Cigarette smoking and e-cigarette use among university students in New Zealand before and after nicotine-containing e-cigarettes became widely available: results from repeat cross-sectional surveys

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ABSTRACT

AIM: To estimate the prevalence and patterns of smoking and vaping, and associations between smoking and vaping, among university students in New Zealand when access to nicotine-containing e-cigarettes was restricted (ie, time point 1 or T1) and 12-months after restrictions were relaxed (ie, time point 2 or T2).

METHOD: Cross-sectional surveys of university students across all eight universities: T1, March 2018 (n=1,932), and T2, March 2019 (n=2,004). Chi-squared tests compared responses between T1 and T2 and logistic regression examined associations between smoking and vaping with student characteristics.

RESULTS: The patterns of smoking (T1 vs T2): current (10.6% vs 12.1%, p=0.716), daily (5.0% vs 4.6%, p=0.121), and cigarettes/day, time to first cigarette, and avoidance of smoking in smoke-free spaces were not significantly different. In contrast, vaping: current (6.8% vs 13.5%, p<0.001), daily (2.7% vs 5.4%, p<0.001), and possibly vaping in smoke-free spaces, were significantly higher at T2. At both periods, males had higher odds of smoking, vaping and dual use; students aged 25–34 and long-term New Zealand residents had higher odds of vaping. Asian and Other students had lower odds of smoking at T1, and Other students had higher odds of vaping at T2.

CONCLUSION: Vaping was significantly more prevalent at T2 than T1, without there being a corresponding decrease in smoking. Age, sex, student type and ethnicity predicted smoking and vaping.

Cigarette smoking is a leading cause of preventable illness and death in New Zealand[1] and globally[2] and a major contributor to inequalities in health and social wellbeing between Māori and non-Māori New Zealanders.[3] New Zealand aims to be smoke-free by 2025 (the Smokefree 2025 goal)[4] and electronic cigarette/e-cigarette use (vaping) is thought to be a promising alternative for people who smoke cigarettes.

Recent data from the New Zealand Health Survey show a general decline in the prevalence of smoking and an increase in vaping in the population.[5] Overall, 14.2% of people aged 15 years or older smoked at least once a month (ie, currently smoked) in 2018/19 vs 13.4% in 2019/20, and 12.5% smoked at least daily in 2018/19 vs 11.6% in 2019/20. By age, current smoking in 2018/19 vs 2019/20 was 14.4% vs 12.4% in 15–24-year-olds and

18.3% vs 19.8% in 25–34-year-olds, and daily smoking was 11.2% vs 10.1% and 15.5% vs 16.7%, respectively. In contrast, 4.7% vaped at least once a month (ie, currently vaped) in 2018/19 vs 5.2% in 2019/20, and 3.2% vaped at least daily in 2018/19 vs 3.5% in 2019/20. By age, current vaping was 7.1% vs 9.2% in 15–24-year-olds and 7.0% vs 7.7% in 25–34-year-olds, and daily vaping was 3.6% vs 4.2% and 5.1% vs 6.0%, respectively.

Before 12 March 2018, it was illegal to sell nicotine-containing e-cigarettes in New Zealand, but individuals could import small amounts for personal use. However, following a District Court ruling (Ministry of Health v Philip Morris),[6] New Zealand effectively had an unregulated environment for vaping products (including nicotine-containing e-cigarettes). As a result, vaping products and retail outlets grew rapidly alongside blatant marketing of vaping to young people as a lifestyle product, until vaping legislation (Smokefree Environments and Regulated Products (Vaping) Amendment Act 2020) was passed in August 2020.[7]

There is limited information about the prevalence and patterns of smoking and vaping among tertiary students in New Zealand. Two studies of university students aged 18–24 years (2018 data) reported that 49.8% ever smoked, 11.1% currently smoked and 5.9% smoked daily,[8] whereas 40.5% ever vaped, 6.1% currently vaped and 1.7% vaped daily.[9]

No previous study has compared the prevalence and patterns of smoking and vaping before (ie, time point 2 or T1) and after (ie, time point 2 or T2) nicotine-containing e-cigarettes became widely accessible in New Zealand. The current study sought to fill this gap. This information is important to help (1) identify potential trends in patterns of smoking and vaping among young people, (2) assess likely implications of any trends in smoking and (3) guide policy considerations to advance the Government's Smokefree 2025 goal.

Method

Data from two cross-sectional surveys of university students from across New Zealand, conducted in March 2018 (T1) and March 2019 (T2), were analysed. Using previously validated questions, the questionnaire (Appendix 1) collected data on smoking, vaping, the Smokefree 2025 goal and participants' health. The ethnicity question was based on the New Zealand census;[10] tobacco use questions were based on the New Zealand Tobacco Use Survey (NZTUS)[11] and the Fagerstrom Test for Nicotine Dependence Questionnaire (FTNQ);[12] and the questions on e-cigarette use were based on Pearson et al.[13] Questions on smoking and vaping in smoke-free spaces were developed in-house. The T2 questionnaire also asked whether respondents participated in the T1 survey (those who did were excluded from the current analysis). The questionnaire and survey tools (online and in-person) were piloted on 22 students at the University of Canterbury in October 2017.[8]

Both surveys aimed to recruit a minimum of 1,062 students with representation from all eight universities in New Zealand (7–9% Māori, 5–7% Pasifika, 84–88% NZ European/Other). The estimated sample assumed random sampling and was calculated based on available data at the time (ie, the 2016 Universities New Zealand data)[14] that showed the total student population of 172,000, a confidence interval (CI) of 95%, estimated ever-vaping and ever-smoking proportion of 0.5 (conservative estimate) and a margin of error of 3%.[8,9]

We used a convenience sample because complete enrolment lists of students were not available from the universities to allow for random sampling. Information about the research was distributed widely online on students' association Facebook pages and through direct contact with research assistants from all universities. Research assistants approached students on campus and provided a short description of the research, handed the questionnaires and pens to participants, collected completed questionnaires and posted them in secure, registered packages to the principal researcher. All research assistants received training and supervision.[9]

Participation was voluntary and participants were required to provide consent before completing the questionnaire (online or on paper). In both survey cycles, participants could enter into a draw to win one of ten NZ$100 cash prizes after completing the survey as a token of appreciation.[9,15] Internet protocol addresses (IP addresses) were used to identify and remove duplicate entries entered online.

All data were de-identified before analysis, and each response was weighted to improve representation of the New Zealand university student population. The calculation of weights required knowledge of the distribution of the relevant variables over the eight universities.[16] At T1, weighting could be accomplished using sex and university size, with data from the Ministry of Education.[17] Each person was assigned a weight so that the adjusted joint sample distribution of sex and university matched that of the published population for all universities in 2018.[16] At T2 (2019 data), data on the distribution of the relevant variables over the eight universities were not available—each person was assigned a weight so that the adjusted sample distributions of sex and university size matched those of the published population for all universities in 2018.[16]

Participants

A total of 2,180 participants took part in T1 and 1,932 were included in the current analysis (46 were not studying and 202 did not choose a valid university). At T2, 2,257 participants took part, of whom 2,004 were included in the current analysis. Of those excluded from T2, 74 did not provide a valid university, 179 participated in T1 or had missing data on participation in T1 (excluded to obtain two independent samples). However, the demographic characteristics of participants and patterns of smoking and vaping were similar at T2, with or without the excluded T1 participants. Valid universities included: Auckland, Canterbury, Lincoln, Massey, Otago, Waikato, Auckland University of Technology and Victoria University of Wellington.

Ethics approval

The University of Canterbury Human Ethics Committee approved both surveys together (research ethics ID: HEC 2017/42/LR-PS) and we undertook Māori consultation through the Ngāi Tahu Consultation and Engagement Group.

Survey measures

Demographic information

Age: For the purpose of analysis, age was categorised into three groups (<25 years, 25–34 years and ≥35 years). This allowed for comparisons with population estimates that use similar age groups[5] as well as ensuring adequate numbers in subgroups.

Gender: We categorised gender into male, female and other (includes respondents who reported gender as "other" and "prefer not to say"). However, only male and female were used in analysis because of small numbers of other (n=24), and thus the variable was labelled "sex."

Ethnicity: Ethnicity was categorised into New Zealand European (NZ European), Māori, Pasifika (included Samoan, Cook Island Māori, Tongan and Niuean), Asian (included Indian and Chinese) and Other. We recorded each ethnicity and thus allowed "n" to increase in the presentation of data.

Student type: Neither survey asked information about the nationality or residency status of participants. For this analysis, participants who had lived in New Zealand for ≤5 years were categorised as short-term New Zealand residents, and those who had lived in New Zealand for ≥6 years were categorised as long-term New Zealand residents.

Cigarette smoking: Respondents who answered "Yes" to the question, "Have you smoked cigarettes or tobacco at all, even just a few puffs?" were categorised as "ever smoked"; respondents who smoked at least once a month as "currently smoked"; and those who smoked at least once a day as "smoked daily," consistent with previous research.[8,9,15,18]

The number of cigarettes per day was categorised as: 1–5, 6–10 and more than 10. The time to smoking the first cigarette after waking up was categorised as: within 30 minutes, 31–60 minutes and more than 60 minutes. Smoking in smoke-free places was categorised as: never/almost never and other. Intentions to quit smoking were categorised as: yes, within 30 days; yes, after 30 days but within 3 months; yes, but not within the next 3 months; and not planning on giving up smoking. Attempts to quit smoking in the last 12 months was categorised as: yes or no. The number of serious attempts to quit in the last 12 months were categorised as: 1–3, 4–5 and more than 5.

E-cigarette use: Respondents who answered "Yes" to the question, "Have you ever tried an e-cigarette or vaping device?" were categorised as "ever vaped"; those who vaped at least once a month as "currently vaped"; and respondents who vaped at least once a day as "vaped daily," consistent with previous research.[9,15,18]

Further, respondents were asked whether they had "used an e-cigarette or vaping device daily for a month or more," and those who had were asked whether the e-cigarette that they used most often contained nicotine. Other variables include: vaping in smoke-free spaces (never/almost never and other); reasons for vaping (quit smoking, enjoyment and curiosity); and perceptions of the harmfulness of e-cigarettes compared with cigarettes (coded on Likert scale: 1 = much less harmful than cigarettes; 2 = somewhat less harmful than cigarettes; 3 = about the same as cigarettes; 4 = somewhat more harmful than cigarettes; and 5 = much more harmful than cigarettes).

Data analysis

Chi-squared tests were used to compare the overall prevalence of smoking and vaping, and Mann–Whitney U tests were used to compare the differences in the perceptions of harmfulness of e-cigarettes compared with cigarettes, between T1 and T2. Further, logistic regression assessed the associations between smoking and vaping with student characteristics (age, sex, student type and ethnicity). Four new variables were created and used in logistic regressions: (1) exclusive smoking (smoking currently[8,19] and not vaping currently); (2) exclusive vaping (vaping currently[20,21] and not smoking currently); (3) dual use (smoking and vaping currently); and (4) non-use (neither smoking nor vaping currently).

The variables were coded as age (1 = ≥35 years, 2 = 25–34 years, 3 = <25 years), sex (1 = male, 2 = female), student type (1 = long-term New Zealand resident, 2 = short-term New Zealand resident) and smoking and vaping (1 = dual use, 2 = exclusive smoking, 3 = exclusive vaping, 4 = non-use). The last category was used as reference category. All statistical analyses were performed using IBM SPSS Statistics V.27 and two-sided $p<0.05$ was considered statistically significant; confidence intervals (95% CI) were reported.

Results

Participants

The demographic characteristics of participants are displayed in Table 1. The age and sex of participants at T1 and T2 were similar; there were more New Zealand European participants (56.4% vs 51.2%) and fewer Pasifika (4.6% vs 6.1%) and Asian participants (15.8% vs 21.5%) at T2; Māori participants were similar at both surveys.

Smoking

Patterns of ever (51.5% vs 50.9%, p=0.716), current (10.6% vs 12.1%, p=0.121) and daily smoking (5.0% vs 4.6%, p=0.528), number of cigarettes per day, time to smoking the first cigarette after waking up, avoiding smoke-free spaces (indoors 88.3% vs 90.1%, p=0.506; outdoors 67.8% vs 67.2%, p=0.874), intentions to quit smoking and the number of serious quit attempts in the last 12 months were not significantly different between the two surveys (Table 2).

E-cigarette use

The prevalence of ever (37.3% vs 47.4%, p<0.001), current (6.8% vs 13.5%, p<0.001) and daily vaping (2.7% vs 5.4%, p<0.001) was significantly higher at T2, whereas non-use in smoke-free spaces (indoors 77.5% vs 68.0%, p=0.003; outdoors 71.3% vs 60.8%, p=0.002) was significantly lower at T2 compared with T1 (Table 3). At T2 there was a significant shift in the perception of harmfulness of e-cigarettes on a 5-point Likert scale (Mann–Whitney test, p=0.010), but over both time periods the majority of students (T1:75.5%, T2: 72.4%) still perceived e-cigarettes as less harmful than cigarettes.

Table 4 displays the reasons for vaping among students at T1 and T2, by age, sex, ethnicity and student type. Overall, curiosity was the leading reason for vaping (except for students ≥35 years at T1 where the majority vaped to quit smoking).

The association between smoking and vaping with student characteristics

A set of multinomial logistic models predicted smoking and vaping status with age, sex, student type and ethnicity as predictors. The T1 model was significant: χ^2 (27, N=1,847) = 93.059, p<0.001 and age, sex, student type and ethnicity made a significant contribution to the model (Table 5). Compared with females, males had higher odds of dual use (OR=3.13, 95% CI: 1.49 to 6.56), exclusive smoking (OR=2.56, 95% CI: 1.82 to 3.61) and exclusive vaping (OR=1.99, 95% CI: 1.29 to 3.06). Asian students had lower odds of exclusive smoking than non-Asian students (OR=0.32, 95% CI:

Table 1: Demographic characteristics of participants at T1 and T2 surveys.

	T1 survey (n = 1,932)		T2 survey (n = 2,004)	
	n	%	n	%
Age (years)				
<25	1,595	82.6	1,631	81.4
25–34	270	14.0	284	14.2
≥35	66	3.4	85	4.2
Missing data	1	0.1	4	0.2
Gender				
Male	740	38.3	828	41.3
Female	1,114	57.7	1,094	54.6
Other*	24	1.2	37	1.8
Missing data	54	2.8	45	2.2
Ethnicity†				
NZ European	989	51.2	1,130	56.4
Māori	156	8.1	161	8.0
Pasifika	117	6.1	92	4.6
Asian	415	21.5	316	15.8
Other	494	25.6	504	25.1
Years lived in New Zealand				
≤5 years	491	25.4	469	23.4
≥6 years	1,434	74.2	1,532	76.4
Missing data	7	0.4	3	0.1

*Includes those who said "other" (13) and "prefer not to say" (11). †Multiple responses were allowed, hence percentages add up to more than 100%.

Table 2: The patterns of smocking at T1 and T2 (overall).

	T1 survey		T2 survey		p-value
	%	95% CI	%	95% CI	
Ever smoked	51.5	49.1–53.7	50.9	48.9–53.1	0.716
Currently smoked	10.6	9.2–12.0	12.1	10.7–13.6	0.121
Smoked daily	5.0	4.1–6.1	4.6	3.7–5.6	0.528
Number of cigarettes/day					
1–5	68.0	61.1–74.3	69.5	63.5–75.1	0.926
6–10	17.5	12.6–23.4	16.2	11.9–21.3	
More than 10	14.6	10.1–20.1	14.3	10.3–19.2	
Time to smoking the first cigarette					
Within 30 minutes	17.2	12.5–22.8	18.2	13.8–23.4	0.740
31–60 minutes	11.8	7.8–16.8	13.8	9.9–18.5	
>60 minutes	71.0	64.6–76.9	68.0	62.1–73.6	
Did not smoke in smoke-free spaces					
Indoors	88.3	83.5–92.2	90.1	86.0–93.4	0.506
Outdoors	67.8	61.4–73.8	67.2	61.2–72.7	0.874
Intentions to quit smoking					
Yes, within 30 days	19.3	14.4–25.0	21.3	16.6–26.7	0.265
Yes, after 30 days but within 3 months	14.5	10.2–19.7	12.5	8.8–17.0	
Yes, but not within the next 3 months	34.7	28.5–41.2	27.9	22.7–33.7	
Not planning on giving up smoking	31.6	25.6–38.0	38.2	32.4–44.3	
Attempts to quit smoking					
Tried to quit in the last 12 months	36.1	29.9–42.7	40.9	35.0–47.0	0.272
Made 1–3 serious quit attempts	69.6	58.3–79.5	70.0	60.5–78.4	0.367
Made 4–5 serious quit attempts	17.7	10.0–27.9	11.8	6.5–19.4	
More than 5 serious quit attempts	12.7	6.2–22.1	18.2	11.5–26.7	

Table 3: The patterns of e-cigarette use at T1 and T2 (overall).

	T1 survey		T2 survey		p-value
	%	95% CI	%	95% CI	
Ever vaped	37.3	35.2–39.5	47.4	45.2–49.6	<0.001
Currently vaped	6.8	5.7–8.0	13.5	12.0–15.1	<0.001
Vaped daily	2.7	2.0–3.5	5.4	4.4–6.5	<0.001
Vaped daily for a month or more	15.4	12.5–18.7	17.8	15.4–20.4	0.247
Used nicotine-containing e-liquids	78.5	67.8–86.9	83.8	77.1–89.1	0.318
Did not vape in smoke-free spaces					
Indoors	77.5	72.7–81.8	68.0	63.8–72.1	0.003
Outdoors	71.3	66.1–76.0	60.8	56.4–65.1	0.002
Reasons for vaping					
To quit smoking	6.2	4.3–8.6	5.7	4.3–7.4	0.689
Enjoyment	13.7	10.9–16.9	16.5	14.2–19.1	0.156
Curiosity/just wanted to try	63.9	59.7–68.0	63.0	59.8–66.2	0.735

Table 4: The reasons for vaping at T1 and T2 by age, sex, ethnicity and student type.

	T1 survey			T2 survey		
	To quit (%)	Enjoyment (%)	Curiosity (%)	To quit (%)	Enjoyment (%)	Curiosity (%)
<25 years	2.4	14.6	68.3	3.9	17.6	64.3
25–34 years	27.9	6.6	41.0	18.9	9.5	55.8
≥35 years	41.7	8.3	16.7	16.7	5.6	44.4
Male	7.1	14.3	60.9	6.0	21.1	54.8
Female	5.6	12.1	67.3	5.4	12.3	71.8
NZ European	6.6	11.9	67.6	5.4	17.6	63.7
Māori	8.3	20.0	61.7	7.0	10.5	60.5
Pasifika	8.1	18.9	62.2	5.9	11.8	58.8
Asian	3.0	19.7	56.1	6.6	11.3	67.0
Other	5.4	13.0	57.6	6.1	15.7	62.1
Long-term NZ resident	6.6	13.3	65.6	5.0	17.0	63.7
Short-term NZ resident	4.1	16.4	52.1	10.0	13.1	59.2

0.14 to 0.71) and students whose ethnicity was Other had lower odds of exclusive smoking than students whose ethnicity was non-Other (OR=0.45, 95% CI: 0.22 to 0.93). Compared with students aged <25 years, students aged 25–34 years (OR=1.90, 95% CI: 1.07 to 3.39) and students aged ≥35 years (OR=2.74, 95% CI: 1.09 to 6.90) had higher odds of exclusive vaping. Long-term residents had higher odds of exclusive vaping (OR=2.94, 95% CI: 1.34 to 6.44) than short-term residents.

Likewise, the T2 model was significant: χ^2 (27, N=1,916) = 167.821, p<0.001 and age, sex, student type and ethnicity made a significant contribution to the model (Table 5). Compared with females, males had higher odds of dual use (OR=4.89, 95% CI: 3.08 to 7.77), exclusive smoking (OR=1.45, 95% CI: 1.01 to 2.09) and exclusive vaping (OR=2.36, 95% CI: 1.68 to 3.33). NZ European students had higher odds of exclusive vaping than non-NZ European students (OR=3.62, 95% CI: 1.90 to 6.90) and students whose ethnicity was Other had higher odds of exclusive vaping than students whose ethnicity was non-Other (OR=2.56, 95% CI: 1.40 to 4.70). Students aged 25–34 years had lower odds of exclusive vaping (OR=0.47, 95% CI: 0.23 to 0.98) compared with students aged <25 years, whereas long-term New Zealand residents had higher odds of exclusive vaping than short-term New Zealand residents (OR=2.24, 95% CI: 1.08 to 4.65).

Discussion

To the best of our knowledge, this is the first study in New Zealand to assess and compare (1) the prevalence and patterns of smoking and vaping, and (2) the associations between smoking and vaping with university student characteristics before (T1) and after (T2) restrictions on access of nicotine-containing e-cigarettes were relaxed in New Zealand.

Overall, we found similar prevalence of smoking (ever, current and daily), cigarettes per day, time to smoking the first cigarette and avoidance of smoking in smoke-free spaces at T1 and T2. In contrast, we found significantly higher prevalence of vaping (ever, current and daily), and significantly lower prevalence of non-use in smoke-free spaces, at T2 compared with T1. At both surveys, males were more likely to exclusively smoke, exclusively vape or dual use than females; students aged 25–34 were more likely to exclusively vape than students <25 or ≥35, and long-term New Zealand residents were more likely to exclusively vape than short-term New Zealand residents. Students who identified as Asian or Other were less likely to exclusively smoke at T1 than non-Asian and non-Other students, respectively. Further, students who identified as Other were more likely to exclusively vape at T2 than non-Other students.

The observed decline in students who reported non-use of e-cigarettes in indoor (from T1 77.5% to T2 68.0%, p=0.003) or outdoor smoke-free spaces (from T1 71.3% to T2 60.8%, p=0.002) is of great concern. If vaping in smoke-free spaces became widespread and led to increased smoking in these spaces, this would be a source of considerable harm to public health. We also found a non-significant increase in the use of nicotine-containing e-liquids (78.5% vs 83.8%, p=0.318). Consistent with previous research,[20–24] our results showed strong associations between smoking and vaping, particularly in male participants.

These findings suggest that university students (and possibly other tertiary students) may be vaping for reasons other than to quit smoking. Indeed, the majority of those who vaped reported curiosity (T1: 63.9%, T2: 63.0%) as the most common primary reason for vaping, followed by enjoyment (T1: 13.7%, T2: 16.5%) and to quit smoking (T1: 6.2%, T2: 5.7%), consistent with previous research.[9] Students aged <25 years were less likely to vape to quit (T1: 2.4%, T2: 3.9%) compared with students aged 25–34 years (T1: 27.9%, T2: 18.9%) or ≥35 years (T1: 41.7%, T2: 16.7%), which might suggest younger students had lower nicotine addiction than older students.

A key finding of this analysis was the significant shift in perceptions of harmfulness of e-cigarettes (moving from "much less/somewhat less harmful" at T1 towards "somewhat more/much more harmful" at T2), but overall more students perceived e-cigarettes as less harmful than cigarettes at both time points. Similar shifts have been reported in adults in the United States, where more people perceived e-cigarettes to be equally or more harmful than cigarettes in 2015 compared with 2012.[25]

Table 5: Multinomial logistic models predicting the likelihood of dual use, exclusive smoking and exclusive vaping in university students in New Zealand at T1 and T2.

		T1 survey			T2 survey		
		OR	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Dual use vs non-use	<25 years	Ref			Ref		
	25–34 years	1.49	0.57–3.91	0.415	0.62	0.30–1.25	0.182
	≥35 years	2.14	0.46–9.94	0.330	0.41	0.10–1.78	0.234
	Female	Ref			Ref		
	Male	3.13	1.49–6.56	0.003	4.89	3.08–7.77	<0.001
	Short-term resident	Ref			Ref		
	Long-term resident	0.68	0.22–2.11	0.506	1.13	0.56–2.29	0.726
	NZ European	3.24	0.82–12.79	0.094	1.94	0.92–4.10	0.082
	Māori	1.37	0.40–4.75	0.619	2.43	1.29–4.57	0.006
	Pasifika	0.92	0.11–7.58	0.935	0.61	0.14–2.68	0.510
	Asian	1.23	0.31–4.85	0.770	0.96	0.40–2.30	0.928
	Other	1.49	0.46–4.87	0.508	1.65	0.76–3.59	0.210
Exclusive smoking vs non-use	<25 years	Ref			Ref		
	25–34 years	0.68	0.39–1.19	0.176	1.49	0.89–2.47	0.127
	≥35 years	0.63	0.22–1.82	0.395	0.85	0.33–2.21	0.744
	Female	Ref			Ref		
	Male	2.56	1.82–3.61	<0.001	1.45	1.01–2.09	0.045
	Short-term resident	Ref			Ref		
	Long-term resident	0.89	0.54–1.46	0.634	0.95	0.54–1.66	0.847
	NZ European	0.55	0.28–1.09	0.087	1.14	0.56–2.32	0.716
	Māori	1.15	0.62–2.15	0.656	1.58	0.82–3.01	0.169
	Pasifika	0.75	0.33–1.72	0.500	0.74	0.24–2.27	0.598
	Asian	0.32	0.14–0.71	0.005	0.78	0.35–1.75	0.552
	Other	0.45	0.22–0.93	0.031	1.01	0.48–2.13	0.976

Table 5: Multinomial logistic models predicting the likelihood of dual use, exclusive smoking and exclusive vaping in university students in New Zealand at T1 and T2 (continued).

		T1 survey			T2 survey		
		OR	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Exclusive vaping vs non-use	<25 years	Ref			Ref		
	25-34 years	1.90	1.07–3.39	0.029	0.47	0.23–0.98	0.044
	≥35 years*	2.74	1.09–6.90	0.032	-	-	-
	Female	Ref			Ref		
	Male	1.99	1.29–3.06	0.002	2.36	1.68–3.33	<0.001
	Short-term resident	Ref			Ref		
	Long-term resident	2.94	1.34–6.44	0.007	2.24	1.08–4.65	0.030
	NZ European	0.94	0.42–2.12	0.882	3.62	1.90–6.90	<0.001
	Māori	1.28	0.62–2.62	0.509	1.00	0.51–1.94	0.999
	Pasifika	0.35	0.08–1.59	0.172	1.17	0.44–3.14	0.751
	Asian	0.58	0.22–1.48	0.251	0.91	0.41–1.99	0.805
	Other	0.76	0.34–1.74	0.519	2.56	1.40–4.70	0.002

*Maximum likelihood estimates for ≥35-year-olds were unable to be calculated for T2 survey because of quasi-complete separation in the data. This was because no ≥35-year-old responded that they exclusively vaped.

Policy implications

Our findings suggest e-cigarette use among university students and possibly use in smoke-free spaces might be increasing. Ongoing data collection is required to better understand how trends in e-cigarette use impact on smoking and the Government's aspirations for New Zealand to become smoke-free by 2025.[16]

Limitations

This study has a number of limitations. Firstly, it used convenience samples, which are susceptible to volunteer bias. However, data were weighted to partly address this bias. Secondly, data were self-reported. Self-reported data are susceptible to under- or over-reporting, which can result in overestimation or underestimation of the reported estimates. Thirdly, although age, sex and the proportion of Māori participants were similar at T1 and T2, there was a greater proportion of NZ European and fewer Pasifika and Asian participants at T2, which might have affected the results. Further, cross-sectional studies cannot assess cause and effect, so the results should be interpreted in that light.

Conclusion

The results suggest a significant increase in the prevalence of vaping between March 2018 and March 2019, a period that was characterised by rapid growth in the vaping industry (products and retail outlets) in New Zealand. However, the increase in vaping was not accompanied by a decrease in the prevalence of cigarette smoking. Ongoing data are required to monitor trends in smoking and vaping, particularly in smoke-free spaces.

Competing interests:
Nil.
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