping risks, but this does not seem to deter their behaviour.

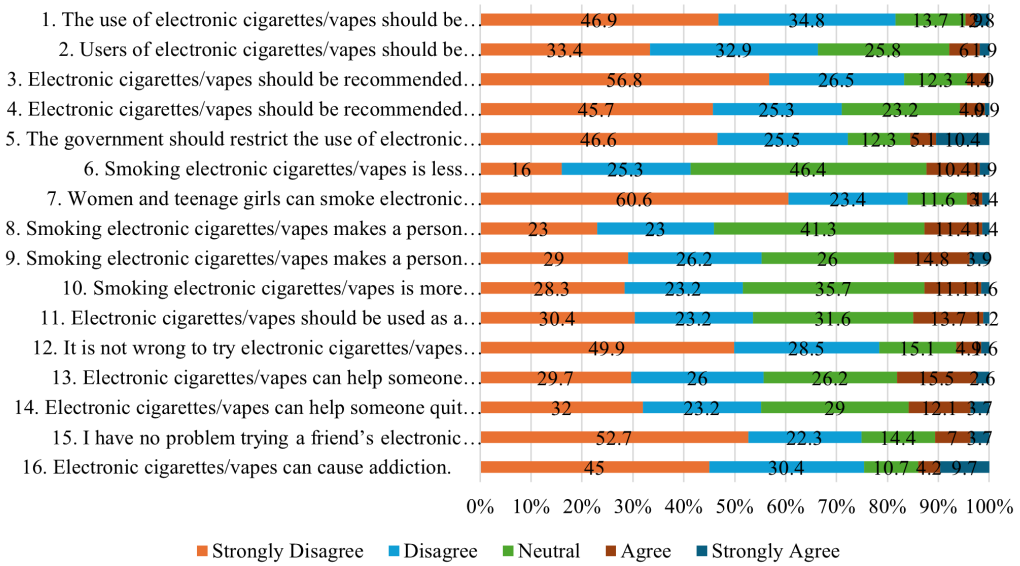

Fig. 3. Attitudes toward vaping (n = 431)

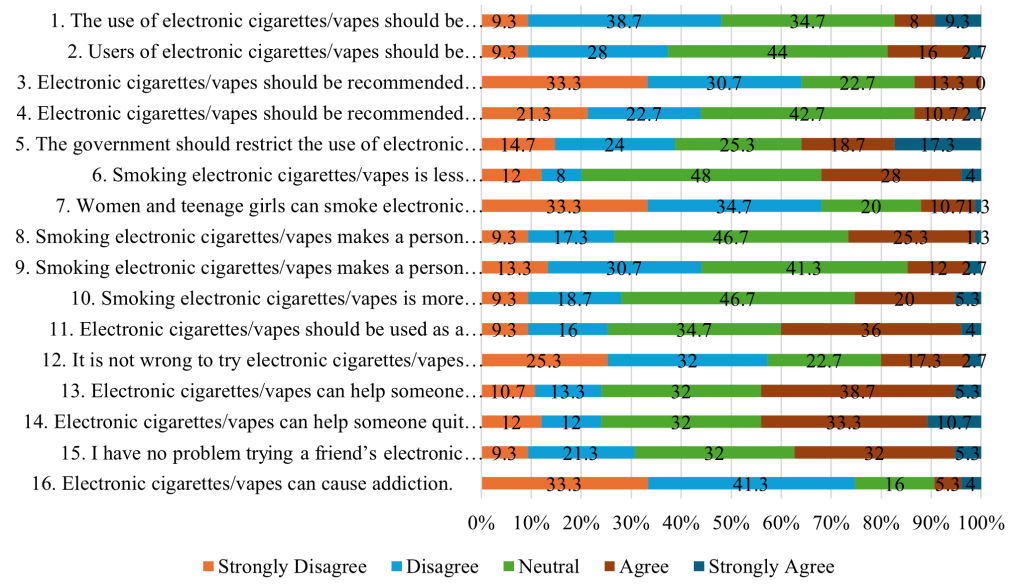

Fig. 4. Attitudes toward vaping (n = 75)

The generally negative attitudes toward vaping among non-vaping students suggest that anti-vaping messages have resonated with the majority. However, the more favourable attitudes among vaping students, particularly regarding vaping as a cessation tool, highlight a dangerous misconception. This belief could lead students to justify their vaping behaviour, thinking it is a safer or more responsible option than smoking. Educational programs need to address these attitudinal differences by reinforcing the idea that vaping is not a proven method for quitting smoking and that it carries significant health risks, including the possibility of dual use (vaping and smoking), which can exacerbate nicotine dependence.

3.4 Vaping Practices Related to Vape Use

In terms of practice, 17.4% (75 students) were active vapers, with most using vape products for 1-4 years (36%) and a substantial number (31%) vaping more than 20 times a day (Table 3). The preference for vape pods (51%) and disposable vape (43%) aligns with market trends, highlighting the ease and convenience of these devices for youth, particularly in environments where vaping may be concealed, such as at home (70%). Furthermore, a worrying 37% of students reported taking fewer than 50 puffs per day, indicating frequent use. Fruity flavours (42%) were the most popular, followed by coffee (20%) and sweet/candy flavours (19%). The popularity of flavoured vape products among youth aligns with findings from Jones & Salzman (2020), which highlight how advertising and appealing flavours significantly influence vaping practices among young people [14]. Regarding nicotine content, more than half of the respondents (57.3%) were unaware of the nicotine concentration in their vape liquids. However, some reported using liquids with nicotine concentrations as high as 28 mg (5.3%), a concerning level given the addictive nature of nicotine. These findings indicate a general lack of awareness among students regarding the substances they are consuming.

The most common symptoms reported by vape users were bad breath (14.3%) and coughing (15.1%), with other symptoms such as headaches (11.0%) and dizziness (12.2%) also frequently reported. A smaller percentage of students experienced more serious symptoms, such as hallucinations (4.1%) and difficulty sleeping (4.5%), which may reflect self-reported exposure to substances beyond nicotine, as reported by 2% of students using vape liquids containing “magic mushrooms”. In terms of expenditure, 45% of vapers spent between RM21-RM50 per month, primarily purchasing their products from vape shops (79%), raising questions about the enforcement of age restrictions in these outlets. While 70% vaped at home, 2% admitted to vaping at school, underscoring the need for stronger supervision both at home and in schools. Students cited the taste of vape (63%), curiosity (47%) and stress relief (41%) as reasons for starting, with 33% believing vaping is safer than smoking. However, most of the vapers (54.7%) are still smoking with the traditional cigarette and only 38.6% quit smoking. These findings point to the misconception that vaping is an alternative to quit smoking with traditional cigarette and consistent with findings reported by Doumi *et al.,* [28] and Mat Salleh *et al.,* [29].

Additionally, 86.7% of vape users indicated plans to quit vaping, with most (82.7%) opting for a gradual reduction rather than sudden cessation. Only a small percentage (7.89%) of vapers recommended vaping to others, showing a clear awareness of its risks despite continued use. Similar findings have been reported by few researchers [37-39] where many vape users have either attempted to quit or plan to stop vaping in the future. Various factors influence their motivation to quit vaping including concerns related to COVID-19 [40], cost of vapes, reduced satisfaction from their use [41] and psychological concerns [42].

Table 3
Vaping practices among active vapers

Profile	Frequency (n)	Percentage (%)
Duration of vaping		
< 1 month	11	14.7
1-6 months	14	18.6
6-12 months	12	16.0
1-4 years	27	36.0
> 4 years	11	14.7
Vaping frequency per day		
1 time	5	6.7

2-5 times	18	24.0
6-10 times	20	26.6
11-20 times	9	12.0
> 20 times	23	30.7
Type of vape		
Disposable	36	43.4
Pods	42	50.6
Mods	3	3.6
Others	2	2.4
Number of puffs per day		
< 50	28	37.3
50-100	23	30.7
100-500	10	13.3
500-1000	4	5.3
> 1000	7	9.4
Others	3	4.0
Vape flavour		
Mix of tobacco and menthol	5	4.4
Fruit flavour	48	42.1
Candy, chocolate, dessert flavours	22	19.3
Coffee	23	20.2
Magic mushroom	2	1.8
Pedon	1	0.9
Tenang is Good	3	2.6
No flavour	1	0.9
Do not know	6	5.2
Others	3	2.6
Monthly vape expenditure		
< RM20	24	32.0
RM21-RM50	34	45.3
RM51-RM100	12	16.0
> RM100	5	6.7
Daily pocket money		
None	8	10.7
<RM5	13	17.3
RM5-RM10	44	58.7
RM11-RM20	4	5.3
> RM20	6	8.0
Vaping location		
Home	58	69.9
School	2	2.4
Others	23	27.7
Source of vape supply		
Vape shop	64	79.0
Convenience store	9	11.1
Night market	2	2.5
Gas station	4	4.9
Others	2	2.5
Reason for starting to vape		
Tastes better than traditional cigarettes	63	13.4
For social purposes	17	3.6
Stress relief	38	8.1
Depression	28	6.0
Peer influence	54	11.5
Reduces craving for traditional cigarettes	57	12.2
To quit smoking traditional cigarettes	41	8.7
Believes vaping is safer	33	7.0

Follows current trends	21	4.5
For entertainment	40	8.5
Cheaper than traditional cigarettes	30	6.4
Curiosity	47	10.0
Others	0	0.0
Symptoms related to vaping		
Bad breath	35	14.3
Gum changes	19	7.8
Tooth loss	5	2.0
Change in tooth colour	18	7.3
Voice changes	17	6.9
Headache	27	11.0
Dizziness	30	12.2
Loss of taste	7	2.9
Coughing	37	15.1
Teeth grinding	5	2.0
Hallucination	10	4.1
Difficulty sleeping	11	4.5
Overexcitement	22	9.0
Others	2	0.8
Nicotine content (mg)		
0	6	8.0
6	11	14.7
12	6	8.0
22	5	6.7
28	4	5.3
Unsure	43	57.3
Plan to quit vaping		
Yes	65	86.7
No	10	13.3
Method of quitting		
Gradual reduction	62	82.7
Sudden cessation	13	17.3
Recommend vaping to others		
Yes	34	45.3
No	41	54.7
Smoking status with traditional cigarettes		
Non-smoker	5	6.7
Current smoker	41	54.7
Former smoker	29	38.6

Values shown are the frequency and percentage of vaping behaviours among 75 active vapers, including duration of vaping, frequency of use, preferred vape type, number of puffs per day and vaping location.

The high frequency of vaping and the type of devices used indicate that many students may already be dependent on nicotine. The fact that most vaping occurs at home suggests that parental supervision may be limited, or that parents may be unaware of the dangers of vaping. In line with study by Rodriguez *et al.,* [43], which emphasizes the role of parental knowledge in shaping adolescent behaviour, interventions should also focus on increasing parental awareness and engagement in preventing adolescent vaping. Additionally, the easy availability of vape products in vape shops calls for stricter regulation and enforcement to limit adolescent access.

Within the KAP framework, these findings reflect on the practice component, demonstrating that quite number of students engage in frequent and potentially harmful vaping behaviours despite varying levels of knowledge and attitudes toward vaping. The persistence of risky practices, including

high-frequency use, uncertainty regarding nicotine content and concurrent cigarette smoking, suggests that behaviour is not solely determined by awareness of health risks.

3.5 Relationship between Knowledge, Attitude and Practice

An independent t-test was conducted to determine the differences in knowledge and attitudes between students who vape and those who do not. The mean knowledge score for vapers (M = 1.2992, SD = 0.14099) was significantly higher than that of non-vapers (M = 1.1710, SD = 0.11808). The t-test results indicated a significant difference in knowledge between the two groups ($t = 8.246$, $p < 0.001$), suggesting that vapers are generally more aware of vaping risks (Table 4). Despite this higher level of knowledge, vapers also displayed significantly more positive attitudes toward vaping (M = 2.7267, SD = 0.50710) compared to non-vapers (M = 1.9651, SD = 0.50551). The t-test for attitude revealed a significant difference ($t = 11.852$, $p < 0.001$), highlighting that vapers hold more favourable views on vaping compared to non-vapers.

The Pearson correlation analysis further supports these findings by showing a moderate positive correlation between knowledge and attitude ($r = 0.504$ for 431 students; $r = 0.453$ for 75 vaping students). This correlation suggests that, generally, students with higher knowledge about vaping tend to have more favourable attitudes towards vaping. While this relationship might initially seem counterintuitive, where we might expect higher knowledge to lead to more negative attitudes, the t-test results clarify that vapers, despite having higher knowledge, hold more positive attitudes toward the behaviour. This disconnect between knowledge and attitude is particularly important because it highlights that knowledge alone is not enough to prevent or reduce vaping behaviour [44-45].

The positive correlation between knowledge and attitude suggests that students who are more familiar with vaping may also perceive it more positively, possibly due to the social normalization of vaping among peers or a belief that they can manage the risks associated with vaping. The t-test results further confirm that these students continue to engage in vaping, despite their awareness of its dangers, because their attitudes remain favourable toward it. Thus, the combination of the t-test and correlation findings suggests that:

- Vaping behaviour is sustained by positive attitudes, even in the presence of high knowledge about vaping risks.
- Attitudinal interventions are necessary alongside educational efforts to shift behaviour, as correcting misconceptions about vaping may not change behaviour if positive attitudes and social influences remain unaddressed.

Table 4
Relationship between knowledge and attitude towards vaping practices

Variable	Vapers	Non-vapers	t-value	95% confidence interval	p-value	Pearson correlation (r) (Vapers)	p-value	Pearson correlation (r) (Non-vapers)	p-value
Knowledge scores	1.2992 ± 0.14099	1.1710 ± 0.11808	8.246	0.09762 – 0.15872	< 0.001	-	-	-	-
Attitude scores	2.7267 ± 0.50710	1.9651 ± 0.50551	11.852	0.63530 – 0.88791	< 0.001	-	-	-	-
Correlation (knowledge-attitude)	-	-	-		-	0.453	< 0.001	0.504	< 0.001

Values shown include mean ± standard deviation (SD), t-values and p-values for the comparison of knowledge and attitude scores between 75 active vapers and 356 non-vapers. Pearson correlation coefficients (r) indicate the relationship between knowledge and attitudes toward vaping.

Although higher knowledge levels were observed among vapers, this finding does not necessarily indicate a protective effect and may appear counterintuitive at first glance. In a cross-sectional context, adolescents may acquire greater knowledge after initiating vaping through exposure to peer networks, product marketing and online content, rather than knowledge acting as a deterrent to use. Importantly, such knowledge may be selective or incomplete, emphasizing perceived benefits such as stress relief, social acceptance, or reduced harm compared to conventional cigarettes, rather than long-term health risks. This helps explain the observed positive association between higher knowledge and more favourable attitudes toward vaping, as adolescents may rationalize continued use despite awareness of risks, consistent with cognitive dissonance theory and patterns reported in previous adolescent studies. In this context, greater knowledge may reflect familiarity with vaping rather than meaningful risk awareness, contributing to normalization of use and sustained positive attitudes. These findings indicate that knowledge alone is insufficient to drive behaviour change, highlighting the dominant role of attitudes, perceived benefits and social influences in shaping vaping behaviour. Consequently, interventions that focus solely on increasing awareness are unlikely to be effective unless they are complemented by strategies that challenge misconceptions, address social norms and target the attitudinal factors that sustain adolescent vaping behaviour. Given the study's cross-sectional design, the directionality of the relationship between knowledge, attitudes and vaping behaviour cannot be established.

4. Limitations and Recommendations

Some limitations in this study include the data were self-reported which may cause bias and dishonesty. Other than that, the study was conducted in selected public secondary schools within a single district, which may limit the generalisability of the findings to adolescents in other regions or educational settings. Additionally, the study did not include chemical analysis of vape products or clinical assessment of health outcomes therefore, reported symptoms and substance exposure could not be objectively verified.

Based on the study findings, interventions should move beyond general awareness campaigns and adopt targeted, multi-level strategies. Given that most vaping occurs at home, parental education programs should be strengthened to improve parents' ability to recognize vaping behaviours and understand associated risks. The predominance of vape shops as the main source of supply highlights the need for improved enforcement of age-restriction regulations, including routine compliance checks at retail outlets.

In schools, prevention programs should focus not only on increasing knowledge but also on addressing positive attitudes and social norms that sustain vaping behaviour, as higher knowledge alone was insufficient to deter use. Behavioural and peer-led interventions that challenge misconceptions about vaping as a safer alternative to smoking may be more effective. Furthermore, the high proportion of students expressing an intention to quit suggests an opportunity to implement school-based cessation support, such as counselling or referral pathways, tailored for adolescents.

5. Conclusions

This study demonstrates that although secondary school students possess relatively high knowledge regarding vaping, particularly among those who vape, this knowledge does not

necessarily translate into negative attitudes or reduced engagement in vaping behaviour. The finding that vapers exhibit both higher knowledge and more favourable attitudes highlights a disconnect between awareness and behaviour, suggesting that familiarity with vaping may contribute to normalization rather than deterrence. The observed positive association between knowledge and attitude indicates that adolescents may rationalize vaping by emphasizing perceived benefits such as stress relief, social acceptance, or reduced harm compared to conventional cigarettes. These findings reinforce the notion that knowledge alone is insufficient to drive behaviour change, particularly in the presence of reinforcing social influences. Within the KAP framework, this study underscores the importance of addressing attitudinal and social factors alongside educational efforts. Interventions that focus solely on increasing awareness of health risks are unlikely to be effective unless they challenge misconceptions about vaping, reduce their social appeal and address peer-driven norms that sustain use. While the study identified self-reported exposure to non-nicotine substances in some vape products, these findings should be interpreted cautiously and within the limitations of self-reported data. Overall, a comprehensive approach that integrates knowledge enhancement with attitude-focused and socially informed strategies, supported by appropriate regulatory measures to limit adolescent access to vape products, is essential for reducing vaping behaviour and improving adolescent health outcomes.

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