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Cigarette smoking among university students aged 18-24 years in New Zealand - Results of the first (baseline) of two national surveys.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-032590
Article Type:	Research
Date Submitted by the Author:	26-Jun-2019
Complete List of Authors:	Wamamili, Ben; University of Canterbury, Health Sciences Wallace-Bell, Mark; Health Sciences Richardson, Ann; University of Canterbury Grace, Randolph; University of Canterbury Coope, Pat; University of Canterbury, Health Sciences
Keywords:	smoking, prevalence, cross-sectional, university students, New Zealand

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Title page

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Keywords: prevalence, cross-sectional survey, cigarette smoking, university students, New Zealand.

Word count: 3,475 (excluding title page, abstract, figures, tables and references).

Abstract

Objectives

This study aimed to examine the prevalence of, and patterns of cigarette smoking among university students in New Zealand aged 18-24 years.

Setting

Although smoking prevalence continues to decline in New Zealand overall, little is known about smoking among university students. A previous study reported daily smoking prevalence of 3%. However, the sample was not representative of the general New Zealand university student population.

Methods

Data came from a March-May 2018 survey of students from all New Zealand universities, on smoking, vaping and NZ's Smokefree 2025 goal. 1611 met the inclusion criteria; SPSS was used for analysis. Results are age, gender and ethnicity-specific.

Participants

Of 1611 participants included, 980 (60.8%) were age 18-20 and 631 (39.2%) were 21-24 years; 600 (37.2%) male and 945 (58.7%) female; 134 (8.3%) Māori and 1477 (91.7%) non-Māori, and 1171 (73.0%) had lived in NZ for over 10 years.

Results

Of 1607 respondents, 51.2% reported ever smoking, 12.6% currently smoked (any frequency), 5.0% smoked at least daily, and 10.9% smoked at least once a month. Of current smokers, 69.1% smoked 1-5 cigarettes/day, 39.9% smoked at least daily, 75.8% smoked first cigarette >60 minutes after waking, 88.5% never/almost never smoked in indoor, and 66.7% in outdoor smokefree spaces, 69.2% planned to quit, and 32.8% had tried to quit.

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4 Ever smoking was significantly higher among those aged 21-24 than 18-20 years ($p<.001$); ever
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6 ($p<.001$), current ($p=.003$), and daily smoking ($p=.004$) were significantly higher in males, and ever
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8 smoking was significantly higher in Māori than non-Māori ($p<.001$).
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12 **Conclusions**
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15 Smoking prevalence among NZ university students aged 18-24 could be higher than previously
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17 thought. However, many appeared less addicted to nicotine, and willing to quit. We recommend
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19 increasing availability of smokefree services for students who wish to quit.
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24 **Strengths and limitations of this study**
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- This is the first study in New Zealand to examine the prevalence of cigarette smoking, and patterns of smoking in a sample of university students across the country.
 - The sample used in this study was representative of the general university student population (aged 18-24 years) in terms of gender, ethnicity, and nationality (domestic or international).
 - The two main limitations of this study are that sampling was not random, and not all universities were equally represented (some were over represented while others were under represented).

INTRODUCTION

Tobacco continues to be a leading cause of preventable morbidity and mortality in Aotearoa New Zealand (New Zealand or NZ), with an estimated 5,000 deaths each year linked to smoking[1]. Smoking is a major contributor to health inequalities in NZ, with mortality rates among Māori, the Indigenous population of NZ, roughly twice those of non- Māori non-Pacific people (mainly NZ European)[2]. Monitoring smoking behaviours is vital in order to inform tobacco control policies to reduce preventable deaths and morbidity, and to reduce inequalities.

Despite an overall decline in smoking prevalence in NZ over recent years, still around 15% of adults aged 15 years or older currently smoke [3] and the prevalence is much higher in people aged 18-24 (20%) and 25-34 (22%), and Pacific peoples (23%), and Māori (34%)[3].

Rationale

There is limited information on smoking among university students in NZ currently. A 2004 study that looked at smoking in students at the University of Otago[4] found 10% of respondents smoked daily and a further 10% reported occasional smoking. These estimates were however much lower than estimates of smoking prevalence among people in the same age-group in the general population at the time, that ranged between 18.8-26.8% in 15-19 year olds and 29.8-30.3% in 20-24 year olds[5]. In another study that estimated the prevalence of daily and occasional smoking among university students aged 17-25 years from five NZ universities in 2013, 14% of participants reported smoking occasionally and 3% reported smoking on a daily basis[6]. As in the previous study however, reported estimates in this study were much lower than those in the wider population within the same age-group[7].

University students experience fundamental changes in social contexts and identity, as they transition to life away from home (most but not all) and make new friends at university[8, 9]. This increased

1 independence and new peers, may promote smoking among occasional smokers, and increase
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4 progression to daily smoking[8].
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8 **Objectives**
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10 The aims of this study were to estimate the prevalence, and patterns of smoking among university
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12 students aged 18-24 years in a national university student population.
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19 **Setting**
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21 Students enrolled at all universities in NZ (eight in total) in 2018.
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27 **METHODS**
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32 We analysed data from the first of two surveys (the ‘Baseline survey’), a cross-sectional survey
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34 conducted between March and May 2018 as part of the corresponding author’s PhD thesis project. The
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36 survey collected data on the perceptions of university students in New Zealand on vaping, cigarette
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38 smoking, and the Smokefree 2025 goal. The Smokefree 2025 goal is an NZ government initiative to
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40 reduce the smoking prevalence in the country to 5% or less by the year 2025[10].
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46 The Baseline survey aimed to recruit a minimum of 1,061 students from all eight NZ universities: 902
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48 domestic and 160 international, using multiple approaches, to increase the participation of Māori and
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50 Pasifika students. Sample size calculations were based on the 2016 Universities NZ data[11] which
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52 showed the total NZ university students at 172,000, 85% of whom were domestic (11% Māori, 7.8%
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54 Pasifika and 81.2% non-Māori non-Pasifika) and 15% international students; a confidence interval (CI)
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56 of 95%; estimated smoking proportion of 0.5 (conservative estimate); margin of error of 3%, and
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58 estimated response rate of 10%. 10,610 students were to be invited, but far more were reached.
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Random sampling was not feasible, because complete enrolment lists of students were not available. However, the questionnaire comprised both an online and printed version and was distributed widely, using social media and other forms of advertising, and direct contact with student volunteers. 2180 students participated and 1611 met the criteria for inclusion in the current study (i.e. they were studying at an NZ university and were aged 18-24 years). **Figure 1** describes how participants were selected.

The survey

In the online route, the project was advertised on students' association Facebook pages at respective universities, where this was possible, using a single advert message and photograph. In addition to adverts in general students' association social media platforms, further engagements were made with Māori and Pasifika students' associations. Printed questionnaires were distributed by research assistants (RAs) and volunteers, from participating universities. RAs were recruited from Student Job Search (SJS), a charitable organisation formed by student associations in NZ to help current students and recent graduates of tertiary education institutions in NZ find work[12].

The questionnaire used validated questions: the ethnicity question was based on the NZ census question[13], ever smoking question on NZ Tobacco Use Survey (NZTUS)[14], frequency of smoking question was adapted from Marsh and others who looked at the association of smoking with drinking in NZ university students[6], and NZTUS[14], cigarettes/day question was adapted from the Fagerstrom Test for Nicotine Dependence Questionnaire (FTNQ)[15], time to first cigarette question was adapted from NZTUS[14] and FTND[15], and quit intentions from NZTUS[14]. Questions on current smoking, smoking in smokefree spaces, and number of quit attempts were developed in-house. We piloted the questionnaire and survey methods on 22 students at the University of Canterbury (UC) in October 2017. Respondents were contacted using approaches described previously.

Survey measures

Responses to two sections: demographic information and tobacco use, out of four sections asked in the Baseline survey are relevant to this paper and explained below.

Demographics

Respondents provided information on:

- Age: 17 years or younger, 18-20 years, 21-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, and 45 years or older. Only those aged 18-24 years were included in the analysis.
- Gender: male, female, other or prefer not to say. Gender-specific analyses included only participants who identified as male or female. This was due to extremely small numbers of those who said ‘Other’, preferred not to identify their gender or did not respond.
- Ethnicity (based on the NZ census question): NZ European, Māori, Samoan, Cook Island Māori, Tongan, Niuean, Chinese, Indian or Other (participants were able to select multiple responses). Ethnicity-specific analyses compared Māori and non-Māori, as in previous studies[4, 16, 17].
- Country of birth: NZ, Australia or Other.
- Years lived in NZ: less than 1 year, 1-5 years, 6-10 years or more than 10 years.
- University where participants were studying: Auckland University of Technology (AUT), Lincoln University (Lincoln), Massey University (Massey), University of Auckland (Auckland), UC, University of Otago (Otago), University of Waikato (Waikato), Victoria University of Wellington (VUW), or Other (participants were asked to state where in writing). More than one university could be selected.

Tobacco use

Respondents were asked ‘Have you smoked cigarettes or tobacco at all, even just a few puffs?’, and responses were: ‘Yes’ and ‘No’. Those who answered ‘Yes’ (defined as ‘ever smokers’) were asked ‘Do you currently smoke cigarettes or tobacco? This includes roll-your-own (RYO)’, and responses

were: 'Yes' and 'No'. Those who answered yes (defined as 'current smokers') were asked 'Which of the following best describes how often you smoke cigarettes or tobacco now?', and responses were: 'At least once a day', 'At least once a week', 'At least once a month', and 'Less often than once a month'. Those who smoked at least once a month or more frequently, were defined as 'regular smokers'. A new variable was created to separate current smokers who smoked at least once a day from those who smoked less often than once a week.

Current smokers were further asked: 'During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?' and responses were: '1 to 5', '6 to 10', '11 to 20', '21 to 30', '31 or more', and 'Don't know'. During coding, two new variables were created, the first one having responses as: '1-5', '6-10', '11-20', and '21 or more', and the second with just two responses as: '1-5 cigarettes' and '>5 cigarettes'.

Time to smoking the first cigarette was asked using the question 'How soon after waking do you smoke your first cigarette?' and responses were: 'Within 5 minutes', '5-30 minutes', '31-60 minutes', and '>60 minutes'. During coding, only three groups were used: 'Within 30 minutes', '31-60 minutes', and '>60 minutes'. This was done because of small numbers in those who reported smoking within 5 minutes.

Smoking in spaces where smoking is banned was assessed by 'How often do you smoke in the following settings...? (1) In indoor spaces where smoking is banned, and (2) In outdoor spaces where smoking is banned', and responses for both were: 'Never', 'Almost never', 'Sometimes', 'Fairly often', and 'Very often'. During coding, those who said 'Never' and 'Almost never' were combined into 'Never/almost never', those who said 'Sometimes' stayed that way and those who said 'Fairly often' and 'Very often' were combined to form 'Fairly/very often'. This was done because of small numbers of those who said fairly or very often.

1 The first question on quitting asked: ‘Are you planning on giving up smoking?’, and responses were:
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3 ‘Yes, within 30 days’, ‘Yes, after 30 days but within 3 months’, ‘Yes, but not within the next 3 months’,
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5 and ‘No, I am not planning on giving up’. During coding, two groups were created: ‘Yes, I plan to quit’
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7 (included all who said planned to quit, regardless of timeline) and ‘Not planning to quit’. The second
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9 question on quitting asked ‘Have you tried to quit smoking at any time in the last 12 months?’, and
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11 responses were: ‘Yes’ and ‘No’.
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17 Those who had tried to quit were asked ‘In the last 12 months, how many serious attempts to stop
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19 smoking did you make that lasted 24 hours or longer? Please include any attempts that you are currently
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21 making.’, and responses were: ‘1-3’, ‘4-5’ and ‘More than 5’. Because of small numbers of those who
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23 reported making ‘4-5’ or ‘More than 5’ attempts, these were combined, resulting in just two groups:
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25 ‘1-3 attempts’ and ‘>3 attempts’.
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31 **Data analysis**

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33 Chi-squared tests were used to compare smoking prevalence by age (18-20 vs. 21-24), gender (male vs.
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35 female) and ethnicity (Māori vs. non-Māori). All statistical analyses were performed using IBM SPSS
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37 Statistic 25 and two-sided $p<.05$ was considered statistically significant.
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44 **RESULTS**

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46 Demographic characteristics of the sample are reported in **Table 1**. 56.2% identified as NZ European,
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48 8.3% as Māori, 7.7% as Pasifika (in this study Pasifika included Samoan, Cook Island Māori, Tongan
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50 and Niuean), 15.1% as Chinese, 5.5% as Indian, and 21.4% as ‘Other’. The total percentage exceeds
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52 100% because, as in the NZ census, respondents could select as many ethnic groups as applied.
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58 ***Overall smoking***

Of 1607 (99.8%) students who responded to this question, 822 (51.2%) reported ever smoking, 203 (24.9% of ever smokers or 12.6% of the entire sample) currently smoked and 176 (86.7% of current smokers or 10.9% of the sample) smoked regularly. Of current smokers, 69.1% smoked 1-5 cigarettes/day, 18.8% smoked 6-10, 8.3% smoked 11-20 and 3.9% smoked 21 or more cigarettes/day; 39.9% (or 5.0% of the entire sample) smoked at least once a day, 25.6% at least once a week, 21.2% at least once a month and 13.3% smoked less often than once a month. 14.2% of smokers smoked their first cigarette within 30 minutes of waking, 10.0% within 31-60 minutes and 75.8% after more than 60 minutes of waking up; 88.5% reported never or almost never smoking in indoor and 66.7% in outdoor spaces where smoking is banned; 69.2% planned to quit; 32.8% reported trying to quit in the last 12-months, and 70.5% of those had made 1-3 serious attempts to quit smoking.

Smoking by age

Ever smoking ($p<.001$) was statistically significantly higher in students aged 21-24 than those aged 18-20 years; current smoking ($p=.359$), regular smoking ($p=.794$), smoking at least once a day ($p=.159$), number of cigarettes/day on the days the respondent smoked ($p=.517$), and trying to quit in the last 12 months ($p=.149$), were not statistically significantly different between the two groups (**Table 2**). 1607 (99.8%) of students responded to the question on ever smoking; 815 (99.1%) of ever smokers responded to the question on current smoking; 203 students responded to the question on regular smoking, and at least once daily smoking (**Table 2**).

Smoking by gender

Gender-specific analyses included 600 (38.8%) males and 945 (61.2%) females. Ever ($p<.001$), current ($p=.003$), and at least daily smoking ($p=.004$) were statistically significantly higher in males compared to females, but regular smoking ($p=.331$), number of cigarettes/day ($p=.076$), and trying to quit in the last 12 months ($p=.859$) were not statistically significantly different (**Table 3**).

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2 ***Smoking by ethnicity***

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4 Ever smoking ($p<.001$) was statistically significantly higher in Māori compared to non-Māori; current
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6 smoking ($p=.396$), regular smoking ($p=.292$), at least daily smoking ($p=.389$), number of cigarettes/day
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8 ($p=.924$), and trying to quit smoking in the last 12 months ($p=.415$), were not statistically significantly
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10 different between Māori and non-Māori (**Table 4**).
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15 **DISCUSSION**

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21 This study estimates, in a New Zealand university student population, the prevalence of current smoking
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23 (daily or occasionally) of 12.6%, regular smoking (at least once a month or more frequently) of 10.9%,
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25 and daily smoking of 5.0%. It also reports higher ever smoking, current smoking and daily smoking
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27 estimates in males compared to females, and higher ever smoking estimates in Māori compared to non-
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29 Māori students.
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35 The two main limitations of the study lay in its inability to access vital information from universities to
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37 facilitate random sampling, and under-representation of some universities (fewer participants relative
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39 to university size). Using the 2017 university enrolments as a guide, lower participation was recorded
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41 from AUT (in our sample 4.0% vs. 16.2% of 2017 NZ university student population), Auckland (20.2%
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43 vs. 23.7%), and Massey (10.6% vs. 17.3%), while Lincoln (4.0% vs. 2.6%), UC (15.5% vs. 9.1%),
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45 Otago (16.8% vs. 11.7%), Waikato (9.2% vs. 6.9%), and VUW (15.8% vs. 12.5%), were slightly over-
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47 represented. The highlighted factors are however unlikely to have biased our findings for three reasons,
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49 firstly, the overall sample was reasonably large, and had similar demographic characteristics to the
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51 general NZ university student population, in terms of age, sex and ethnicity[18], and secondly, the larger
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53 project from which our data were obtained included three broad areas (smoking, vaping, and the
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55 Smokefree 2025 goal), which would reasonably be of interest to a wider student population, than say
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57 smoking alone.
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Our estimates are low compared with national smoking prevalence estimates in the same age-group[3]. Comparison with results of a previous study by Marsh and others[6] that looked at smoking in a sample of students aged 17-25, from five universities, suggests that the prevalence of current smoking among students decreased marginally while daily smoking increased by two thirds in the last 6 years. However, there are important differences in demographic characteristics of participants: there were more Māori (8.3% vs. 6.8%) and Pacifika students (7.7% vs. 4.0%), slightly fewer NZ European (56.2% vs. 62.3%), and more international students (about 18% vs. 8.7%) in our study, compared to Marsh and others[6]; students who had lived in NZ for five years or less are used as proxy for international students in our study.

The prevalence of smoking is generally higher in Māori and Pacifika than in non-Māori non-Pacifika[3], and a large proportion of international students in NZ come from countries with traditionally high smoking prevalence[18]. Combined, these could have a substantial contribution to observed prevalence estimates. It is also possible that students may have reduced the number of cigarettes/day without quitting entirely, due to increasing cost of cigarettes[19] as a result of annual cigarette tax increase[20]; about 69% of current smokers in our study smoked 1-5 cigarettes/day.

Smoking prevalence among male compared to female students, was of particular concern, with ever smoking 61.3% vs. 45.1%; current smoking 28.8% vs. 19.7%, and daily smoking 49.5% vs. 29.1%. One possibility might be that males are more likely to have smoking peers. A European study that looked at predictors of smoking behaviour of first year university students in Turkey found only 5% of students whose best friends were non-smokers were themselves smokers, while about 50% of those whose three best friends smoked were also regular smokers [21]. Another possibility is that males are more likely to live away from home, than females. Living with parents or boarding was found to be protective against smoking in a previous study[6].

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Many current smokers however smoked five or fewer cigarettes/day (69.1%), smoked their first cigarette more than 60 minutes after waking (75.8%), did not smoke in places where smoking is banned (88.5% indoors and 66.7% outdoors), suggesting low nicotine dependence[15]. Furthermore, 69.2% planned to quit and 32.8% had tried to quit in the last 12 months. Combined, these characteristics makes this population of smokers more likely to successfully quit (if appropriately supported to do so)[22, 23], which is good news from a public health perspective.

It may be helpful to explore new approaches, specifically targeted at university students, and other tertiary educational institutions, to reduce smoking in this population group. For instance, Quitline[24] could work closely with student associations, student unions/clubs, or with university management teams to have information on its services included in orientation material, to reach a wider student population. Additionally, mobile phone-based interventions, including text messaging[25] and apps that can easily be localised and owned by students can be developed and tested. The vast majority of university students in NZ fall in the 16-34 year age-group which is thought to be highly familiar with mobile technology and is most likely to own a smart phone[26].

As far as we are aware, this is the first study to examine the prevalence of, and patterns of smoking in a national sample of university students aged 18-24 years in New Zealand. Repeat cross-sectional data are necessary to establish a clear picture of smoking in this population and to monitor any measures deployed to align smoking rates towards the Smokefree 2025 goal target[10].

Strengths of this study include a large sample that was similar to NZ university students[18], making it likely that our conclusions may be generalizable to the wider university student population. The questionnaire was both online and in print to reach a wider student community and to increase the response rate; prevalence estimates for online and paper questionnaire responses were similar.

CONCLUSIONS

Our findings suggest that smoking prevalence (daily smoking in particular) among university students in New Zealand aged 18-24 could be substantially higher than previously estimated from other surveys of university students, particularly among male students, and this is of concern. Many smokers however appear to have a low nicotine dependence, and are willing to quit, suggesting smoking prevalence in this population could substantially be reduced and aligned with the Smokefree 2025 goal target of 5% or less by the year 2025.

We recommend greater presence, and availability of smokefree services, and trialling of new mobile-phone based interventions to support students who wish to quit do so. Follow-up studies on this segment of the population will help us better understand the problem and update interventions to tackle it.

What this paper adds

What is already known on this subject

- The smoking prevalence of New Zealand university students aged 18-24 years is substantially lower than of similar age group in the general population.
- The prevalence of smoking among Māori is generally higher than that of non-Māori.

What important gaps in knowledge exist on this topic

- Few studies have examined the patterns of smoking in New Zealand university students
- To date, no study has estimated the prevalence of, and/or patterns of smoking using a sample drawn from all eight universities in New Zealand.

What this paper adds

- The prevalence of daily smoking among New Zealand university students aged 18-24 years is likely higher than previously estimated.

- A large proportion of smokers however appear less addicted to nicotine, and are more willing to quit.

Acknowledgements

The authors wish to acknowledge the university students across New Zealand who took part in this research. We also wish to extend our thanks to research assistants and staff of Student Job Search, who supported the in-person data collection process and enabled this research to be undertaken.

Contributors

BMW was the primary author (and PhD student), and planned the study, collected and analysed data, and wrote the manuscript. MW-B (BMW’s primary supervisor), AR (BMW’s co-supervisor) and RG (BMW’s co-supervisor) contributed to the planning, study design and manuscript. PC (statistical advisor) contributed to study design, data collection and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data sharing statement No additional data are available.

Ethics approval University of Canterbury Human Ethics Committee.

Patient involvement No patients were involved.

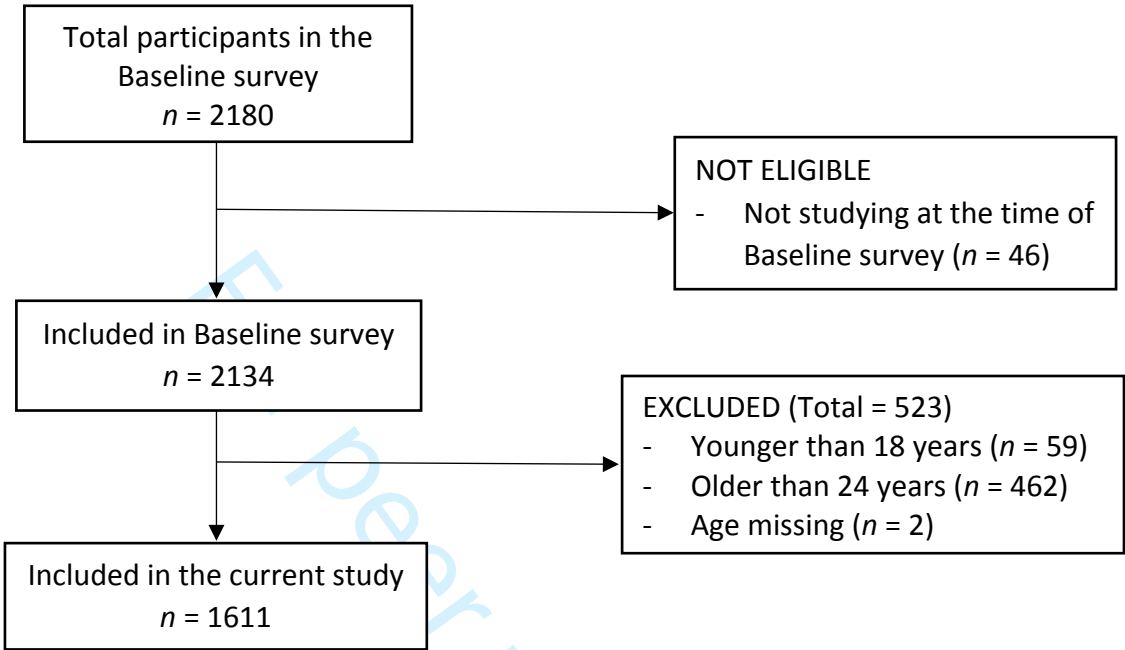
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Tables and Figures

Figure 1. Flowchart of selection of participants included in this study.



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Table 1. Demographic characteristics of participants

Variable	Total sample (n = 1611) %	Variable	Total sample (n = 1611) %
Age		Years lived in NZ	
18-20 years	980 (60.8)	Less than 1 year	144 (8.9)
21-24 years	631 (39.2)	1-5 years	182 (11.3)
Gender		6-10 years	107 (6.6)
Male	600 (37.2)	More than 10 years	1171 (72.7)
Female	945 (58.7)	Missing data	7 (0.4)
Other	10 (0.6)	University	
Prefer not to say	9 (0.6)	AUT*	65 (4.0)
Missing data	47 (2.9)	Lincoln University	65 (4.0)
Ethnicity		Massey University	170 (10.6)
NZ European	906 (56.2)	University of Auckland	325 (20.2)
Māori	134 (8.3)	UC**	249 (15.5)
Samoan	73 (4.5)	University of Otago	270 (16.8)
Cook Island Māori	18 (1.1)	University of Waikato	149 (9.2)
Tongan	27 (1.7)	VUW***	254 (15.8)
Niuean	6 (0.4)	Other****	38 (2.4)
Chinese	243 (15.1)	Missing data	26 (1.6)
Indian	88 (5.5)		
Other	344 (21.4)		
Country of birth			
New Zealand	1005 (62.4)		
Australia	20 (1.2)		
Other	575 (35.7)		

*Auckland University of Technology. **University of Canterbury. ***Victoria University of Wellington.

****Stated in writing where they were studying.

Table 2. Ever, current, regular and at least once daily smoking, number of cigarettes/day, and quit intentions; by Age group					
		18-20 years	21-24 years	Total	P-value
Have you ever smoked cigarettes?	Yes	462 (47.3)	360 (57.1)	822 (51.2)	<.001
	No	514 (52.7)	271 (42.9)	785 (48.8)	
	Total	976 (100.0)	631 (100.0)	1607 (100.0)	
Do you currently smoke?	Yes	106 (23.2)	93 (26.0)	199 (24.4)	.359
	No	351 (76.8)	265 (74.0)	616 (75.6)	
	Total	457 (100.0)	358 (100.0)	815 (100.0)	
Do you smoke at least once a month?*	Yes	96 (87.3)	80 (86.0)	176 (86.7)	.794
	No	14 (12.7)	13 (14.0)	27 (13.3)	
	Total	110 (100.0)	93 (100.0)	203 (100.0)	
Do you smoke at least once daily?	Yes	39 (35.5)	42 (45.2)	81 (39.9)	.159
	No	71 (64.5)	51 (54.8)	122 (60.1)	
	Total	110 (100.0)	93 (100.0)	203 (100.0)	
Number of cigarettes per day	1-5 cigarettes	69 (71.1)	56 (66.7)	125 (69.1)	.517
	>5 cigarettes	28 (28.9)	28 (33.3)	56 (30.9)	
	Total	97 (100.0)	84 (100.0)	181 (100.0)	
Tried to quit	Yes	31 (28.4)	35 (38.0)	66 (32.8)	.149
	No	78 (71.6)	57 (62.0)	135 (67.2)	
	Total	109 (100.0)	92 (100.0)	201 (100.0)	

*Regular smoker (smoked at least once a day, once a week or once a month).

Table 3. Ever, current, regular and at least once daily smoking, number of cigarettes/day, and quit intentions; by Gender					
		Male	Female	Total	P-value
Have you ever smoked cigarettes?	Yes	367 (61.3)	425 (45.1)	792 (51.4)	<.001
	No	232 (38.7)	518 (54.9)	750 (48.6)	
	Total	599 (100.0)	943 (100.0)	1542 (100.0)	
Do you currently smoke?	Yes	105 (28.8)	83 (19.7)	188 (23.9)	.003
	No	260 (71.2)	338 (80.3)	598 (76.1)	
	Total	365 (100.0)	421 (100.0)	786 (100.0)	
Do you smoke at least once a month?*	Yes	93 (88.6)	72 (83.7)	165 (86.4)	.331
	No	12 (11.4)	14 (16.3)	26 (13.6)	
	Total	105 (100.0)	86 (100.0)	191 (100.0)	
Smokes at least once daily	Yes	52 (49.5)	25 (29.1)	77 (40.3)	.004
	No	53 (50.5)	61 (70.9)	114 (59.7)	
	Total	105 (100.0)	86 (100.0)	191 (100.0)	
Cigarettes per day	1-5 cigarettes	57 (62.0)	59 (74.7)	116 (67.8)	.076
	>5 cigarettes	35 (38.0)	20 (25.3)	55 (32.2)	
	Total	92 (100.0)	79 (100.0)	171 (100.0)	
Tried to quit	Yes	36 (35.0)	29 (33.7)	65 (34.4)	.859
	No	67 (65.0)	57 (66.3)	124 (65.6)	
	Total	103 (100.0)	86 (100.0)	189 (100.0)	

*Regular smoker (smoked at least once a day, once a week or once a month).

Table 4. Ever, current, regular and at least once daily smoking, number of cigarettes/day, and quit intentions; by Ethnicity					
		Māori	Non-Māori	Total	P-value
Have you ever smoked cigarettes?	Yes	105 (78.4)	717 (48.7)	822 (51.2)	<.001
	No	29 (21.6)	756 (51.3)	785 (48.8)	
	Total	134 (100.0)	1473 (100.0)	1607 (100.0)	
Do you currently smoke?	Yes	21 (21.0)	178 (24.9)	199 (24.4)	.396
	No	79 (79.0)	537 (75.1)	616 (75.6)	
	Total	100 (100.0)	715 (100.0)	815 (100.0)	
Do you smoke at least once a month?*	Yes	20 (80.0)	156 (87.6)	176 (86.7)	.292
	No	5 (20.0)	22 (12.4)	27 (13.3)	
	Total	25 (100.0)	178 (100.0)	203 (100.0)	
Smokes at least daily	Yes	8 (32.0)	73 (41.0)	81 (39.9)	.389
	No	17 (68.0)	105 (59.0)	122 (60.1)	
	Total	25 (100.0)	178 (100.0)	203 (100.0)	
Cigarettes per day	1-5 cigarettes	15 (68.2)	110 (69.2)	125 (69.1)	.924
	>5 cigarettes	7 (31.8)	49 (30.8)	56 (30.9)	
	Total	22 (100.0)	159 (100.0)	181 (100.0)	
Tried to quit	Yes	10 (40.0)	56 (31.8)	66 (32.8)	.415
	No	15 (60.0)	120 (68.2)	135 (67.2)	
	Total	25 (100.0)	176 (100.0)	201 (100.0)	

*Regular smoker (smoked at least once a day, once a week or once a month).

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1-3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9,10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	10,11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	

		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12
Generalisability	21	Discuss the generalisability (external validity) of the study results	13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Cigarette smoking among university students aged 18-24 years in New Zealand - Results of the first (baseline) of two national surveys.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-032590.R1
Article Type:	Original research
Date Submitted by the Author:	17-Sep-2019
Complete List of Authors:	Wamamili, Ben; University of Canterbury, Health Sciences Wallace-Bell, Mark; University of Canterbury, Health Sciences Richardson, Ann; University of Canterbury Grace, Randolph; University of Canterbury, School of Psychology, Speech and Hearing. Coope, Pat; University of Canterbury, Health Sciences
Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Smoking and tobacco
Keywords:	smoking, prevalence, cross-sectional, university students, New Zealand

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Title page

Title: Cigarette smoking among university students aged 18-24 years in New Zealand - Results of the first (baseline) of two national surveys.

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Keywords: prevalence, cross-sectional survey, cigarette smoking, university students, New Zealand.

Word count: 3,164 (excluding title page, abstract, figures, tables and references).

Abstract

Objectives

Although the smoking prevalence continues to decline in New Zealand (NZ) overall, little is known about smoking in university students. A 2013 survey of students aged 17-25 years found 14% were current, and 3% daily smokers. However, the sample did not include students from all NZ universities. This study examines the prevalence of, and patterns of cigarette smoking among students aged 18-24 years.

Setting

University students across NZ.

Methods

Data came from a March-May 2018 survey of students from all NZ universities, and were weighted to account for under- and over-sampling, based on university size. Chi-squared tests were used to compare smoking by age, gender and ethnicity.

Participants

1540 participants were included: 952 (61.8%) aged 18-20 and 588 (38.2%) aged 21-24 years; 569 (36.9%) male and 907 (58.9%) female, 124 (8.1%) Māori and 1416 (91.9%) non-Māori.

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Results

49.3% (95% CI: 46.8-51.8) of respondents reported ever smoking, 10.9% (95% CI: 9.3-12.5) currently smoked (smoked at least once a month) and 5.5% (95% CI: 4.3-6.5) smoked at least daily (daily smokers). Of current smokers, 66.1% smoked 1-5 cigarettes/day, 43.0% smoked daily, 74.6% smoked first cigarette >60 minutes after waking, 86.8% never/almost never smoked in indoor and 67.1% in outdoor smokefree spaces, 67.8% planned to quit, and 29.5% had tried to quit.

Ever, current and daily smoking were significantly higher in 21-24 compared to 18-20 year olds, and in males compared to females. Older participants were more likely to report smoking more cigarettes/day. Māori were more likely to report ever smoking than non-Māori.

Conclusions

Current smoking among NZ university students aged 18-24 appears to be declining but daily smoking could be increasing. However, many students appeared less addicted to nicotine, and willing to quit. We recommend increasing availability of smokefree services for students who wish to quit.

Strengths and limitations of this study

- This is the first study in New Zealand to examine the prevalence of cigarette smoking, and patterns of smoking in a sample of university students across the country.
- The sample was weighted to account for university sizes and the general New Zealand university student population.
- The main limitation of this study is that sampling was not random.

INTRODUCTION

Tobacco continues to be a leading cause of preventable morbidity and mortality in Aotearoa New Zealand (New Zealand or NZ), with an estimated 5,000 deaths each year linked to smoking[1]. Smoking is a major contributor to health inequalities in NZ, with mortality rates among Māori, the Indigenous population of NZ, roughly twice those of non- Māori non-Pacific people (mainly NZ European)[2]. Monitoring smoking behaviours is vital in order to inform tobacco control policies to reduce preventable deaths and morbidity, and to reduce inequalities.

In March 2011 the NZ Government adopted the Smokefree Aotearoa 2025 goal (Smokefree 2025 or Smokefree goal) for NZ, in response to the recommendations of a landmark Parliamentary inquiry by the Māori Affairs select committee into the tobacco industry in Aotearoa and the consequences of tobacco use for Māori[3]. The goal aspires to reduce the prevalence of smoking and tobacco availability to minimal levels (5% or less) by the year 2025[3]. The Government has maintained a 10% tax increase (above inflation) on tobacco products (effected on 1st January) annually since 2010[4], among other measures to reduce smoking[5].

Despite an overall decline in the prevalence of smoking, with current smoking reducing from 18.2% in 2011/12 to 14.9% in 2017/18 and daily smoking from 16.3% to 13.1% in the same period[6], the prevalence remains high in people aged 18-24 years (20%), 25-34 years (22%), Pasifika peoples (23%) and Māori (34%), compared to the general population[6].

There is limited information on smoking among university students in NZ currently. A 2013 survey that estimated the prevalence of daily and occasional smoking among university students aged 17-25 years from five NZ universities reported that 14% of participants smoked occasionally and 3% smoked on a

1 daily basis[7]. These estimates were much lower than those in the wider population within the same
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3 age-group[8]. A previous survey of University of Otago students in 2002 found that 10% of respondents
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5 smoked daily and a further 10% reported occasional smoking[9]. These estimates were likewise much
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7 lower than estimates of smoking prevalence among people in the same age-group in the general
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9 population at the time, that ranged between 18.8-26.8% in 15-19 year olds and 29.8-30.3% in 20-24
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11 year olds[10].
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19 University students experience fundamental changes in social contexts and identity, as they transition
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21 to life away from home (most but not all) and make new friends at university[11, 12]. Greater
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23 independence and new peers may promote smoking among occasional smokers, and increase
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25 progression to daily smoking[12]. This study sought to estimate the prevalence, and patterns of smoking
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27 among university students aged 18-24 years in a national university student population.
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33 **METHODS**
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36 We analysed data from the first of two surveys (the ‘Baseline survey’), a cross-sectional survey
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38 conducted between March and May 2018 as part of the corresponding author’s PhD thesis project. The
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40 survey collected data on the perceptions of university students in New Zealand on vaping, cigarette
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42 smoking, and the Smokefree 2025 goal. This paper concentrates on the data on smoking.
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49 The Baseline survey aimed to recruit a minimum of 1,061 students from all eight NZ universities: 902
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51 domestic and 160 international, using multiple approaches, to increase the participation of Māori and
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53 Pasifika students. Sample size calculations were based on the 2016 Universities NZ data[13] which
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55 showed the total NZ university students at 172,000, 85% of whom were domestic (11% Māori, 7.8%
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57 Pasifika and 81.2% non-Māori non-Pasifika) and 15% international students; a confidence interval (CI)
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of 95%; estimated smoking proportion of 0.5 (conservative estimate); margin of error of 3%, and estimated response rate of 10%. 10,610 students were to be invited, but far more were reached.

Random sampling was not feasible, because complete enrolment lists of students were not available from the universities. However, data were weighted to account for under- and over-sampling, by institution size, and the questionnaire comprised both an online and printed version and was distributed widely, using social media and other forms of advertising, and direct contact with student volunteers. 2180 students participated and 1540 met the criteria for inclusion in the current study (i.e. they were studying at an NZ university and were aged 18-24 years). **Figure 1** describes how participants were selected.

The survey

In the online route, the project was advertised on students' association Facebook pages at respective universities, where this was possible, using a single advert message and photograph. In addition to adverts in general students' association social media platforms, further engagements were made with Māori and Pasifika students' associations. Printed questionnaires were distributed by research assistants (RAs) and volunteers, from participating universities. RAs were recruited from Student Job Search (SJS), a charitable organisation formed by student associations in NZ to help current students and recent graduates of tertiary education institutions in NZ find work[14].

The questionnaire used validated questions: the ethnicity question was based on the NZ census[15], ever smoking question on NZ Tobacco Use Survey (NZTUS)[16], frequency of smoking question was adapted from Marsh and others who looked at the association of smoking with drinking in NZ university students[7], and NZTUS[16], cigarettes/day question was adapted from the Fagerstrom Test for Nicotine Dependence Questionnaire (FTNQ)[17], time to first cigarette question was adapted from

1 NZTUS[16] and FTND[17], and quit intentions from NZTUS[16]. Questions on current smoking,
2 smoking in smokefree spaces, and number of quit attempts were developed in-house. We piloted the
3 questionnaire and survey methods on 22 students at the University of Canterbury (UC) in October 2017.
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5 Respondents were contacted using approaches described previously.
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14 **Patient and Public Involvement**
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17 No patients were involved in this project.
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23 **Survey measures**
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26 Responses to two sections: demographic information and tobacco use, out of four sections asked in the
27 Baseline survey are relevant to this paper and explained below.
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34 Demographics
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37 Respondents provided information on age, gender, ethnicity, years lived in NZ and the university where
38 they were studying. Only those aged 18-24 years were included in the analysis because two main
39 reasons, firstly, we did not have much flexibility with recoding data from the original project (Baseline
40 survey), to for example, include ages 17-25, which would have reduced the proportion of participants
41 excluded based on age, and secondly, the 18-24 aged allowed for comparisons with national estimates
42 that use a similar age band[6]. Gender-specific analyses included only participants who identified as
43 male or female due to extremely small numbers of other genders. Ethnicity-specific analyses compared
44 Māori and non-Māori, as in previous studies[9, 18, 19]. Years lived in NZ (five or less) was used as
45 proxy for international students. Participants could select one or more of the eight universities: Auckland
46 University of Technology (AUT), Lincoln University, Massey University, University of Auckland, UC,
47 University of Otago, University of Waikato and Victoria University of Wellington (VUW).
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Tobacco use

Respondents were asked 'Have you smoked cigarettes or tobacco at all, even just a few puffs?', and responses were: 'Yes' and 'No'. Those who answered 'Yes' (defined as 'ever smokers') were asked 'Do you currently smoke cigarettes or tobacco? This includes roll-your-own (RYO)', and responses were: 'Yes' and 'No'. Those who answered yes were asked 'Which of the following best describes how often you smoke cigarettes or tobacco now?', and responses were 'At least once a day', 'At least once a week', 'At least once a month', and 'Less often than once a month'. Those who smoked at least once a day were defined as 'daily smokers', and those who smoked at least once a month or more frequently were defined as 'current smokers'.

Current smokers were further asked: 'During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?' and responses were '1 to 5', '6 to 10', '11 to 20', '21 to 30', '31 or more', and 'Don't know'. A new variable was created with just two responses as '1-5 cigarettes' and '>5 cigarettes'.

Time to smoking the first cigarette was asked using the question 'How soon after waking do you smoke your first cigarette?' and responses were: 'Within 5 minutes', '5-30 minutes', '31-60 minutes', and '>60 minutes'. A new variable with only two levels: 'within 60 minutes', and '>60 minutes' was created. This was due to small numbers in the three response categories that fell within 60 minutes of waking. This variable was only used in overall prevalence analyses, not for analyses by age, gender or ethnicity.

Smoking in spaces where smoking is banned was assessed by 'How often do you smoke in the following settings...? (1) In indoor spaces where smoking is banned, and (2) In outdoor spaces where smoking is banned', and responses for both were: 'Never', 'Almost never', 'Sometimes', 'Fairly often', and 'Very often'. A new variable was created combining those who said 'Never' and 'Almost never' into 'Never/almost never' and the rest grouped together into 'Other'. This was due to small numbers of those

1 who said sometimes, fairly or very often. This variable was only used in overall prevalence analyses,
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4 not for analyses by age, gender or ethnicity.
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9 The first question on quitting asked: ‘Are you planning on giving up smoking?’, and responses were:
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11 ‘Yes, within 30 days’, ‘Yes, after 30 days but within 3 months’, ‘Yes, but not within the next 3 months’,
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13 and ‘No, I am not planning on giving up’. During coding, a new variable was created with only two
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15 levels: ‘Yes, I plan to quit’ (included all who said planned to quit, regardless of timeline) and ‘Not
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17 planning to quit’. The second question on quitting asked ‘Have you tried to quit smoking at any time in
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19 the last 12 months?’, and responses were ‘Yes’ and ‘No’.
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25 Those who had tried to quit were asked ‘In the last 12 months, how many serious attempts to stop
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27 smoking did you make that lasted 24 hours or longer? Please include any attempts that you are currently
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29 making.’, and responses were ‘1-3’, ‘4-5’ and ‘More than 5’. Because of small numbers of those who
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31 reported making ‘4-5’ or ‘More than 5’ attempts, these were combined, resulting in just two groups:
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33 ‘1-3 attempts’ and ‘>3 attempts’. This variable was only used in overall prevalence analyses, not for
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35 analyses by age, gender or ethnicity.
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41 **Data analysis**
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44 Chi-squared tests were used to compare smoking prevalence by age (18-20 vs. 21-24), gender (male vs.
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46 female) and ethnicity (Māori vs. non-Māori). All statistical analyses were performed using IBM SPSS
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48 Statistic 25 and two-sided $p<.05$ was considered statistically significant. Confidence intervals (CI) were
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50 included where appropriate. Responses were weighted to account for under- and over-sampling, based
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52 on institution. Inconsistent reporting of summary data across universities meant that weights to account
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54 for under- and over-sampling with respect to gender, age and ethnicity could not be calculated.
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RESULTS

Demographic characteristics of the sample (unweighted) are reported in **Table 1**. 56.0% identified as NZ European, 8.1% as Māori, 7.3% as Pasifika (in this study Pasifika included Samoan, Cook Island Māori, Tongan and Niuean), 15.2% as Chinese, 5.5% as Indian, and 21.9% as 'Other'. The total percentage exceeds 100% because, as in the NZ census, respondents could select as many ethnic groups as applied.

Table 1. Demographic characteristics of participants			
Variable	Sample (n = 1540) %	Variable	Sample (n = 1540) %
Age		Years lived in NZ	
18-20 years	952 (61.8)	Less than 1 year	142 (9.2)
21-24 years	588 (38.2)	1-5 years	171 (11.1)
Gender		6-10 years	102 (6.6)
Male	569 (36.9)	More than 10 years	1119 (72.9)
Female	907 (58.9)	Missing data	6 (0.4)
Other	10 (0.6)	University	
Prefer not to say	8 (0.5)	AUT*	65 (4.2)
Missing data	46 (3.0)	Lincoln University	65 (4.2)
Ethnicity		Massey University	170 (11.0)
NZ European	863 (56.0)	University of Auckland	325 (21.1)
Māori	124 (8.1)	University of Canterbury	249 (16.2)
Samoan	65 (4.2)	University of Otago	270 (17.5)
Cook Island Māori	16 (1.0)	University of Waikato	149 (9.7)
Tongan	27 (1.8)	VUW**	254 (16.5)
Niuean	5 (0.3)		
Chinese	234 (15.2)		
Indian	84 (5.5)		
Other	338 (21.9)		

Note: This table presents unweighted data. Respondents could select one or more universities. *Auckland University of Technology.

**Victoria University of Wellington.

Overall smoking

49.3% (95% CI: 46.8-51.8) of respondents reported ever smoking, 10.9% (95% CI: 9.3-12.5) currently smoked and 5.5% (95% CI: 4.3-6.5) smoked daily (**Table 2**). Of current smokers, 66.1% smoked 1-5 cigarettes/day, 19.3% smoked 6-10, 9.9% smoked 11-20 and 4.7% smoked 21 or more cigarettes/day; 43.0% smoked at least daily, 24.7% at least once a week, 18.7% at least once a month, and 13.6% smoked less often than once a month. 15.9% of smokers smoked their first cigarette within 30 minutes

of waking, 9.5% within 31-60 minutes and 74.6% after more than 60 minutes of waking up; 86.8% reported never or almost never smoking in indoor and 67.1% in outdoor spaces where smoking is banned; 67.8% planned to quit; 29.5% reported trying to quit in the last 12-months, and 72.7% of those had made 1-3 serious attempts to quit smoking.

Smoking by age

Statistically significantly more participants aged 21-24 years reported ever (54.3% vs. 46.2%, $p=.002$), current (13.6% vs. 9.2%, $p=.008$) and daily smoking (8.4% vs. 3.6%, $p<.001$), and smoking >5 cigarettes/day (42.5% vs. 26.4%, $p=.026$), than those aged 18-20 years, but quit intentions were not statistically significantly different (32.2% vs. 27.7%, $p=.498$) (Table 2).

Table 2. Ever, current, regular and at least once daily smoking, number of cigarettes/day, and quit intentions; by Age group					
		18 to 20 years	21 to 24 years	Total	P-value
Ever smoked?	Yes	434 (46.2)	315 (54.3)	749 (49.3)	.002
	No	505 (53.8)	265 (45.7)	770 (50.7)	
	Total	939 (100.0)	580 (100.0)	1519 (100.0)	
Currently smoke?	Yes	87 (9.2)	79 (13.6)	166 (10.9)	.008
	No	854 (90.8)	500 (86.4)	1354 (89.1)	
	Total	941 (100.0)	579 (100.0)	1520 (100.0)	
Smokes daily?	Yes	34 (3.6)	49 (8.4)	83 (5.5)	<.001
	No	907 (96.4)	531 (91.6)	1438 (94.5)	
	Total	941 (100.0)	580 (100.0)	1521 (100.0)	
Number of cigarettes/day	1-5 cigarettes	67 (7.3)	46 (57.5)	113 (66.1)	.026
	>5 cigarettes	24 (26.4)	34 (42.5)	58 (33.9)	
	Total	91 (100.0)	80 (100.0)	171 (100.0)	
Ever tried to quit	Yes	28 (27.7)	29 (32.2)	57 (29.8)	.498
	No	73 (72.3)	61 (67.8)	134 (70.2)	
	Total	101 (100.0)	90 (100.0)	191 (100.0)	

Note: the cells contain rounded weighted counts and sometimes the marginal totals are not exactly the sum of the component cells.

Smoking by gender

Gender-specific analyses included only males and females. Ever (59.1% vs. 43.5%, $p<.001$), current (16.3% vs. 7.2%, $p<.001$), and daily smoking (9.7% vs. 2.8%, $p<.001$) were statistically significantly higher in males compared to females, but smoking >5 cigarettes/day (41.3% vs. 26.5%, $p=.052$) and quit intentions (28.2% vs. 33.8%, $p=.419$) were not statistically significantly different (Table 3).

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		Male	Female	Total	P-value
Ever smoked?	Yes	334 (59.1)	384 (43.5)	718 (49.6)	<.001
	No	231 (40.9)	499 (56.5)	730 (50.4)	
	Total	565 (100.0)	883 (100.0)	1448 (100.0)	
Currently smoke?	Yes	92 (16.3)	64 (7.2)	156 (10.8)	<.001
	No	474 (83.7)	820 (92.8)	1294 (89.2)	
	Total	566 (100.0)	884 (100.0)	1450 (100.0)	
Smokes daily?	Yes	55 (9.7)	25 (2.8)	80 (5.5)	<.001
	No	510 (90.3)	859 (97.2)	1369 (94.5)	
	Total	565 (100.0)	884 (100.0)	1449 (100.0)	
Number of cigarettes/day	1-5 cigarettes	54 (58.7)	50 (73.5)	104 (65.0)	.052
	>5 cigarettes	38 (41.3)	18 (26.5)	56 (35.0)	
	Total	92 (100.0)	68 (100.0)	160 (100.0)	
Ever tried to quit	Yes	29 (28.2)	26 (33.8)	55 (30.6)	.419
	No	74 (71.8)	51 (66.2)	125 (69.4)	
	Total	103 (100.0)	77 (100.0)	180 (100.0)	

Note: the cells contain rounded weighted counts and sometimes the marginal totals are not exactly the sum of the component cells.

Smoking by ethnicity

Ever smoking (75.9% vs. 47.3%, $p<.001$) was statistically significantly higher in Māori than in non-Māori, but current smoking (13.0% vs. 10.8%, $p=.479$), daily smoking (4.6% vs. 5.5%, $p=.695$), smoking >5 cigarettes/day (26.7% vs. 34.8%, $p=.524$), and quit intentions (38.9% vs. 28.3%, $p=.349$) were all not statistically significantly different between Māori and non-Māori (**Table 4**).

		Māori	Non-Māori	Total	P-value
Ever smoked?	Yes	82 (75.9)	667 (47.3)	749 (49.3)	<.001
	No	26 (24.1)	744 (52.7)	770 (50.7)	
	Total	108 (100.0)	1411 (100.0)	1519 (100.0)	
Currently smoke?	Yes	14 (13.0)	152 (10.8)	166 (10.9)	.479
	No	94 (87.0)	1261 (89.2)	1355 (89.1)	
	Total	108 (100.0)	1413 (100.0)	1521 (100.0)	
Smokes daily?	Yes	5 (4.6)	78 (5.5)	83 (5.5)	.695
	No	103 (95.4)	1335 (94.5)	1438 (94.5)	
	Total	108 (100.0)	1413 (100.0)	1521 (100.0)	
Number of cigarettes/day	1-5 cigarettes	11 (73.3)	101 (65.2)	112 (65.9)	.524
	>5 cigarettes	4 (26.7)	54 (34.8)	58 (34.1)	
	Total	15 (100.0)	155 (100.0)	170 (100.0)	
Ever tried to quit	Yes	7 (38.9)	49 (28.3)	56 (29.3)	.349
	No	11 (61.1)	124 (71.7)	135 (70.7)	
	Total	18 (100.0)	173 (100.0)	191 (100.0)	

Note: the cells contain rounded weighted counts and sometimes the marginal totals are not exactly the sum of the component cells.

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DISCUSSION

This study estimates, in a New Zealand university student population, the prevalence of current smoking (at least once a month or more frequently) of 10.9% and daily smoking of 5.5%. It also reports higher ever smoking, current smoking and daily smoking estimates students aged 21-24 years compared to those aged 18-20 years and in males compared to females, and higher ever smoking estimates in Māori compared to non-Māori students.

The two main limitations of the study lay in its inability to access vital information from universities to facilitate random sampling, and under-representation of some universities (fewer participants relative to university size); data weighting was done to address the latter. Volunteer bias could lead to underestimation of prevalence estimates, while affecting to a minor extent the associations between smoking and age, gender and ethnicity.

Our estimates are low compared with the national smoking prevalence estimates in the same age-group[6]. Comparison with results of a previous study by Marsh and others[7] that looked at smoking in a sample of students aged 17-25, from five universities using 2013 data suggests that the prevalence of current smoking among students decreased marginally from 14.1% in 2013 to 10.9% in 2018 while daily smoking increased slightly from 2.9% to 5.5% in the same period. However, important differences exist in demographic characteristics of participants in these two surveys: there were more Pasifika students (7.3% vs. 4.0%), slightly fewer NZ European students (56.0% vs. 62.3%), more international students (20.3% vs. 8.7%) and slightly different age bands (18-24 years vs. 17-25 years), in the current study compared to Marsh and others[7]. Students who had lived in NZ for five years or less are used as proxy for international students in the current study. Our daily smoking prevalence estimate of 5.5% is nevertheless lower than the 10% reported in a 2002 survey of students at Otago[9].

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NZ is currently at Stage 4 of the smoking epidemic characterised by a marked downturn in smoking prevalence in both men and women[20, 21]. The prevalence of smoking is generally higher in Māori and Pasifika than in non-Māori non-Pasifika[6], and a large proportion of international students in NZ come from countries with traditionally high smoking prevalence[22]. Combined, these could have a substantial contribution to observed prevalence estimates. It is also possible that students may have reduced the number of cigarettes/day without quitting entirely, due to increasing cost of cigarettes[23] as a result of annual cigarette tax increase[4]; about 66% of current smokers in our study smoked 1-5 cigarettes/day. Most NZ universities also have smokefree campuses.

Smoking prevalence among male compared to female students, was of particular concern, with ever smoking 59.1% vs. 43.5%, current smoking 16.3% vs. 7.2%, and daily smoking 9.7% vs. 2.8%. One possibility might be that males are more likely to have many smoking peers. A European study that looked at predictors of smoking behaviour of first year university students in Turkey found only 5% of students whose best friends were non-smokers were themselves smokers, while about 50% of those whose three best friends smoked were also regular smokers[24]. Another possibility is that males are more likely to live away from home, than females. Living with parents or boarding was found to be protective against smoking in a previous study[7].

Many current smokers however smoked five or fewer cigarettes/day (66.1%), smoked their first cigarette more than 60 minutes after waking (74.6%), did not smoke in places where smoking is banned (86.8% indoors and 67.1% outdoors), suggesting low nicotine dependence[17]. Furthermore, 67.8% planned to quit and 29.5% had tried to quit in the last 12 months. Combined, these characteristics makes this population of smokers more likely to successfully quit (if appropriately supported to do so)[25, 26], which is good news from a public health perspective.

Besides the current tobacco control measures used in NZ, including higher cigarette taxes/prices, mass media campaigns, smokefree environments, publicly funded stop smoking medicines (nicotine

1 replacement therapy), community-based stop smoking services, among others, it may be helpful to
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3 explore new approaches targeted at university/tertiary students, to reduce smoking in this population
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5 group. For instance, Quitline[27] could work closely with student associations, student unions/clubs, or
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7 with university management teams to have information on its services included in orientation material,
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9 to reach a wider student population. Additionally, mobile phone-based interventions, including text
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11 messaging[28] and apps that can easily be localised and owned by students can be developed and tested.
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13 The vast majority of university students in NZ fall in the 16-34 year age-group which is thought to be
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15 highly familiar with mobile technology and is most likely to own a smart phone[29].
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22 As far as we are aware, this is the first study to examine the prevalence of, and patterns of smoking in
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24 a national sample of university students aged 18-24 years in New Zealand. Repeat cross-sectional data
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26 are necessary to establish a clear picture of smoking in this population and to monitor any measures
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28 deployed to align smoking rates towards the Smokefree 2025 goal target[3].
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33 Strengths of this study include a reasonably large sample that was closely similar to NZ university
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35 students (**Table 5**), making it likely that our conclusions may be generalizable to the wider university
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37 student population. The questionnaire was available online and in print to reach a wider student
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39 community and to increase the response rate; prevalence estimates for online and paper questionnaire
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41 responses were similar.
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Table 5. Demographic characteristics of students in this study vs. NZ university students.				
		This paper		NZ university student population (%)
		Unweighted (%)	Weighted (%)	
Student type	Domestic	79.7	78.3	84.1*
	International	20.3	21.7	15.9*
Ethnicity	Māori	8.1	7.1	9.6*
	Non-Māori	91.9	92.9	90.4*
Gender	Male	36.9	37.2	40**
	Female	58.9	58.1	60**
	All others***	4.2	4.7	N/A

58 *Source: Universities NZ[22] **Source: Otago Daily Times[30]. ***Includes those who said ‘Other’, ‘Prefer not to say’ or data was
59 missing.
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CONCLUSIONS

Our findings suggest that the prevalence of current smoking among university students in New Zealand aged 18-24 is declining but daily smoking could be increasing, compared with previously reported estimates using 2013 data from five universities. Smoking among males and older students (ages 21-24 years) is of particular concern. However, many smokers appear to have a low nicotine dependence, and are willing to quit, suggesting smoking prevalence in this population could substantially be reduced and aligned with the Smokefree 2025 goal target of 5% or less by the year 2025.

We recommend greater presence, and availability of smokefree services, and trialling of new technologies such as mobile-phone based interventions to support students who wish to quit to do so. Follow-up studies on this segment of the population will help us better understand the problem and update interventions to tackle it.

Acknowledgements

The authors wish to acknowledge the university students across New Zealand who took part in this research. We also wish to extend our thanks to research assistants and staff of Student Job Search, who supported the in-person data collection process and enabled this research to be undertaken.

Contributors

BMW (PhD student) planned the study, collected and analysed data, and wrote the manuscript.

MW-B, AR and RCG are BMW's supervisors and contributed to the planning, study design and writing the manuscript.

PC contributed to the study design, data collection, data weighting and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing Interests No, there are no competing interests for any author.

Data sharing statement No additional data are available.

Ethics approval University of Canterbury Human Ethics Committee. Research Ethics ID: HEC 2017/42/LR-PS.

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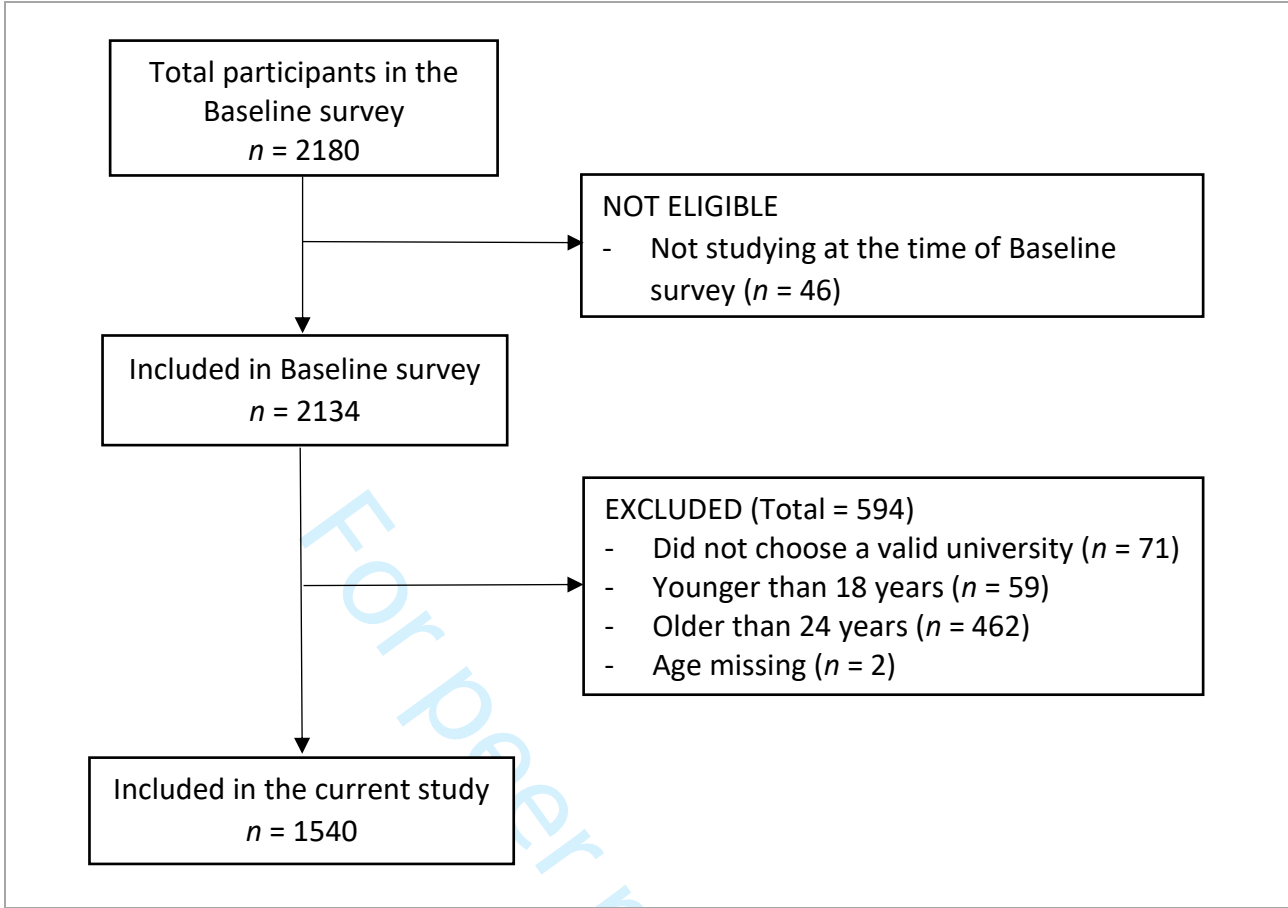
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Figure legend

Figure 1. Flowchart of selection of participants included in this study.



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2 & 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-9
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	11-13
Outcome data	15*	Report numbers of outcome events or summary measures	10-13

Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Cigarette smoking among university students aged 18-24 years in New Zealand - Results of the first (baseline) of two national surveys.

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-032590.R2
Article Type:	Original research
Date Submitted by the Author:	07-Nov-2019
Complete List of Authors:	Wamamili, Ben; University of Canterbury, Health Sciences Wallace-Bell, Mark; University of Canterbury, Health Sciences Richardson, Ann; University of Canterbury Grace, Randolph; University of Canterbury, School of Psychology, Speech and Hearing. Coope, Pat; University of Canterbury, Health Sciences
Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Smoking and tobacco, Epidemiology
Keywords:	smoking, prevalence, cross-sectional, university students, New Zealand

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Title page

Title: Cigarette smoking among university students aged 18-24 years in New Zealand - Results of the first (baseline) of two national surveys.

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Keywords: prevalence, cross-sectional survey, cigarette smoking, university students, New Zealand.

Word count: 3,286 (excluding title page, abstract, figures, tables and references).

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Abstract

Objectives

Although the smoking prevalence continues to decline in New Zealand (NZ) overall, little is known about smoking in university students. A 2013 survey of students aged 17-25 years found 14% were current, and 3% daily smokers. However, the sample did not include students from all NZ universities. This study examines the prevalence of, and patterns of cigarette smoking among students aged 18-24 years.

Setting

University students across NZ.

Methods

Data came from a March-May 2018 survey of students from all NZ universities, and were weighted to account for under- and over-sampling, based on gender and university size. Chi-squared tests were used to compare smoking by age, gender and ethnicity.

Participants

1,476 participants were included: 919 (62.3%) aged 18-20 and 557 (37.7%) aged 21-24 years; 569 (38.6%) male and 907 (61.4%) female, 117 (7.9%) Māori and 1,359 (92.1%) non-Māori.

Results

49.8% (95% CI: 47.2-52.4) of respondents reported ever smoking, 11.1% (95% CI: 9.5-12.9) currently smoked (smoked at least once a month) and 5.9% (95% CI: 4.8-7.3) smoked at least daily (daily smokers). Of current smokers, 63.6% smoked 1-5 cigarettes/day, 45.8% smoked daily, 73.4% smoked first cigarette >60 minutes after waking, 86.0% never/almost never smoked in indoor and 64.6% in outdoor smokefree spaces, 69.9% planned to quit, and 32.4% had tried to quit.

Ever, current and daily smoking were significantly higher in 21-24 compared to 18-20 year olds, and in males compared to females. Older participants were more likely to report smoking more cigarettes/day. Māori were more likely to report ever smoking than non-Māori.

Conclusions

Current smoking among NZ university students aged 18-24 appears to be declining but daily smoking could be increasing. However, many students appeared less addicted to nicotine, and willing to quit. We recommend increasing availability of smokefree services for students who wish to quit.

Strengths and limitations of this study

- This is the first study in New Zealand to examine the prevalence of cigarette smoking, and patterns of smoking in a sample of university students across the country.
- The sample was weighted by gender and university size to improve its representation of the general New Zealand university student population.
- The main limitation of this study is that sampling was not random.

INTRODUCTION

Tobacco continues to be a leading cause of preventable morbidity and mortality in Aotearoa New Zealand (New Zealand or NZ), with an estimated 5,000 deaths each year linked to smoking[1]. Smoking is a major contributor to health inequalities in NZ, with mortality rates among Māori, the Indigenous population of NZ, roughly twice those of non- Māori non-Pacific people (mainly NZ European)[2]. Monitoring smoking behaviours is vital in order to inform tobacco control policies to reduce preventable deaths and morbidity, and to reduce inequalities.

In March 2011 the NZ Government adopted the Smokefree Aotearoa 2025 goal (Smokefree 2025 or Smokefree goal) for NZ, in response to the recommendations of a landmark Parliamentary inquiry by the Māori Affairs select committee into the tobacco industry in Aotearoa and the consequences of tobacco use for Māori[3]. The goal aspires to reduce the prevalence of smoking and tobacco availability to minimal levels (5% or less) by the year 2025[3]. The Government has maintained a 10% tax increase (above inflation) on tobacco products (effected on 1st January) annually since 2010[4], among other measures to reduce smoking[5].

Despite an overall decline in the prevalence of smoking, with current smoking reducing from 18.2% in 2011/12 to 14.9% in 2017/18 and daily smoking from 16.3% to 13.1% in the same period[6], the prevalence remains high in people aged 18-24 years (20%), 25-34 years (22%), Pasifika peoples (23%) and Māori (34%), compared to the general population[6].

There is limited information on smoking among university students in NZ currently. A 2013 survey that estimated the prevalence of daily and occasional smoking among university students aged 17-25 years from five NZ universities reported that 14% of participants smoked occasionally and 3% smoked on a

1 daily basis[7]. These estimates were much lower than those in the wider population within the same
2
3 age-group[8]. A previous survey of University of Otago students in 2002 found that 10% of respondents
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5 smoked daily and a further 10% reported occasional smoking[9]. These estimates were likewise much
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7 lower than estimates of smoking prevalence among people in the same age-group in the general
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9 population at the time, that ranged between 18.8-26.8% in 15-19 year olds and 29.8-30.3% in 20-24
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11 year olds[10].
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19 University students experience fundamental changes in social contexts and identity, as they transition
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21 to life away from home (most but not all) and make new friends at university[11, 12]. Greater
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23 independence and new peers may promote smoking among occasional smokers, and increase
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25 progression to daily smoking[12]. This study sought to estimate the prevalence, and patterns of smoking
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27 among university students aged 18-24 years in a national university student population.
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33 **METHODS**
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36 We analysed data from the first of two surveys (the ‘Baseline survey’), a cross-sectional survey
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38 conducted between March and May 2018 as part of the corresponding author’s PhD thesis project. The
39
40 survey collected data on the perceptions of university students in New Zealand on vaping, cigarette
41
42 smoking, and the Smokefree 2025 goal. This paper concentrates on the data on smoking.
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49 The Baseline survey aimed to recruit a minimum of 1,061 students from all eight NZ universities: 902
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51 domestic and 160 international, using multiple approaches, to increase the participation of Māori and
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53 Pasifika students. Sample size calculations were based on the 2016 Universities NZ data[13] which
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55 showed the total NZ university students at 172,000, 85% of whom were domestic (11% Māori, 7.8%
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57 Pasifika and 81.2% non-Māori non-Pasifika) and 15% international students; a confidence interval (CI)
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of 95%; estimated smoking proportion of 0.5 (conservative estimate); margin of error of 3%, and estimated response rate of 10%. 10,610 students were to be invited, but far more were reached.

Random sampling was not feasible, because complete enrolment lists of students were not available from the universities. However, data were weighted to account for under- and over-sampling, by gender (male and female) and institution size. Furthermore, the questionnaire comprised both an online and printed version and was distributed widely, using social media and other forms of advertising, and direct contact with student volunteers. 2,180 students participated in the Baseline survey and 1,476 met the criteria for inclusion in the current study (i.e. they were studying at an NZ university and were aged 18-24 years). **Figure 1** describes how participants were selected.

The survey

In the online route, the project was advertised on students' association Facebook pages at respective universities, where this was possible, using a single advert message and photograph. In addition to adverts in general students' association social media platforms, further engagements were made with Māori and Pasifika students' associations. Printed questionnaires were distributed by research assistants (RAs) and volunteers, from participating universities. RAs were recruited from Student Job Search (SJS), a charitable organisation formed by student associations in NZ to help current students and recent graduates of tertiary education institutions in NZ find work[14].

The questionnaire used validated questions: the ethnicity question was based on the NZ census[15], ever smoking question on NZ Tobacco Use Survey (NZTUS)[16], frequency of smoking question was adapted from Marsh and others who looked at the association of smoking with drinking in NZ university students[7], and NZTUS[16], cigarettes/day question was adapted from the Fagerstrom Test for Nicotine Dependence Questionnaire (FTNQ)[17], time to first cigarette question was adapted from

1 NZTUS[16] and FTND[17], and quit intentions from NZTUS[16]. Questions on current smoking,
2 smoking in smokefree spaces, and number of quit attempts were developed in-house. We piloted the
3 questionnaire and survey methods on 22 students at the University of Canterbury (UC) in October 2017.
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8 Respondents were contacted using approaches described previously.
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14 **Patient and Public Involvement**
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17 No patients were involved in this project.
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23 **Survey measures**
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26 Responses to two sections: demographic information and tobacco use, out of four sections asked in the
27 Baseline survey are relevant to this paper and explained below. For the benefit of the reader, a brief
28 description of items on vaping (ever, current and daily vaping) is provided.
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37 Demographics
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40 Respondents provided information on age, gender, ethnicity, years lived in NZ and the university where
41 they were studying. Only those aged 18-24 years were included in the analysis because this allowed for
42 comparisons with national estimates that use a similar age band[6]. Gender-specific analyses included
43 only participants who identified as male or female due to extremely small numbers of other genders.
44
45 Ethnicity-specific analyses compared Māori and non-Māori, as in previous studies[9, 18, 19]. Years
46 lived in NZ (five or less) was used as proxy for international students. Participants could select one or
47 more of the eight universities: Auckland University of Technology (AUT), Lincoln University, Massey
48 University, University of Auckland, UC, University of Otago, University of Waikato and Victoria
49 University of Wellington (VUW).
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Tobacco use

Respondents were asked 'Have you smoked cigarettes or tobacco at all, even just a few puffs?', and responses were: 'Yes' and 'No'. Those who answered 'Yes' (defined as 'ever smokers') were asked 'Do you currently smoke cigarettes or tobacco? This includes roll-your-own (RYO)', and responses were: 'Yes' and 'No'. Those who answered yes were asked 'Which of the following best describes how often you smoke cigarettes or tobacco now?', and responses were 'At least once a day', 'At least once a week', 'At least once a month', and 'Less often than once a month'. Those who smoked at least once a day were defined as 'daily smokers', and those who smoked at least once a month or more frequently were defined as 'current smokers'.

Current smokers were further asked: 'During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?' and responses were '1 to 5', '6 to 10', '11 to 20', '21 to 30', '31 or more', and 'Don't know'. A new variable was created with just two responses as '1-5 cigarettes' and '>5 cigarettes'.

Time to smoking the first cigarette was asked using the question 'How soon after waking do you smoke your first cigarette?' and responses were: 'Within 5 minutes', '5-30 minutes', '31-60 minutes', and '>60 minutes'. A new variable with only two levels: 'within 60 minutes', and '>60 minutes' was created. This was due to small numbers in the three response categories that fell within 60 minutes of waking. This variable was only used in overall prevalence analyses, not for analyses by age, gender or ethnicity.

Smoking in spaces where smoking is banned was assessed by 'How often do you smoke in the following settings...? (1) In indoor spaces where smoking is banned, and (2) In outdoor spaces where smoking is banned', and responses for both were: 'Never', 'Almost never', 'Sometimes', 'Fairly often', and 'Very often'. A new variable was created combining those who said 'Never' and 'Almost never' into 'Never/almost never' and the rest grouped together into 'Other'. This was due to small numbers of those

1 who said sometimes, fairly or very often. This variable was only used in overall prevalence analyses,
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3 not for analyses by age, gender or ethnicity.
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9 The first question on quitting asked: ‘Are you planning on giving up smoking?’, and responses were:
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11 ‘Yes, within 30 days’, ‘Yes, after 30 days but within 3 months’, ‘Yes, but not within the next 3 months’,
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13 and ‘No, I am not planning on giving up’. A new variable was created with only two levels: ‘Yes, I plan
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15 to quit’ (included all who said planned to quit, regardless of timeline) and ‘Not planning to quit’. The
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17 second question on quitting asked ‘Have you tried to quit smoking at any time in the last 12 months?’,
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19 and responses were ‘Yes’ and ‘No’.
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25 Those who had tried to quit were asked ‘In the last 12 months, how many serious attempts to stop
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27 smoking did you make that lasted 24 hours or longer? Please include any attempts that you are currently
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29 making.’, and responses were ‘1-3’, ‘4-5’ and ‘More than 5’. Because of small numbers of those who
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31 reported making ‘4-5’ or ‘More than 5’ attempts, these were combined, resulting in just two groups:
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33 ‘1-3 attempts’ and ‘>3 attempts’. This variable was only used in overall prevalence analyses, not for
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35 analyses by age, gender or ethnicity.
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41 Electronic cigarette use (vaping)
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43 ‘Ever vaper’ refers to those who said ‘Yes’ in response to the question, ‘Have you ever tried an e-
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45 cigarette or vaping device?’, ‘current vaper’ refers to those who reported vaping at least once a month
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47 or more frequently in response to the question, ‘How often do you currently use an e-cigarette or vaping
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49 device?’, while ‘daily vaper’ refers to those who reported vaping at least once daily.
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55 **Data analysis**
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58 Chi-squared tests were used to compare smoking prevalence by age (18-20 vs. 21-24), gender (male vs.
59
60 female) and ethnicity (Māori vs. non-Māori). All statistical analyses were performed using IBM SPSS

Statistic 25 and two-sided $p < .05$ was considered statistically significant. CIs were included where appropriate. Responses were weighted to account for under- and over-sampling, based on gender and institution size. Inconsistent reporting of summary data across universities meant that weights to account for under- and over-sampling with respect to age and ethnicity could not be calculated.

RESULTS

Demographic characteristics of the sample (unweighted) are reported in **Table 1**. 56.2% identified as NZ European, 7.9% as Māori, 7.4% as Pasifika (in this study Pasifika included Samoan, Cook Island Māori, Tongan and Niuean), 15.2% as Chinese, 5.4% as Indian, and 22.2% as 'Other'. The total percentage exceeds 100% because, as in the NZ census, respondents could select as many ethnic groups as applied. **Table 2** compares characteristics of students in this study (domestic or international, ethnicity and gender) with the general NZ university student population.

Table 1. Demographic characteristics of participants			
Variable	Sample (n = 1,476) %	Variable	Sample (n = 1,476) %
Age		Years lived in NZ	
18-20 years	919 (62.3)	Less than 1 year	139 (9.4)
21-24 years	557 (37.7)	1-5 years	168 (11.4)
Gender		6-10 years	99 (6.7)
Male	569 (38.6)	More than 10 years	1,065 (72.2)
Female	907 (61.4)	Missing data	5 (.3)
Ethnicity		University	
NZ European	830 (56.2)	AUT*	59 (4.0)
Māori	117 (7.9)	Lincoln University	64 (4.3)
Samoan	62 (4.2)	Massey University	165 (11.2)
Cook Island Māori	16 (1.1)	University of Auckland	306 (20.7)
Tongan	26 (1.8)	University of Canterbury	243 (16.5)
Niuean	5 (.3)	University of Otago	258 (17.5)
Chinese	224 (15.2)	University of Waikato	142 (9.6)
Indian	79 (5.4)	VUW**	246 (16.7)
Other	327 (22.2)		

Note: This table presents unweighted data. Respondents could select one or more universities. *Auckland University of Technology.

**Victoria University of Wellington.

Table 2. Demographic characteristics of students in this study vs. NZ university students.				
		This paper		NZ university student population (%)*
		Unweighted (%)	Weighted (%)	
Student type	Domestic	79.1	77.5	82.0
	International	20.9	22.5	18.0
Ethnicity	Māori	7.9	6.9	9.6
	Non-Māori	92.1	93.1	90.4
Gender	Male	38.6	40.8	41.8
	Female	61.4	59.2	58.2

*Source: Ministry of Education.[20] Data extracted from Excel sheets ENR.31, ENR.32 and ENR.34.

Overall smoking

49.8% (95% CI: 47.2-52.4) of respondents reported ever smoking, 11.1% (95% CI: 9.5-12.9) currently smoked and 5.9% (95% CI: 4.8-7.3) smoked daily (Table 3). Of current smokers, 63.6% smoked 1-5 cigarettes/day, 20.8% smoked 6-10, 10.5% smoked 11-20 and 5.1% smoked 21 or more cigarettes/day; 45.8% smoked at least daily, 20.9% at least once a week, 18.9% at least once a month, and 14.4% smoked less often than once a month. 17.3% of smokers smoked their first cigarette within 30 minutes of waking, 9.3% within 31-60 minutes and 73.4% after more than 60 minutes of waking up; 86.0% reported never or almost never smoking in indoor and 64.6% in outdoor spaces where smoking is banned; 69.9% planned to quit; 32.4% reported trying to quit in the last 12-months, and 71.7% of those had made 1-3 serious attempts to quit smoking.

Smoking by age

Statistically significantly more participants aged 21-24 years reported ever (55.6% vs. 46.3%, $p=.001$), current (15.0% vs. 8.7%, $p<.001$) and daily smoking (9.8% vs. 3.6%, $p<.001$), and smoking >5 cigarettes/day (45.0% vs. 27.4%, $p=.019$), than those aged 18-20 years, but quit intentions were not statistically significantly different (32.6% vs. 31.9%, $p=.919$) (Table 3).

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		18 to 20 years	21 to 24 years	Total	P-value
Ever smoked?	Yes	414 (46.3)	308 (55.6)	722 (49.9)	.001
	No	480 (53.7)	246 (44.4)	726 (50.1)	
	Total	894 (100.0)	554 (100.0)	1448 (100.0)	
Currently smoke?	Yes	78 (8.7)	83 (15.0)	161 (11.1)	<.001
	No	817 (91.3)	471 (85.0)	1288 (88.9)	
	Total	895 (100.0)	554 (100.0)	1449 (100.0)	
Smokes daily?	Yes	32 (3.6)	54 (9.8)	86 (5.9)	<.001
	No	863 (96.4)	499 (90.2)	1362 (94.1)	
	Total	895 (100.0)	553 (100.0)	1448 (100.0)	
Number of cigarettes/day	1-5 cigarettes	61 (72.6)	44 (55.0)	105 (64.0)	.019
	>5 cigarettes	23 (27.4)	36 (45.0)	59 (36.0)	
	Total	84 (100.0)	80 (100.0)	164 (100.0)	
Ever tried to quit	Yes	30 (31.9)	30 (32.6)	60 (32.3)	.919
	No	64 (68.1)	62 (67.4)	126 (67.7)	
	Total	94 (100.0)	92 (100.0)	186 (100.0)	

Note: the cells contain rounded weighted counts and sometimes the marginal totals are not exactly the sum of the component cells. Ever, current and daily smoking questions were answered by the entire sample. Cigarettes/day and quit intentions questions were answered by both current smokers (smoking at least once a month) and those who smoked less frequently than once a month.

Smoking by gender

Gender-specific analyses included only males and females. Ever (59.8% vs. 43.0%, $p<.001$), current (16.6% vs. 7.3%, $p<.001$), and daily smoking (10.0% vs. 3.1%, $p<.001$) were statistically significantly higher in males compared to females, but smoking >5 cigarettes/day (40.8% vs. 28.8%, $p=.115$) and quit intentions (29.1% vs. 37.7%, $p=.219$) were not statistically significantly different (**Table 4**).

		Male	Female	Total	P-value
Ever smoked?	Yes	353 (59.8)	368 (43.0)	721 (49.9)	<.001
	No	237 (40.2)	488 (57.0)	725 (50.1)	
	Total	590 (100.0)	856 (100.0)	1446 (100.0)	
Currently smoke?	Yes	98 (16.6)	63 (7.3)	161 (11.1)	<.001
	No	492 (83.4)	796 (92.7)	1288 (88.9)	
	Total	590 (100.0)	859 (100.0)	1449 (100.0)	
Smokes daily?	Yes	59 (10.0)	27 (3.1)	86 (5.9)	<.001
	No	532 (90.0)	831 (96.9)	1363 (94.1)	
	Total	591 (100.0)	858 (100.0)	1449 (100.0)	
Number of cigarettes/day	1-5 cigarettes	58 (59.2)	47 (71.2)	105 (64.0)	.115
	>5 cigarettes	40 (40.8)	19 (28.8)	59 (36.0)	
	Total	98 (100.0)	66 (100.0)	164 (100.0)	
Ever tried to quit	Yes	32 (29.1)	29 (37.7)	61 (32.6)	.219
	No	78 (70.9)	48 (62.3)	126 (67.4)	
	Total	110 (100.0)	77 (100.0)	187 (100.0)	

Note: the cells contain rounded weighted counts and sometimes the marginal totals are not exactly the sum of the component cells. Ever, current and daily smoking questions were answered by the entire sample. Cigarettes/day and quit intentions questions were answered by both current smokers (smoking at least once a month) and those who smoked less frequently than once a month.

Smoking by ethnicity

Ever smoking (75.2% vs. 48.0%, $p<.001$) was statistically significantly higher in Māori than in non-Māori, but current smoking (14.0% vs. 10.9%, $p=.342$), daily smoking (6.0% vs. 5.9%, $p=.979$), smoking >5 cigarettes/day (31.3% vs. 36.9%, $p=.655$), and quit intentions (41.2% vs. 31.4%, $p=.409$) were all not statistically significantly different between Māori and non-Māori (**Table 5**).

Table 5. Ever, current, regular and at least once daily smoking, number of cigarettes/day, and quit intentions; by Ethnicity					
		Māori	Non-Māori	Total	P-value
Ever smoked?	Yes	76 (75.2)	646 (48.0)	722 (49.9)	<.001
	No	25 (24.8)	701 (52.0)	726 (50.1)	
	Total	101 (100.0)	1347 (100.0)	1448 (100.0)	
Currently smoke?	Yes	14 (14.0)	147 (10.9)	161 (11.1)	.342
	No	86 (86.0)	1201 (89.1)	1287 (88.9)	
	Total	100 (100.0)	1348 (100.0)	1448 (100.0)	
Smokes daily?	Yes	6 (6.0)	80 (5.9)	86 (5.9)	.979
	No	94 (94.0)	1268 (94.1)	1362 (94.1)	
	Total	100 (100.0)	1348 (100.0)	1448 (100.0)	
Number of cigarettes/day	1-5 cigarettes	11 (68.8)	94 (63.1)	105 (63.6)	.655
	>5 cigarettes	5 (31.3)	55 (36.9)	60 (36.4)	
	Total	16 (100.0)	149 (100.0)	165 (100.0)	
Ever tried to quit	Yes	7 (41.2)	53 (31.4)	60 (32.3)	.409
	No	10 (58.8)	116 (68.6)	126 (67.7)	
	Total	17 (100.0)	169 (100.0)	186 (100.0)	

Note: the cells contain rounded weighted counts and sometimes the marginal totals are not exactly the sum of the component cells. Ever, current and daily smoking questions were answered by the entire sample. Cigarettes/day and quit intentions questions were answered by both current smokers (smoking at least once a month) and those who smoked less frequently than once a month.

Vaping prevalence

39.8% of the sample reported ever vaping, 6.0% currently vaped (vaped at least once a month) and 1.6% vaped at least daily. Detailed data on vaping are under consideration in a separate paper.

DISCUSSION

This study estimates, in a New Zealand university student population, the prevalence of current smoking (at least once a month or more frequently) of 11.1% and daily smoking of 5.9%. It also reports higher ever smoking, current smoking and daily smoking estimates in students aged 21-24 years compared to those aged 18-20 years and in males compared to females, and higher ever smoking estimates in Māori compared to non-Māori students.

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The two main limitations of the study lay in its inability to access vital information from universities to facilitate random sampling, and under-representation of some universities (fewer participants relative to university size); data weighting was done to address the latter. Volunteer bias could lead to underestimation or overestimation of prevalence estimates, while affecting to a minor extent the associations between smoking and age, gender and ethnicity.

Our estimates are low compared with the national smoking prevalence estimates in the same age-group[6]. Comparison with results of a previous study by Marsh and others[7] that looked at smoking in a sample of students aged 17-25, from five universities using 2013 data suggests that the prevalence of current smoking among students decreased marginally from 14.1% in 2013 to 11.1% in 2018 while daily smoking increased slightly from 2.9% to 5.9% in the same period. However, important differences exist in demographic characteristics of participants in these two surveys: there were more Pasifika students (7.4% vs. 4.0%), slightly fewer NZ European students (56.2% vs. 62.3%), more international students (20.8% vs. 8.7%) and slightly different age bands (18-24 years vs. 17-25 years), in the current study compared to Marsh and others[7]. Students who had lived in NZ for five years or less are used as proxy for international students in the current study. Our daily smoking prevalence estimate of 5.9% is nevertheless lower than the 10% reported in a 2002 survey of students at Otago[9].

NZ is currently at Stage 4 of the smoking epidemic characterised by a marked downturn in smoking prevalence in both men and women[21, 22]. The prevalence of smoking is generally higher in Māori and Pasifika than in non-Māori non-Pasifika[6], and a large proportion of international students in NZ come from countries with traditionally high smoking prevalence[23]. Combined, these could have a substantial contribution to observed prevalence estimates. It is also possible that students may have reduced the number of cigarettes/day without quitting entirely, due to increasing cost of cigarettes[24] as a result of annual cigarette tax increase[4]; about 64% of current smokers in our study smoked 1-5 cigarettes/day. Most NZ universities also have smokefree campuses.

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Smoking prevalence among male compared to female students, was of particular concern, with ever smoking 59.8% vs. 43.0%, current smoking 16.6% vs. 7.3%, and daily smoking 10.0% vs. 3.1%. One possibility might be that males are more likely to have many smoking peers. A European study that looked at predictors of smoking behaviour of first year university students in Turkey found only 5% of students whose best friends were non-smokers were themselves smokers, while about 50% of those whose three best friends smoked were also regular smokers[25]. Another possibility is that males are more likely to live away from home, than females. Living with parents or boarding was found to be protective against smoking in a previous study[7].

Many current smokers however smoked five or fewer cigarettes/day (63.6%), smoked their first cigarette more than 60 minutes after waking (73.4%), did not smoke in places where smoking is banned (86.0% indoors and 64.6% outdoors), suggesting low nicotine dependence[17]. Furthermore, 69.9% planned to quit and 32.4% had tried to quit in the last 12 months. Combined, these characteristics makes this population of smokers more likely to successfully quit (if appropriately supported to do so)[26, 27], which is good news from a public health perspective.

Besides the current tobacco control measures used in NZ, including higher cigarette taxes/prices, mass media campaigns, smokefree environments, publicly funded stop smoking medicines (nicotine replacement therapy), community-based stop smoking services, among others, it may be helpful to explore new approaches targeted at university/tertiary students, to reduce smoking in this population group. For instance, Quitline[28] could work closely with student associations, student unions/clubs, or with university management teams to have information on its services included in orientation material, to reach a wider student population. Additionally, mobile phone-based interventions, including text messaging[29] and apps that can easily be localised and owned by students can be developed and tested. The vast majority of university students in NZ fall in the 16-34 year age-group which is thought to be highly familiar with mobile technology and is most likely to own a smart phone[30].

As far as we are aware, this is the first study to examine the prevalence of, and patterns of smoking in a national sample of university students aged 18-24 years in New Zealand. Repeat cross-sectional data are necessary to establish a clear picture of smoking in this population and to monitor any measures deployed to align smoking rates towards the Smokefree 2025 goal target[3].

Strengths of this study include a reasonably large sample that was closely similar to NZ university students (**Table 2**), making it likely that our conclusions may be generalizable to the wider university student population. The questionnaire was available online and in print to reach a wider student community and to increase the response rate; prevalence estimates for online and paper questionnaire responses were similar.

CONCLUSIONS

Our findings suggest that the prevalence of current smoking among university students in New Zealand aged 18-24 is declining but daily smoking could be increasing, compared with previously reported estimates using 2013 data from five universities. Smoking among males and older students (ages 21-24 years) is of particular concern. However, many smokers appear to have a low nicotine dependence, and are willing to quit, suggesting smoking prevalence in this population could substantially be reduced and aligned with the Smokefree 2025 goal target of 5% or less by the year 2025.

We recommend greater presence, and availability of smokefree services, and trialling of new technologies such as mobile-phone based interventions to support students who wish to quit to do so. Follow-up studies on this segment of the population will help us better understand the problem and update interventions to tackle it.

Acknowledgements The authors wish to acknowledge the university students across New Zealand who took part in this research. We also wish to extend our thanks to research assistants and staff of Student Job Search, who supported the in-person data collection process and enabled this research to be undertaken.

Contributors BMW (PhD student) planned the study, collected and analysed data, and wrote the manuscript. MW-B, AR and RCG are BMW’s supervisors and contributed to the planning, study design and writing the manuscript. PC contributed to the study design, data collection, data weighting and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing Interests None declared.

Data sharing statement No additional data are available.

Ethics approval University of Canterbury Human Ethics Committee. Research Ethics ID: HEC 2017/42/LR-PS.

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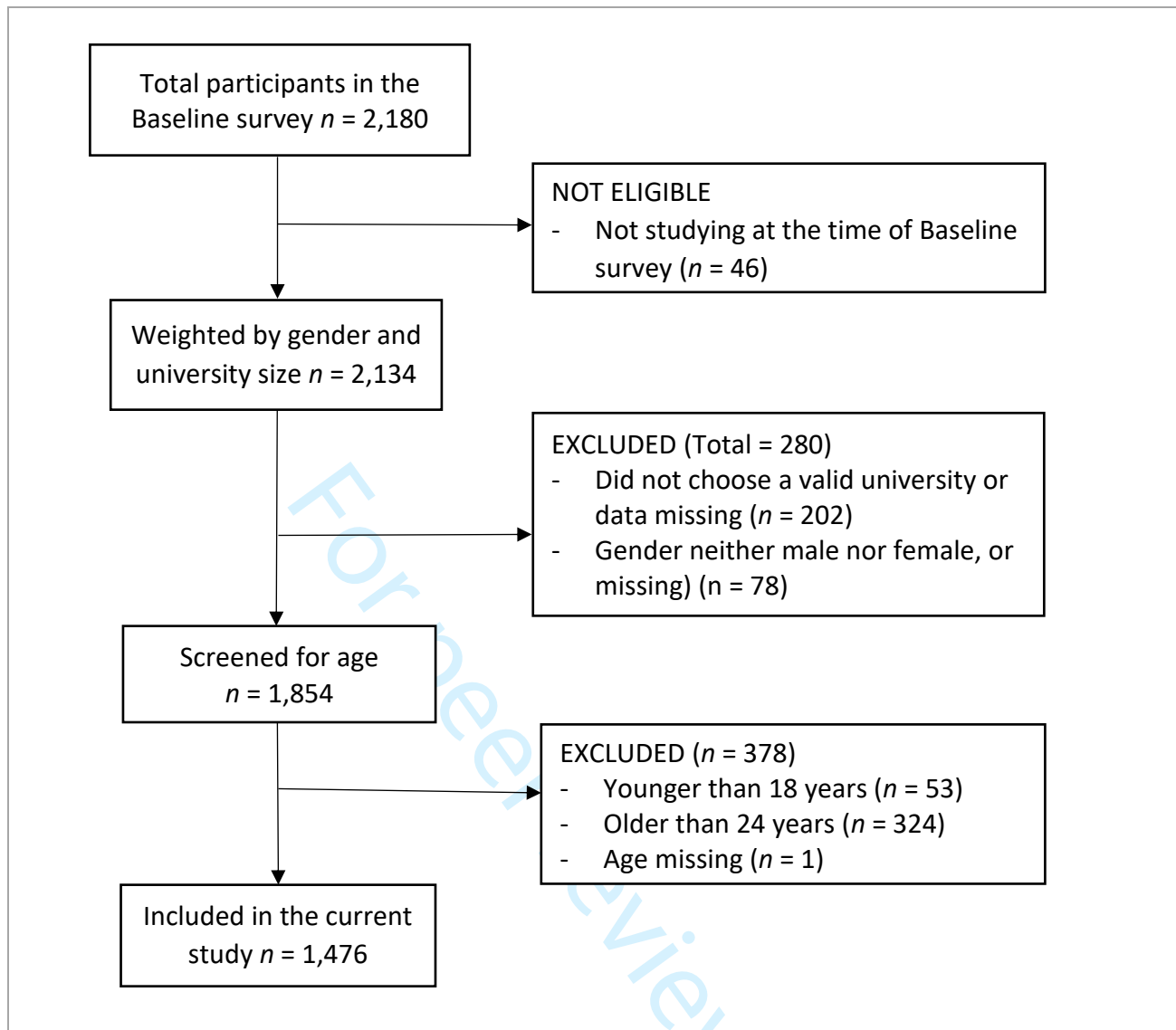
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Figure legend

Figure 1. Flowchart of selection of participants included in this study.

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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2 & 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-9
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-9
Bias	9	Describe any efforts to address potential sources of bias	9, 10
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9, 10
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10, 11
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10, 11
		(b) Indicate number of participants with missing data for each variable of interest	11-13
Outcome data	15*	Report numbers of outcome events or summary measures	10-13

Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.