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The Use and Knowledge Around Vaping and Their Correlates Among University Students—A Cross-sectional Australian Study

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Abstract

The increasing prevalence of e-cigarette use ("vaping") among youth has emerged as a public health concern. We aim to explore vape use, knowledge levels, and correlates in a sample of Australian young adults. Participants from six residential university colleges in Queensland, Australia, were invited to complete an online survey. The sample included 716 students (M_{age}=18.1 years). Correlates of vape use and knowledge examined included socio-demographic variables, other substance use, and mental health, including PHQ-9 depression and GAD-7 anxiety. In our sample, 62% of students reported lifetime vaping. Just under half (47.5%) of the sample had used flavour with nicotine vapes, 18.0% had used flavour only, and 2.8% had used other drugs. Past month vaping rates were low at 4.2% for daily use of flavour with nicotine vapes. Co-use of cigarettes was observed with nicotine vapes but most only vaped occasionally. A substantial proportion lacked knowledge about the legality (37.4%) and health harms (25.4%) of vapes. Males had higher odds of vaping. Use of cigarettes, binge drinking, and cannabis use were associated with vaping. While the co-use of cigarettes with nicotine vapes was observed, this was generally only seen among those who vaped occasionally. A notable knowledge gap existed regarding the legality and awareness of the health harms of vaping, signalling a need for educational initiatives. Future research should continue to monitor emerging vaping trends and long-term outcomes. The project was pre-registered on the Australian New Zealand Clinical Trials Registry (registration number: ACTRN12622000239763).

Keywords Vaping · e-Cigarette · Knowledge · University students · Nicotine vapes · Co-use · Cigarettes · Substance use · Anxiety · Depression

e-Cigarettes, also known as vapes, have rapidly increased in prevalence since their emergence in 2003 (Jerzyński et al., 2021), particularly among young adults aged 18–25 years (Cole et al., 2021). This is concerning as young adulthood, characterised by newfound independence and identity development throughout ages 18 to 25, is a particularly vulnerable period for developing risky substance use behaviours (Arnett & Emerging Adulthood,

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2000). For this reason, studies on young adult populations provide useful insights into potential changes in substance use behaviours during this critical period.

An important sub-population of young adults is university students. They are typically young people who have completed high school and entered into a higher education institute enrolled in an undergraduate (Bachelor's) degree, and some will go on to further study for a postgraduate degree. Therefore, it is a critical period of young adulthood. In the Australian context, there is a substantial overlap between young adulthood and university-attending young adults. Indeed, close to 60% of Year 12 students leaving school in Australia will continue their education at university (Australian Government Productivity Commission, 2022). University students are a unique population of young adults, with differences in substance usage compared to their peers who are not studying (Tavolacci et al., 2013; Walters et al., 2018). A 2017 study that focused on vaping among Australian university students found that vaping, smoking, and dual use were more common among males than females (Wamamili et al., 2021). In addition, the study found that older students (> 25 years) were more likely to use nicotine-containing e-liquid than younger students, and significant associations were found between vaping and smoking (Wamamili et al., 2021). Considering the recent public health issue of vaping, understanding vaping behaviours of Australian university students is important for profiling the larger Australian young adult cohort. Accordingly, recent Australian data suggests vaping is most prevalent among those aged 18–24 years, with approximately one in five young adults (19.8%) reporting current use in 2023 (Wakefield et al., 2023). However, vaping trends have been rapidly changing since 2017 and less is known about associations with other demographic characteristics.

Young adult vaping may also have varying associations with tobacco cigarette smoking. For example, some young adults may use vapes as a smoking cessation tool (Butler et al., 2022; Liu et al., 2018), while others may commence smoking following vape use (Wills et al., 2017; Soneji et al., 2017). Associations with vaping and other substance use, such as alcohol and marijuana, have also been documented (Cohn et al., 2015). For example, the combination of nicotine vaping with marijuana use has been associated with a greater likelihood of using other illicit substances (Boccio & Jackson, 2021). Prevention and early intervention efforts are therefore urgently needed to avoid establishing harmful patterns of vaping and polysubstance use among this population.

Increasing knowledge and ensuring accurate perceptions of harm are important tools often used within public health campaigns and intervention approaches. Given that vaping was originally marketed as a safe alternative to tobacco cigarette smoking, there is potential for widespread misconception about the harms of vaping (Harrell et al., 2015). However, few studies have investigated the current state of knowledge about the potential harms of vapes among young adults. Among the limited research, one study involving 853 health students found knowledge about vaping to be poor, particularly about vaping-related harms (Franks et al., 2017). While laws about vaping have evolved over time with the changing landscape of vape use, few studies have investigated knowledge of vaping laws and its association with use. Therefore, there is a need for more research investigating the patterns of vape use, knowledge levels, and key correlates of vaping, particularly among young adults.

While it is well established that use of alcohol, tobacco, and other drugs commonly co-occurs with mental health problems (Kingston et al., 2017), relatively little is known about the link between vaping and mental health. A recent systematic review identified associations between vaping and depression and suicidal ideation, although causality could not be established (Becker et al., 2021). Among 3572 university students in the USA, it was found that lifetime use of e-cigarettes was significantly associated with a range of mental health conditions, including a history of ADHD, PTSD, and anxiety (Grant et al., 2019).

In addition, a recent review found that vaping was associated with anxiety and depressive symptoms (Truong & Cotton, 2023). However, limited studies have examined the associations between vaping and mental health among Australian young adults.

This study aims to explore: (1) the proportion of young university students who report vaping and the types of vaping products used; (2) whether vapes are co-used with tobacco cigarettes; (3) levels of knowledge about the legality and potential harms of vapes; and (4) the correlates of vape use and vape-related knowledge. This study provides novel insights because the majority of Australian high school students go on to study in university; therefore, it provides important information on behaviours and factors associated with vaping during young adulthood.

Methods

Study Design and Settings

Data were from a broader study aiming to reduce alcohol and other drug use (AOD) and related harms among residential college students (the QuikFix Good Night Out project). The broader project was a three-arm cluster randomized controlled trial conducted across six residential colleges located within The University of Queensland, Australia. Ethical approval was obtained from the University of Queensland Human Research Ethics Committee (ID: 2020/HE002817). The project was pre-registered on the Australian New Zealand Clinical Trials Registry (registration number: ACTRN12622000239763). This study used cross-sectional data from the February 2022 baseline survey before interventions were conducted.

Participants

Students were sent an online link to a consent form and baseline survey from their respective college contacts approximately 1 week before the start of their orientation week. Members of the research team also visited each college in person to provide information and answer any questions about the project. Students completed the survey online or over the phone. Participants were eligible for the project if they were a current first-year university student living in a residential college.

Measures

Socio-demographic Factors

Socio-demographic variables included age, sex ("What is your sex?", with "Male", "Female", "Other" presented with a free-text box, or "Prefer not to say" response options), ethnicity (Caucasian; Aboriginal and/or Torres Strait Islander; Asian; Pacific Islander; Latin American/Hispanic, African, Middle Eastern, or Other), first language (not English; English), and area of residence of their family home (selecting either "Urban (City)" or "Rural (Country)"). In addition, students were asked if they were receiving income support from the government and were presented with a list of common income support payments, as well as a free-text box. Government income support was included as a proxy for

socio-economic status instead of area-level socio-economic status because all participants resided in the same local area. Additionally, in the Australian context, eligibility for government income social security support is determined by financial disadvantage.

Past-Month Substance use

For use of substances other than vapes, we measured the total number of days past-month use of combustible cigarettes, alcohol, and cannabis using the Australian Treatment Outcomes Profile (ATOP) (Ryan et al., 2014). The ATOP has good to excellent inter-rater reliability and concurrent validity for measuring levels of past-month use, typically delivered in an interview format to substance-using samples (Deacon et al., 2021). It demonstrated strong reliability for use by young adults. In addition, it has been shown to have strong reliability for measuring past-month tobacco use in a study that compared measures taken using self-reports vs. interviews (kappa = 0.82) (Carlyle et al., 2023). Students were also asked to report the number of times in the past month they had consumed five or more (males/other) or four or more (females) alcoholic drinks on one occasion.

Mental Health

Two measures were used to assess mental health: the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001), and the Generalized Anxiety Disorder Scale (GAD-7) (Spitzer et al., 2006). The PHQ-9 is a nine-item scale used to assess symptoms of depression. Item responses were provided on a Likert scale (0 = *not at all* to 3 = *nearly every day*) and were summed to yield total scores ranging from 0 to 27 (Kroenke et al., 2001). Scores were categorised as 0 to 9 as lower (minimal to mild) and ≥ 10 as higher (moderate to severe) (Levis et al., 2019). The GAD-7 is a seven-item scale which assesses symptoms associated with generalized anxiety disorder measured on a Likert scale (0 = *not at all* to 3 = *nearly every day*), with total scores ranging from 0 to 21 (Spitzer et al., 2006). Scores were categorised as 0 to 9 as lower (minimal to mild) and ≥ 10 as higher (moderate to severe) (Spitzer et al., 2006). The depressive and anxiety symptoms measures were moderately correlated ($r = 0.53$, $p < 0.001$); due to the association not being strong, they were able to be analysed as independent variables in the analyses. The PHQ-9 (Zhang et al., 2013) and GAD-7 (Byrd-Bredbenner et al., 2020; White & Karr, 2023) scales have strong reliability and validity when used with university students and have previously been applied in Australian university samples (Farrer et al., 2016).

Knowledge

Students were provided with a 21-item knowledge questionnaire including facts and common myths associated with various substances. Items included in the AOD Knowledge Scale were derived from items used in previous research with young adults to measure knowledge about alcohol, cannabis, e-cigarettes and cigarettes, and MDMA (Davidson et al., 2022; Hides et al., 2014, 2020; Pocuca et al., 2016). The items also correspond directly to trivia content delivered in an AOD workshop for university students, covering general AOD knowledge, alcohol, cannabis, e-cigarettes and cigarettes, and party drugs. There were two items that were about vaping: "In Australia, it is illegal to sell, use, or possess non-prescription e-cigarettes that contain nicotine" (True); and "Currently, there is no evidence of health harms associated with vaping" (False). Students could respond with

"True", "False", or "Don't Know". Responses were re-coded as "Had knowledge" (True) or "Lacked knowledge" (Incorrect; Don't Know) for each item.

Vaping Behaviour

We examined lifetime and past-month vape use. The term vaping refers to students' self-report of using electronic-cigarette or vaping devices. Lifetime vape use was measured using an item that asked: "In your life, have you ever used an electronic-cigarette or a vaping device?". Participants who responded "yes" were asked a further question to determine the content of the electronic-cigarette or vaping device. Participants responded via tick-boxes with options for the following: "Flavour with nicotine"; "Flavour-only"; "Nicotine-only"; "Other drugs"; and "Don't know".

Past-month vape use was measured using the ATOP. The ATOP was presented to measure participants use of electronic-cigarettes or vaping devices containing (a) nicotine (with flavour) and (b) flavour only. Participants' data for total number of days of use in the past month was recoded into three categories: "no use" (0 days), "occasional use" (1 to 19 days), and "daily or near daily use" (20 + days).

Statistical Analysis

First, to examine vaping and types of vapes used, descriptive statistics were used to estimate proportions of lifetime and past-month use of vapes. Second, to examine the co-use of vapes and traditional cigarettes, proportions of vape use were cross-tabulated by cigarette use, with chi-squared tests to examine associations. Third, to examine knowledge levels around the legality and potential harms of vapes, proportions of students who had knowledge on the knowledge items were presented. Lastly, three logistic regression analyses were conducted with the vape use and the two knowledge items as the dependent variables. The socio-demographic, other substance use, and mental health variables were entered into the models as independent variables all together, accounting for college-level clustering. All analyses were conducted using SPSS version 29.

Results

The participants in this paper included 716 first-year residential college students (80.3% response from 892 students). Participants had a mean age of 18.09 years (SD = 1.20).

Missing data

We found no missing entries for vape ever-use. Missing data was minimal in this study, with less than 5% of all variables affected (see Supplement 1). Out of the total dataset, 638 participants (89.1%) provided complete data across all the variables under examination. To handle the missing data, we employed multiple imputations (Jakobsen et al., 2017), running five rounds to replace any absent information. We used the fully conditional specification method with ten iterations. The imputation models utilized logistic regression for the imputation model type. All variables of interest in this study were included, regardless of the extent of missingness, ensuring maximum predictability and accuracy of imputed

data. A comparison of the original and imputed datasets revealed substantial similarity (Table 1), confirming the robustness of the imputation process. Consequently, the results reported below are based on the imputed dataset, ensuring the most comprehensive analysis possible of e-cigarette use among university students.

Participant Characteristics

As detailed in Table 1, the sample had fewer males compared to females (34.1%) and a low number of individuals identifying with another sex (0.4%). The majority of participants were 18 years or older (78.5%) and identified as Caucasian (85.8%), while small percentages identified as Asian (8.0%), Pacific Islander (2.0%), Aboriginal and/or Torres Strait Islander (1.0%), or other ethnicities (3.4%). Over half were from urban areas (59.4%), and most did not receive government benefits (87.7%). Regarding past-month substance use, most participants reported no combustible cigarette (89.1%) or cannabis use (87.8%); however, the majority reported engaging in binge drinking (66.5%). Most participants had minimal to mild signs of depression and anxiety, with 13.0% meeting thresholds for moderate to severe scores on the PHQ-9, and 13.4% of participants meeting thresholds for moderate to severe scores on the GAD-7 (Spitzer et al., 2006; Levis et al., 2019).

Proportion Who Reported Vaping

More than half (61.9%) of participants reported lifetime (ever-vaped) use of vapes (Table 1). The most common type of e-cigarette used was flavour with nicotine (47.5%), with fewer participants vaping flavour only (18.0%) or other drugs (2.8%). A small proportion (2.8%) reported using a vape without knowing the content.

Although lifetime use of vapes was over 50%, close to three-quarters of the respondents (73.60%) had not vaped in the past month. Among the cohort, those who vaped in the past month mostly vaped occasionally (22.2%, flavour with nicotine; 3.1%, flavour only), while less than 5% of the cohort reported daily or near daily vaping of flavour with nicotine, and no participants reported daily or near daily vaping of flavour only.

Vaping Co-use with Combustible Cigarettes

There were significant associations between vaping and combustible cigarette smoking for the use of flavour with nicotine vapes ($p < 0.001$), but not for flavour-only vapes ($p = 0.084$; Table 2). Among those who smoked, almost all had vaped at some time, compared to only a little over half among those who did not smoke cigarettes.

Looking into the specific types of e-cigarettes used, we observed that less than half of the non-smoking group had used flavour with nicotine, while 83.3% of the smoking group had. Flavoured e-cigarettes without nicotine were less commonly used by both groups.

Examining current use of vapes, a low proportion reported daily or near daily use of flavour with nicotine vapes across both groups. Use of flavour with nicotine vapes in cigarette users vs. non-cigarette users was significant. Most of those who smoked traditional cigarettes used nicotine flavour vapes occasionally, rather than daily or near daily.

Table 1 Participant characteristics in the original and imputed datasets ($N=716$)

	Original data		Imputed data
	n	%	%
Sociodemographic factors			
Sex			
Female	469	65.5%	65.5%
Male	244	34.1%	34.1%
Other	3	0.4%	0.4%
Age			
16–17	154	21.5%	21.5%
18+	562	78.5%	78.5%
Ethnicity			
Caucasian	614	85.8%	85.8%
Aboriginal and/or Torres Strait Islander	7	1.0%	1.0%
Asian	57	8.0%	8.0%
Pacific Islander	14	2.0%	2.0%
Other	24	3.4%	3.4%
First language			
Not English	35	4.9%	4.9%
English	681	95.1%	95.1%
Area of residence			
Rural	291	40.6%	40.6%
Urban	425	59.4%	59.4%
Government benefits			
No	628	87.7%	87.7%
Yes	88	12.3%	12.3%
Other substance use in past month			
Cigarettes			
No	638	89.1%	89.1%
Yes	78	10.9%	10.9%
Binge drinking			
No	225	32.8%	33.5%
Yes	462	67.2%	66.5%
Cannabis			
No	629	87.8%	87.8%
Yes	87	12.2%	12.2%
Mental health			
Depression (PHQ-9)			
Lower (score 0–9)	617	86.2%	87.0%
Higher ($\geq$10)	92	12.8%	13.0%
Anxiety (GAD-7)			
Lower (score 0–9)	614	85.8%	86.6%
Higher ($\geq$10)	94	13.1%	13.4%
Vaping trivia			
It is illegal to sell, use, or possess non-prescription e-cigarettes that contain nicotine			

Table 1 (continued)

	Original data		Imputed data
	n	%	%
Had knowledge	264	37.2%	37.4%
Lacked knowledge	446	62.8%	62.6%
Currently, there is no evidence of health harms associated with vaping			
Had knowledge	180	25.4%	25.4%
Lacked knowledge	530	74.6%	74.6%
Ever vaped (any)			
No	273	38.10%	38.10%
Yes	443	61.90%	61.90%
Specific types ever used[a]			
Flavour with nicotine	340	47.5%	47.5%
Flavour only	129	18.0%	18.0%
Other drugs	20	2.8%	2.8%
Don't know	20	2.8%	2.8%
Frequency of vaping in past month[b]			
Flavour with nicotine			
No	524	74.1%	73.6%
Occasional	154	21.8%	22.2%
Daily or near daily	29	4.1%	4.2%
Flavour only			
No	693	96.9%	96.9%
Occasional	22	3.1%	3.1%
Daily or near daily	0	0.0%	0.0%

GAD-7, generalized anxiety disorders assessment; *PHQ-9*, Patient Health Questionnaire for assessing depression. [a]Tick all that applies. [b]Frequency of vaping in past month was only asked specifically for flavour with nicotine and flavour-only vapes (no data on any vaping overall)

Knowledge Around the Legality and Potential Harms of Vapes

While most participants had knowledge regarding the legality and health impacts of vaping, a substantial proportion lacked knowledge (Fig. 1). Specifically, over a third (37.4%) lacked knowledge on the legality question, and a quarter (25.4%) lacked knowledge about the presence of health harms associated with vaping.

Correlates of Vaping Behaviours and Knowledge

Our regression analysis revealed a significant association between ever vaping with sex ($p = 0.005$) and other substance use ($p < 0.001$). Participants who had smoked cigarettes engaged in binge drinking or used cannabis exhibited higher odds of using e-cigarettes. Moderate or severe depression and anxiety did not have a significant relationship with vape use. Other sociodemographic factors in our analysis did not significantly correlate with vape use.

Table 2 Co-use of vapes with traditional cigarettes

	Past-month cigarette use[a]		p
	No	Yes	
Ever vaped (any)			
No	42.3%	3.8%	<0.001
Yes	57.7%	96.2%	
Specific types ever used			
Flavour with nicotine			
No	56.9%	16.7%	<0.001
Yes	43.1%	83.3%	
Flavour only			
No	82.9%	74.4%	0.084
Yes	17.1%	25.6%	
Frequency of vaping in past month			
Flavour with nicotine			
No	78.5%	33.3%	<0.001
Occasional	17.5%	60.8%	
Daily or near daily	4.0%	5.9%	
Flavour only			
No	97.0%	96.2%	0.677
Occasional	3.0%	3.8%	
Daily or near daily	0.0%	0.0%	

[a]Column percentages

For the correlates of vaping knowledge, there were some overlaps and disparities with the factors associated with vaping behaviour. Male participants had a higher level of knowledge across both aspects of vaping trivia (legality and associated harms). Binge drinking was significantly associated with knowledge about the legality of e-cigarettes ($p < 0.001$) (Table 3).

Discussion

We conducted a cross-sectional study to examine the vaping behaviours, knowledge, and their correlates in a sample of first-year residential college students. We found a considerable rate of lifetime vaping; however, current vaping rates were low and daily use of nicotine vapes was minimal, suggesting a potentially high level of initial experimentation with vaping, but lower frequency of continued use. Our findings did not indicate a strong trend of co-use between vapes and traditional cigarettes. While knowledge about the legalities and potential harms of vaping was relatively sound among the participants, a significant portion lacked this essential information, indicating a need for strategies to improve awareness on vaping harms and laws. Correlates of vaping behaviour included use of other substances, indicating potential polysubstance use. The findings provide useful insights for developing
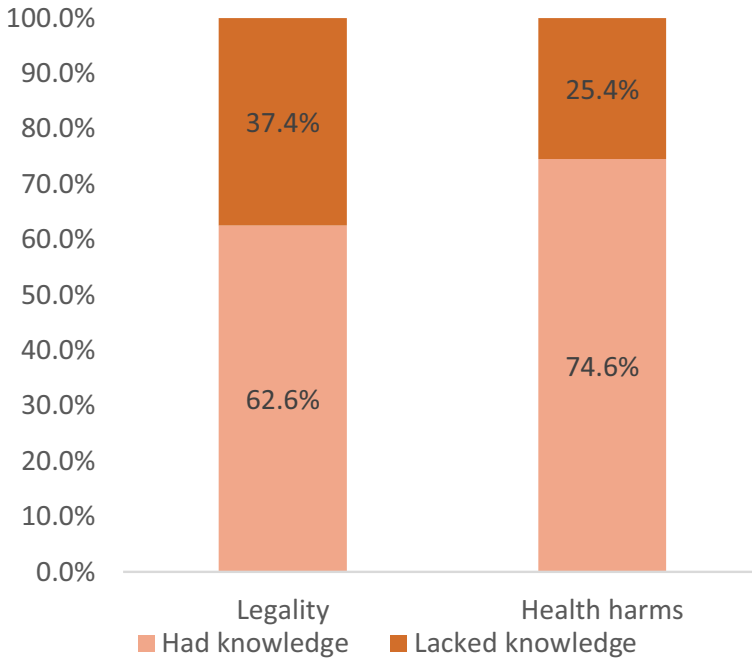
Fig. 1 Knowledge on the legality and health harms of vapes

Table 3 Logistic regression vape use and knowledge

	Adjusted odds ratios and 95%CIs					
	Vaped (ref: no)		Had knowledge (ref: lacked knowledge)			
	Ever vape		Legality		Health harms	
	OR [95%CI]	p	OR [95%CI]	p	OR [95%CI]	p
Male (ref: female/other)	1.74 [1.19–2.56]	0.005	1.76 [1.25–2.47]	0.001	1.55 [1.08–2.22]	0.017
Age 18+ (ref: 16–17)	1.05 [0.68–1.62]	0.827	0.73 [0.49–1.09]	0.122	0.80 [0.52–1.24]	0.322
Urban (ref: rural)	1.06 [0.73–1.54]	0.760	1.13 [0.81–1.58]	0.467	1.16 [0.80–1.67]	0.436
Government benefits (ref: no)	1.00 [0.57–1.75]	0.987	0.78 [0.48–1.26]	0.306	0.93 [0.54–1.59]	0.786
Smoked cigarettes (ref: no)	11.44 [3.35–39.09]	<0.001	1.57 [0.88–2.82]	0.126	0.92 [0.52–1.63]	0.773
Binge drank (ref: no)	5.98 [4.14–8.63]	<0.001	1.94 [1.36–2.78]	<0.001	1.02 [0.69–1.50]	0.920
Cannabis use (ref: no)	9.17 [3.16–26.58]	<0.001	1.64 [0.94–2.84]	0.080	0.94 [0.54–1.61]	0.815
Depression (ref: lower)	0.83 [0.44–1.57]	0.565	0.85 [0.49–1.46]	0.550	0.57 [0.32–1.04]	0.066
Anxiety (ref: lower)	1.51 [0.78–2.92]	0.216	0.88 [0.51–1.51]	0.637	1.90 [0.99–3.65]	0.053

interventions and public health policy to address the emerging public health concern of increasing vaping use among young adults.

Specifically, these results indicate that vaping-specific information should be built into university alcohol and other drug (AOD) harm minimisation efforts (e.g. orientation week AOD education sessions), which are common at Australian residential colleges. More broadly, public health campaigns and policies that aim to minimise vaping and educate the public about its harms should be implemented in Australia, especially targeting young adults. These campaigns could be modelled on or combined with pre-existing public health campaigns and regulations about cigarette smoking that have been successful at reducing cigarette smoking and associated harms in Australia in recent decades.

We found that a minor proportion of participants reported vaping substances other than nicotine, such as other drugs. This trend warrants attention, given the potential risks associated with vaping "other drugs", for instance, the association between vaping contaminated cannabis oil sourced from the black market and acquiring lung injury (Mendelsohn et al., 2023). A noteworthy proportion of respondents also reported using vapes without knowing the content, which also carries inherent risks (i.e. potential to unknowingly consume contaminants, psychoactive substances like THC, or addictive substances like nicotine). Future research should continue to monitor trends in vape use by youth, including rates of use, vape content, and awareness about vaping (in general and specific to their own use), given the high level of use and knowledge gaps observed in this study.

Regarding knowledge, we found a significant number of participants lacked accurate knowledge about vaping. Over a third lacked knowledge on the legality of e-cigarette devices in Australia, and a quarter were unaware of the proven health harms associated with vaping. Our findings correspond with a USA study of undergraduate students that found that students expressed uncertainty about the health risks and addictiveness of vapes (Katz et al., 2022), and a systematic review of young people's health perception of e-cigarettes, which found that there were conflicting perceptions about the health impacts of vapes (Sharma et al., 2021). In a more recent study of a large sample of Australian youths aged 12 and over, adolescents (aged 12–17) and young adults (aged 18–24) were more likely to believe that e-cigarettes hold positive outcomes, such as making people feel relaxed and helping with stress and emotions, than adults aged 25 and over (Thoonen & Jongenelis, 2023). This may imply that youth may be more susceptible to misconceptions and lack of vaping-related knowledge. Youth may be exposed to mixed messages around vaping, including positive messages on social media (Sun et al., 2023), leading to confusion regarding information about e-cigarettes and associated health facts. The lack of awareness found in our study is concerning as it might lead to individuals to unknowingly engaging in illegal activities or behaviours that harm their health. There is a clear need for health promotion programmes to enhance public knowledge in these areas.

There are debates whether vaping leads to traditional cigarette smoking (Shahab et al., 2022). Studies from the USA, where the trend of vaping emerged earlier, found little evidence that vaping has increased traditional smoking rates in youth (Sun et al., 2021). Common risk factors likely play a role in the relationship between vaping and cigarette smoking (Chan et al., 2021a, b). Our data also indicated that vaping flavours without nicotine was not associated with a likelihood of co-using traditional cigarettes. This suggests that non-nicotine flavour vaping is unlikely to act as a gateway to smoking. However, with new regulations restricting vapes with nicotine, there is concern about nicotine-containing vapes being incorrectly labelled. Unknowing consumption of such products could potentially lead to nicotine addiction.

We found that being male was a risk factor for vaping, consistent with the risk factors for traditional cigarette use. However, there have been emerging examples of vaping products marketed specifically towards females that warrant further investigation (Davidson & Al-Hamdani, 2023). Our study sample did not include a significant number of gender-diverse participants and it is known that these groups often face higher risks of substance use and harms (Hoy-Ellis, 2023). Previous studies have reported higher rates of vaping among transgender and gender-diverse youth populations (Felner et al., 2022; Hill et al., 2021; Sawyer et al., 2022). Future research should ensure adequate representation of gender-diverse youth to understand vape use among this community.

Use of other substances was a strong correlate to vaping behaviour in our study. One possible explanation could be that individuals who vape are also those typically at risk for substance use. Previous studies have shown that polysubstance users often face greater health risks and may have less success in abstaining from substance use (Connor et al., 2014). The role of vaping in polysubstance use requires further investigation.

There have been mixed findings on the association between depression, anxiety, and vaping in previous studies (Leung et al., 2023; Melka et al., 2021). Our findings show no significant association between symptoms of depression or anxiety with vaping behaviours. This contrasts previous research, which has indicated a link between traditional cigarette smoking and poorer mental health (Leung et al., 2011). One explanation could be that only a small fraction of our sample vaped nicotine daily. This is consistent with a previous study of adolescents across 47 countries in the World Health Organization's Global Youth Tobacco Survey where the prevalence of frequent vaping (vaped ≥ 10 days in the past month) was low (Chan et al., 2022). Future research should focus on individuals who vape regularly (e.g. daily or weekly) to better understand how vape use relates to mental health. We did not have any hypothesis about the relationship between mental health and knowledge, but we used the same set of correlates in the knowledge and the vape use analysis. We found no association between symptoms of depression and anxiety and knowledge around the legality and potential health harms of vaping. Future research could evaluate the effectiveness of health promotion campaigns that aims to elicit anxiety or fear on the risk of vaping.

Limitations

This study is cross-sectional and causal inferences cannot be made. Additionally, the sample consisted of residential college university students from one Australian university. We attempted to increase generalisability by collecting data across multiple colleges. However, estimates on the levels of vape use are unlikely to be representative of the general young adult population because university students likely differ by social factors. A previous study of young adults aged 18–24 in the USA found that non-students were more likely to vape than college students (Trumbo & Harper, 2016), and if the trend is the same in Australia, our estimated proportion of youth vaping may be underestimated compared to the general youth population.

Our main analyses were focused on lifetime (or ever use) of vapes or e-cigarettes. However, it may have been more informative to examine current use, and particularly regular use. Regrettably, for the current analysis, our survey did not delve into the specific frequency of tobacco product usage, especially when individuals used both cigarettes and nicotine-containing e-cigarettes/vapes. The original survey question prompted students to

detail their usage of various tobacco products, including cigarettes, cigars, and nicotine/tobacco-only e-cigarettes/vapes. However, since the question grouped vaping products together with other tobacco products, we were unable to investigate the simultaneous use of nicotine-only vaping products and other non-vaping nicotine products. Future studies that focus on the regular use of e-cigarette use or vaping are warranted.

While e-cigarettes can be used as a cessation aid for quitting combustible cigarettes (Chan et al., 2021a, b), and Australian data has shown that those who use e-cigarettes daily are more likely to quit smoking (Sun et al., 2022), we did not have data to specifically explore this, but cigarette smoking rates were low in our sample. Future research on people who smoke would enable a deeper understanding of the use of vapes to assist with quitting cigarettes.

Conclusion

We examined vaping behaviours and associated knowledge among university students. Our study reported that the majority had vaped, but a very low percentage vaped regularly. Despite some awareness around the legalities and health impacts of vaping, a notable knowledge gap persists, signalling a need for targeted educational initiatives for young Australians. The link between vaping and other substance use suggests potential polysubstance use. These findings offer valuable insights into youth-focused interventions addressing vaping as a public health issue. Future research should continue to monitor emerging vaping trends, longitudinal relationships, and nicotine cessation efforts.

Declarations

Conflict of Interest The authors declare no competing interests.

Ethics Approval The QuikFix Good Night Out Project was reviewed and approved by The University of Queensland Human Research Ethics Committee (Approval Number: 2020002817).

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