

# Smoking behaviours and other substance use among Indigenous and non-Indigenous Australian secondary students, 2017

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## Abstract

**Introduction and Aims.** Smoking is a major cause of preventable illness for Indigenous peoples. As most regular smoking is established during adolescence when other substances are often first used, effective tobacco prevention requires an understanding of the patterns of related substance use for Indigenous youth. **Design and Methods.** We reviewed smoking among Indigenous students through cross-sectional analyses of the 2017 Australian Secondary Students' Alcohol and Drug survey and compared findings to non-Indigenous participants. We used logistic regression to evaluate differences in prevalence of tobacco, alcohol and cannabis use, and how smoking and other substance use were related. **Results.** Past month smoking was strongly associated with alcohol and cannabis use for both Indigenous and non-Indigenous students. The association between tobacco and cannabis use did not differ by Indigenous status, but the tobacco and alcohol use association was weaker for Indigenous students ( $P = 0.004$ ). However, the prevalence of tobacco [odds ratio (OR) 1.91 (95% confidence interval; CI 1.55, 2.36)], alcohol [OR 1.44 (1.25, 1.66)] and cannabis [OR 1.97 (1.56, 2.48)] use in the past month was significantly higher in Indigenous than non-Indigenous students. Even within the most socially advantaged sub-group, Indigenous students were more likely to smoke than non-Indigenous students [OR 3.37 (2.23, 5.09)]. **Discussion and Conclusions.** Cannabis and alcohol use are important predictors of smoking for all students. Tobacco policies and community programs must address common determinants of tobacco and other substance use, including resilience and social influence skills as well as broader family and community factors that may be different for Indigenous students. [Heris C, Guerin N, Thomas D, Chamberlain C, Eades S, White VM. Smoking behaviours and other substance use among Indigenous and non-Indigenous Australian secondary students, 2017. *Drug Alcohol Rev* 2020]

**Key words:** adolescent, tobacco, cannabis, alcohol consumption, oceanic ancestry group.

## Introduction

Smoking continues to be a major cause of preventable ill-health globally, with half of all smokers estimated to die from tobacco-related illnesses [1]. In Australia, smoking is the leading single cause of disease and death [2] and accounts for two-thirds of deaths in current smokers [3]. Australian adult daily smoking rates have declined from 24% in 1995 to 14% in 2017–2018 [4], with current (weekly) smoking also declining markedly between 1996 and 2017 for adolescents aged 12–15 (17% to 3%) and 16–17 years (30% to 10%) [5]. Record low

prevalence has been achieved through a range of tobacco control measures over recent decades [6].

In Australia, smoking has also declined in populations with historically higher prevalence, including those experiencing greater social disadvantage, living outside major cities and Aboriginal and Torres Strait Islander peoples [hereafter, Indigenous people (Note: We use the term 'Indigenous' to refer to Aboriginal and Torres Strait Islander people in Australia and First Nations communities worldwide collectively. This is for ease of reading the paper only and we respectfully acknowledge the diversity and autonomy of Indigenous peoples within this inclusive term)] [2]. Daily smoking among Indigenous adults aged

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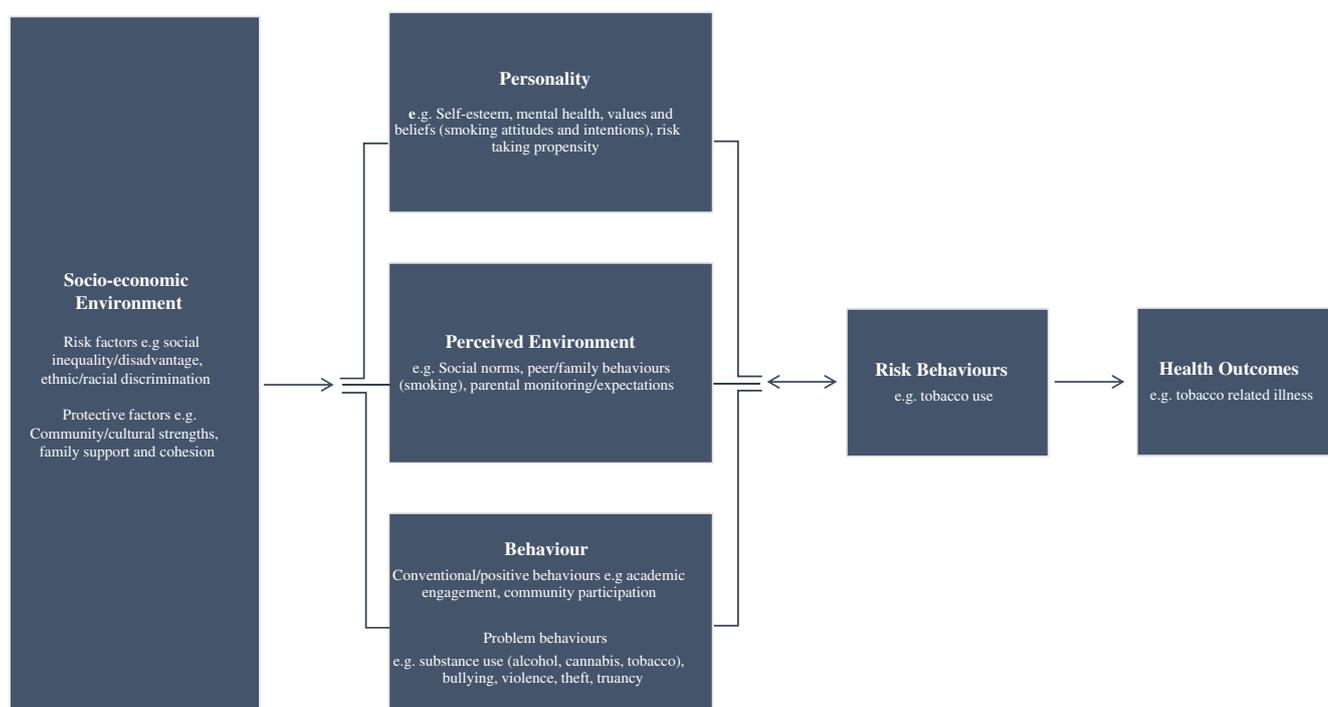
18 years and over declined between 2004–2005 and 2018–2019, from 50% to 40%, but remains almost three times more prevalent than in non-Indigenous Australians (14%) [7]. Smoking is the largest contributing risk factor to the gap in disease burden [8]. This disparity in smoking rates and health outcomes is a legacy of colonisation that introduced commercial tobacco to Indigenous people in rations and entrenched social disadvantage through the enduring impact of government policies [9]. As an ongoing process, colonisation contributes to experiences of life stress, discrimination and disconnection from family and culture, each related to higher smoking prevalence and normalisation [9,10]. This mirrors the experience of colonised Indigenous peoples internationally where smoking rates are higher than the dominant settler population [10].

Most smoking is established during adolescence, including for Indigenous Australians [11,12]. Therefore, it is important to target this age group in prevention programs. The design of effective targeted and mainstream tobacco control interventions will be best supported by improved understanding of current patterns of tobacco use among Indigenous young people and how these differ from non-Indigenous adolescents. A key focus of the current research is the relationship between smoking and known risk factors such as alcohol and other drug use, often also initiated during adolescence [13].

The relationship between smoking and alcohol consumption or illicit drug use has been widely demonstrated

for adults and adolescents [11,14–17]. Problem Behaviour Theory (PBT) explains the co-occurrence of these ‘problem behaviours’ in adolescence [18]. This psychosocial model of health behaviour describes common determinants within three ‘systems’ and how these interact to increase or decrease risk of problem behaviour [18,19]. The systems of: (i) personality (such as self-esteem, values, beliefs); (ii) perceived environment (including peer behaviours, parental monitoring); and (iii) behaviour, conventional (such as academic achievement) and problem behaviours (including substance use), with each problem behaviour related to increased risk of others [18,19]. Later iterations of PBT integrate the broader socio-demographic and socioeconomic environment, and present risk and protective factors in a more exhaustive, ecological model [18,19]. PBT offers a model to understand differences in behaviour between population groups where there are different demographic/economic conditions, social norms and personality system assets (such as self-esteem) (Figure 1).

A handful of studies have explored the relationship between smoking and other substance use for Indigenous adolescents. One systematic review described a strong relationship between smoking and other substance use (primarily alcohol and cannabis) [22]. A longitudinal study of North American Indigenous adolescents in that review used PBT as an analytical framework and found both alcohol and cannabis predicted smoking [21]. Other key predictors were



**Figure 1.** Problem behaviour theory and Indigenous adolescent tobacco use. Adapted from Jessor [20], Yu [21].

deviant behaviours (such as bullying, theft, violence), friends' smoking, intention to smoke and depressive symptoms [21]. However, few studies have explored the relationship between tobacco and substance use in Indigenous Australian adolescents and these have largely been qualitative [23,24]. One found smoking commonly occurred alongside alcohol and cannabis use in social settings, with alcohol providing the opportunity for young people to socialise, increasing access to cigarettes and lowering inhibitions to smoking [23].

In the present study, we used data from the 2017 Australian Secondary Students' Alcohol and Drug Survey (ASSAD), a large, representative sample of students aged 12–17 years. Previous comparisons of regular (past week) and occasional (past month) smoking from the 2014 ASSAD showed higher prevalence among Indigenous than non-Indigenous students (2.6 and 2.4 times higher, respectively [25]). However, these analyses did not explore variations by remoteness and area-level socioeconomic advantage, nor the relationship between smoking and other substance use. We aimed to compare patterns of past month tobacco use among Indigenous and non-Indigenous adolescents aged 12–17 years and evaluate any differences between these groups in associations between smoking and alcohol or cannabis use.

## Methods

### *ASSAD survey*

ASSAD is a national, triennial schools-based self-report survey of tobacco, alcohol and other drug use among Australian secondary students. Sampling and survey administration have been described previously and briefly here [26,27]. ASSAD uses a stratified two-stage probability sampling method to randomly select two samples of secondary schools (years 7–10; and years 11–12) in each state and territory, stratified by education sector (government schools, independent schools and Catholic schools), and randomly select representative classes of students within each participating school. Schools with fewer than 100 enrolled students were excluded. Research staff administered the printed questionnaire to participants. All responses were anonymous and confidential.

### *Ethics and approvals*

Principals gave permission to conduct the survey within their school and informed consent was gained from individual students and their parents using active or passive protocols as approved by education bodies.

Approval for the current study was granted by the Cancer Council Victoria Human Research Ethics Committee (HREC1013) and the University of Melbourne HREC (1953771).

### *Current study*

We used data collected during the 2017 school year and included participants aged 12–17 years who reported their Indigenous status.

### *Measures*

*Substance use.* Primary outcome variables for tobacco, alcohol and cannabis use were calculated as binary measures of 'ever use' (ever had at least a few puffs of a cigarette/not; ever had even part of an alcoholic drink/not; ever smoked or used cannabis/not), and 'past month' use (used in the previous 4 weeks/not).

*Indigenous status.* Students were asked "Are you of Aboriginal or Torres Strait Islander descent?" and responded: No; Yes—Aboriginal descent; Yes—Torres Strait Islander descent; or Yes—both Aboriginal and Torres Strait Islander descent. Students who self-identified as Aboriginal and/or Torres Strait Islander were classified as 'Indigenous' and those who selected 'No' as 'non-Indigenous'. Those who did not indicate Indigenous status were excluded.

*Demographics.* Demographic variables included age (continuous and groups 12–15, 16–17), sex (male, female), state or territory, education sector (government, independent, Catholic) and school postcode. School postcode generated two measures of location: area-level socio-economic advantage using the Australian Bureau of Statistics 2016 Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage (tertiles of most to least socially disadvantaged areas: 'Low', 'Mid', 'High' Advantage); and 'urban location' ('Urban': major cities; or 'Non-Urban': regional/remote) using the 2016 Australian Statistical Geography Standard five-category remoteness classifications (major cities, inner regional, outer regional, remote, very remote) [28,29]. This five-category remoteness variable was also used.

### *Statistical analysis*

We used STATA MP 14.2 for all analyses. Descriptive statistics for sample characteristics are reported by Indigenous status and age-group (Table 1).

Proportions for past-month substance use are reported by Indigenous status (Tables 2–4). We used logistic regression to assess differences between Indigenous and non-Indigenous students in the likelihood of past-month tobacco, alcohol and cannabis use, a significant effect indicated substance use differed between Indigenous and non-Indigenous students. We also evaluated interactions of Indigenous status and demographic variables. When the *P*-value of adding an interaction term was less than 0.10, we repeated the original analysis separately for the relevant sub-group (completed for area-level socio-economic advantage, sex).

We used the same logistic regression approach to assess whether past-month smoking was associated with past-month alcohol use; past-month cannabis use; or past-month alcohol use and cannabis use considered together. Interaction terms (Indigenous status × alcohol use; Indigenous status × cannabis use) indicated differences by Indigenous status in the association between smoking and alcohol use or cannabis use. Unweighted data was used in all logistic regression models and adjusted for clustering within schools to calculate unadjusted odds ratios with 95% confidence intervals (CI). All logistic regression models adjusted for education sector and state/territory, and finally sex, age (continuous), remoteness (five category) and area-level advantage.

## Results

Sample characteristics are summarised in Table 1. ASSAD 2017 data included valid responses from 19 430 participants, with 1225 participants self-identifying as Indigenous. We excluded responses from 114 participants (0.6% of the sample) who did not indicate Indigenous status. The proportion of Indigenous students in the sample (6.3%) closely approximated the 5% of Australians aged

12–17 years that self-identified as being of Indigenous origin in the 2016 Census [30]. Higher proportions of non-Indigenous students than Indigenous students attended schools in urban and more socially advantaged areas [Urban: 65.1% non-Indigenous cf. 37.7% Indigenous (*P* < 0.001); High social advantage: 39.0% cf. 15.4% (*P* < 0.001)]. The majority were aged 12–15 years, and a greater proportion of Indigenous students (73.4%) than non-Indigenous (63.2%) were in this age group.

Two-thirds of all students aged 12–17 years had ever used alcohol, while less than one-third had ever used tobacco or cannabis (Table 1). Ever use of alcohol did not differ significantly by Indigenous status overall (*P* = 0.137). Indigenous males were significantly more likely than non-Indigenous males to have ever consumed alcohol [odds ratio (OR) 1.31 (1.04, 1.65)], and Indigenous students in urban [OR 1.39 (1.14, 1.69)] and most disadvantaged areas [OR 1.28 (1.03, 1.60)] were more likely than non-Indigenous students to have consumed alcohol. The likelihood of having ever used tobacco [OR 1.93 (1.65, 2.25)] or cannabis [OR 1.86 (1.54, 2.23)] was significantly higher for Indigenous than non-Indigenous students aged 12–17 years. Among those aged 12–15 years, Indigenous students were around twice as likely to have ever smoked [OR 2.24 (1.88, 2.66)] or used cannabis [OR 2.05 (1.61, 2.61)].

Indigenous students were significantly more likely than non-Indigenous students to have used tobacco [OR 1.91 (1.55, 2.36)], alcohol [OR 1.44 (1.25, 1.66)] or cannabis [OR 1.97 (1.56, 2.48)] in the past-month (Table 2). Odds of past-month tobacco use continued to be significantly higher for Indigenous students compared to non-Indigenous students when also adjusting for alcohol use [OR 1.71 (1.36, 2.15)], cannabis use [OR 1.48 (1.12, 1.94)] or both [OR 1.45 (1.09, 1.93)].

For smoking, the effect of Indigenous status was greater in areas of higher social advantage (overall

**Table 1.** Number of secondary school students aged between 12 and 17 years surveyed across Australia in 2017, by Indigenous status, age, gender, location and Socio-Economic Indexes for Areas index; lifetime tobacco and other substance use experience

	12–15 years		16–17 years		12–17 years	
	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous	Indigenous	Non-Indigenous
Total ( <i>n</i> )	899	11 441	326	6650	1225	18 091
% Males	45.5	48.0	50.2	43.9	46.8	46.5
% Urban	33.4	61.2	49.5	71.8	37.7	65.1
% Low advantage	55.6	29.7	47.1	26.0	53.4	28.4
% Mid advantage	30.0	33.1	34.8	31.9	31.3	32.6
% High advantage	14.4	37.2	18.2	42.1	15.4	39.0
% Ever use: Tobacco	24.3	11.2	44.9	31.2	29.8	18.6
% Ever use: Alcohol	64.6	59.7	86.5	83.0	70.4	68.2
% Ever use: Cannabis	18.8	9.5	42.3	29.8	25.2	17.2

**Table 2.** Likelihood of past month tobacco, alcohol and cannabis use among students aged 12–17 years in 2017 by Indigenous status and significant interactions with socioeconomic status and sex

	% (n/total)	OR (95% CI)	AOR (95% CI)	P-value of interaction with Indigenous status
<b>Past month tobacco use</b>				
<i>Total, 12–17 years</i>				
Non-Indigenous	8.0 (1429/17 947)	1	1	
Indigenous	14.0 (170/1212)	1.89 (1.55, 2.30)	1.91 (1.55, 2.36)	
<i>Area-level social advantage</i>				
Low				
Non-Indigenous	8.9 (452/5085)	1	1	
Indigenous	12.7 (82/646)	1.49 (1.12, 1.98)	1.73 (1.28, 2.33)	<i>P</i> = 0.059
Mid				
Non-Indigenous	8.6 (504/5835)	1	1	
Indigenous	13.7 (52/379)	1.68 (1.24, 2.29)	1.70 (1.22, 2.38)	
High				
Non-Indigenous	6.7 (464/6979)	1	1	
Indigenous	19.4 (36/186)	3.37 (2.23, 5.09)	3.54 (2.12, 5.92)	
<b>Past month alcohol use</b>				
<i>Total, 12–17 years</i>				
Non-Indigenous	28.4 (5121/18014)	1	1	
Indigenous	34.1 (416/1221)	1.30 (1.11, 1.52)	1.44 (1.25, 1.66)	
<b>Past month cannabis use</b>				
<i>Total, 12–17 years</i>				
Non-Indigenous	8.6 (1343/15645)	1	1	
Indigenous	14.1 (145/1031)	1.74 (1.39, 2.8)	1.97 (1.56, 2.48)	<i>P</i> = 0.041
<i>Sex</i>				
Male				
Non-Indigenous	9.6 (684/7143)	1	1	
Indigenous	14.2 (64/450)	1.57 (1.16, 2.11)	1.61 (1.18, 2.20)	
Female				
Non-Indigenous	7.6 (629/8277)	1	1	
Indigenous	14.0 (78/556)	1.98 (1.50, 2.62)	2.31 (1.73, 3.08)	

AOR: odds ratio (OR) adjusted for school type, state, age, sex, school location, area-level advantage. CI, confidence interval.

interaction test approached significance:  $P = 0.059$ ). Specifically, smoking among Indigenous students in areas of high social advantage was 19.4%, 6.7% non-Indigenous [OR 3.54 (2.12, 5.92)]; 12.7% in areas of low social advantage cf. 8.9% [OR 1.73 (1.28, 2.33)].

Patterns of past-month tobacco use were similar for both Indigenous and non-Indigenous students (Table 3) with no significant difference in the likelihood of use by sex, urban/non-urban or social advantage of area. Older students (16–17 years) were significantly more likely to have used tobacco in the past month than younger students (12–15 years) [Indigenous OR 2.53 (1.72, 3.70); non-Indigenous OR 3.79 (3.23, 4.34)].

For both Indigenous and non-Indigenous students, the likelihood of past-month smoking increased significantly with past-month alcohol and/or cannabis use (Table 4). Adjusting for use of the other substance (either cannabis or alcohol) reduced the associations between past month smoking and drinking or cannabis use substantially (by approximately half), but the

relationship remained significant for both Indigenous and non-Indigenous students.

The relationship between cannabis and tobacco use did not vary significantly by Indigenous status [interaction  $P = 0.86$ , Indigenous OR 18.17 (11.14, 29.62); non-Indigenous OR 24.23 (20.56, 28.56)]. There was however a significant interaction between Indigenous status and past month drinking ( $P = 0.004$ ) whereby the association of smoking and drinking was stronger among non-Indigenous students [OR 17.39 (14.51, 20.85)] than Indigenous students [OR 8.79 (5.73, 13.48)].

## Discussion

We examined smoking and other substance use among Australian secondary students in 2017 and found that regardless of Indigenous status smoking prevalence was higher among those who had used either alcohol or cannabis than for non-users. However, the association between alcohol and tobacco use was significantly

**Table 3.** Association of demographic factors with past month tobacco use among Indigenous and non-Indigenous students aged 12–17 years in 2017 by sex, age and residence

	% (n/total)	OR (95% CI)	AOR (95% CI)
<b>Past month tobacco use</b>			
<i>Indigenous</i>			
Total	14.0 (170/1212)	-	
Sex			
Male	14.8 (81/547)	1	1
Female	13.3 (84/634)	0.88 (0.64, 1.20)	0.92 (0.67, 1.27)
Age, years			
12–15	10.6 (94/887)	1	1
16–17	23.4 (76/325)	2.57 (1.81, 3.66)	2.53 (1.72, 3.70)
School location			
Urban	14.5 (66/455)	1	1
Non-urban	13.8 (104/756)	0.94 (0.63, 1.40)	1.50 (0.93, 2.43)
Area-level advantage			
Low advantage	12.7 (82/646)	1	1
Mid advantage	13.7 (52/379)	1.09 (0.70, 1.72)	1.11 (0.70, 1.74)
High advantage	19.4 (36/186)	1.65 (1.07, 2.55)	1.59 (0.94, 2.70)
<i>Non-Indigenous</i>			
Total	8.0 (1429/17947)	—	
Sex			
Male	8.1 (660/8197)	1	1
Female	7.8 (736/9482)	0.96 (0.83, 1.12)	0.93 (0.81, 1.07)
Age, years			
12–15	4.3 (487/11328)	1	1
16–17	14.2 (942/6619)	3.69 (3.04, 4.48)	3.79 (3.23, 4.34)
School location			
Urban	7.6 (886/11648)	1	1
Non-urban	8.5 (534/6251)	1.13 (0.87, 1.48)	1.14 (0.91, 1.41)
Area-level advantage			
Low advantage	8.9 (452/5085)	1	1
Mid advantage	8.6 (504/5835)	0.97 (0.71, 1.32)	0.92 (0.74, 1.15)
High advantage	6.7 (464/6979)	0.73 (0.52, 1.03)	0.94 (0.71, 1.26)

AOR, odds ratio (OR) adjusted for school type, state, age, sex, school location, area-level advantage. CI, confidence interval.

**Table 4.** Likelihood of past month tobacco use among Indigenous and non-Indigenous students 12–17 years in 2017, by past month alcohol and cannabis use

		Past month tobacco use			
	% (n/total)	OR (95% CI)	AOR <sup>a</sup> (95% CI) adjusted for demographics	AOR <sup>b</sup> (95% CI) adjusted for demographics and substance use	P-value of interaction with Indigenous status
<b>Indigenous students</b>					
<i>Past-month alcohol use</i>					
No	4.2 (33/794)	1	1	1	
Yes	33.1 (137/414)	11.41 (7.93, 16.41)	8.79 (5.73, 13.48)	4.79 (2.89, 7.94)	0.004 <sup>a</sup> /0.013 <sup>b</sup>
<i>Past-month cannabis use</i>					
No	6.4 (56/880)	1	1	1	
Yes	57.9 (84/145)	20.26 (12.97, 31.65)	18.17 (11.14, 29.62)	11.57 (7.12, 18.79)	0.086 <sup>a</sup> /0.282 <sup>b</sup>
<b>Non-Indigenous students</b>					
<i>Past-month alcohol use</i>					
No	1.4 (178/12789)	1	1	1	—
Yes	24.4 (1242/5090)	22.87 (19.07, 27.42)	17.39 (14.51, 20.85)	9.31 (7.65, 11.31)	
<i>Past-month cannabis use</i>					
No	3.7 (528/14224)	1	1	1	—
Yes	55.6 (741/1333)	32.47 (27.74, 38.00)	24.23 (20.56, 28.56)	12.07 (10.23, 14.23)	

<sup>a</sup>Adjusted for all demographic variables (school type, state, age, sex, school location, area-level advantage). <sup>b</sup>Adjusted for other substance use variable with all demographic variables (school type, state, age, sex, school location, area-level advantage and alcohol or cannabis). AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

weaker for Indigenous students. Overall, Indigenous students had higher prevalence of tobacco, alcohol and cannabis use in the past month than non-Indigenous students. These findings for 2017 ASSAD data extend reported 2014 findings [25] and allow evaluation of the effects of the later Australian policy environment, which saw further increases in cigarette price and more legislation for smoke-free environments [6,31].

Many studies have identified a cluster of risk behaviours for adolescent smoking, including alcohol and illicit drug use [11,14–17]. These associations have been found among Indigenous adolescents of North America [22,32] and in qualitative work in Australia [23,24] with researchers noting the importance of social settings that promote sharing and experimentation with illicit substances. Our results suggest other substance use is an important risk factor for smoking for all young people.

Our finding of a significantly weaker association between alcohol and tobacco use for Indigenous than non-Indigenous students indicates a less uniquely important role of alcohol use for Indigenous students. One potential explanation is that smoking in non-Indigenous students more commonly occurs in social settings where students are trialling alcohol. In contrast, with higher community level smoking prevalence, Indigenous students are likely to have more frequent access and opportunities to experiment with tobacco, and consequently establish regular smoking. Indigenous adolescents are also more likely to experience other drivers of smoking. An Australian qualitative study reported that Indigenous and non-Indigenous Australian adolescents provided similar descriptions of concurrent social smoking and alcohol use, but Indigenous adolescents were more likely to say their smoking was related to stress and life problems [24], which may be related to a greater likelihood of experiencing such events [22]. The stronger and consistent association between cannabis and tobacco use may reflect that cannabis is often mixed with tobacco when it is smoked [33].

The strong association between smoking, drinking and cannabis use clearly suggests common determinants as explained by PBT. Adolescent smoking can also serve as an indicator of risk, with those who experiment or establish smoking in early high school more likely to adopt other problem behaviours, including substance use, later in high school and adolescence [32,34]. The call for coordinated health promotion programs to address multiple risk behaviours through common determinants has been made for both Indigenous adolescents [21,32,35] and adolescents in general [15,34]. These determinants may include self-efficacy and other coping and refusal skills that can be applied to multiple behaviours, as well as important protective factors such as self-esteem, family relationships and peer attitudes [15,32]. Additional protective factors

identified specifically for Indigenous adolescents include cultural connectedness [21,35].

Our results thus suggest that a coordinated and holistic approach to substance use prevention is likely to be most effective, and provide efficiencies in community programs and school curriculums. This is supported by reviews of school-based interventions, which have shown mixed results for tobacco prevention and recommend targeting broader determinants to protect against substance use, rather than focusing on information provision alone. Broader determinants include promoting social and emotional wellbeing, and skills development, such as self-efficacy and problem solving [36,37]. An Australian school-based cluster-randomised controlled trial of a program aiming to improve mental health and build resilience among students while reducing tobacco, alcohol and illicit drug use, achieved reductions in regular smoking [38]. However, a second trial showed no effect on smoking, highlighting the need for a better understanding of individual, family and community-level protective factors as well as additional risk factors, such as substance use among family and friends [39].

One approach focused on promoting protective factors in the social and community environment to reduce adolescent risk behaviours is *Communities That Care*, a community-based intervention framework first developed in the United States and later applied in Australia [40]. Using a mix of evidence-based family, school and community interventions, *Communities That Care* localities saw significant and more rapid declines in adolescent tobacco, alcohol and cannabis use than in the general population [40]. However, the evaluation did not report results specifically for Indigenous Australian adolescents, and there continues to be limited evidence of the effectiveness of tobacco prevention interventions with Indigenous adolescents [41,42].

While it is likely that some components of an intervention will be universally effective, tobacco prevention programs must also take into account the smoking context for Indigenous adolescents, including higher community prevalence and the influence of unique social, economic, cultural and historical factors. Our finding of greater past month tobacco use among Indigenous than non-Indigenous adolescents is consistent with international findings of higher smoking among other Indigenous populations, including Māori in New Zealand, and American Indian or Alaska Native secondary students in North America [43,44]. The drivers of this are complex and include the normalisation of smoking in high prevalence environments. As the ASSAD survey does not collect national information on family or peer smoking, a key predictor for youth smoking, it was not possible to consider this in our analysis.

Moreover, the higher prevalence of smoking in Indigenous communities is underpinned by a range of social and cultural determinants related to ongoing colonisation processes that manifest in persistent disparities in education, employment and access to health services (including tobacco control activities), combined with forced disconnection from culture, limits on self-determination, effects of intergenerational trauma and experiences of racial discrimination [10,45].

In our study, the differences between Indigenous and non-Indigenous smoking prevalence were greater for those in more socio-economically advantaged areas than for those in more disadvantaged areas. That is, prevalence was more similar in students attending schools in more socio-economically disadvantaged areas (where there is a higher overall likelihood of smoking) reflecting the relationship between social determinants and smoking for all populations. Although relative advantage as determined by school location does not necessarily equate to individual household situation, our findings indicate that the difference in smoking prevalence in Indigenous and non-Indigenous students in more advantaged areas is not fully explained by socio-economic factors. Similar findings have been reported for Indigenous adults, where smoking differences by Indigenous status were greater among adults who were not experiencing socioeconomic disadvantage [46]. Again, highlighting the additional risk factors experienced by Indigenous people. Conversely, increasingly evidence shows the importance of Indigenous cultures for health and wellbeing and protective against adolescent smoking [35,47,48].

#### *Strengths and limitations*

A key strength of this study is the largely representative sample, with the proportion of Indigenous students corresponding to national census data [30]. Furthermore, the proportion of Indigenous students from urban schools (38%) closely approximated the proportion of Indigenous people residing in urban areas (37% major cities) and the sample skewed towards areas of greater social disadvantage, in line with the national distribution of Indigenous people against the SEIFA index [49]. The Indigenous leadership in this study is also a key strength of the work and a self-determining research approach.

However, some limitations should be also be considered. ASSAD sampling excludes schools of fewer than 100 students, which might have reduced the representativeness as smaller schools are more likely to be in non-urban areas. Also, our analyses are cross-sectional and do not support causal conclusions. While teachers were frequently present when students completed the

survey, it was administered by research staff and we found no evidence of under-reporting substance use with teacher presence. Finally, only adolescents currently attending school are included in the sample. Older adolescents might be underrepresented and, as school attendance is associated with non-smoking [5], our findings might underestimate prevalence for students aged 16–17 generally and Indigenous adolescents specifically with lower proportions aged 16–17 years in this sample (27% Indigenous cf. 37% non-Indigenous) and lower comparative school attendance [50]. However, the large size and highly representative random sample of younger adolescents allowed us to evaluate key risk factors for adolescent smoking including age, remoteness, social disadvantage, and other substance use, while noting that both remoteness and social disadvantage are areas level indicators from school postcode, not individual residence, and as such some participants may be misclassified.

#### *Implications for policy and practice*

Our findings demonstrate the importance of considering underlying social and cultural determinants of smoking in developing tobacco control policy, as well as reducing the appeal and availability of tobacco products. Unlike school-based interventions, community-driven programs also have the potential to reach young people not attending school and to leverage family and community protective factors, to holistically address related risk factors which also predict alcohol and cannabis use. Additional risk and protective factors likely to also be important for smoking among Indigenous adolescents include racism [51], and the role of cultural strengths in promoting adolescent wellbeing [35,52]. While a significant evidence gap remains for the effectiveness of prevention interventions with Indigenous youth, comprehensive, resourced, strengths-based community-controlled programs are likely to be most effective and urgently needed [9,41]. Integrating and disseminating Indigenous-led program evaluation findings would benefit Indigenous communities globally. However, mainstream programs and population level policies to reduce tobacco and other substance use among both young people and adults remain vital to ensure community level interventions are reinforced in wider social and economic environments. Evaluation of the impact of these measures with Indigenous adolescents is also a priority.

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## Conflict of Interest

The authors have no conflicts of interest.

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