

# Tracking the course of vaping and cigarette smoking across adolescence: the Child to Adult Transition Study



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## Summary

**Background** Adolescence is characterised by incident substance use which carries risks for lifelong harms. In Australia, public health measures have limited adolescent smoking, but there has been rapid uptake of vaping over the past decade and the natural history of vaping across adolescence is yet unknown.

**Methods** We used data from 1181 participants from the prospective, longitudinal Child to Adult Transition Study, recruited in 2012 at age nine. We report annual prevalence of vaping, smoking, and dual use, and incidence, age of uptake, and order of first product use from nine annual waves of data spanning ages 12–21. Multiple imputation addressed missing data.

**Findings** Prevalence of vaping at any frequency (46.9%, 95% CI: 43.6%, 50.3%), smoking (32.9%, 95% CI: 30.0%, 35.9%), and dual use (27.8%, 95% CI: 24.9%, 30.6%) peaked in wave 12 (mean age 20). Daily vaping had the highest frequency (17.2%, 95% CI: 14.7%, 19.8%) in wave 13 (mean age 21). For smoking and dual use, the highest frequency of daily use was also in wave 12 (smoking: 5.3%, 95% CI: 3.8%, 6.7%; dual use: 3.0% (95% CI: 1.9%, 4.2%)). Cumulative incidence by wave 13 was 75.8% (95% CI: 73.0%, 78.7%) for vaping and 60.2% (95% CI: 56.7%, 63.7%) for smoking. Use  $\geq 4$  days/week in  $\geq 2$  consecutive waves was 17.3% (95% CI: 14.8%, 19.8%) for vaping and 6.3% (95% CI: 4.6%, 8.0%) for smoking. Of those who vaped and smoked during adolescence, 40.1% (95% CI: 35.2%, 45.0%) started with vaping, 23.9% (95% CI: 19.5%, 28.4%) started with smoking, and 35.9% (95% CI: 31.1%, 40.7%) initiated both at the same wave.

**Interpretation** These patterns of vaping and smoking in young Australians affirm that regulations and public health initiatives are urgently needed to prevent uptake of all nicotine and tobacco products.

**Funding** National Health and Medical Research Council, Royal Children's Hospital Foundation, Gidleigh Foundation.

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**Keywords:** Adolescent; Cigarette smoking; Cohort study; Substance use; Vaping

## Introduction

Globally, tobacco use is a leading preventable cause of premature death and disease. The World Health Organization Framework Convention on Tobacco Control (FCTC) came into force in 2005, obliging signatories to implement a broad range of tobacco control measures.<sup>1</sup> Australia was among the first countries to ratify the FCTC, and its comprehensive tobacco control program has led to profound reductions in cigarette smoking

over the past few decades.<sup>2</sup> In 2022–23, 5% of Australian students aged 16–17 reported past-month smoking, compared with 35% in 1999.<sup>3</sup> In contrast, vaping among young people has dramatically increased in recent years to become a major public health challenge. More than one in five (22%) 16–17-year-old students reported past-month vaping in 2022–23 in the most recent data from Australia's national survey of alcohol and drug use in secondary school students.<sup>3</sup> This

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The Lancet Regional Health - Western Pacific 2025;64: 101719

Published Online xxx  
<https://doi.org/10.1016/j.lanwpc.2025.101719>

### Research in context

#### Evidence before this study

We searched PubMed up to August 2025 using the following search terms “tobacco” OR “smok\*” OR “vape” OR “vaping” OR “cigar\*” OR “e-cigarette\*” OR “nicotine”. Six recent cohort studies were identified that have examined vaping trajectories among young people, five in the US and one in the UK. Findings show that an appreciable proportion of young people who initiate vaping sustain and escalate use over time.

#### Added value of this study

Our study analysed data from nine annual waves (2015–2024) of a population-based cohort study from Melbourne, Australia to describe the natural course of vaping and smoking from 12 to 21 years of age. This provides the

first longitudinal data in the Australian regulatory context and spans the entire period from the early stages of growth in vaping popularity through to the time immediately prior to the implementation of vaping reforms. Findings show a rapid increase in vaping prevalence among this cohort of young Melbournians, and identify concerning patterns of sustained, frequent, and escalating vaping among a considerable proportion of young people. To a lesser extent, similar patterns were also observed for smoking.

#### Implications of all the available evidence

These patterns of vaping and smoking affirm that regulations and public health initiatives are urgently needed to prevent uptake of all vaping, nicotine and tobacco products during this critical developmental period.

reflects international patterns, with countries such as England, Canada, the United States of America, and New Zealand also experiencing high levels of vaping in adolescents in the context of relatively low levels of cigarette smoking.<sup>4</sup>

E-cigarettes (also known as vapes) were originally developed as a smoking cessation aid,<sup>5</sup> and vaping was initially concentrated among tobacco users.<sup>6</sup> For people who smoke, completely switching to e-cigarettes may be beneficial for their health.<sup>7</sup> However, many adolescents who vape have never smoked tobacco<sup>8</sup> and would not otherwise be exposed to nicotine and other chemicals during this critical developmental window.<sup>9</sup> Nicotine use during adolescence may have long-term impacts on emotional regulation and higher cognitive function,<sup>10</sup> and adolescents can rapidly develop symptoms of dependence.<sup>11</sup> Cross-sectional studies of adolescents show that vaping is associated with poorer mental<sup>12</sup> and respiratory health,<sup>13</sup> as well as insufficient sleep<sup>14</sup> and lower academic achievement.<sup>15</sup> Due to their relative recency on the market, the long-term health risks of vaping are not yet known. However, toxicological and biomarker studies suggest that vaping may have the potential to increase the risk of respiratory diseases, cancer, and other health problems.<sup>16</sup>

Distinguishing patterns of vaping is important for understanding its potential for harm, particularly across the critical developmental period of adolescence. If vaping among adolescents is largely experimental or transient, as some have suggested from cross-sectional data,<sup>17</sup> it may be argued that it could pose less of a risk compared with escalating and persistent patterns of use. Cohort studies have established a markedly increased risk of cigarette smoking uptake among adolescents who vape,<sup>18,19</sup> however there is limited evidence on longitudinal trajectories of e-cigarette use among young people; that is, changes in the intensity and frequency of use over adolescence and whether

vaping during the teenage years is sustained into the third decade. Given the substantial increase in vaping uptake during the early 2020s, even a small proportion transitioning to ongoing or escalated use could represent many thousands of young people at risk of health harms and addiction. A small number of longitudinal studies in the US have shown that appreciable proportions of adolescents who initiate vaping progress to sustained and frequent use and exhibit signs of nicotine dependence.<sup>20–24</sup> Those initiating vaping in the more recent waves of these longitudinal studies appear to be at greater risk of escalation, likely reflecting changing social norms and the development of increasingly appealing and addictive products.<sup>21,23</sup> One study in the UK examining data up to 2021 found that there was approximately a one in four probability that adolescents who vaped remained e-cigarette users five years later.<sup>25</sup> A recent US PATH study similarly found that about one quarter of young people who used e-cigarettes for the first time went on to use them frequently and regularly.<sup>26</sup>

With rapid increases in the prevalence of vaping among adolescents, and as patterns of smoking and vaping are affected by country-specific regulations, industry tactics, prevention efforts, and social norms,<sup>27</sup> longitudinal data from multiple countries are important for documenting patterns of use, determining risks of vaping uptake, and informing regulatory and public health strategies. Compared with the US and the UK, Australia has taken a more precautionary stance on e-cigarettes, but to our knowledge there is no study that has described longitudinal patterns of vaping and smoking among adolescents in Australia. There is also limited research exploring the course of nicotine product use across adolescence or spanning the last decade, that is, since the beginning of the rapid growth in popularity of e-cigarettes through to contemporary estimates.

The present study utilises data from the Childhood to Adult Transition Study (CATS), an Australian population-based cohort that recruited around 1200 children who have been studied annually across adolescence.<sup>28</sup> We describe the prevalence of vaping, smoking, and dual use (i.e., concurrent vaping and cigarette smoking) among adolescents from 12 years old in 2015 to 21 years old in 2024, and report incidence and age of uptake. We also describe the persistence and course of vaping and smoking, and for those reporting use of both products during adolescence, the order of first product use.

## Methods

### Study population, design, procedure

Data for this study are from CATS, an ongoing longitudinal cohort study that has a broad focus on the health and wellbeing, education, and social adjustment of children as they mature through puberty across adolescence and into young adulthood, as previously detailed.<sup>29</sup> Briefly, students were drawn from a stratified random sample of 43 primary schools (Government, Catholic, Independent) in Melbourne, Australia, in 2012. All Year Three students (fourth year of formal schooling) in selected schools were invited to participate (N = 2289), of whom 1239 (54%) were recruited into the original cohort. Retention rates were high (>90%) in the primary school waves (waves 1–4) and have remained higher than 70% for the most recent waves.

Participants were followed annually from wave 1 (mean age 9 years; 2012) to wave 13 (mean age 21 years; 2024). Data collection occurred through self-reported questionnaires in primary schools (waves 1–4), with the additional option of survey completion online, by post or by Computer Assisted Telephone Interview (CATI, waves 5–6). From wave 7 (age 15) onwards, data collection was primarily completed online. At waves 1 and 2, a parent of each participant also completed a brief survey. Influenced by the COVID-19 pandemic in Melbourne, wave 11 (age 19) consisted of a brief survey in which substance use questions were omitted.

### Ethical considerations

Ethics approval was granted by the Royal Children's Hospital Human Research Ethics Committee (#31089). Permission was granted from the Victorian Department of Education and Training and the Catholic Education Office Melbourne to recruit through their schools, and from individual independent schools. Participants were recruited through active, written, informed parent consent. From wave 11, participants themselves provided written informed consent as all had turned 18.

### Measures

#### Demographics

Information on participants' sex at birth, Aboriginal and Torres Strait Islander (ATSI) status, and postcode

(used to define family socioeconomic position, see [Supplementary Material](#) (page 5) for details) were collected from parents at wave 1.

#### Vaping and smoking

The specific questions and response options for vaping and smoking collected at waves 4–10, 12, and 13 are shown in the [Supplementary Material](#) (page 2).

For vaping and smoking separately, we took the age at the wave vaping or smoking was first reported as the age of first use. For each of the waves, we defined *daily use* as reported use every day, *regular use* as use at least 4 days per week (including daily use), and *current use* as reported use at least 1 day a month (including regular and daily use).

We defined the following persistent patterns of use across waves 8 to 13 for vaping and smoking separately<sup>1</sup>: two or more consecutive waves of use at any frequency,<sup>2</sup> two or more consecutive waves of current use,<sup>3</sup> two or more consecutive waves of regular use, and<sup>4</sup> two or more consecutive waves of daily use. These groups were not mutually exclusive.

Based on reported use over waves 8–13 (when use was more prevalent), we defined the following patterns for smoking and vaping separately<sup>1</sup>: infrequent users – only ever vaped or smoked at a less than monthly frequency<sup>2</sup>; rapid uptakers—used at least monthly when first reported vaping or smoking,<sup>3</sup> ever increasers—increased their frequency of vaping or smoking at some point over adolescence (not necessarily over consecutive waves). Rapid uptakers and ever increasers were not mutually exclusive groups of young people.

### Statistical analysis

All analyses were performed using Stata 18.0 (Stata Corp, College Station, TX). Descriptive statistics were reported for demographic characteristics (sex at birth, age, ATSI status, socioeconomic disadvantage/advantage quintile). Categorical measures were summarised using numbers and percentages, and continuous measures using means and standard deviations (SD).

We estimated prevalence (and corresponding 95% confidence intervals (CI)) of vaping, smoking, and dual use (i.e., vaping and smoking reported at the same wave) at any frequency at waves 4–10, 12 and 13. Prevalence of current, regular, and daily use were estimated at waves 8–10, 12 and 13.

Crude cumulative incidence and incidence rate for age at the first wave of reported use were estimated using flexible parametric survival models (Royston-Parmar models)<sup>30</sup> using restricted cubic splines with 3 degrees of freedom to model the log cumulative baseline hazard over time. The timescale was age (origin was age 0), the entry time was age at wave 4, and the event time was age at the first wave of report. Participants who never reported use were censored at their age at wave 13. For individuals with wave 4 as their first

wave of reported use, we added 0.1 day to their age at first wave of report (exit time) so that they were not excluded from analyses.

For vaping and smoking separately, we estimated average age of first use (and corresponding 95% CI), as well as the prevalence of the above-described persistent patterns of use as well as patterns of use across waves 8–13.

Of those who reported vaping and/or smoking (at any frequency) at one or more waves during adolescence, the prevalence of those who (i) only ever reported vaping (ii) only ever reported smoking, or (iii) reported vaping and smoking at some point during adolescence (not necessarily at the same wave), was estimated.

In addition, of those who reported vaping (any frequency) and smoking (any frequency) at some point during adolescence, the prevalence of those who (i) initiated vaping before smoking, (ii) initiated smoking before vaping, and (iii) initiated both vaping and smoking at the same wave of data collection, was estimated. Age at first wave of report was used to determine when smoking and vaping were initiated.

Of the total CATS participants, 58 (3.7%) were excluded as no vaping or smoking data were available at any wave, resulting in an analysis sample of  $N = 1181$ . Information on the proportion of included participants with missing values for wave-specific vaping and smoking variables and demographic variables is presented in [Supplementary Table S1](#). Missing data were handled using multiple imputation (MI). Following advice on best practice, the number of imputations were chosen to reflect the proportion of participants with missing data in at least one variable.<sup>31</sup> Any frequency vaping/smoking, current vaping/smoking, regular vaping/smoking, daily vaping/smoking, and types of vaping/smoking were imputed using separate imputation models, using the fully conditional specification with a Moving Time Window approach,<sup>32</sup> using the waves directly adjacent to the missing measurement as the temporal window. For current, regular, and daily vaping/smoking, only data from waves 8 to 13 were multiply imputed because across waves 4–7, the prevalence of smoking, vaping and dual use at any frequency was very low. Logistic regression was used to impute the binary variables, predictive mean matching was used to impute maternal highest level of education (a four-category variable), and linear regression was used to impute the continuous variables. See [Supplementary Table S2a–e](#) for variables included in each imputation model. For the flexible parametric survival models, we used Substantive Model Compatible Fully Conditional Specification<sup>33</sup> as the MI approach to facilitate achieving compatibility between the imputation and analysis models. For all analyses, each imputed dataset was analysed and results were pooled using Rubin's rules to obtain the final estimates and 95% CIs.<sup>34</sup>

As an additional analysis, prevalence of smoking, vaping, and dual use at any frequency, current use,

regular use, and daily use at waves 4–10, 12 and 13 were estimated using available-case data.

### Role of the funding source

The funding sources had no role in the study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

### Results

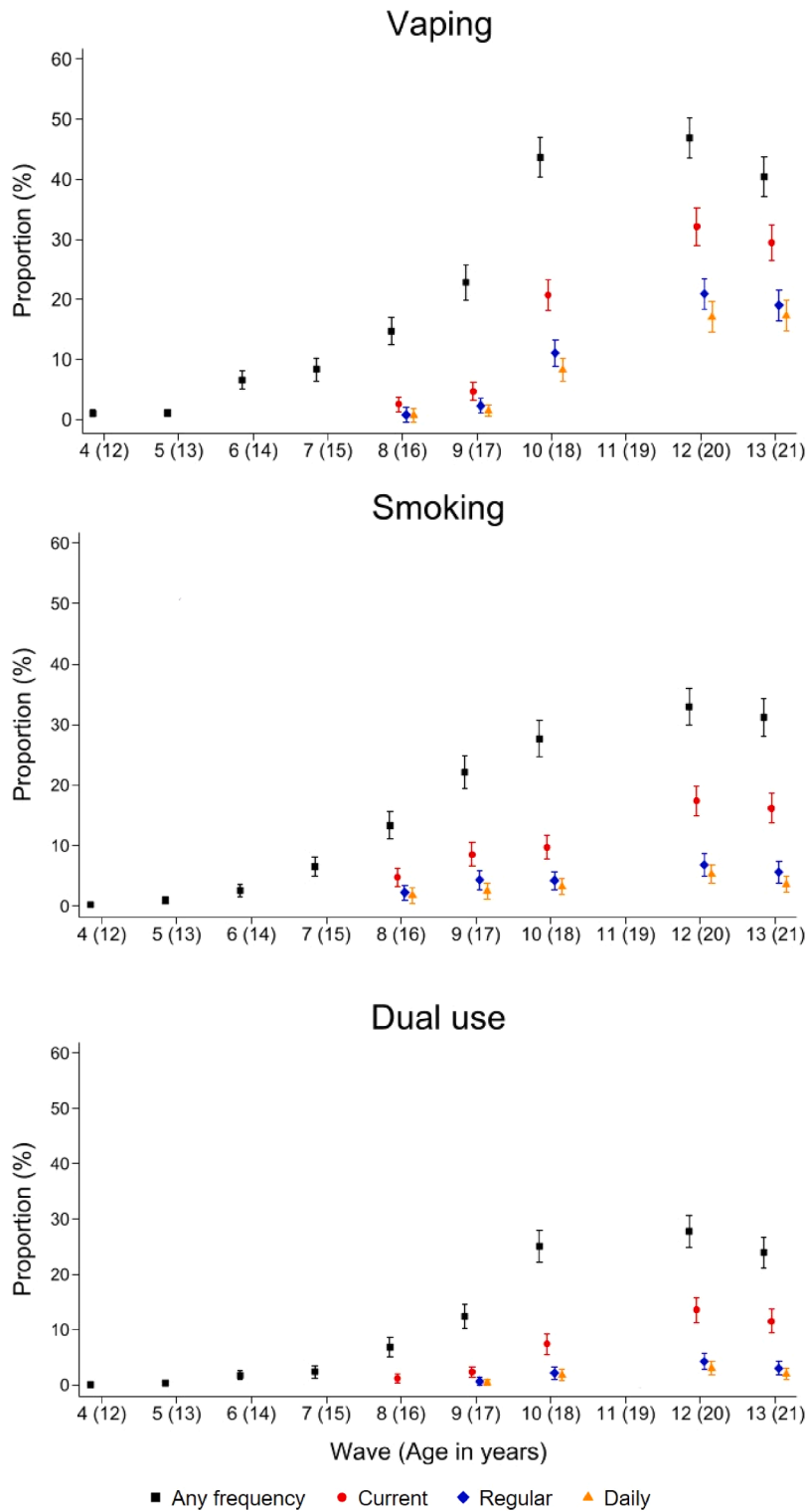
Of the 1181 included participants, 46% were male, 5% identified as Aboriginal and Torres Strait Islander, and 34% were in the most advantaged socioeconomic quintile (13% were in the most disadvantaged quintile). Mean (SD) age at recruitment was 9.0 (0.4) years. Demographic characteristics among those included in the analysis sample were similar to the original cohort ( $N = 1239$ ) ([Supplementary Material Table S3](#)).

Results presented in the main text are based on analysis of multiply imputed data, unless otherwise specified.

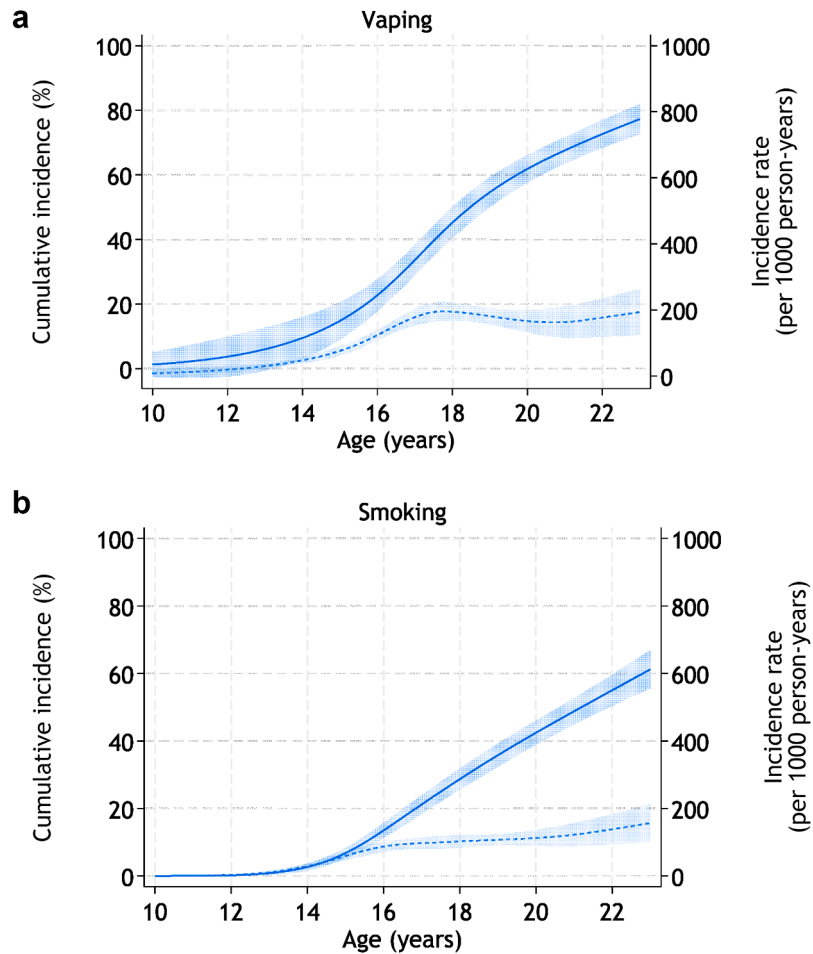
### Prevalence of vaping and smoking

Prevalence of vaping increased with age up to wave 12 (mean age 20 years) ([Fig. 1](#), point estimates and 95% CIs are also reported in [Supplementary Table S4](#)). An estimated 1.0% (95% CI: 0.4%, 1.6%) vaped at any frequency within the past 12 months at wave 4 (mean age 12 years). This peaked at an estimated 46.9% (95% CI: 43.6%, 50.3%) at wave 12 (mean age 20 years) and reduced to 40.4% (95% CI: 37.2%, 43.7%) at wave 13 (mean age 21 years). A steep increase in the prevalence of vaping at any frequency was seen between waves 9 (mean age 17 years) and 10 (mean age 18 years). Prevalence of current (at least monthly) vaping was low (less than 5%) until wave 10, after which it rose to 20.7% (95% CI: 18.1%, 23.3%) at wave 10 (18 years), 32.1% (95% CI: 29.0%, 35.3%) at wave 12 (20 years), and 29.5% (95% CI: 26.5%, 32.4%) at wave 13 (21 years). At wave 10 (18 years), 11% of adolescents reported regular vaping (4–6 days per week) (95% CI: 8.9%, 13.2%); this increased to nearly one in five adolescents at wave 13 (21 years) (19.0%, 95% CI: 16.5%, 21.5%). At wave 10 (mean age 18), 8.2% (95% CI: 6.4%, 10.1%) reported daily vaping, which increased to nearly one in five adolescents at wave 13 (21 years) (17.2%, 95% CI: 14.7%, 19.8%).

Smoking was uncommon and less prevalent than vaping across the early waves. However, across waves 7–9 (mean age 15–17), prevalence of smoking at any frequency steadily increased to levels similar to vaping ([Fig. 1](#)). This prevalence continued to increase to wave 10 (mean age 18) (27.6%, 95% CI: 24.6%, 30.6%), but to a lesser extent than vaping at any frequency at wave 10 (43.6%, 95% CI: 40.3%, 47.0%). Nearly one in three adolescents reported smoking at any frequency at wave



**Fig. 1:** Prevalence of vaping (past 12 months), smoking (past 12 months), and dual vaping and smoking (past 12 months), across adolescence. The error bars represent the 95% confidence intervals. Substance use data were not collected at wave 11 (average age 19 years old). Prevalence of substance use (at current, regular, and daily frequencies) was not estimated at waves 4–7 due to low proportions in the observed data (see [Supplementary Table S5](#)).



**Fig. 2:** Estimated cumulative incidence (solid line) and incidence rate (dashed line) with 95% confidence intervals (shaded area) for (a) vaping (any frequency), and (b) smoking (any frequency).

12 (mean age 20) (32.9%, 95% CI: 30.0%, 35.9%) or 13 (mean age 21) (31.2%, 95% CI: 28.1%, 34.3%). Prevalence of current (at least monthly) smoking was less than 10% prior to waves 12 and 13, at which point it increased to 17.4% (95% CI: 14.9%, 19.9%) at wave 12 (age 20) and 16.1% (13.7%, 18.6%) at wave 13 (age 21). Prevalence of regular smoking (6.8%, 95% CI: 5.0%, 8.6%) and daily smoking (5.3%, 95% CI: 3.8%, 6.7%) were highest in wave 12 (mean age 20).

The prevalence of dual use at any frequency was low across the earlier waves, then rose steadily from wave 8 (mean age 16) (6.8%, 95% CI: 5.1%, 8.5%) to 10 (25.1%, 95% CI: 22.2%, 27.9%), and peaked at wave 12 (27.8%, 95% CI: 24.9%, 30.6%). Prevalence of current dual use was less than 10% before waves 12 and 13, at which point it increased to 13.6% (95% CI: 11.4%, 15.9%) at wave 12 (age 20) and 11.5% (95% CI: 9.3%, 13.7%) at wave 13 (age 21). Prevalence of regular dual use was greatest in wave 12 (4.2%, 95% CI: 2.8%, 5.6%), as was the prevalence of daily dual use (3.0%, 95% CI: 1.9%, 4.2%).

Prevalence estimates (and corresponding 95% CIs) based on available case-data ([Supplementary Material Table S5](#)) were similar to those obtained using multiply imputed data.

**Incidence of vaping and smoking**

**Fig. 2** displays the crude cumulative incidence and incidence rate of vaping and smoking over time. An estimated 75.8% (95% CI: 73.0%, 78.7%) vaped, and an estimated 60.2% (95% CI: 56.7%, 63.7%) smoked at some point between early and late adolescence. For vaping, an increased incidence rate was seen from age 14–18 years. For smoking, the incidence rate appeared relatively constant from around age 15–20 years.

**Average age at first use**

The estimated average age of first use at any frequency was 17.2 years (95% CI: 17.0, 17.4) for vaping and 17.5 years (95% CI: 17.3, 17.7) for smoking.

### Persistent patterns of use for vaping and smoking (waves 8 to 13)

Across waves 8–13, nearly one in two adolescents vaped persistently (i.e., at two or more consecutive waves) (46.4%, 95% CI: 43.2%, 49.6%) and one in three smoked persistently (35.1%, 95% CI: 32.0%, 38.2%) at any frequency (Table 1).

An estimated 17.3% (95% CI: 14.8%, 19.8%) and 13.8% (95% CI: 11.4%, 16.2%) vaped persistently at regular and daily frequencies respectively. This was over twice the rate of persistent regular smoking (6.3%, 95% CI: 4.6%, 8.0%) and over three times the rate of persistent daily smoking (4.0%; 95% CI: 2.6%, 5.4%).

### Vaping and cigarette smoking patterns (waves 8–13)

Table 2 presents vaping and smoking patterns among adolescents who reported use between waves 8 (mean age 13 years) and 13 (age 21). Around half were infrequent users (i.e., using less than monthly), with prevalence at 47.3% (95% CI: 43.5%, 51.1%) for vaping and 55.1% (95% CI: 50.6%, 59.6%) for smoking. About one in five were rapid uptakers (initiating use at least monthly) for vaping (21.1%, 95% CI: 18.0%, 24.2%) and smoking (19.6%, 95% CI: 16.0%, 23.2%). More than one-third of those who vaped increased their frequency of use over adolescence (36.9%; 95% CI: 33.2%, 40.6%) compared with slightly under one-third of smokers (31.8%, 95% CI: 27.6%, 36.0%).

Of those who vaped or smoked at any point during adolescence, 30.0% (95% CI: 26.4%, 33.6%) only ever vaped, 5.5% (95% CI: 3.6%, 7.4%) only ever smoked, and the majority (64.5% (95% CI: 60.7%, 68.3%)) used both (not necessarily at the same time). Of those who vaped and smoked during adolescence (not necessarily at the same time), 40.1% (95% CI: 35.2%, 45.0%) started with vaping, 23.9% (95% CI: 19.5%, 28.4%) with smoking, and 35.9% (95% CI: 31.1%, 40.7%) initiated both at the same wave.

	% <sup>b</sup>	95% CI
<b>Persistent pattern of vaping across waves 8–13</b>		
Any frequency	46.4	43.2, 49.6
At least once per month (current)	28.2	25.3, 31.1
At least 4–6 days per week (regular)	17.3	14.8, 19.8
Daily	13.8	11.4, 16.2
<b>Persistent pattern of smoking across waves 8–13</b>		
Any frequency	35.1	32.0, 38.2
At least once per month (current)	15.0	12.7, 17.3
At least 4–6 days per week (regular)	6.3	4.6, 8.0
Daily	4.0	2.6, 5.4

<sup>a</sup>Occurring at two or more consecutive waves. <sup>b</sup>Percent out of the total analysis sample (N = 1181).

**Table 1:** Prevalence of persistent patterns of use<sup>a</sup> for vaping and smoking across waves 8–13.

	%	95% CI
<b>Vaping across waves 8–13<sup>a</sup></b>		
Infrequent user <sup>b</sup>	47.3	43.5, 51.1
Rapid uptaker <sup>c</sup>	21.1	18.0, 24.2
Ever increaser <sup>d</sup>	36.9	33.2, 40.6
<b>Smoking across waves 8–13<sup>a</sup></b>		
Infrequent user <sup>b</sup>	55.1	50.6, 59.6
Rapid uptaker <sup>c</sup>	19.6	16.0, 23.2
Ever increaser <sup>d</sup>	31.8	27.6, 36.0

<sup>a</sup>Denominator is equal to the number of adolescents who reported vaping at some point during waves 8–13. <sup>b</sup>Only ever used at a less than monthly frequency. <sup>c</sup>Used at least monthly when first reported use. <sup>d</sup>Increased frequency of use at some point over adolescence (not necessarily at consecutive waves). <sup>e</sup>Denominator is equal to the number of adolescents who reported smoking at some point during waves 8–13.

**Table 2:** Prevalence of different patterns of vaping and smoking across waves 8–13.

### Discussion

This study found substantial increases in vaping prevalence with increasing age among a contemporary cohort of adolescents from Melbourne, Australia with evidence of frequent, sustained and escalating vaping among a considerable proportion of participants. Similar patterns were found for cigarette smoking, although prevalence, persistence and frequency of smoking were less pronounced than for vaping. Dual use was also relatively common.

Targeted marketing to young people alongside poor enforcement of regulations banning the retail sale of nicotine vapes to minors has led to substantial increases in vaping in Australia.<sup>35</sup> These findings align with other data showing increasing use by age and over time among young Australians,<sup>3,6</sup> and highlight concerning high levels of nicotine use among this cohort. In 2024, 17.2% of CATS participants aged approximately 21 years old reported daily vaping and 29.5% reported current (at least monthly) vaping. The proportion of participants reporting current smoking in 2024 was much higher than those reporting daily smoking (3.6%) or regular smoking (5.6%). Exclusive smoking was rare as almost all participants who smoked also used vapes, suggesting that occasional cigarette smoking may be promoted or sustained by switching between both products. In line with research showing a bidirectional relationship between smoking and vaping,<sup>36</sup> the present findings on the order of first product use among dual users suggests that uptake of either product may encourage uptake of the other.

In contrast to arguments that vaping is largely short-lived among young people,<sup>17</sup> almost half of these adolescents were estimated to be vaping across consecutive waves, and 17.3% persistently vaped at least four days per week. Among those who initiated vaping, more than one-third reported escalating use, and about one in five reported at least monthly vaping when they first

reported use. Beyond showing a sharply increasing prevalence across adolescence, these levels of sustained and frequent use are concerning as they suggest that a significant proportion of these young Australians may have developed nicotine dependence, as has been shown for young Americans.<sup>22</sup> Product designs and flavours that appeal to young people,<sup>37</sup> alongside the development of products that can deliver high concentrations of nicotine,<sup>38</sup> have likely influenced these patterns of use. While fewer adolescents reported persistent or frequent cigarette smoking compared with vaping, such patterns were still reported by a significant minority. Concerningly, recent studies in Australia and New Zealand found that the rate of decline in smoking among young people slowed markedly after the emergence of vaping,<sup>39,40</sup> highlighting the importance of comprehensive tobacco and vaping control programs that prevent uptake of both products.

In 2024, Australia introduced reforms that restricted access to vapes from participating pharmacies and banned sales from general retailers.<sup>41</sup> The present findings showing a slight reduction in vaping in wave 13 are a promising early indicator that vaping may have reached its peak in this cohort. This pattern aligns with other contemporary Australian data showing that after sharply increasing in the early 2020s, vaping now appears to have stabilised among young people.<sup>42,43</sup> The present results pre-date Australia's policy changes, but may reflect the effects of wider community discussion about their introduction, as well as increased perceptions of harmfulness and decreased social acceptability of vaping.<sup>42,44</sup>

There are a number of limitations of this study. Data were self-reported which, beyond poor recall, could introduce social desirability bias.<sup>45</sup> Although we used MI to address missing data there is still potential for selection bias as those who smoke or vape may be more likely to have missing data. Notwithstanding that CATS was conducted annually, we were unable to disentangle the order of first product use for the one-third of dual users who reported uptake of smoking and vaping in the same year. Participants were recruited from metropolitan Melbourne and are therefore not representative of the Australian population, and rates of vaping and smoking in the present study were higher than those found in nationally representative samples.<sup>6</sup> Strengths of the study include the use of nine waves of longitudinal data which provides valuable insights into trajectories of smoking and vaping across adolescence.

The current findings provide further evidence of the extent to which progress in reducing nicotine use and addiction among adolescents has been undermined by the enormous rise in vaping. Preventing use of all nicotine products during this critical developmental period is urgently needed to avert the known and potential harms from vaping and smoking.

#### Contributors

SMS, SGD and LC contributed to the conceptualisation of this Article. SMS, SGD, LC, and SE contributed to the study design and statistical analysis methods. LC completed the data analysis in consultation with SGD and SE. LC, EG and SMS drafted the manuscript, and all authors critically revised and reviewed the manuscript for important intellectual content. SMS obtained funding and was responsible for the decision to submit the manuscript. All authors read the final manuscript and approved the submission. All authors had access to the data.

#### Data sharing statement

The Child to Adult Transition Study is based at the Murdoch Children's Research Institute. Details of the data source can be found at LifeCourse (<https://www.mcric.edu.au/research/research-areas/population-health/lifecourse>). Requests to access data can be submitted online.

#### Declaration of interests

Cancer Council Victoria is a non-profit organisation that conducts research and advocacy aimed at reducing the harms of tobacco in the community, especially those pertaining to cancer. EG has received funding from the Department of Health and Aged Care and MS has received funding from State Cancer Councils for work on publication of *Tobacco in Australia: Facts and Issues*. MS has received funding from the Department of Health and Aged Care for work aimed at ensuring technical accuracy and effectiveness of graphic health warnings on tobacco packages. Both are current members of Cancer Council Australia's Tobacco Issues Committee.

#### Acknowledgements

This study was funded by the National Health and Medical Research Council (NHMRC) of Australia (GNT 1010018 (2011-15), GNT 1122189 (2017-20), GNT 2024177 (2023-28), and GNT 1106451) as well as a grant from the Royal Children's Hospital Foundation and a donation from the Gidleigh Foundation. It was also supported by the Melbourne Children's LifeCourse Initiative, which has received funding from the Victorian Government's Department of Health and Human Services, Victor Chiodo Foundation, and Morgan Stanley. SMS and SGD hold NHMRC Investigator Grants (GNT 1196999, GNT 202171).

#### Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.lanwpc.2025.101719>.

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