

## Predictors of E-cigarette Use Among Young Australian Women



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**Introduction:** E-cigarette use is controversial worldwide. The majority of previous studies on e-cigarette use were not gender specific. This study aimed to identify the predictors of e-cigarette use among young Australian women.

**Methods:** This study used cross-sectional data from the 1989–1995 cohort of the Australian Longitudinal Study on Women's Health. In 2015, study participants (N=8,915) aged 19–26 years completed an online survey. Multivariable logistic regression was used to identify predictors of e-cigarette use. Data were analyzed in 2018.

**Results:** The prevalence of ever and past-year e-cigarette use among young Australian women was 11.1% and 6.4%, respectively. More than a quarter of past-year and ever e-cigarette users were never cigarette smokers. Use of e-cigarettes in the past year was associated with younger age (AOR per year increase=0.87, 95% CI=0.82, 0.93); financial difficulty (AOR=0.68, 95% CI=0.54, 0.87); being an ex-smoker (AOR=5.05, 95% CI=3.64, 7.01) or current cigarette smoker (AOR=10.01, 95% CI=7.77, 12.89); drinking at a level of lifetime risk of harm from alcohol-related disease or injury (AOR=1.23, 95% CI=1.01, 1.53). Ever e-cigarette use showed similar associations and was also associated with rural residence (AOR=0.74, 95% CI=0.60, 0.91) and intimate partner violence (AOR=1.44, 95% CI=1.17, 1.76).

**Conclusions:** The high prevalence of e-cigarette use among never cigarette smokers has significant public health implications. Interventions to curb the use of e-cigarettes among young Australian women should focus on risk factors, such as early age, cigarette smoking, alcohol use, and intimate partner violence.

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### INTRODUCTION

E-cigarette use is controversial worldwide.<sup>1–3</sup> Many e-cigarettes contain addictive substances (primarily nicotine) that lead to long-term nicotine addiction, which can affect brain development in young people.<sup>4</sup> Cross-sectional and longitudinal studies have confirmed a positive relationship between e-cigarette use and consequent initiation of conventional cigarette smoking among nonsmokers.<sup>5,6</sup> WHO does not recognize e-cigarettes as a smoking-cessation aid and strongly recommends a control and ban of such products.<sup>7</sup>

Most of the previous literature has identified a positive relationship between traditional tobacco smoking and

e-cigarette use among young people. E-cigarette use and traditional tobacco smoking often share many risks and protective factors in common.<sup>8</sup> Factors such as alcohol use and younger age have been identified as risk factors for e-cigarette use.<sup>9–12</sup> Though the majority of previous

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studies have not been gender specific, several risk factors have been identified as more prevalent among women, including intimate partner violence and mental illness.<sup>13,14</sup> Although not addressed in this study, psychosocial factors, such as attitude towards e-cigarettes, and the use of e-cigarettes by household members and friends were also positively associated with e-cigarette use.<sup>15</sup> This study identifies predictors of e-cigarette use among young Australian women.

## METHODS

### Study Sample

This study used data collected in the third wave from the 1989–1995 cohort of the Australian Longitudinal Study on Women's Health. Recruitment of study participants took place in 2012–2013 and was mainly conducted through social and online media (e.g., Facebook, Twitter, and YouTube). To participate in the study, women were required to have a Medicare card, provide their biographic data, agree to take part in longitudinal follow-up surveys, and consent to data linkage. Details about the recruitment strategies and inclusion criteria have been published elsewhere.<sup>16–18</sup> For this analysis, data were taken from the third online survey of participants in 2015. The response rate for the third wave was 53% (N=8,961) compared with the baseline survey. From 8,961 study participants, 8,915 (99.5%) participants aged 19–26 years provided data for the outcome variables in this study. Participants were more likely to take part in follow-up surveys if they were older, more educated, and found it easier to manage on their available income at baseline. Ethics approval for the Australian Longitudinal Study on Women's Health was provided by the University of Queensland and the University of Newcastle Human Research Ethics Committees, and the Australian Government Department of Health Human Research Ethics Committee.

### Measures

Outcome variables were use of e-cigarettes in the past year and ever e-cigarette use. Explanatory variables were derived from previous literature and included sociodemographic factors, cigarette use variables, intimate partner violence, mental illness, and parental relationship<sup>8–14</sup> (Table 1).

### Statistical Analysis

Descriptive statistics comprised frequencies with percentages, with differences assessed using chi-square tests. For each outcome measure, ORs were estimated for each predictor using logistic regression. Variables with a *p*-value <0.25 were included in a multivariate logistic regression model. Results were presented as crude ORs and AORs with 95% CI; a *p*-value of 0.05 was used for declaring statistical significance. Data were analyzed in 2018. Data analysis was performed using Stata, version 15.

## RESULTS

The mean age of study participants was 22.5 years. The prevalence of ever and past-year e-cigarette use among young Australian women was 11.1% and 6.4%,

respectively. More than a quarter of past-year and ever e-cigarette users had never reported smoking cigarettes (Table 2).

For each 1-year age increase, the odds of past-year e-cigarette use decreased by about 13% (AOR=0.87, 95% CI=0.82, 0.93). Women who reported the ability to manage on their available income as easy were less likely to have used e-cigarettes in the past year compared with those who found it challenging to manage on their available income (AOR=0.68, 95% CI=0.54, 0.87). Ex-smokers and current cigarette smokers had 5- (AOR=5.05, 95% CI=3.64, 7.01) and 10-fold (AOR=10.01, 95% CI=7.77, 12.89) higher odds of past-year e-cigarette use, respectively, compared with never cigarette smokers. Women who reported drinking at a level of lifetime risk of harm from alcohol-related disease or injury (drinking more than two standard drinks on any day) were more likely to have used e-cigarettes in the past year (AOR=1.23, 95% CI=1.01, 1.53), compared with those who did not report drinking at this level. Results for ever e-cigarette use were similar, with additional associations for rural residence (AOR=0.74, 95% CI=0.60, 0.91) and intimate partner violence (AOR=1.44, 95% CI=1.17, 1.76; Table 3).

## DISCUSSION

In the 2013 Australian National Drug Strategy Household Survey report, the prevalence of past-year e-cigarette use was 27% among young people aged 18–24 years, a figure that was higher than the current study.<sup>19</sup> The prevalence was higher than that reported among young Swiss men.<sup>20</sup> The difference in prevalence could be accounted for difference in gender composition, sample size, and age of the study participants.

In this study, more than one quarter of respondents who declared past-year and ever e-cigarette use had never reported cigarette use. In a number of studies, it has been shown there is positive relationship between e-cigarette use and consequent initiation of conventional tobacco smoking among nonsmokers.<sup>5,6,21</sup> For instance, a systematic review that included nine longitudinal studies concluded that e-cigarette use was positively associated with subsequent traditional cigarette smoking initiation among noncigarette smokers.<sup>21</sup>

Consistent with previous research, this study found that being younger was positively associated with past-year and ever e-cigarette use.<sup>22–25</sup> This could reflect the fact that young people are more likely to experiment with new behaviors than older people. Similar with earlier studies, this study also identified that both past-year and ever e-cigarette use were strongly associated with being an ex-smoker or current cigarette smoker.<sup>9,20,26–28</sup>

**Table 1.** Description and Coding of Variables Used in Analysis

Variable assessed	Questionnaire item	Original response options	Analytic coding
Past year e-cigarette use	Have you used battery-operated e-cigarettes in the last 12 months	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Ever e-cigarette use	Have you ever used battery-operated e-cigarettes?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Age of respondents	When is your birthday	Complete year	Complete year
Highest level of education	What is the highest level of education you have completed?	<ul style="list-style-type: none"> <li>• Year 10 or below</li> <li>• Year 11 or equivalent</li> <li>• Year 12 or equivalent</li> <li>• Certificate I/II</li> <li>• Certificate III/IV</li> <li>• Advanced diploma/diploma</li> <li>• Bachelor degree</li> <li>• Graduate diploma/graduate certificate</li> <li>• Postgraduate degree</li> </ul>	<ul style="list-style-type: none"> <li>• Year 10 or below</li> <li>• Year 11 or 12</li> <li>• Trade/certificate/diploma</li> <li>• University Degree</li> </ul>
Marital status	What is your current relationship status?	<ul style="list-style-type: none"> <li>• Married / de facto</li> <li>• Separated / divorced / widowed / never married</li> </ul>	<ul style="list-style-type: none"> <li>• Partnered</li> <li>• Non-partnered</li> </ul>
Employment status	Are you currently unemployed and actively seeking work?	<ul style="list-style-type: none"> <li>• Yes, unemployed for &lt;6 months</li> <li>• Yes, unemployed for ≥6 months</li> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Unemployed</li> <li>• Employed</li> </ul>
Area of residence	Accessibility/remoteness Index of Australia was used to group using postal code	<ul style="list-style-type: none"> <li>• Major cities</li> <li>• Inner regional / outer regional</li> <li>• Remote/Very remote</li> </ul>	<ul style="list-style-type: none"> <li>• Urban</li> <li>• Rural</li> <li>• Remote</li> </ul>
Financial management	How do you manage on the income you have available?	<ul style="list-style-type: none"> <li>• It is impossible</li> <li>• It is difficult all the time</li> <li>• It is difficult some of the time</li> <li>• It is not too bad</li> <li>• It is easy</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulty managing income</li> <li>• Easy managing income</li> </ul>
Intimate partner violence	Have you ever been in a violent relationship with a partner/spouse?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
General health rating	In general, would you say your health is:	<ul style="list-style-type: none"> <li>• Excellent</li> <li>• Very good</li> <li>• Good</li> <li>• Fair</li> <li>• Poor</li> </ul>	<ul style="list-style-type: none"> <li>• Excellent</li> <li>• Very good</li> <li>• Good</li> <li>• Fair</li> <li>• Poor</li> </ul>
History of depression	Have you ever been diagnosed or treated for depression?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>
Smoking status	How often do you currently smoke cigarettes or any tobacco products?	<ul style="list-style-type: none"> <li>• Never smoked</li> <li>• Ex-smoker</li> <li>• Current smokers</li> </ul>	<ul style="list-style-type: none"> <li>• Never smokers</li> <li>• Ex-smokers</li> <li>• Current smokers</li> </ul>
Risk of alcohol-related harm over a lifetime <sup>a</sup>	On a day when you drink alcohol, how many standard drinks do you usually have?	<ul style="list-style-type: none"> <li>• Never drink</li> <li>• 1 or 2 drinks per day</li> <li>• 3 or 4 drinks per day</li> <li>• 5 to 8 drinks per day</li> <li>• 9 or more drinks per day</li> </ul>	<ul style="list-style-type: none"> <li>• Low risk of alcohol-related harm over a lifetime</li> <li>• Risk of alcohol-related harm over a lifetime</li> </ul>
History of parental divorce	During your childhood, did your parents divorce or permanently separate?	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>

<sup>a</sup>According to 2009 Australian alcohol guidelines, drinking greater than 2 standard drinks on any day increases the lifetime risk of harm from alcohol-related disease or injury, which is termed as “risk of alcohol-related harm over a lifetime.”

In previous studies, binge drinking of alcohol was identified as a risk factor for e-cigarette use.<sup>12,29,30</sup> In the current study, drinking alcohol at an at-risk level of alcohol-related harm over a lifetime was also found to be an important predictor of e-cigarette use. In this study, urban residence was also a risk factor associated with

ever e-cigarette use, which is in line with other previous research.<sup>31</sup> One possible reason for this could be the availability of e-cigarette products, mainly in urban areas. Consistent with previous research, this study has also identified that intimate partner violence was positively associated with substance use.<sup>10,11</sup>

**Table 2.** Past Year and Ever E-cigarette Use<sup>a</sup> Among Young Australian Women by Selected Background Characteristics

Variables	n	Past year e-cigarette use <sup>b</sup>		p-value	Ever e-cigarette use <sup>c</sup>		p-value	Missing value <sup>d</sup> (%)
		Yes, n (%)	No, n (%)		Yes, n (%)	No, n (%)		
Age, years				<b>&lt;0.001</b>			<b>&lt;0.001</b>	0 (0)
19–22	4,428	329 (57.7)	4,099 (49.1)		544 (54.9)	3,884 (49.0)		
23–26	4,487	241 (42.3)	4,246 (50.9)		446 (45.1)	4,041 (51.0)		
Highest level of education				<b>&lt;0.001</b>			<b>&lt;0.001</b>	241 (2.7)
Year 10 or below	159	29 (5.3)	130 (1.6)		47 (5.0)	112 (1.5)		
Year 11 or 12	2,514	182 (33.4)	2,332 (28.7)		317 (33.4)	2,197 (28.4)		
Trade/certificate/diploma	2,452	201 (36.9)	2,251 (27.7)		357 (37.6)	2,095 (27.1)		
University degree	3,549	133 (24.4)	3,416 (42.0)		228 (24.0)	3,321 (43.0)		
Currently unemployed				<b>&lt;0.001</b>			<b>&lt;0.001</b>	242 (2.7)
Yes	1,124	111 (20.4)	1,013 (12.5)		188 (19.8)	936 (12.1)		
No	7,549	434 (79.6)	7,115 (87.5)		761 (80.2)	6,788 (87.9)		
Marital status				0.878			0.908	245 (2.8)
Partnered	2,660	165 (30.4)	2,495 (30.7)		289 (30.5)	2,371 (30.7)		
Non-partnered	6,010	378 (69.6)	5,632 (69.3)		658 (69.5)	5,352 (69.3)		
Residence				0.175			0.073	103 (1.2)
Urban	6,648	445 (78.8)	6,203 (75.2)		767 (78.4)	5,881 (75.1)		
Rural	2,055	114 (20.2)	1,941 (23.5)		200 (20.4)	1,855 (23.7)		
Remote	109	6 (1.0)	103 (1.3)		12 (1.2)	97 (1.2)		
Ability to manage income				<b>&lt;0.001</b>			<b>&lt;0.001</b>	245 (2.8)
Difficulty managing income	4,609	389 (71.6)	4,220 (51.9)		652 (68.8)	3,957 (51.2)		
Easy managing income	4,061	154 (28.4)	3,907 (48.1)		295 (31.2)	3,766 (48.8)		
Violent relationship with a partner/spouse				<b>&lt;0.001</b>			<b>&lt;0.001</b>	2,254 (25.3)
Yes	1,008	130 (28.2)	878 (14.2)		240 (30.2)	768 (13.1)		
No	5,653	331 (71.8)	5,322 (85.8)		555 (69.8)	5,098 (86.9)		
General health				<b>&lt;0.001</b>			<b>&lt;0.001</b>	0 (0)
Excellent	737	21 (3.7)	716 (8.6)		39 (3.9)	698 (8.8)		
Very good	3,266	164 (28.8)	3,102 (37.2)		267 (27.0)	2,999 (37.8)		
Good	3,474	227 (39.8)	3,247 (38.9)		416 (42.0)	3,058 (38.6)		
Fair	1,187	125 (21.9)	1,062 (12.7)		209 (21.1)	978 (12.4)		
Poor	251	33 (5.8)	218 (2.6)		59 (6.0)	192 (2.4)		
Ever had depression				<b>&lt;0.001</b>			<b>&lt;0.001</b>	4 (0.04)
Yes	3,432	312 (54.7)	3,120 (37.4)		550 (55.6)	2,882 (36.4)		
No	5,479	258 (45.3)	5,221 (62.6)		439 (44.4)	5,040 (63.6)		
Smoking status				<b>&lt;0.001</b>			<b>&lt;0.001</b>	0 (0)
Never smokers	6,710	147 (25.8)	6,563 (78.6)		268 (27.1)	6,442 (81.3)		
Ex-smokers	712	82 (14.4)	630 (7.6)		157 (15.9)	555 (7.0)		
Current smokers	1,493	341 (59.8)	1,152 (13.8)		565 (57.0)	928 (11.7)		
Risk of alcohol-related harm over a lifetime				<b>&lt;0.001</b>			<b>&lt;0.001</b>	2 (0.02)
Risk of alcohol-related harm over a lifetime	4,789	396 (69.5)	4,393 (52.6)		694 (70.1)	4,095 (51.7)		
No risk of alcohol-related harm over a lifetime	4,124	174 (30.5)	3,950 (47.4)		296 (29.9)	3,828 (48.3)		
Parents divorce/permanently separate during childhood				<b>&lt;0.001</b>			<b>&lt;0.001</b>	142 (1.6)
Yes	2,811	232 (41.9)	2,579 (31.4)		411 (42.7)	2,400 (30.7)		
No	5,962	322 (58.1)	5,640 (68.6)		552 (57.3)	5,410 (69.3)		

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Column percentage is calculated to compare the past and ever e-cigarette use by background variables.

<sup>b</sup>Used e-cigarette at least once in the past 12 months.

<sup>c</sup>Used e-cigarette at least once in their lifetime.

<sup>d</sup>Missing for the two outcome variables: past year and ever e-cigarette use.

**Table 3.** Associations With Past Year and Ever E-cigarette Use Among Young Australian Women

Variables	Past year e-cigarette use		Ever e-cigarette use	
	COR (95% CI)	AOR <sup>a</sup> (95% CI)	COR (95% CI)	AOR <sup>a</sup> (95% CI)
Age	0.88 (0.84, 0.93)	<b>0.87 (0.82, 0.93)**</b>	0.92 (0.89, 0.95)	<b>0.92 (0.87, 0.97)**</b>
Highest level of education				
Year 10 or below (ref)	1.00	1.00	1.00	1.00
Year 11 or 12	0.36 (0.23, 0.51)	0.83 (0.50, 1.37)	0.38 (0.28, 0.49)	1.05 (0.67, 1.64)
Trade/certificate/diploma	0.44 (0.32, 0.62)	0.85 (0.52, 1.39)	0.47 (0.36, 0.62)	1.04 (0.67, 1.61)
University degree	0.19 (0.13, 0.27)	0.76 (0.45, 1.29)	0.19 (0.14, 0.25)	0.77 (0.48, 1.22)
Currently unemployed				
Yes	1.80 (1.44, 2.24)	1.22 (0.93, 1.59)	1.80 (1.51, 2.13)	1.17 (0.93, 1.47)
No (ref)	1.00	1.00	1.00	1.00
Residence				
Urban (ref)	1.00		1.00	1.00
Rural	0.81 (0.66, 1.01)		0.83 (0.70, 0.97)	<b>0.74 (0.60, 0.91)**</b>
Remote	0.81 (0.35, 1.86)		0.95 (0.52, 1.74)	0.88 (0.42, 1.86)
Ability to manage income				
Difficulty managing income (ref)	1.00	1.00	1.00	1.00
Easy managing income	0.43 (0.35, 0.52)	<b>0.68 (0.54, 0.87)**</b>	0.47 (0.41, 0.54)	<b>0.76 (0.63, 0.92)**</b>
Violent relationship with a partner/spouse				
Yes	2.38 (1.92, 2.95)	1.14 (0.89, 1.46)	2.87 (2.42, 3.40)	<b>1.44 (1.17, 1.76)**</b>
No (ref)	1.00	1.00	1.00	1.00
General health				
Excellent (ref)	1.00	1.00	1.00	1.00
Very good	1.80 (1.13, 2.86)	1.46 (0.84, 2.52)	1.59 (1.13, 2.25)	1.27 (0.83, 1.96)
Good	2.38 (1.51, 3.75)	1.16 (0.67, 2.01)	2.43 (1.74, 3.42)	1.26 (0.82, 1.93)
Fair	4.01 (2.50, 6.43)	1.66 (0.93, 2.93)	3.82 (2.68, 5.46)	1.61 (0.98, 2.54)
Poor	5.16 (2.93, 9.11)	1.36 (0.67, 2.73)	5.49 (3.56, 8.49)	1.53 (0.88, 2.69)
Ever had depression				
Yes	2.02 (1.71, 2.40)	1.08 (0.87, 1.35)	2.19 (1.92, 2.50)	1.15 (0.96, 1.38)
No (ref)	1.00	1.00	1.00	1.00
Smoking status				
Never smokers (ref)	1.00	1.00	1.00	1.00
Ex-smokers	5.81 (4.38, 7.71)	<b>5.05 (3.64, 7.01)**</b>	6.79 (5.48, 8.43)	<b>5.34 (4.14, 6.89)**</b>
Current smokers	13.22 (10.78, 16.19)	<b>10.01 (7.77, 12.89)**</b>	14.63 (12.46, 17.18)	<b>10.57 (8.66, 12.91)**</b>
Risk of alcohol-related harm over a lifetime <sup>b</sup>				
Risk of alcohol-related harm over a lifetime	2.05 (1.70, 2.46)	<b>1.23 (1.01, 1.53)*</b>	2.19 (1.90, 2.53)	<b>1.40 (1.17, 1.68)**</b>
Low risk of alcohol-related harm over a lifetime (ref)	1.00	1.00	1.00	1.00
Parents divorce / permanently separate during childhood				
Yes (ref)	1.00	1.00	1.00	1.00
No	0.63 (0.53, 0.76)	0.92 (0.74, 1.14)	0.59 (0.52, 0.68)	0.83 (0.69, 1.01)

Note: Boldface indicates statistical significance (\* $p < 0.05$ ; \*\* $p < 0.01$ ) for AOR.

<sup>a</sup>Each variable was adjusted for all of the other variables listed in this table.

<sup>b</sup>2009 Australian National alcohol guidelines classification for lifetime risk of alcohol-related harm.

COR, crude OR.

### Limitations

One limitation of this study was participation bias due to the high attrition rate of study participants by the third

wave. Moreover, because the current analysis was cross-sectional in nature, it was not possible to infer causation. The high rate of missing values associated with intimate

partner violence could introduce bias. Most of the previous studies assessed a history of e-cigarette use in the 30 days preceding data collection. However, in this study past-year e-cigarette use was used to measure recent use. It is not known whether the e-cigarettes used by the women contained nicotine or not. However, it has been reported that 70% of e-cigarettes sold in New South Wales contain nicotine.<sup>32</sup>

## CONCLUSIONS

Importantly, this study identified that although cigarette smoking was strongly associated with e-cigarette use, it was not the only risk factor that was significantly associated with e-cigarette use. Younger age, financial difficulty, and alcohol use were also risk factors for both past-year and ever e-cigarette use. Furthermore, the high prevalence of e-cigarette use among never cigarette smokers has significant public health implications. Interventions to curb the use of e-cigarettes among young Australian women should focus on risk factors.

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