



Examining trends in alcohol consumption during pregnancy in Australia, 2001-2016

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Conflict of interest

The authors declare no conflict of interest.

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Executive summary

BACKGROUND AND AIMS

Drinking alcohol during pregnancy is linked to Fetal Alcohol Spectrum Disorder (FASD). FASD is a spectrum disorder that is difficult to predict, with varying degrees of severity particular to each person. Some may have more physical disabilities and others greater cognitive impacts. Alcohol consumption during pregnancy is also associated with other conditions such as low birth weight, neuropsychological disorders and pre-term births.

The 2009 National Health and Medical Research Council's (NHMRC) Australian Guidelines to Reduce Health Risks from Drinking Alcohol recommends for women who are pregnant, for those who are planning a pregnancy and for those who are breastfeeding, not drinking alcohol is the safest option.

Using the cross-sectional survey data of pregnant women from six waves of the Australian National Drug Strategy Household Survey (NDSHS), this study estimated and investigated trends in female alcohol consumption during pregnancy and before knowledge of pregnancy by age and education level groups from 2001- 2016.

KEY FINDINGS

- The estimated proportion of pregnant women who consumed alcohol while pregnant decreased between 2001 and 2016, indicating that alcohol consumption among pregnant women is decreasing in real time. The decreases were significant after controlling for the confounding effects of changes in the age and education level of pregnant women. The largest decline in drinking any alcohol while pregnant observed between 2001 and 2010.
- There was a rapid decline in drinking while pregnant before being aware of the pregnancy between 2010 and 2016. However, the percentage of women who consumed while pregnant after knowledge of their pregnancy appeared to plateau after 2010.
- Older women were significantly more likely than younger women to report drinking while pregnant, but equally likely to reduce their consumption when they became pregnant as their younger counterparts.
- Women with a high level of education were more likely than women with less education to drink while pregnant, but those with less education were more likely to maintain or increase their consumption when they became pregnant.

CONCLUSIONS

The overall decrease in the prevalence of alcohol consumption during pregnancy, combined with a cohort effect in which younger pregnant women are less likely to consume alcohol during pregnancy than older women, suggests there has been a significant shift in the way Australian women think about drinking during pregnancy.

Women's attitudes, perceptions and behaviours related to drinking during pregnancy may have shifted during this period in concert with tightening of the drinking guidelines and public health awareness campaigning to encourage women who may be, or are trying to be, pregnant, to abstain from alcohol.

This study identified a cohort effect whereby younger pregnant women were less likely than older pregnant women to drink during pregnancy. In the next decade, research is needed to ascertain whether the observed decrease in consumption during pregnancy persists as the cohort that currently make up the younger group of pregnant women age. If alcohol consumption during pregnancy continues to decrease or plateaus,

education and health promotion campaigns should continue to encourage abstention during pregnancy to ensure these improvements to public health are advanced or retained.

Older, more highly educated women are more likely to drink at all after knowledge of pregnancy; however, less highly educated women are more likely than their highly educated counterparts to drink at the same, or higher, rates as they did before they were pregnant. Therefore, health promotion campaigns should focus on older, more highly educated women who appear less likely to refrain entirely from drinking during pregnancy, and on those with lower education levels who appear to be more likely to drink at higher-risk levels during pregnancy.

Introduction

Fetal Alcohol Spectrum Disorder (FASD) poses a considerable risk to the neurodevelopment and physical health of unborn babies. The 2016 Australian Guide to the diagnosis of FASD refers to two diagnostic subcategories:

- FASD with three sentinel facial features
- FASD with less than three sentinel facial features

This is a significant diagnostic change and more encompassing than previous diagnoses since Fetal Alcohol Syndrome was first recognised and defined in 1973 (Jones, Smith, Ulleland, & Streissguth, 1973). FASD causes permanent brain damage, specific facial or characteristic features and learning difficulties as a result of prenatal and postnatal maternal alcohol consumption (NOFASD Australia, 2017). Effects can vary depending on the level and frequency of consumption, however, even small quantities of alcohol can impact brain development (Riley, Infante, & Warren, 2011).

Alcohol consumption during pregnancy is now widely regarded as an unsafe consumption behaviour. The National Health and Medical Research Council's (NHMRC) *Australian Guidelines to Reduce Health Risks from Drinking Alcohol* recommends for women who are pregnant, for those who are planning a pregnancy and for those who are breastfeeding, not drinking alcohol is the safest option (NHMRC, 2009).

Public health awareness campaigns have been shown to play a significant role in changing attitudes towards alcohol consumption during pregnancy. For example, researchers found that nearly 93% of participants could recall the key warning message of the Italian 'Mummy Drinks Baby Drinks' campaign, with 84% recalling the associated visual image (Bazzo et al., 2012). Researchers concluded that the image had not only obtained a high level of visibility but had also been effective in spreading the campaign message (Bazzo et al., 2012). In France, warning labels recommending abstinence introduced in 2007 were found to successfully communicate the abstinence message with over 98% of participants believing the labels to suggest abstinence (Dumas, Toutain, Hill, & Simmat-Durand, 2018).

However, the knowledge of the risks associated with certain beverages was poor, for example, spirits were seen as being more harmful than wine or beer (Dumas et al., 2018). Problematically, news and popular media regularly reinflate debates regarding low-to-moderate consumption as safe during pregnancy and may underestimate the potential adverse outcomes of drinking at this level while pregnant (Charness, Riley, & Sowell, 2016; Sarman, 2018).

Such debates may portray conflicting public health messages about drinking during pregnancy and may lead some women to misunderstand the risks of drinking while pregnant (Charness et al., 2016). Research by Raymond and colleagues found that conflicting media messages resulted in diverse attitudes regarding maternal consumption of alcohol and the associated risks (Raymond, Beer, Glazebrook, & Sayal, 2009). Further education campaigns may assist to elucidate the harms from alcohol during pregnancy to counter problematic reporting and continue to increase awareness of abstinence as the only safe option.

In the past, more ambiguity surrounded what was an acceptable level of alcohol to consume while pregnant. As recently as 2001, the NHMRC guidelines advised women who choose to drink while pregnant to consume 'less than seven standard drinks in a week and no more than two on any one day' (NHMRC, 2001). The advice provided to pregnant women was changed with the 2009 NHMRC Guidelines to advise abstinence as the safest option (NHMRC, 2009).

While there is the potential for conflicting guidelines to affect women's consumption of alcohol during pregnancy, research has suggested that intention to consume alcohol during a future pregnancy was associated with alcohol use during the last pregnancy (Peadon et al., 2011). Consequently, women's past experiences with alcohol along with current consumption patterns were the strongest predictors of consumption while pregnant (Peadon et al., 2011). Crucially, previous studies have found a decreasing trend

in alcohol consumption among pregnant women suggesting abstinence messages are working (Callinan & Ferris, 2014). Despite previously ambiguous messages, a large body of extant research details the harms from alcohol while pregnant.

Drinking alcohol during pregnancy has also been linked to low birth weight (Wright et al., 1983), neuropsychological disorders (Aronson & Hagberg, 1998), and pre-term births (O'Leary, Nassar, Kurinczuk, & Bower, 2009). Alcohol poses a more severe threat to the foetus than the mother because its capacity to metabolise ethanol is only 5-10% that of the mothers, meaning the alcohol remains in the foetus for much longer (Burd, Blair, & Dropps, 2012; Sarman, 2018).

A 2017 systematic review found that approximately 10% of women worldwide consumed alcohol during pregnancy, with one in 67 giving birth to a child with Fetal Alcohol Syndrome (FAS) (Popova, Lange, Probst, Gmel, & Rehm, 2017). In supplementary meta-analyses of the current literature, the authors estimated the prevalence of any alcohol use during pregnancy was 35.6%, and the prevalence of FAS was 2.4 per 10,000 people, among the general population of Australia (Popova et al., 2017). A 2012 report published by FARE estimated that among a sample of pregnant Australian women in 2010 47% consumed alcohol while pregnant before they were aware that they were pregnant, while 20% consumed alcohol while pregnant after they were aware of their pregnancy (Callinan & Room, 2012). A subsequent paper (Callinan & Ferris, 2014) indicated that alcohol consumption among pregnant Australian women decreased between 2001 and 2010, and younger groups and cohorts of pregnant women may have decreased consumption at a faster rate during this time-period than older groups and cohorts.

The primary aim of current research is to update the findings of this work (Callinan & Ferris, 2014; Callinan & Room, 2012) on alcohol consumption rates among pregnant women by estimating and investigating trends in female consumption of alcohol during pregnancy and before knowledge of pregnancy from 2001 to 2016¹. Specifically, using the cross-sectional survey data of pregnant women from six waves of the Australian National Drug Strategy Household Survey (NDSHS), this study aims to describe:

1. How did the proportion of pregnant women who consumed alcohol while pregnant change in Australian samples between 2001 and 2016? And specifically, did the observed decreasing proportion of pregnant women who consumed alcohol while pregnant between 2001 and 2010 persist until 2016?
2. Were there differences in changes in the proportion of pregnant women who consumed alcohol between younger women and older women between 2001 and 2016?
3. How did the proportion of pregnant women who consumed less, the same amount, or more alcohol while pregnant than when not pregnant change in Australian samples between 2001 and 2016?
4. Is the average age of pregnant women changing over time, and is education level associated with likelihood of drinking while pregnant during this period?

Coinciding with Callinan and Ferris' findings for 2001-2010 (Callinan & Ferris, 2014), public health promotion efforts and media attention on understanding and raising public awareness of the potential harmful of effects of drinking during pregnancy, we expect to observe a persistent decrease in the proportion of pregnant women who drink alcohol while pregnant and the relative amount of alcohol consumed while pregnant between 2001 and 2016. We also expect to observe an increase in the average age of pregnant women over time, and for the age and educational level of pregnant women to be associated with the likelihood of drinking during pregnancy.

Methods

MATERIALS AND SAMPLE

The NDSHS is a national household survey of alcohol and drug use patterns, attitudes and behaviours which has been repeated every two to three years since 1985 (AIHW, 2017). This study uses data from six of the repeated cross-sectional surveys between 2001 and 2016. Each wave of the NDSHS collected data on a largely representative sample of the Australian population aged 14 years and above. The number of respondents to the NDSHS between 2001 and 2016 ranged from 23,356 in 2007 to 29,445 in 2004, with response rates ranging from 46% in 2004 to 51% in 2010 and 2016 (AIHW, 2017). Respondents completed the surveys via either a paper form which was administered via a drop-and-collect method, online form, computer-assisted telephone interview or face-to-face interview (AIHW, 2017).

As the focus of this study was drinking during pregnancy, only female respondents aged 14 years and above were included in the final sample. Respondents to the 2001, 2004 and 2007 surveys who completed the survey via computer-assisted telephone interview were not asked the section of the survey with questions pertaining to alcohol and drug use during pregnancy and were subsequently removed (% of all respondents dropped = 4.3% in 2001, 9.9% in 2004, 8.8% in 2007). Lastly, as this study aims to explore trends in drinking behaviours among pregnant women (i.e. independent of changes in the percentage of women who were pregnant in each year), the majority of analyses were conducted among women who were pregnant at any time in the last 12 months (final Ns described in Table 1).

MEASURES

This analysis draws on a section of the surveys which asked pregnant women (specifically, women aged 14 or above who reported being pregnant at any time in the last 12 months) about their alcohol and drug use during their pregnancy. Three main outcome variables were generated from respondents' answers to these items.

Consumed alcohol while pregnant

The National Health and Medical Research (NHMRC) Australian drinking guidelines (NHMRC, 2009) recommends women not to drink while pregnant, planning a pregnancy or breastfeeding because maternal alcohol consumption can harm the developing foetus. In the 2001, 2004 and 2007 surveys, respondents were asked, "At any time in the last 12 months when you were pregnant or breastfeeding, did you use any of the following?" and asked to select which substances they had consumed or select "none" of the list of substances "when pregnant only", "when breastfeeding only", and "when pregnant and breastfeeding".

From their answers to this item, respondents to the 2001, 2004 and 2007 surveys were categorised into one of two categories: (1) did not drink alcohol while pregnant in the last 12 months; (2) drank alcohol while pregnant in the last 12 months. In the 2010 survey and subsequent surveys, respondents were instead asked "At any time in the last 12 months when you were pregnant but did not yet know, did you use any of the following?" and asked to select which substances they had consumed or select "none of these", then asked, "At any time in the last 12 months when you were pregnant, did you use any of the following after you knew you were pregnant?" and provided the same response options.

As demonstrated in Figure 1 and explained in a previous analysis using NDSHS data (Callinan & Room, 2012), the item asking whether respondents consumed alcohol after they were aware they were pregnant provides a better match with the previous years' item than the item on drinking before awareness of pregnancy and is therefore assumed to have been equivalently interpreted to the previous years' item. Thus, respondents to the 2010, 2013 and 2016 surveys were categorised into one of two categories for comparison with previous years: (1) did not drink alcohol while pregnant after aware pregnant in the last 12 months; (2) consumed

alcohol while pregnant after aware pregnant in the last 12 months. As “none of these” was listed last or second-to-last in a list of 6-21 response options in all surveys, respondents who did not select any box were assumed not to have consumed any of the list of substances (for more information on this decision, please see Callinan & Room, 2012).

Amount of alcohol consumed while pregnant vs. alcohol consumption when not pregnant

Two outcome variables were derived from respondents answers to “In the last 12 months when you were pregnant, in general, did you drink more, less or the same amount of alcohol compared to when you were neither pregnant nor breastfeeding?” The first categorised respondents into one of four categories: (1) don’t (i.e. didn’t) drink, (2) consumed less, (3) consumed the same amount, and (4) consumed more alcohol (while pregnant than when neither pregnant nor breastfeeding). The second categorised respondents into one of two categories: (1) didn’t drink or consumed less alcohol, and (2) consumed the same amount or more alcohol (while pregnant than when neither pregnant nor breastfeeding).

Variables for age group and level of education were derived from survey responses. Respondents were split into two age groups: those aged less than 30 years, and those aged 30 or more years when they completed the survey. Respondents were categorised according to the highest year of primary or secondary schooling they had completed or highest educational qualification they had attained. The categories for respondents’ highest level of educational qualification, in ascending order, were as follows: has not completed grade 12, completed grade 12, obtained a certificate or diploma, obtained university degree (e.g. bachelors, masters or doctorate).

ANALYSIS

The denominator for all analyses (unless otherwise specified) includes all women aged 14 years or more who were pregnant at any stage in the last 12 months. Descriptive statistics were used to estimate trends in the percentage of pregnant women who reported consuming alcohol while pregnant, by age group, and the percentage who don’t drink, consumed less, consumed the same amount and consumed more while pregnant than when not pregnant or breastfeeding. All descriptive statistics estimates are accompanied by 95% confidence intervals in parentheses in tables, and as capped vertical lines in figures. Statistically significant differences in estimated percentages and means between groups at the $p < 0.05$ level are indicated by confidence intervals that do not overlap.

Bivariate and multivariate logistic regression models were fitted to test if the percentage of pregnant women who consumed while pregnant, and consumed the same amount or more while pregnant than when not pregnant, changed significantly over time (year was entered as a categorical variable to allow for non-linear changes over time), after controlling for changes in the age and level of education of pregnant women over time.

All counts are unweighted and, all estimates are weighted to adjust for participants’ probability of being selected to participate (according to household size) and non-response (to match the Australian adult population distributions of geographical stratification, age and sex for the year of each survey), such that the weighted data can be considered highly representative (AIHW, 2017). All analyses were conducted using Stata version 14 (Stata Corp., 2015), and graphical representations of estimates were constructed using Microsoft Excel, 2013 edition (Microsoft Corp., 2013).

Results

The number of women that were pregnant at any stage in the last 12 months triennially from 2001 to 2016 (the sample) are depicted in Table 1. The estimated percentage among the full samples of women that reported being pregnant in the last 12 months fluctuated between a low of 6.3% in 2016 and a high of 7.8% in 2013. As is also shown in Table 1, the average age of pregnant women significantly increased by an estimated two years from 2001 to 2016.

Table 1: Percentage of women that were pregnant, and age of pregnant women, in Australian samples aged 14 years or more, 2001-2016.

Year	N pregnant ^a women	% pregnant ^{a,b} among all women (CI)	Age of pregnant women, mean years (CI)
2001	1,014	7.2 (6.8, 7.8)	29.9 (29.5, 30.4)
2004	914	6.7 (6.2, 7.2)	30.3 (29.8, 30.9)
2007	736	7.1 (6.5, 7.7)	31.5 (30.7, 32.2)
2010	945	7.0 (6.6, 7.5)	31.4 (30.8, 32.0)
2013	886	7.8 (7.3, 8.4)	31.0 (30.5, 31.5)
2016	729	6.3 (5.8, 6.8)	31.9 (31.1, 32.7)

CI: 95% confidence interval; ^a At any time in the last 12 months; ^b Variable has >5% missing.

The percentage of pregnant women who consumed any alcohol while pregnant in the last 12 months between 2001 and 2016 is depicted in Figure 1. These results are percentages and confidence intervals of these estimates are also tabulated in Table 2. The percentage of pregnant women who consumed any alcohol while pregnant decreased steadily from 2001 to 2007.

Due to a change in the survey question, the percentages of both pregnant women that consumed any alcohol *before* they were aware of their pregnancy, and pregnant women that consumed any alcohol *after* they were aware of their pregnancy, were plotted for the 2010, 2013 and 2016 samples. The item asking whether respondents consumed alcohol after knowledge of their pregnancy provided a better match with the previous years' item than the item on drinking before awareness of pregnancy, whereas the percentage of pregnant women who consumed alcohol before knowledge of pregnancy were much higher than the two other measures.

The estimated percentage of pregnant women who consumed alcohol while pregnant after they were aware of their pregnancy in 2010 was 6.1% lower than the percentage of pregnant women who consumed alcohol while pregnant in 2007 – a similar size of decline to that observed for drinking while pregnant between 2001 and 2004 (6.8%) and 2004 and 2007 (7.6%). While the point estimates indicate a potential downward trend in alcohol consumption while pregnant after aware of pregnancy between 2010 and 2016, the triennial changes between 2010 and 2016 were not statistically significant, indicating a plateau in the percentage of women who consumed alcohol while pregnant after knowledge of their pregnancy after 2010. However, the estimated percentage of pregnant women that consumed alcohol while pregnant before they were aware of their pregnancy almost halved from 44.6% in 2010 to 22.9% in 2016.

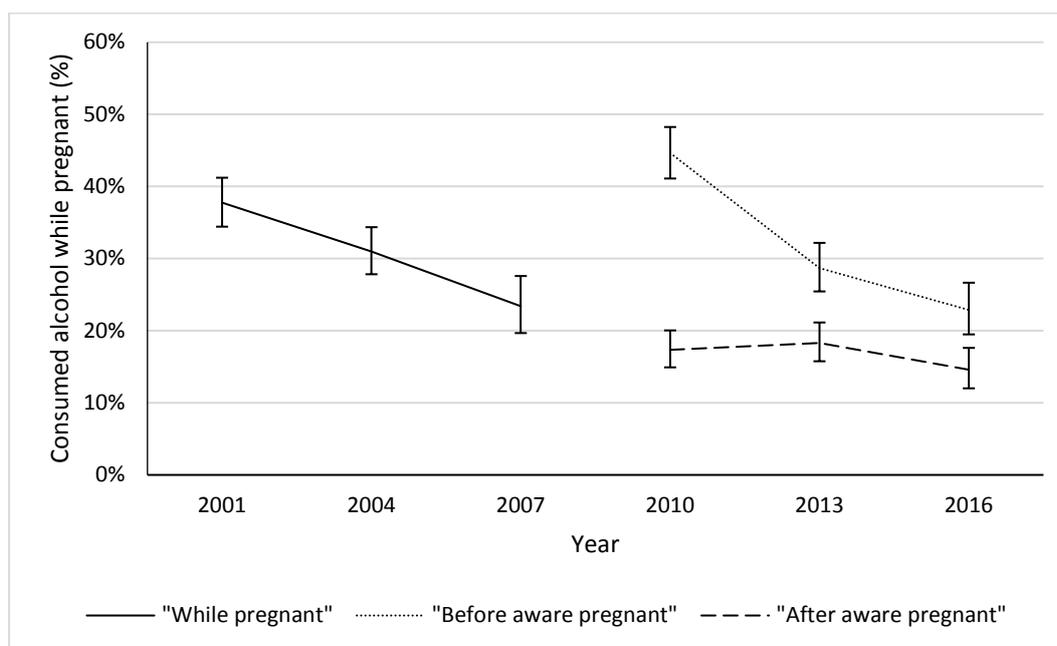


Figure 1: Percentage of pregnant women who consumed alcohol while pregnant in the last 12 months in Australia 2001-2016.

I 95% confidence interval.

Table 2: Percentage (CI) of pregnant women who consumed alcohol while pregnant in the last 12 months in Australia 2001-2016.

Year	N	"While pregnant"	"Before aware pregnant"	"After aware pregnant"
2001	1,014	37.8 (34.4, 41.2)		
2004	914	31.0 (27.8, 34.4)		
2007	736	23.4 (19.7, 27.6)		
2010	945		44.6 (41.1, 48.2)	17.3 (14.9, 20.0)
2013	886		28.7 (25.4, 32.2)	18.3 (15.8, 21.1)
2016	730		22.9 ^a (19.5, 26.7)	14.6 (12.0, 17.6)

CI: 95% confidence interval; ^a Variable has >5% missing.

Figure 2 and Table 3 present the percentage of pregnant women aged under 30 years and pregnant women aged 30 or above who consumed any alcohol while pregnant in the last 12 months between 2001 and 2016. For both younger women older women, decreases were observed in the percentage of pregnant women who consumed alcohol while pregnant between 2001 and 2007 and who consumed alcohol while pregnant before they were aware of their pregnancy between 2010 and 2016. However, the percentage who consumed alcohol while pregnant after they were aware of their pregnancy did not significantly change among both younger and older pregnant women between 2010 and 2016.

The percentage of pregnant women that consumed alcohol while pregnant (2001-2007), and while pregnant after they were aware of their pregnancy (2010-2016), was consistently lower among younger pregnant women than older pregnant women (significantly lower in 2004, 2010 and 2013). The percentage who consumed alcohol while pregnant before they were aware of the pregnancy decreased significantly in 2010-2016 for both younger and older pregnant women, and rates of alcohol consumption while pregnant before being aware of the pregnancy did not significantly differ between the age groups.

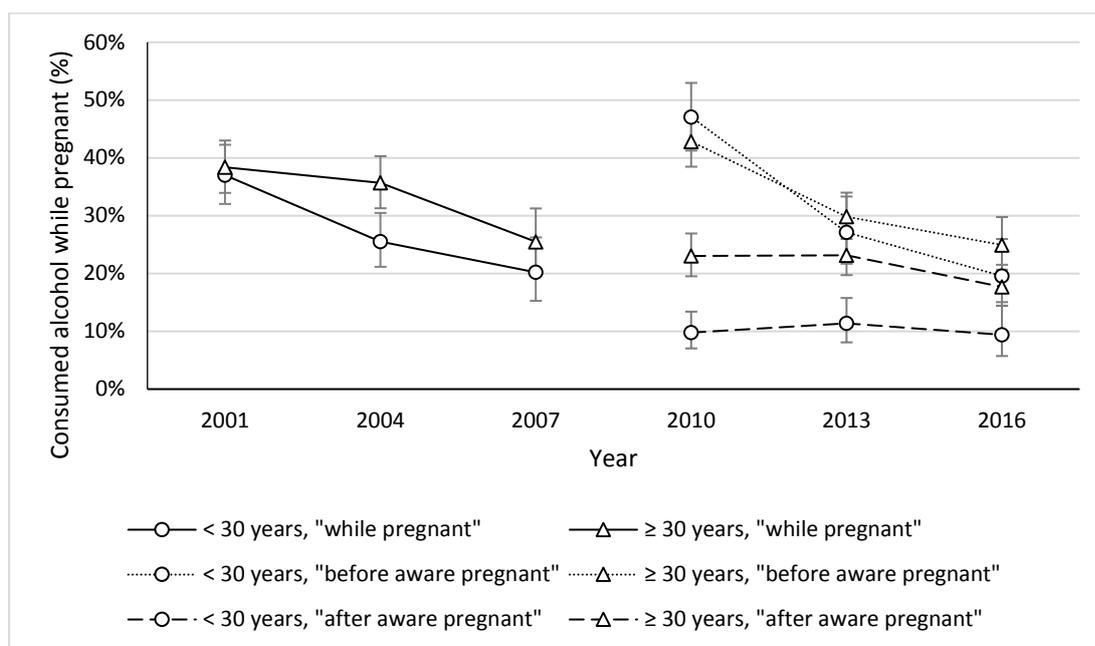


Figure 2: Percentage of pregnant women age < 30 years, and ≥ 30 years, who consumed alcohol while pregnant in the last 12 months in Australia 2001-2016.

I 95% confidence interval.

Table 3: Percentage (CI) of pregnant women age < 30 years, and ≥ 30 years, who consumed alcohol while pregnant in the last 12 months in Australia 2001-2016.

Year	Age, years	N	"While pregnant"	"Before aware pregnant"	"After aware pregnant"
2001	< 30	445	37.0 (32.0, 42.3)		
	≥ 30	569	38.4 (33.9, 43.0)		
2004	< 30	417	25.5 (21.2, 30.5)		
	≥ 30	497	35.7 (31.3, 40.3)		
2007	< 30	257	20.2 (15.3, 26.2)		
	≥ 30	479	25.5 (20.5, 31.3)		
2010	< 30	362		47.1 (41.3, 53.0)	9.8 (7.0, 13.4)
	≥ 30	583		42.8 (38.5, 47.3)	23.0 (19.5, 26.9)
2013	< 30	288		27.1 (21.7, 33.3)	11.4 (8.1, 15.8)
	≥ 30	598		29.8 (26.0, 34.0)	23.1 (19.7, 27.0)
2016	< 30	234		19.6 ^a (14.4, 26.0)	9.4 (5.7, 15.0)
	≥ 30	496		24.9 ^a (20.7, 29.8)	17.7 (14.4, 21.5)

CI: 95% confidence interval; ^a Variable has >5% missing.

Table 4 describes the percentage of pregnant women who don't drink, consumed less, consumed the same amount, and consumed more alcohol while pregnant than when not pregnant or breastfeeding between 2001 and 2016. While it was uncommon to drink the same amount or more alcohol while pregnant than when not pregnant or breastfeeding in all years and most changes between years were not significant, the estimated percentage of pregnant women who do so tended to decrease over time. The percentage of pregnant women who consumed less alcohol while pregnant than when not pregnant or breastfeeding also decreased from 2001 to 2016, however, this was largely driven by an increasing percentage of pregnant women who abstained from alcohol over time.

Table 4: Percentage (CI) of pregnant women who don't drink, drank less, drank the same amount, and drank more alcohol while pregnant in the last 12 months, compared to when they were not pregnant or breastfeeding, in Australia 2001-2016.

Year	N	"Don't drink alcohol"	"Less"	"Same amount"	"More"
2001	1,014	36.2 (32.7, 39.7)	59.4 (55.8, 62.9)	2.9 (2.0, 4.3)	1.5 (0.7, 3.2)
2004	914	37.7 (34.0, 41.5)	59.0 (55.2, 62.7)	3.2 (2.2, 4.6)	0.1 (0.0, 0.6)
2007 ^a	736	40.0 (35.9, 44.3)	56.6 (52.3, 60.9)	2.8 (1.6, 4.6)	0.6 (0.1, 4.0)
2010 ^a	945	48.9 (45.2, 52.7)	48.7 (44.9, 52.4)	2.0 (1.1, 3.5)	0.4 (0.1, 1.3)
2013	886	52.9 (49.2, 56.6)	45.9 (42.2, 49.6)	1.2 (0.6, 2.3)	0.0 (0.0, 0.3)
2016 ^a	730	55.9 (51.5, 60.3)	42.9 (38.5, 47.4)	1.1 (0.5, 2.2)	0.1 (0.0, 0.9)

CI: 95% confidence interval; ^a Variable has >5% missing.

The likelihood of drinking any alcohol while pregnant (after awareness of pregnancy for 2010, 2013 and 2016 respondents provides a better match with the previous years' item than the item on drinking before awareness of pregnancy) according to the survey year, and age and level of education of pregnant women is depicted in Table 5. The likelihood of drinking the same amount or more alcohol while pregnant than when not pregnant or breastfeeding (vs. less or no alcohol), according to the same variables is depicted in Table 6.

Older women were significantly more likely than younger women to report drinking while pregnant after controlling for the year and their level of education (Table 5). However, they were equally likely as younger women to drink the same amount or more alcohol than usual while pregnant (vs. drinking less than usual or no alcohol while pregnant) after controlling for the year and level of education (Table 6).

Women who had completed a University degree were more likely than women who had not completed grade 12 to drink while pregnant after controlling for the year and age. In contrast, women with a higher level of educational training (completed a certificate or diploma or University degree) were less likely than women who had not completed grade 12 to drink the same amount or more alcohol than usual while they were pregnant after controlling for the year and age. Importantly, both the odds of drinking any alcohol while pregnant and the odds of drinking the same amount or more alcohol than usual while pregnant decreased over time, even after controlling for the confounding effects of changes in the age and education level of pregnant women.

Table 5: Trends in odds of drinking alcohol while pregnant^{a,b} among pregnant Australian women between 2001 and 2016 (N = 5,225), controlling for age and education.

	BV, OR	MV, OR
<i>Year (vs. 2001)</i>		
2004	0.74**	0.73**
2007	0.50***	0.45***
2010	0.35***	0.32***
2013	0.37***	0.33***
2016	0.28***	0.24***
<i>Age (+1 year)</i>	1.01*	1.01**
<i>Highest level of educational qualification (vs. < Grade 12)</i>		
Grade 12	1.14	1.29
Certificate or diploma	0.93	1.12
University degree (bachelor's, master's, doctorate)	1.42**	1.84***

^a In the last 12 months; ^b "While pregnant" for 2001, 2004 and 2007 samples, "after aware pregnant" for 2010, 2013 and 2016 samples; OR: Odds ratio; BV: Bivariate logistic regression models; MV: Multivariate logistic regression model; * p<0.05; ** p<0.01; *** p<0.001.

Table 6: Trends in odds of drinking the same amount or more alcohol while pregnant as when not pregnant or breastfeeding^{a,b} among pregnant Australian women between 2001 and 2016 (N = 5,225), controlling for age and education.

	BV, OR	MV, OR
<i>Year (vs. 2001)</i>		
2004	0.74	0.76
2007	0.74	0.81
2010	0.53	0.59
2013	0.27**	0.32**
2016	0.26**	0.35*
<i>Age (+1 year)</i>	0.93**	0.96
<i>Highest level of educational qualification (vs. < Grade 12)</i>		
Grade 12	0.55	0.65
Certificate or diploma	0.39**	0.52*
University degree (bachelor's, master's, doctorate)	0.20***	0.31**

^a In the last 12 months; ^b Variable has >5% missing data; BV: Bivariate logistic regression models; MV: Multivariate logistic regression model; OR: Odds ratio; * p<0.05; ** p<0.01; *** p<0.001.

Discussion

As hypothesised, the findings of this report indicate that the proportion of pregnant women who drink alcohol while pregnant decreased between 2001 and 2016. Measured triennially, the decline in drinking any alcohol while pregnant was largest between 2001 and 2010. While there was a rapid decline in drinking while pregnant before awareness of the pregnancy between 2010 and 2016, the percentage of women who consumed while pregnant after knowledge of their pregnancy appeared to plateau after 2010. While the rates of consumption are higher than global estimates (Popova et al., 2017), the option to acknowledge consumption before knowledge of pregnancy is thought to elucidate higher rates of reported consumption (Callinan & Room, 2012).

The shape of the trends was similar for younger and older pregnant women, however, a larger proportion of older women consumed alcohol while pregnant, and after knowledge of pregnancy. Older women were significantly more likely than younger women to report drinking while pregnant, but equally likely to reduce their consumption when they became pregnant as their younger counterparts. Women with a high level of education were more likely than women with less education to drink while pregnant after controlling for the year and age, but those with less education were more likely to maintain or increase their consumption when they became pregnant. Importantly, both the odds of drinking any alcohol while pregnant and the odds of drinking the same amount or more alcohol than usual while pregnant decreased over time after controlling for the confounding effects of changes in the age and education level of pregnant women, indicating that alcohol consumption among pregnant women is decreasing in real time.

The overall decrease in the prevalence of alcohol consumption during pregnancy, combined with a cohort effect in which younger pregnant women are less likely to consume alcohol during pregnancy than older women, suggests there has been a significant shift in the way Australian women think about drinking during pregnancy. One plausible explanation for this shift is the change in the NHMRC guidelines from recommending pregnant women to consume less than seven standard drinks in a week and no more than two on any one day (NHMRC, 2001) to recommending no alcohol during pregnancy (NHMRC, 2009). Additionally, there have been prolonged efforts via public health awareness campaigns which may have been effective in increasing public understanding of the risks involved with drinking during pregnancy (Bazzo et al., 2012; Dumas et al., 2018)).

As a result, women's attitudes and perceptions of drinking during pregnancy may have shifted during this period in concert with the tightening of the drinking guidelines. In particular, women from later birth cohorts may experience stronger social pressure to abstain from drinking while pregnant than earlier birth cohorts due to there being greater understandings of the risks of drinking when they were in the formative life stages of adolescence and early adulthood. Also, notably, there has been a marked decrease in consumption before knowledge of pregnancy, which appears to be consistent among age groups, since 2010. It is possible that this trend is a reflection of those efforts to encourage women who may be, or are trying to be, pregnant, to abstain from alcohol. Given that FASD is preventable, the observed decreases in consumption before knowledge of pregnancy are a promising trend for alcohol-related health promotion efforts and public health.

Interestingly, the group that seems the most resistant to the broader decrease in rates of drinking after knowledge of pregnancy is older women with higher levels of education. However, it is possible that these women are continuing to drink at relatively low levels as the debate over harms from lower levels of alcohol consumption during pregnancy continues (Charness et al., 2016). Indeed, this study found that older and more highly educated women were equally or more likely than younger and less highly educated women to reduce their alcohol consumption when they become aware that they are pregnant, but less likely to abstain from alcohol throughout pregnancy. While no level of alcohol consumption is considered safe during pregnancy (NHMRC, 2009), higher levels of consumption come with higher risk. As such, drinkers with lower education attainment might be at highest risk of FASD-related harms.

This study identified a cohort effect whereby younger pregnant women were less likely than older pregnant women to drink during pregnancy. In the next decade, research is needed to ascertain whether the observed

decrease in consumption during pregnancy persists as the cohort that currently make up the younger group of pregnant women age. If alcohol consumption during pregnancy continues to decrease or plateaus, education and health promotion campaigns should continue to encourage abstinence during pregnancy to ensure these improvements to public health are advanced or retained.

There are a number of limitations of the current study that should be taken into account when interpreting results. First and foremost, self-report measures of alcohol consumption are prone to recall bias, particularly social desirability bias where a respondent might not wish to admit to a behaviour that they perceive would not be viewed favourably by others. In particular, as the knowledge of the risks inherent to drinking during pregnancy increase, the incentive to not acknowledge this behaviour might increase as the actual occurrence of the behaviour decreases. Unfortunately, this study was not able to estimate trends in total alcohol consumption during pregnancy or frequency of drinking more than a certain amount in one occasion during pregnancy. This information would have been useful to determine whether total alcohol consumption and other drinking patterns during pregnancy also decreased in Australia between 2001 and 2016.

CONCLUSIONS

The proportion of pregnant women that consumed alcohol while pregnant decreased between 2001 and 2016. Rates of alcohol consumption among Australian women after knowledge of pregnancy have plateaued somewhat around the 15-18% mark since 2010. However, rates of consumption before knowledge of pregnancy have almost halved from 45% in 2010 to 23% in 2016. Older, more highly educated women are more likely to drink at all after knowledge of pregnancy; however, women with less education were more likely than their highly educated counterparts to maintain or increase their consumption when they became pregnant. Health promotion campaigns should focus on older, more highly educated women who appear less likely to refrain entirely from drinking during pregnancy, and on those with lower education levels who appear to be more likely to drink at higher-risk levels during pregnancy.

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