

## Article

# Footprints in time: individual, social, and environmental factors and never-use of e-cigarettes among Indigenous adolescents

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## Abstract

Electronic cigarette (e-cigarettes or vapes) use is becoming increasingly common, including among adolescents aged 12–15 years, who are often targeted through marketing and flavoured products. We aimed to investigate associations between individual, social, and environmental factors and e-cigarette never-use (hereafter referred to as never-use) among Aboriginal and Torres Strait Islander adolescents in 2018. This was a cross-sectional analysis of Wave 11 data from the Longitudinal Study of Indigenous Children ( $N = 440$ ). Poisson regression was used to calculate prevalence ratios of never-use in relation to individual, social, and environmental factors. Never-use was reported by 89.3% of adolescents; 2.5% reported e-cigarette use with nicotine in the last 12 months. Never-use was associated with not using other substances (cigarettes, alcohol, or marijuana), positive social relationships as well as supportive home and education environments. We did not identify significant associations between e-cigarette use and (1) individual factors: suicidal ideation and physical activity; or e-cigarette use and (2) family factors: caregivers' perception of the child's friends and schooling. Never-use was common within a cohort of Aboriginal and Torres Strait Islander adolescents aged 12–15 years and was associated with supportive peer groups, school, and community environments. The factors identified as protective against e-cigarette use largely mirror those protective against cigarette use in this population.

**Keywords:** Indigenous peoples; tobacco control; tobacco industry; human rights; public policy; surveillance and monitoring; priority/special populations

### Contribution to Health Promotion

- This article contributes to health promotion by identifying factors that prevent e-cigarette (vaping) uptake among Aboriginal and Torres Strait Islander adolescents, aged 12–15 years, in the context of ongoing impacts of racism and colonization.
- The research highlights the importance of supporting health promotion initiatives tailored to Aboriginal and Torres Strait Islander peoples by addressing the influence of the tobacco and nicotine industry, which disproportionately targets Indigenous populations, and by fostering protective factors such as positive social relationships, substance-free behaviours, and supportive home, school, and community environments.
- Findings underscore the critical importance of recent changes to Australia's vaping laws, which restrict the sale of vapes to pharmacies, enforce plain pharmaceutical packaging, and limit nicotine concentrations, as an opportunity to reduce e-cigarette uptake and associated harms. These measures align with health promotion goals to protect adolescents from nicotine dependence and the harmful marketing tactics of the tobacco and nicotine industry.
- Findings emphasize that addressing systemic factors, including colonization and racism, and countering the influence of the tobacco and nicotine industry, is critical to preventing e-cigarette (vaping) uptake. Culturally safe environments, structural supports, and policies that align with recent world leading tobacco and vaping reforms are essential to enhancing individual, social, and environmental well-being and reducing vaping prevalence and harms in this population.

## INTRODUCTION

Electronic cigarettes (e-cigarettes or vapes) are battery-operated devices that heat a liquid which may or may not contain nicotine to generate aerosol for inhalation. In 2024, the Australian Government introduced multiple world leading e-cigarettes and tobacco reforms. However, there is a lag time between the reforms and effect, and as a result, there is currently an abundance of nicotine e-cigarette products. In Australia, individuals aged 18 and over can purchase e-cigarettes containing up to 20 mg/ml of nicotine from participating pharmacies without a prescription, subject to state and territory laws. Those under 18 or requiring higher nicotine concentrations need a prescription, with all e-cigarettes restricted to mint, menthol, or tobacco flavours and plain pharmaceutical packaging (Australian Government Department of Health and Aged Care 2023).

Although e-cigarettes were initially marketed as a smoking cessation tool by the tobacco industry and their affiliates, their use has become increasingly popular among adolescents who are targeted through appealing flavours, branding, and marketing (Government of Canada 2019, Guerin and White 2020). The increasing uptake and associated e-cigarette harms—including addiction, poisoning, acute nicotine toxicity, and lung injury—are concerning (Gotts et al. 2019, Summers et al. 2022, Banks et al. 2023). A recent review identified strong evidence that e-cigarette use increased smoking uptake among adolescents. Individuals who did not smoke but used e-cigarettes were three times as likely to take up smoking compared to people who did not smoke and who did not use e-cigarettes (Banks et al. 2023).

Aboriginal and Torres Strait Islander peoples have increasingly voiced concern about the use of e-cigarettes and nicotine dependence (Maddox et al. 2022). Reducing e-cigarette use among Aboriginal and Torres Strait Islander adolescents is a priority given the links to tobacco use and the potential to halt and reverse the progress made in reducing tobacco use in recent decades.

Community-driven efforts and leadership have significantly reduced tobacco use, with prevalence among Aboriginal and Torres Strait Islander peoples decreasing from 54% in 1995 to 43% in 2018–19 (Colonna et al. 2020, Heris et al. 2020b, Thurber et al. 2020b). Among young people, smoking prevalence and initiation has declined significantly (Australian Bureau of Statistics 2017, Heris et al. 2020b).

The enduring effects of systemic racism, colonization, and tobacco industry targeting have fuelled tobacco use among Aboriginal and Torres Strait Islander peoples, including the use of tobacco as payment in lieu of wages and economic engagement (Brady 2002, van der Sterren et al. 2016a; Waa et al. 2020). The tobacco industry and their collaborators continues to exploit Indigenous peoples, while undermining tobacco control measures, including regulation (van der Sterren et al. 2016a, b; Maddox et al. 2022). Despite significant achievements in tobacco control and resistance, smoking remains the leading preventable cause of illness and death, accounting for 37% of all Aboriginal and Torres Strait Islander deaths (Thurber et al. 2021a).

Data on e-cigarette use among Aboriginal and Torres Strait Islander adolescents remain limited, partly due to the recent emergence of e-cigarettes. In the 2017 Australian Secondary School Students Alcohol and Drug (ASSAD) survey, 18% of

Aboriginal and Torres Strait Islander adolescents aged 12–15 years (Heris et al. 2022). In the 2018–19 National Aboriginal and Torres Strait Islander Health Survey (NATSIHS), 3.8% of Aboriginal and Torres Strait Islander adolescents aged 15–17 years had ever tried e-cigarettes, although this is likely to underestimate the true prevalence due to potential biases (Barrett et al. 2022).

E-cigarette use increases the likelihood of smoking initiation among people who did not smoke (Banks et al. 2023). Preventing e-cigarette initiation reduces the initiation and establishment of smoking and also directly reduces the harms of e-cigarettes (Banks et al. 2023). The growing use of e-cigarettes among young people raises concerns about their immediate health impacts and their role in promoting tobacco use. This is underscored by an increase in smoking prevalence among 14- to 17-year-olds in Australia from 2018 to 2022, coinciding with the increase in vaping within the same age bracket during this period (Wakefield et al. 2023). Evidence from other populations suggests that risk factors for e-cigarette initiation—such as substance use and poor mental health—are similar to those for smoking initiation (Dunbar et al. 2019, Kim and Selya 2020).

Among Aboriginal and Torres Strait Islander adolescents, factors such as younger age, living in smoke-free homes, good mental health, and strong social connections are associated with lower rates of smoking (Heris et al. 2020b, 2021). However, there is limited evidence quantifying the relationships between individual, social, and environmental factors and e-cigarette use in this population.

The primary objective of this study was to quantify relationships between e-cigarette use and a range of potential protective factors in a national cohort of Aboriginal and Torres Strait Islander adolescents. This research aims to help inform e-cigarette programs, policies, and strategies.

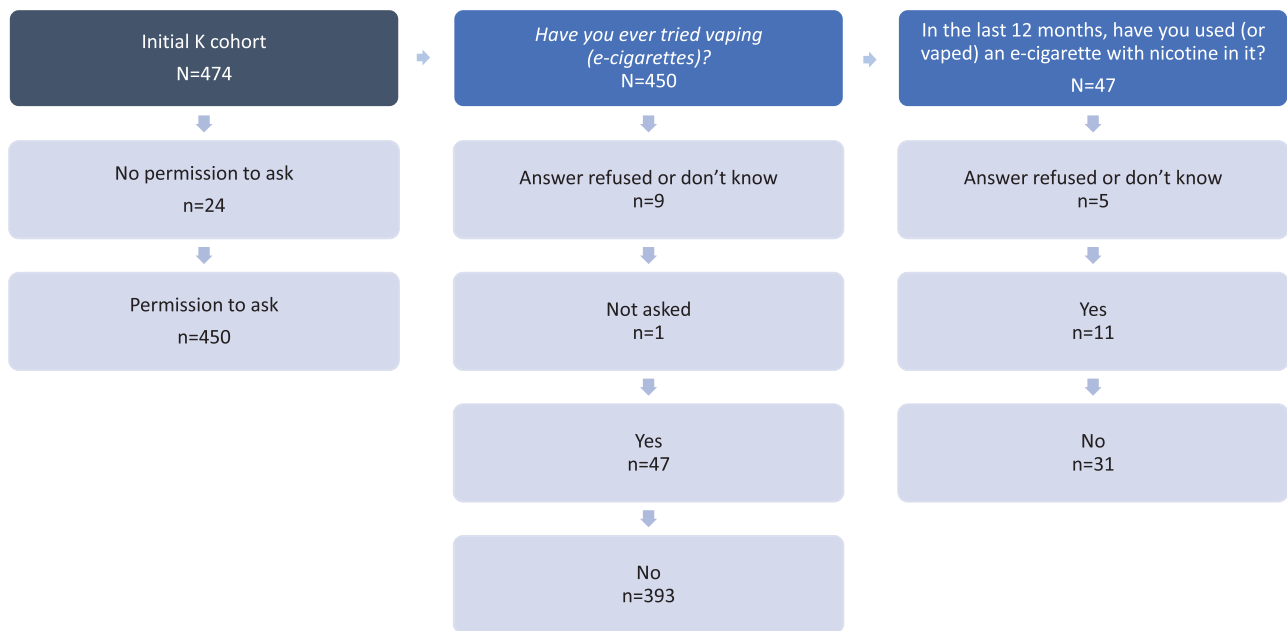
## METHODS

### Study design

This study is a cross-sectional analysis of the data from Wave 11 of the Longitudinal Study of Indigenous Children (LSIC), also known as *Footprints in Time*. The design and conduct of the study adhered to Indigenous governance and Indigenous Data Sovereignty Principles, guided by Thiitu Tharrmay, an Aboriginal and Torres Strait Islander Reference Group. Community input, guidance, and feedback were considered and incorporated throughout the research process. Thiitu Tharrmay's feedback included guidance on analysis and associated variables, with several Thiitu Tharrmay members (L.L., M.K., and T.C.) joining the research team in authoring this article.

These principles guided the identification of items for analysis, including existing evidence on e-cigarette use as outlined above. However, data on e-cigarette use among Aboriginal and Torres Strait Islander adolescents remain limited, underscoring the importance of this research.

We have used a strengths-based approach to identify factors protective against initiation of e-cigarette use among Aboriginal and Torres Strait Islander adolescents, exploring relationships with individual, family, and community strengths often underrepresented in research. By prioritizing these strengths, the study better reflects community values and principles while maintaining scientific rigour to build on the existing evidence base (Thurber et al. 2020a).



**Figure 1.** Cohort flow diagram for vaping status in the Longitudinal Study of Indigenous Children.

## Study population

LSIC includes two groups of Aboriginal and Torres Strait Islander children who were aged 6–18 months (B cohort) and 3.5–5 years (K cohort) when the study began in 2008. Initially, 11 diverse sites were selected and used across Australia, and then Aboriginal and Torres Strait Islander children were recruited using purposive sampling. Annual face-to-face interviews by Aboriginal and Torres Strait Islander Research Administration Officers (RAOs) were conducted with the children and their primary caregiver (henceforth, ‘caregiver’). Further information regarding the study design and implications has been described elsewhere (Hewitt 2012, Thurber et al. 2015).

This analysis used data collected in 2018, from the Wave 11 K cohort, noting the B Cohort were not asked follow-up questions about e-cigarette use, so were not included in the analysis. We used the adolescent’s self-reported data and questions answered by their caregiver that provide a broader context for the adolescent’s social environment.

## Measures

### Use of e-cigarettes (outcome)

The primary outcome was having never used e-cigarettes (never-use). The adolescents were asked ‘Have you ever tried vaping (e-cigarettes)?’. Those who answered ‘no’, were categorized as ‘never’, and those who answered ‘yes’ as ‘ever’. Those who responded ‘don’t know’, refused to answer, or whose caregiver did not give permission to ask these questions, were categorized as ‘missing’. Those who answered ‘yes’ were then asked ‘In the last 12 months, have you used (or vaped) an e-cigarette with nicotine in it?’ (Fig. 1).

### Individual, social, and environmental factors (exposures)

We conducted a literature review of quantitative and qualitative studies (with Aboriginal and Torres Strait Islander adolescents and Indigenous adolescents internationally) to identify

individual, social, and environmental factors associated with smoke-free behaviours among Aboriginal and Torres Strait Islander adolescents (Johnston et al. 2012, Heris et al. 2020a, 2021). Given the limited e-cigarettes evidence base, we included factors related to both e-cigarette and cigarette use.

We mapped the factors identified against questionnaire items available in the LSIC survey, incorporating relevant items into the analysis. The selected variables are described below. Additional information regarding how each factor was asked and categorized is detailed in Supplementary Table S1. The exposures were categorized into individual, social, and environmental factors based on the theory of triadic influence (Flay 1999). However, we recognize that many exposures impact at the individual, social, and/or environmental level.

Individual factors included demographics (age, sex, and remoteness), measures of the adolescents’ well-being (physical activity; no suicide ideation), and their engagement in risk-taking behaviours (cigarette use; alcohol use; and cannabis use). Remoteness was classified using the Australian Statistical Geography Standard (ASGS) Remoteness Areas, a framework developed by the Australian Bureau of Statistics (Australian Bureau of Statistics 2016) to help measure relative access to services. In 2018 (period of data collection), e-cigarettes were primarily concentrated in major cities (Greenhalgh et al. 2020). To help account for this, we examined remoteness based on major cities as well as inner/outer regional or remote areas.

Social factors included measures of family (e.g. smoke-free homes, caregiver smoking status, and family relationships), friends (peer e-cigarette and cigarette use and peer relationships), and school experience (regular school attendance, educational enjoyment, and academic performance).

Environmental factors included cultural connection (connection to country, knowledge about culture), physical environment (not feeling bored; non-crowded housing), and systems of racism and exclusion (no exposure to racism; no experiences of bullying; and no encounters with the police).

## Statistical analysis

We quantified the prevalence of e-cigarette use (ever-use and use of e-cigarette with nicotine in the past 12 months) in the sample overall and by age group, sex, and remoteness. Chi-squared tests were performed to test for significant differences in e-cigarette use between these groups. Poisson regression was used to calculate unadjusted prevalence ratios (PRs) and 95% confidence intervals (CIs) for never-e-cigarette use in relation to each exposure variable. The models were then adjusted for age (age groups 12–13/14–15 years) and remoteness (major cities/inner, outer regional and remote and very remote); these adjusted PRs (aPRs) are discussed in the text. Sex was not adjusted for due to the small sample size and lack of evidence supporting a potential confounding effect of the relationships under study. Missing data were excluded or included as its own category, where indicated. In line with LSIC policy on small cells, we suppressed cells based on counts of < 4, with the exception of the missing data categories. Analyses were conducted in Stata SE 16.1.

Preliminary findings were shared with the Aboriginal and Torres Strait Islander Research Administration Officers (RAOs) responsible for conducting LSIC, and their valuable feedback was integrated into this article. RAOs were also invited to become authors, reflecting the collaborative and inclusive nature of this research. We acknowledge that Aboriginal and Torres Strait Islander engagement goes beyond advisory roles and authorship. This study reflects ongoing relationships with Aboriginal and Torres Strait Islander peoples and communities, including those working in tobacco control and everyday engagement; actively embedding knowledge users throughout these research processes contextualizes the findings, enhancing the relevance and impact of this work.

## Ethics

The community-driven research questions were identified through ongoing engagement with Aboriginal and Torres Strait Islander peoples and communities. We worked with Aboriginal and Torres Strait Islander peoples (including authors M.K., M.M.B., R.C., M.O., L.L., and T.C.) in developing the data analysis plan, undertaking analysis, contextualizing findings, and developing conclusions and recommendations.

The project upholds ethical principles of research with Aboriginal and Torres Strait Islander peoples consistent with the National Health and Medical Research Council (NHMRC) Guidelines for ethical conduct in Aboriginal and Torres Strait Islander Health Research. LSIC data collection is conducted with approvals from the Departmental Ethics Committee of the Australian Government Department of Health and Aged Care, as well as additional approval at the State, Territory, or regional level from the relevant bodies. This current analysis has been granted ethical approval by the Australian National University's Human Research Ethics Committee (Protocol No. 2016/534).

## Research team

We also recognize the importance of the research team's worldviews, which are predicated on our respective backgrounds, values, and perspectives (Moreton-Robinson 2017). The first author (E.R.) is a non-Indigenous medical student, and our research team includes Aboriginal and Torres Strait Islander lived experience (R.C., M.M.B., M.K., T.C., L.L., and

M.O.B.), Indigenous lived experience (R.M.), and tobacco research experience (C.H., E.M.B., R.C., M.M.B., M.K., T.C., L.L., M.O.B., K.A.T., and R.M.), public health (all authors), and epidemiology (C.H., E.M.B., M.O.B., K.A.T., and R.M.).

## RESULTS

### Demographics

Of the 440 adolescents with e-cigarette data (Fig. 1), 49.8% were female and 45.2% were aged 12–13 years (Table 1). The majority of the study population lived in inner/outer regional or remote areas (70.0%). Characteristics of participants with missing versus complete data are presented in Supplementary Table S2.

### E-cigarette use (vaping)

Of the total 440 adolescents, 393 (89.3%) responded 'no' to 'have you ever tried vaping (e-cigarettes)?' (Table 2). Of those who had ever tried an e-cigarette, a quarter (26.2%;  $n = 11/42$ ) reported using an e-cigarette containing nicotine in the last 12 months. The prevalence of never-use and use in the last 12 months did not differ significantly between adolescents of different age groups ( $\chi^2$   $P$ -value = .496) or sex ( $\chi^2$   $P$ -value = .362).

Of those who lived in major cities, 83.3% reported never-use, compared to 91.9% in regional and remote areas, which was a statistically significant difference ( $\chi^2$   $P$ -value = .008). E-cigarette use with nicotine in the last 12 months did not differ significantly between levels of remoteness ( $\chi^2$   $P$ -value = .726).

### Relationships between exposures and never-use of e-cigarettes

#### Individual

A significantly higher prevalence of adolescents reported never-use of e-cigarettes if they lived in regional or remote areas (aPR = 1.10, 95%CI: 1.02, 1.19), compared to those living in major cities. Those who had never smoked cigarettes (aPR = 1.40; 1.19, 1.64), not smoked cigarettes in the past year (aPR = 1.86; 1.36, 2.54), never used alcohol (aPR = 1.60; 1.25, 2.04), not used alcohol in the past year (adjusted PR = 1.45; 1.13, 1.87), and never used marijuana (aPR = 1.57; 1.16, 2.12) had a significantly higher prevalence of never-use, when compared to those that had reported use of each respective substance (Table 3).

**Table 1.** Profile of adolescents with valid e-cigarette data from the Australian Longitudinal Study of Indigenous Children (LSIC), Wave 11, 2018

	n	%
<b>Total</b>	<b>440</b>	<b>100</b>
Age (years)		
12–13 years	199	45.2
14–15 years	241	54.8
Sex		
Male	221	50.2
Female	219	49.8
Level of remoteness		
Major cities	132	30.0
Inner/outer regional and remote/very remote	308	70.0

While there was a higher prevalence of never-use for those who had not had any suicidal ideation in the past 12 months, it was not statistically significant (aPR = 1.19; 0.92, 1.54), whereas a null relationship appears between never-smoking and physical activity (aPR = 0.96; 0.89, 1.03) (Table 3).

### Social

Prevalence of never-use was significantly more common among adolescents who reported that their friends did not use, versus used, e-cigarettes (aPR = 1.53; 1.29, 1.81) or cigarettes (aPR = 1.29; 1.16, 1.45). There was a significantly higher prevalence of never-use among adolescents who reported they were happy to go to school (aPR = 1.13; 1.01, 1.26), compared to those who were not (Table 3).

Several other social (family, friends, and schooling) factors, including smoke-free homes, caregiver smoking, family relationships, economic security (parents employment and running short of money), funeral attendance, school attendance and performance, and factors relating to the caregiver's perception of the child's friends were not statistically significant (Table 3).

### Environmental

Adolescents who disagreed that there was nothing to do where they lived (i.e. there were things to do where they lived) were more likely to report never-use, compared to those who agreed or strongly agreed (strongly disagree/disagree aPR = 1.11; 1.02, 1.20; neither agree/disagree aPR = 1.13; 1.05, 1.23) (Table 3).

Those who had never bullied others were more likely to report never-use (aPR = 1.14; 1.05, 1.25) compared to those who had been bullied. While the magnitude of effect for those who had not been bullied (aPR = 1.06; 0.99, 1.14), or bullied specifically for being Indigenous (aPR = 1.12; 0.95, 1.32), is relatively strong, but is not statistically significant. If the caregiver reported that the family had 'hardly ever' or 'never' experienced racism, discrimination, or prejudice, the child was more likely to report never-use (aPR = 1.09; 1.01, 1.18) (Table 3).

The results for the other factors reported and analysed were not statistically significant, including overcrowding (aPR = 1.00; 0.90, 1.12), feeling safe in class about being Indigenous (aPR = 1.12; 0.93, 1.34), connection to country (aPR = 0.99; 0.92, 1.07), and problems with the police (aPR = 1.09; 0.97, 1.23) (Table 3).

## DISCUSSION

To our knowledge, this study is among the first to examine potential protective factors against e-cigarette initiation among Aboriginal and Torres Strait Islander adolescents. The findings build on an invaluable 2018 baseline dataset, which provides critical insights into the health and well-being of Aboriginal and Torres Strait Islander adolescents and their resilience in the face of predatory actions by the e-cigarette industry. This dataset serves as a vital benchmark for assessing trends over time and also offers significant longitudinal potential to evaluate the impacts of emerging policies, such as the 2024 Australian government's e-cigarette reforms, health promotion strategies, and the Tackling Indigenous Smoking program. These measures are a step towards the broader goal of eradicating the harms caused by the commercial tobacco industry and their collaborators, which continues to profit at the expense of public health and well-being (Maddox et al. 2024).

E-cigarettes pose a significant and growing concern for adolescent substance use in Australia, threatening the declines in smoking behaviours observed in the most recent ASSAD survey data (2002–17) (Guerin and White 2020). This highlights the urgent need for proactive measures to counter these threats, including real-time evaluation data which are critical to informing policy and addressing the escalating risks associated with novel tobacco and nicotine products.

We found that factors established as protective against smoking may also protect against the predatory actions of the e-cigarette industry and e-cigarette use; generating actionable insights into protecting the health and well-being of children and adolescents. The recent findings by Banks et al. (2023)

**Table 2.** Prevalence of e-cigarette use in sample overall and by age, sex, and remoteness

	E-cigarette use (N = 440)				P-value for chi-square	E-cigarette use with nicotine in last 12 months (N = 42)				P-value for chi-square
	Never		Ever			Yes		No		
	%	n/N	%	n/N		%	n/N	%	n/N	
Total	89.3	393/440	10.7	47/440		26.2	11/42	73.8	31/42	
Age (years)										
12–13 years	91.5	182/199	8.5	17/199		–		–		
14–15 years	87.6	211/241	12.4	30/241	0.187	–		–		0.362
Sex										
Male	86.9	192/221	13.1	29/221		20.8	5/24	79.2	19/24	
Female	91.8	201/219	8.2	18/219	0.096	33.3	6/18	66.7	12/18	0.362
Level of remoteness										
Major cities	83.3	110/132	16.7	22/132		28.6	6/21	71.4	15/21	
Inner/outer regional and remote/very remote	91.9	283/308	8.1	25/308	0.008	23.8	5/21	76.2	16/21	0.726

– indicates suppressed data due to small numbers.

**Table 3.** Relationship between exposures and never-use of e-cigarettes, Wave 11, 2018

	E-cigarette use				PR	95% CI	Adjusted PR	95% CI
	Never		Ever					
	%	n/N	%	n/N				
Total	89.3	393/440	10.7	47/440				
<b>INDIVIDUAL FACTORS</b>								
<i>Demographics</i>								
Age (years)								
12–13 years	91.5	182/199	8.5	17/199	1.00		1.00	
14–15 years	87.6	211/241	12.4	30/241	0.96	0.90, 1.02	0.96	0.90, 1.02
Sex								
Male	86.9	192/221	13.1	29/192	1.00		1.00	
Female	91.8	201/219	8.2	18/219	1.06	0.99, 1.13	1.05	0.99, 1.13
Remoteness								
Major cities	83.3	110/132	16.7	22/132	1.00		1.00	
Inner/outer regional and remote/very remote	91.9	283/308	8.1	25/308	<b>1.10</b>	<b>1.02, 1.19</b>	<b>1.10</b>	<b>1.02, 1.19</b>
<i>Well-being</i>								
Hours active on weekday <sup>^</sup>								
< 1 h	93.1	54/58	6.9	4/58	1.00		1.00	
≥ 1 h	89.0	317/356	11.0	39/356	0.96	0.89, 1.03	0.96	0.89, 1.03
Missing	84.6	22/26	15.4	4/26				
Suicide ideation in the past 12 months								
Yes	76.2	16/21	23.8	5/21	1.0		1.00	
No	90.2	331/367	9.8	36/367	1.18	0.91, 1.54	1.19	0.92, 1.54
Missing	88.5	46/52	11.5	6/52				
<i>Risk-taking behaviours</i>								
Smoking status								
Ever	67.9	55/81	32.1	26/81	1.00		1.00	
Never	94.8	331/349	5.2	18/349	<b>1.40</b>	<b>1.19, 1.64</b>	<b>1.42</b>	<b>1.21, 1.66</b>
Missing	70.0	7/10	30.0	3/10				
Smoked in last 12 months								
Yes	51.3	20/39	48.7	19/39	1.00	–	1.00	
No	94.6	365/386	5.4	21/386	<b>1.84</b>	<b>1.35, 2.52</b>	<b>1.86</b>	<b>1.37, 2.53</b>
Missing	53.3	8/15	46.7	7/15				
Marijuana use								
Ever	59.0	23/39	41.0	16/39	1.00		1.00	
Never	92.8	361/389	7.2	28/389	<b>1.57</b>	<b>1.16, 2.13</b>	<b>1.59</b>	<b>1.18, 2.14</b>
Missing	75.0	9/12	25.0	3/12				
Alcohol status								
Use in the past year	60.0	33/55	40.0	22/55	1.00		1.0	
Used but not past year	87.1	88/101	12.9	13/101	<b>1.45</b>	<b>1.13, 1.87</b>	<b>1.46</b>	<b>1.15, 1.87</b>
Never used alcohol	96.3	258/268	3.7	10/268	<b>1.60</b>	<b>1.26, 2.05</b>	<b>1.61</b>	<b>1.27, 2.05</b>
Missing	87.5	14/16	12.5	2/16				
<b>SOCIAL FACTORS</b>								
<i>Family</i>								
Anyone smokes in the house <sup>^^</sup>								
Yes	89.3	50/56	10.7	6/56	1.00		1.00	
No	89.2	339/380	10.8	41/380	1.00	0.90, 1.11	1.02	0.92, 1.13
Missing	100.0	4/4	0.0	0/4				
Parent current smoking status <sup>^</sup>								
Current smoker with no past year quit attempts	87.0	40/46	13.0	6/46	1.00	–	1.00	
Current smoker—past year quit attempts	84.5	120/142	15.5	22/142	0.97	0.86, 1.10	0.97	0.86, 1.09
Ex or never smoker	93.0	226/243	7.0	17/243	1.07	0.95, 1.20	1.07	0.95, 1.21
Missing	77.8	7/9	22.2	2/9				
Family well-being <sup>^</sup>								
Low	82.6	19/23	17.4	4/23	1.00		1.00	

Table 3. Continued

	E-cigarette use				PR	95% CI	Adjusted PR	95% CI
	Never		Ever					
	%	n/N	%	n/N				
Medium	83.0	39/47	17.0	8/47	1.00	0.81, 1.24	1.01	0.83, 1.25
High	90.3	327/362	9.7	35/362	1.09	0.92, 1.31	1.10	0.92, 1.31
Missing	100.0	8/8	0.0	0/8				
Family gets along with each other								
Never/Not much/Little bit	87.1	27/31	12.9	4/31	1.00		1.00	
Always/Most of the time/Fair bit	89.2	355/398	10.8	43/398	1.02	0.90, 1.16	1.04	0.92, 1.17
Missing	100.0	11/11	0.0	0/0				
Child upset by family arguments <sup>^</sup>								
Yes child or other child who lives here	84.9	79/93	15.1	14/93	1.00		1.00	
No or yes but a child not living here	90.7	303/334	9.3	31/334	1.07	0.98, 1.17	1.07	0.98, 1.17
Missing	84.6	11/13	15.4	2/13				
Number of funerals attended <sup>^</sup>								
3+	88.3	98/111	11.7	13/111	1.00		1.00	
1–2	91.0	132/145	9.0	13/145	1.03	0.96, 1.11	1.04	0.96, 1.11
None	89.6	146/163	10.4	17/163	1.01	0.93, 1.10	1.03	0.94, 1.12
Missing	81.0	17/21	19.0	4/21				
Times short of money <sup>^</sup>								
Yes at least once	88.5	131/148	11.5	17/148	1.00		1.00	
Not at all	89.8	254/283	10.2	29/283	1.01	0.95, 1.09	1.01	0.95, 1.08
Missing	88.9	8/9	11.1	1/9				
Parent employment <sup>^</sup>								
Unemployed	89.2	33/37	10.8	4/37	1.00		1.00	
Employed	89.3	260/291	10.7	31/291	1.00	0.89, 1.13	1.00	0.89, 1.13
Missing	89.3	100/112	10.7	12/112				
<b>Friends</b>								
Child's friends use (vape) e-cigarettes								
Yes	62.0	44/71	38.0	27/71	1.00		1.00	
No	95.2	298/313	4.8	15/313	1.54	1.30, 1.82	1.52	1.28, 1.80
Missing	91.1	51/56	8.9	5/56				
Child's friends smoke cigarettes								
Yes	74.4	93/125	25.6	32/125	1.00		1.00	
No	95.6	259/271	4.4	12/271	1.28	1.15, 1.44	1.30	1.16, 1.46
Missing	93.2	41/44	6.8	3/44				
Child's plays with a good group of kids <sup>^</sup>								
Definitely/Usually not	75.0	12/16	25.0	4/16	1.00		1.00	
Sometimes	81.8	54/66	18.2	12/66	1.09	0.84, 1.42	1.11	0.85, 1.44
Mostly/Always	91.3	283/310	8.7	27/310	1.22	0.96, 1.54	1.24	0.98, 1.58
Missing	91.7	44/48	8.3	4/48				
Days a week child plays with older children <sup>^</sup>								
Most days (5+)	88.6	78/88	11.4	10/88	1.00		1.00	
1–4 days	87.1	88/101	12.9	13/101	0.98	0.89, 1.08	0.99	0.90, 1.09
Less than weekly/Rarely/Never	90.5	181/200	9.5	19/200	1.02	0.93, 1.12	1.03	0.94, 1.13
Missing	90.2	46/51	9.8	5/51				
<b>School experience</b>								
Skipped school in last 2 weeks								
Yes	75.9	22/29	24.1	7/29	1.00		1.00	
No	92.6	289/312	7.4	23/312	1.22	0.97, 1.53	1.25	<1.00, 1.56
Missing	82.8	82/99	17.2	17/99				
Happy to go to school								
Not much/Never	81.1	43/53	18.9	10/53	1.00		1.00	
Fair/Little bit	90.1	128/142	9.9	14/142	1.11	0.99, 1.24	1.11	0.99, 1.24

Table 3. Continued

	E-cigarette use				PR	95% CI	Adjusted PR	95% CI
	Never		Ever					
	%	n/N	%	n/N				
Always/Most of the time	92.6	212/229	7.4	17/229	1.14	1.03, 1.27	<b>1.13</b>	<b>1.02, 1.26</b>
Missing	62.5	10/16	37.5	6/16				
Being good at school work								
Not much/Never	80.0	24/30	20.0	6/30	1.00		1.00	
Fair/Little bit	90.2	157/174	9.8	17/174	1.13	0.95, 1.34	1.13	0.95, 1.35
Always/Most of the time	91.8	201/219	8.2	18/219	1.15	0.97, 1.36	1.15	0.97, 1.36
Missing	64.7	11/17	35.3	6/17				
<b>ENVIRONMENTAL</b>								
<i>Physical environment</i>								
There is nothing to do								
Strongly agree/Agree	83.7	144/172	16.3	28/172	1.00		1.00	
Neither agree/Disagree	94.2	114/121	5.8	7/121	1.13	1.04, 1.21	<b>1.13</b>	<b>1.04, 1.22</b>
Strongly disagree/Disagree	91.8	123/134	8.2	11/134	1.10	1.01, 1.19	<b>1.11</b>	<b>1.03, 1.20</b>
Missing	92.3	12/13	7.7	1/13				
Home is overcrowded <sup>^</sup>								
Yes	88.2	45/51	11.8	6/51	1.00		1.00	
No	89.4	345/386	10.6	41/386	1.01	0.91, 1.13	1.00	0.90, 1.12
Missing	100.0	3/3	0.0	0/3				
<i>Cultural connection</i>								
Child feels safe about being Indigenous								
Never/Not much/Little bit	81.5	22/27	18.5	5/27	1.00		1.00	
Always/Most of the time/Fair bit	90.6	346/382	9.4	36/382	1.11	0.93, 1.34	1.12	0.93, 1.34
Missing	80.6	25/31	19.4	6/31				
Child's connection to country <sup>^</sup>								
No	87.9	94/107	12.1	13/107	1.00		1.00	
Yes here or not around here	89.3	275/308	10.7	33/308	1.02	0.94, 1.10	0.99	0.92, 1.07
Missing	96.0	24/25	4.0	1/25				
<i>Systems of exclusion and discrimination</i>								
Child bullied others								
Yes	82.2	97/118	17.8	21/118	1.00		1.00	
No	93.7	266/284	6.3	18/284	1.14	1.05, 1.24	<b>1.15</b>	<b>1.06, 1.25</b>
Missing	78.9	30/38	21.1	8/38				
Child bullied								
Yes	86.9	113/130	13.1	17/130	1.00		1.00	
No	91.9	250/272	8.1	22/272	1.06	0.98, 1.14	1.06	0.99, 1.14
Missing	78.9	30/38	21.1	8/38				
Child was bullied because they're Indigenous <sup>^</sup>								
Yes always/Sometimes	82.4	28/34	17.6	6/34	1.00		1.00	
No	93.8	75/80	6.2	5/80	1.14	0.96, 1.35	1.12	0.95, 1.32
Missing	89.0	290/326	11.0	36/326				
Family experiences racism, discrimination, or prejudice <sup>^</sup>								
At least weekly/Sometimes/Occasionally	84.6	165/195	15.4	30/195	1.00		1.00	
Hardly ever/Never	92.8	220/237	7.2	17/237	1.10	1.02, 1.18	<b>1.09</b>	<b>1.01, 1.17</b>
Missing	100.0	8/8	0.0	0/8				
Problems with police <sup>^</sup>								
Yes	82.8	53/64	17.2	11/64	1.0		1.00	
No	90.3	337/373	9.7	36/373	1.09	0.97, 1.23	1.09	0.97, 1.23
Missing	100.0	3/3	0.0	0/3				

– indicates suppressed data due to small numbers.

<sup>^</sup> indicates survey question asked of caregiver.

**Bold** indicates statistically significant findings ( $p < 0.05$ ).

further validate the importance of these protective factors, demonstrating a nearly fivefold increase in the likelihood of smoking initiation among adolescents who vaped. The findings from [Egger et al. \(2024\)](#), combined with the data presented here, underscore the urgent need for early, targeted interventions to prevent e-cigarette use and disrupt the progression from vaping to smoking among adolescents, particularly within priority groups. These interventions are essential to safeguard against the transition to combustible tobacco and nicotine products and their associated harms.

The 2024 Australian Government e-cigarettes and tobacco reforms are an important step in reducing initiation and protecting young people from the health harms of e-cigarettes. These reforms include significant measures, such as restricting sales to pharmacies, introducing plain pharmaceutical packaging, limiting flavours to mint, menthol, and tobacco, and requiring prescriptions for under-18s. These policies are expected to curb access to harmful products and disrupt the ability of the tobacco and nicotine industry to target population groups, including Aboriginal and Torres Strait Islander adolescents. By incorporating these measures into a broader framework of tobacco control, the reforms provide a unique opportunity to evaluate their impact on adolescent behaviours longitudinally, further reinforcing the value of datasets like LSIC in policy analysis ([Guerin and White 2020](#)).

In 2018, most of the LSIC study population reported never-use of e-cigarettes (89.3%) and 2.5% reported using e-cigarettes with nicotine in the last 12 months. While prevalence estimates from the K cohort within LSIC are not intended to be generalizable beyond the study, they underscore the value of tracking trends over time. Consistent with [Dessaix et al. \(2022\)](#), RAOs reported substantial increases in e-cigarette uptake among adolescents in the previous 12 months up to late 2022, particularly on the east coast of Australia. This aligns with national data showing an alarming rise in vaping among young Australians, necessitating urgent, targeted action. The LSIC dataset offers a robust mechanism for monitoring the impacts of these trends, particularly in the context of regulatory and policy shifts ([Guerin and White 2020](#)).

E-cigarette use among young people is a rapidly evolving with urgent action required. In Wave 11, adolescents living outside major cities were more likely to report never-use than those who lived in major cities, consistent with other evidence on e-cigarette prevalence among Aboriginal and Torres Strait Islander adults, which shows fewer users in remote areas ([Thurber et al. 2021b](#)).

However, RAOs reported that use was primarily occurring in urban and regional centres and rarely in remote communities ([Thomas et al. 2019](#), [Thurber et al. 2020b](#), [Greenhalgh et al. 2020](#)). The new legislative changes, including limiting non-pharmacy sales, are expected to address this disparity by reducing the availability of e-cigarettes in high-use areas.

Some RAOs noted that e-cigarettes were now reaching remote Top End and Torres Strait communities, being brought in by contractors and young people returning from boarding schools in urban centres. This variability in prevalence across urban, regional, and remote areas reflects factors like accessibility, marketing intensity, social norms, and perceptions of harm ([Greenhalgh et al. 2020](#)). Further exploration of these nuanced perceptions will be critical for tailoring health promotion and tobacco resistance strategies.

One RAO described the different perceived harms of e-cigarettes in remote communities versus non-remote areas,

stating that in urban and regional areas, young people generally understood the harms of tobacco smoking and were trying e-cigarettes out of curiosity as they perceived them to be a 'healthier' alternative. In remote areas, however, adolescents were more concerned about e-cigarette harms than tobacco harms. Further exploration of these perceptions would be valuable.

There was an association between never-smoking and e-cigarette never-use, with those reporting never-smoking 1.4 times as often reporting never using e-cigarettes than those who had ever smoked. Furthermore, never-use of e-cigarettes was almost twice as common among those who had not smoked in the past 12 months (or ever), compared to those who had. The findings from [Banks et al. \(2023\)](#) and [Egger et al. \(2024\)](#) further emphasize the bidirectional risks, noting that people who did not smoke and who used e-cigarettes were significantly more likely to transition to smoking.

Adolescents who had also abstained from using marijuana or alcohol were more likely to have never used e-cigarettes. These findings are consistent with international studies that demonstrate e-cigarette use is commonly associated with poly-substance use ([Zuckermann et al. 2019](#)), including cigarette smoking. These are likely to have shared root causes, such as racism, discrimination, and trauma. Comprehensive adolescent health promotion programs, addressing such shared determinants are crucial for preventing e-cigarettes and other substance use.

The new legislative requirement for under-18s to obtain a prescription to purchase vapes provides an opportunity for health professionals to engage adolescents in discussions about vaping harms and cessation, further supporting prevention and genuine harm reduction efforts.

Social environments play a key role in preventing e-cigarette use, reinforcing nicotine-free norms, and fostering strong social relationships. Adolescents with friends who did not use e-cigarettes or smoke cigarettes were more likely to report never-use of e-cigarettes, mirroring that previously shown for smoking ([Johnston et al. 2012](#), [Heris et al. 2020a](#)). The new packaging and flavour restrictions are expected to contribute to the de-normalization of vaping among young people, supporting broader community efforts to create nicotine-free environments. Nicotine-free (e-cigarette and cigarette) social norms in the broader community are important for influencing young people's attitudes towards use, including through social media. Consistent with reporting on ABC Four Corners ([ABC News 2022](#)), RAOs reported that professional athletes (such as rugby league players), who did not smoke, were now vaping and vaping inside the home.

Adolescents who were not engaged with bullying were more likely to be never users. Studies looking at smoking among Aboriginal and Torres Strait Islander adolescents have similarly shown the importance of peer relationships, including an absence of bullying, as a protective factor against tobacco use ([Johnston et al. 2012](#), [Heris et al. 2020a](#)). This relationship between bullying and smoking is complex and may provide a stress relief and a sense of self-control. Furthermore, RAOs discussed the importance of parents and caregivers in creating a safe space for young people to ask questions about smoking and vaping, maintaining an open dialogue with adolescents about their interest in e-cigarettes and the potential harms, including financial and health impacts of e-cigarette use and nicotine addiction.

Educational engagement also emerged as a protective factor against smoking, with adolescents who reported being happy to go to school were more likely to report never-use of e-cigarettes. This reflects the importance of culturally safe and engaging school environments (Ockenden 2014). However, it is concerning to hear from RAOs and others (Ockenden 2014, O'Flaherty 2023) that young people were being excluded from school (suspended/sent home) for e-cigarette use. There is an important role for schools to play in enforcing smoke and vape-free expectations as well as providing a setting for health promotion activities.

A lack of boredom also served as a protective factor, highlighting the value of community and recreational engagement in preventing risk-taking behaviours (O'Flaherty 2023). This was supported by the RAOs who shared some of the recreational activities being introduced to keep young people active, such as bush hunting and fishing trips. However, RAOs also highlighted that funding cuts had adversely affected the availability of recreational spaces, including sports grounds, in certain communities.

We found an association between an absence of caregiver-reported family experiences of discrimination/racism and the never-use of e-cigarettes by adolescents. Discrimination and racism remains a public health crisis, with direct and indirect impacts on health and well-being. Exposure to everyday experiences of discrimination has been associated with smoking among Aboriginal and Torres Strait Islander adults (Thurber *et al.* 2021a) and accounts for approximately half of the burden of high/very high psychological distress in the population (Thurber *et al.* 2022).

Although these exposures influence e-cigarette use, they are beyond individual choice and control, and demand remediation and structural changes in the broader social and cultural environment. Structural changes are urgently needed to address these pervasive issues.

Overall, the associations identified in this study demonstrate that factors protective against smoking are also protective against e-cigarette use, reinforcing the shared determinants of these behaviours and the need for harmonized prevention efforts. The findings, in conjunction with Australia's progressive legislative changes, provide a pathway to eradicate e-cigarette uptake and help safeguard the health and well-being of Aboriginal and Torres Strait Islander adolescents.

## Limitations

This analysis has various strengths and limitations. For example, this is among the first to examine e-cigarette use among Aboriginal and Torres Strait Islander adolescents and adds to the limited evidence base. However, given the rapid growth in e-cigarette prevalence (Dessaix *et al.* 2022, Gardner *et al.* 2022, Watts *et al.* 2022), it is important to recognize that the data reported were collected and reflect the context in 2018, prior to mass proliferation of e-cigarettes in Australia. As a result, while we essentially have baseline data, this e-cigarettes proliferation was not captured or presented in this article, and we recognize the need for regular monitoring and evaluation.

Furthermore, this could include strict regulations on e-cigarettes to help safeguard the health and well-being of children and adolescents (Dessaix *et al.* 2022). In addition, our analytical power was limited by the relatively small sample size (of those with e-cigarette experience); accordingly, confidence intervals were wide for many PRs, and we were restricted to a

simple adjustment strategy (age and remoteness). The finding of very few adolescents reporting e-cigarette use with nicotine in the last 12 months meant we were unable to quantify relationships with all demographic factors. This small number of participants may reflect language consistency issues between the initial 'ever-use of e-cigarette' question and the subsequent question about use in the past 12 months which specified 'e-cigarettes with nicotine'. It would be valuable to have data on any e-cigarette use in the last 12 months, given the significant health impacts, as well as data specifically on e-cigarettes containing nicotine. However, the LSIC survey questions may not fully align with all identified factors of interest for this study, particularly regarding e-cigarette use and related variables. This misalignment limits the ability to comprehensively explore specific relationships or emerging topics.

To address this gap, the LSIC questions were amended from Wave 15 (data collected in 2022) to include more relevant information on e-cigarette use. Despite these limitations, using an existing survey like LSIC provides access to a robust dataset developed with Indigenous governance, community input, and ethical practices. This ensures cultural relevance and offers valuable longitudinal insights, enabling a meaningful analysis of factors influencing the health and well-being of Aboriginal and Torres Strait Islander children and adolescents.

Another limitation included that some caregivers did not give permission, and some adolescents did not answer smoking-related questions, including e-cigarette questions. However, this constituted a relatively small proportion of participants. A significantly higher proportion of participants with missing e-cigarette data lived in inner/outer regional and remote/very remote areas compared to major cities (Supplementary Table S2), limiting the generalizability of regional and remote findings.

This study relies on self-reported and caregiver-reported data, which has limitations. The measure of the child's experiences of racism in class was asked of the caregiver, who may have limited insight into the class environment and experiences of racism. The high prevalence and normalization of racism may have contributed to participants not specifically identifying their experiences as racism or discrimination.

The cross-sectional nature of this study and the limitations for analysis have been acknowledged. It is also important to note that participants were relatively young during Wave 11 data collection, and self-reported e-cigarette use at a time (2018) prior to the widespread proliferation of easily accessible, cheap, disposable vapes (Watts *et al.* 2022, Freeman *et al.* 2023), and the increased uptake as reported by the RAOs. Ongoing longitudinal analysis provides an opportunity to explore the influence of this changing environment, over time, in annual LSIC follow-ups. These data have been collected since the earliest introduction of e-cigarettes and are a strength of the broader study, i.e. surveys in 2018, 2019, 2021, 2022, and future surveys with no self-reported e-cigarette data collected in 2020 for Wave 13 due to COVID-19.

## Implications for health promotion

The mounting evidence for e-cigarette harms, including poisoning, acute nicotine toxicity, lung injury, and the role in nicotine dependence and tobacco use, demonstrates the need for urgent action to avoid preventable morbidity and mortality (Gotts *et al.* 2019, Banks *et al.* 2023). Our findings on the importance of a positive peer, school, and community

environment provide insights regarding protective factors against e-cigarette use, including the relationship with never smoking.

There are opportunities for community and sporting organizations to role model positive behaviours, including smoke-free and vape-free behaviours. In addition to reducing access to e-cigarettes and the associated illegal retail sales, better development, implementation and resourcing of programs and policies that address individual, social, and environmental contexts are likely to be most effective in promoting e-cigarette-free norms and promoting health and well-being. RAOs were concerned about the particular influence of role models and social media promotion of vaping and internet sales. RAOs indicated that the tobacco and e-cigarette industries were continuing to target young people, acquiring a new generation of dependent customers. The recent e-cigarette and tobacco reforms are expected to help address e-cigarette and tobacco use among adolescents, including closing marketing loopholes which require urgent implementation and enforcement (Australian Government Department of Health and Aged Care 2023).

## CONCLUSION

There are increasing concerns about e-cigarette harms and their ability to undermine successes in reducing tobacco use, including among the Aboriginal and Torres Strait Islander populations. Our study found associations between never-use of e-cigarettes and not using other substances (including cigarettes, marijuana, and alcohol), a positive social environment, not experiencing racism and being engaged with school and the community. Similarly to tobacco control, e-cigarette use is everybody's business and a comprehensive, appropriately resourced multifaceted approach to fostering health and well-being is required to address the drivers of e-cigarette use.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at *Health Promotion International* online.

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in acknowledgement of their contribution. The findings and views reported in this article, however, should not be attributed to the Australian Government, DSS, or any of DSS' contractors or partners. DOI: 10.26193/ICEBFP 'Footprints in Time: The Longitudinal Study of Indigenous Children, Release 11 (Waves 1-11)'.

## CONFLICT OF INTEREST

Consistent with the journal's policies, the authors have no conflict of interest to declare.

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## DATA AVAILABILITY

The data used in this study were accessed through the Longitudinal Study of Indigenous Children (LSIC) conducted by the Australian Government Department of Social Services (DSS) in accordance with DSS protocols and processes. This study recognizes the critical importance of Indigenous Data Sovereignty Principles (IDSP), which assert that Aboriginal and Torres Strait Islander peoples have the right to self-determination in the collection, ownership, and use of their data. Researchers are strongly encouraged to respect, uphold, and integrate these principles in the design, analysis, and reporting of Indigenous data consistent with ethical practice. Applications for access to LSIC datasets can be made by following the procedures outlined by the DSS, with detailed information available on the DSS website.

## ETHICS AND DECLARATIONS

The project upholds ethical principles of research with Aboriginal and Torres Strait Islander peoples consistent with the National Health and Medical Research Council Guidelines for ethical conduct in Aboriginal and Torres Strait Islander Health Research. LSIC data collection is conducted with approvals from the departmental ethics committee of the Australian Government Department of Health and Aged Care, and from ethics committees in each state and territory, including relevant Aboriginal and Torres Strait Islander organizations. Ethics approval for this LSIC analysis was granted by the Australian National University's Human Research Ethics Committee (Protocol No. 2016/534).

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