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Pregnant Women's Alcohol Consumption: The Predictive Utility of Intention to Drink and Prepregnancy Drinking Behavior

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Abstract

Objective: This study had two aims: (1) to examine pregnant women's alcohol consumption across time from prepregnancy until childbirth and (2) to explore whether prepregnancy drinking and intention to drink predict prenatal alcohol consumption while controlling for relevant demographic variables.

Methods: At 17–21 weeks, 248 pregnant women completed questions about demographics, intention to drink alcohol during the subsequent pregnancy, and retrospective measures of prepregnancy and early pregnancy consumption. After this time, calendars were sent fortnightly assessing daily alcohol consumption until birth.

Results: For women who drank both prepregnancy and postpregnancy confirmation, average fortnight alcohol consumption in the first weeks of pregnancy was lower than during prepregnancy, and consumption continued to decrease between gestational weeks 1 and 8, particularly following pregnancy confirmation, after which it remained relatively stable. When predicting whether women drank in late pregnancy, intention accounted for unique variance after controlling for income and prepregnancy drinking. For women who drank after pregnancy confirmation, prepregnancy drinking quantity significantly predicted intention to drink, which in turn predicted fortnight alcohol consumption in later pregnancy, after controlling for prepregnancy drinking and income.

Conclusions: Findings highlight the need to measure alcohol consumption at multiple time points across pregnancy, the need for educating and supporting women to reduce consumption when planning pregnancies, and the usefulness of intention to drink as a predictor of drinking during pregnancy.

Introduction

The association between heavy maternal alcohol consumption and serious fetal effects is now well established. In contrast, the evidence about the effects of low to moderate drinking is conflicting, with a recent review suggesting even low amounts of gestational alcohol consumption may be linked to behavioral and neurocognitive consequences in the unborn child. Thus, there is no established safe threshold for maternal alcohol consumption, and the most current Australian Alcohol Guidelines recommend abstinence during pregnancy, similar to other countries, such as the United States. Up until October 2007 and during the current study's data collection phase, however, 2001 Australian Guidelines recommended pregnant women consume less than 2 standard drinks in 1 day and less than 7 drinks in 1 week.

Adverse consequences of prenatal alcohol consumption have been shown to vary with timing of exposure; exposure during weeks 4–9 of pregnancy may produce damage to the brain and cranial structures, whereas exposure later in pregnancy can lead to fetal growth, behavioral, and cognitive disturbances (for review, see ref. 1). Studies generally find that reported consumption during pregnancy is usually lower than prepregnancy levels, with decreased rates mostly reported in the period when pregnancy has been confirmed and an increase in abstinence following preg-
nancy confirmation. However, the accuracy of reported consumption rates in previous research is limited by methodological problems, including retrospective measurement at one assessment of various time periods (e.g., preconception and postconfirmation), questions asking about average frequency and quantity over long periods of time (months), and early pregnancy measures inclusive of preconception periods. Longitudinal research of alcohol consumption across pregnancy is conflicting, with studies varying as to the time frame examined, making it difficult to ascertain when the largest decreases in consumption take place. Some studies found decreases across months in the first and third trimesters, from one trimester to the next, or from early to later pregnancy. Another study reported little change from midpregnancy to late pregnancy following an initial decrease from preconception to early pregnancy. However, a lack of tests of significance and consumption rates being averaged over monthly, or longer, time periods limit these findings.

Previous research has not explored changes in alcohol consumption across shorter time periods within the preconception and postconception periods. Changes across shorter time periods would suggest that using average quantity measures may provide inaccurate information about likely effects of varying levels and timing of alcohol consumption. Researchers have argued that designs using multiple measures of consumption across pregnancy are needed to gain accurate information about consumption patterns systematically. To our knowledge, the current study was the first to implement a prospective longitudinal approach that involved multiple fortnightly retrospective measures of daily consumption. Our first aim was to explore alcohol consumption patterns across the entire pregnancy for women who were drinkers both before and after their pregnancies were confirmed. We predicted that women’s fortnightly average alcohol consumption would decrease across time as increasing numbers of women became aware of their pregnancy, that consumption in the first few weeks of pregnancy would not differ significantly from reported drinking levels 12 months prior to pregnancy, and that fortnight alcohol consumption would decrease significantly in the fortnight after pregnancy confirmation.

Our second aim was to determine if preconception drinking behavior and early pregnancy intention to drink predict alcohol consumption in middle to late pregnancy. The theoretical and practical implications of this aim are clear. Intervention strategies for reducing or eliminating the consumption of alcohol during pregnancy will be successful only when the factors contributing to prenatal alcohol use are known. Multiple measures of prior drinking behavior, including lifetime drinking history and preconception and early pregnancy drinking, have been shown to be significant factors associated with the persistence of drinking during pregnancy. Given that most studies have selected samples based on prior heavy or at-risk drinking behavior, replication in a community sample is needed. One study used annual measures across more than 13 years and controlled for at-risk drinking status. Women who reported recent drinking in questionnaires completed prior to pregnancy were three times more likely to report any drinking in a subsequent prenatal drinking measure, although inclusion of the preconception period in the outcome measure may have inflated this finding. Another study found prepregnancy drinking was related to drinking measured at 7 months gestation in a community sample of smokers. Lack of an association in non-smokers, a small sample, and questions predominantly about binge drinking limit this finding.

In nonpregnant samples, it has been shown that past drinking behavior impacts on intention to drink, which in turn has been shown to predict future drinking behavior. To our knowledge, however, Chang et al. are the only researchers who have explored intention to drink alcohol as a predictor of prenatal alcohol consumption. It was demonstrated that women who were abstinent prior to a brief intervention were more likely to state their goal was to abstain during the rest of pregnancy. Further, women with the goal to abstain from alcohol were more likely to actually abstain or reduce their consumption for the rest of their pregnancy. However, their findings were limited by postpartum retrospective measurement of consumption and selection of an at-risk drinking sample, and the intervention provided to assist goal achievement may have enhanced the relationship between the goals stated and subsequent drinking. Based on findings from nonpregnant or heavy-drinking pregnant samples and the limited findings of Chang et al. we hypothesized that both higher levels of prepregnancy drinking and intention to drink during pregnancy (measured at 17–20 weeks gestation) would predict whether women drink alcohol in late pregnancy after time 1 T1 questionnaire completion; that higher prepregnancy drinking would predict intention to drink (measured at 17–20 weeks gestation) during pregnancy, and that intention to drink would predict greater average alcohol consumed in late pregnancy, after controlling statistically for prepregnancy drinking.

Materials and Methods

Participants

The sample consisted of 248 pregnant women aged 18–42 years (mean [M] = 31.53, standard deviation [SD] = 4.65). Recruitment was for a broader ongoing research project exploring health and well-being during pregnancy via pregnancy-related health clinics, exercise classes, expos, and printed and online multimedia. From these sources, 355 women agreed to participate, but 107 did not return or complete all questionnaires (Fig. 1). Of the 248 final participants, most (85.1%) reported that their pregnancy was planned, and 48% reported being primiparous. The majority were born in Australia (80.6%), with the rest from the United Kingdom (6.5%), New Zealand (3.6%), Europe (2.8%), Asia (2%), the United States (2%), South America (1.2%), the Middle East (0.8%), and South Africa (0.4%). Most women (72.8%) reported having a tertiary education, 42% reported having a family income of >AUD$95,000 (approximately USD$72,827), and 15.6% reported having a family income of <AUD$45,000 (approximately USD$34,497). Almost all women were in a married or de facto relationship (95.6%); only 5 (2%) reported smoking during pregnancy.

Measures

The T1 questionnaire package included questions about demographic details, date of pregnancy confirmation, whether the pregnancy was planned, and alcohol-related
questions embedded within a larger questionnaire. A visual key of standard drinks adapted from the 2001 Australian Alcohol Guidelines was also supplied. One standard drink was equivalent to 10 g of alcohol.

Prepregnancy alcohol consumption. Women were asked to indicate if at 12 months prior to becoming pregnant they were consuming alcohol on a daily, weekly, or monthly basis and, if so, to indicate average standard drinks of beer, wine, and spirits (per day/week/month accordingly). The average number of standard drinks per fortnight was then calculated.

Amount of alcohol participants intend to consume during pregnancy. Women were asked to indicate (at 17–20 weeks gestation) how many standard drinks of beer, wine, and spirits they intended to drink on a daily, weekly, or monthly basis. Average standard drinks per fortnight were then calculated.

Alcohol consumption throughout pregnancy. At 17–20 weeks of gestation, alcohol consumption from the estimated time of conception to the questionnaire completion date (M = 18.51 weeks, SD = 1.32) was assessed using the timeline follow-back (TLFB) method. Participants were asked to indicate retrospectively on a 6-months calendar the amount of beer, wine, and spirits consumed each day in standard drinks during the relevant period, using the calendar as a memory cue. Women were also asked to mark special events to assist recall. Alcohol consumption from the questionnaire completion date until 36 weeks of gestation was assessed using the same format. A calendar was sent every second Monday showing the fortnight prior, and women were asked to recall their daily alcohol consumption during that period.

Procedure

Following University ethics approval, women were sent a questionnaire package at T1, between 17 and 20 weeks of gestation (M = 18.51 weeks, SD = 1.32), to ensure the pregnancy was confirmed and the threat of miscarriage had subsided. The package contained study information, consent forms, an early pregnancy questionnaire, and a reply-paid...
envelope to return the completed questionnaire and consent form. Alcohol consumption diaries were sent to the participants via their preferred method (41.9% mail, 58.1% e-mail) every fortnight until the baby’s birth, to be completed immediately and returned by e-mail or reply-paid envelope.

Analyses

Univariate outliers were adjusted by assigning a score one unit larger than the next most extreme score, to reduce impact on the distributions.33 To reduce the risk of type 1 errors, the alpha level was set at 0.01 unless otherwise stated. Of the 203 women who reported their pregnancy confirmation date, 98.5% reported confirmation by 10 weeks of gestation. Consequently, 10 weeks of gestation (fortnight 5) was used as the cutoff point for the 45 women failing to report a confirmation date. Women were classified as drinkers for the preconfirmation period or postpregnancy confirmation period if they consumed any amount of alcohol within that period. The total alcohol consumption for each fortnight throughout pregnancy was calculated for the subsample of women who were drinkers both prepregnancy and postpregnancy confirmation (n = 136, of the 167 women who drank postconfirmation). Because of the small sample size, analyses were not conducted for women who ceased (n = 23) or commenced (n = 31) drinking postconfirmation. To investigate significant changes in consumption from fortnights 1 to 18, the 95% confidence intervals (CI) for the mean difference of consecutive fortnights were compared. Prepregnancy fortnightly consumption was compared also to fortnight 1 (weeks 1–2) consumption.44 Paired-samples t-tests were then conducted to confirm significant differences in consecutive fortnights that were identified in the previous analyses. For women who were drinkers throughout pregnancy and had a reported confirmation date, paired-samples t-tests were used to investigate if alcohol consumption decreased from the fortnight before to the fortnight after pregnancy confirmation.

Average fortnight alcohol consumption in later pregnancy was calculated for each woman from her date of T1 questionnaire completion to birth. Demographic found to be correlated (p < 0.10) with both dependent and predictor variables in the following analyses were controlled for in the first step of the relevant models. For the whole sample (n = 248), a sequential logistic regression was used to explore if midpregnancy intention to drink, measured at 17–20 weeks of gestation, significantly predicted whether women were drinkers or abstainers in late pregnancy after accounting for prepregnancy drinking. Next, to examine relationships between predictors of alcohol consumption for women who were drinkers after pregnancy confirmation (n = 67), a multiple regression was conducted to determine if prepregnancy drinking predicted midpregnancy intention to drink during pregnancy. For the same subgroup, a hierarchical multiple regression was conducted to confirm whether midpregnancy intention was a significant predictor of average fortnight alcohol consumption in later pregnancy, above that of prepregnancy drinking. All variables were positively skewed, and log or reflected and square root transformations were applied successfully to income, prepregnancy drinking, intention, and late pregnancy drinking and used for analyses, although reported means were nontransformed.

Results

Patterns of alcohol consumption

Whole sample. Women reported they drank an average (mean) of 84.94 g of alcohol per fortnight at 12 months prepregnancy (SD = 96.08) and at T1 questionnaire reported intending to drink an average of 9.96 g per fortnight in the remaining pregnancy (SD = 18.11). Of the total sample, 10.9% of the sample reported abstaining at all assessed time points, including prepregnancy, and an additional 12.5% reported abstaining both prepregnancy and postpregnancy confirmation. For the 190 women (76.6%) who were classified as drinkers at some point during pregnancy, the period during which they consumed alcohol was divided into prepregnancy confirmation and postpregnancy confirmation, with the majority of drinkers (71.6%) drinking during both pregnancy time periods (Fig. 1 and Table 1). Prior to pregnancy confirmation, 159 women drank alcohol, and the majority of these women (65.4%) consumed alcohol on at least one occasion at levels higher than the more lenient 2001 Australian guidelines of <2 standard drinks in 1 day and <7 drinks in 1 week.5 Following pregnancy confirmation, whereas some women (n = 23) became new abstainers, a greater number of abstainers (n = 31) commenced drinking. A total of 167 women reported drinking postconfirmation, with most (74.9%) consuming alcohol within 2001 Australian Guidelines, and approximately half drinking consistently across more than half of the fortnights that followed pregnancy confirmation.

Women who were drinkers both prepregnancy and postpregnancy confirmation. For women who were drinkers prior to and following pregnancy confirmation (n = 136), the mean difference in fortnight alcohol consumption and its 95% CI was calculated for each consecutive pair of fortnights across pregnancy from 0 to 36 weeks, by subtracting the later fortnight from the earlier fortnight (Table 2). A mean difference 95% CI inclusive of 0 indicates no significant difference (p > 0.05) between the two consecutive fortnights.44 Based on the 95% CI of the mean difference, fortnight alcohol consumption decreased from prepregnancy levels to gestational weeks 1–2. The decrease in consumption levels continued from gestational weeks 1–2 to weeks 7–8, after which it was relatively stable, excluding an increase of approximately half a standard drink at gestational weeks 19–20 (possibly attributed to a change in length of retrospective measures to a fortnightly basis) and a decrease at 35–36 weeks gestation (possibly associated with a decrease in participant numbers, given some women had given birth). Paired-sample t-tests confirmed significant decreases in alcohol consumption from prepregnancy to gestational weeks 1–2, t(135) = 3.67, p < 0.001, $\eta^2 = 0.09$; weeks 1–2 to 3–4, t(135) = 3.77, p < 0.001, $\eta^2 = 0.10$; weeks 3–4 to 5–6, t(135) = 6.69, p < 0.001, $\eta^2 = 0.25$; and weeks 5–6 to 7–8, t(135) = 4.15, p < 0.001, $\eta^2 = 0.11$; as well as from weeks 17–18 to 19–20, t(135) = −2.95, p < 0.01, $\eta^2 = 0.06$. No other significant differences were found, including from weeks 33–34 to 35–36, t(119) = 1.64, p = 0.10.

One hundred fourteen of the 136 women (72.3%) who were drinkers both prior to and following pregnancy confirmation reported their pregnancy confirmation date. A paired-samples t-test indicated a significant, large decrease
in alcohol consumption from the fortnight before (M = 67.00 g, SD = 75.20) to the fortnight after women’s pregnancies were confirmed (M = 18.31 g, SD = 34.61), t(113) = 7.33, p < 0.001, r² = 0.33.

**Factors predicting alcohol consumption during pregnancy**

First correlations were performed to examine which demographic variables should be controlled in predicting drinker status during pregnancy (drinker vs. abstainer). Family annual income was the only demographic variable that approached significance with prepregnancy drinking (r = 0.12, p = 0.06) and correlated significantly with mid-pregnancy intention to drink (r = 0.16, p < 0.01) and drinking status during pregnancy (r = 0.21, p = 0.001); the higher the family income, the more women tended to consume alcohol prepregnancy, the more they intended to drink during pregnancy, and the more likely they were to be drinkers.

**Table 1. Classification of Drinkers During Pregnancy (n = 190) in Relation to Australian 2001 and 2007 Guidelines for Periods before and after Pregnancy Confirmation**

<table>
<thead>
<tr>
<th>Drinking pattern</th>
<th>Abstained; met 2007 Guidelines</th>
<th>Drinking within 2001 Guidelines</th>
<th>Drinking outside 2001 Guidelines</th>
<th>Days bingeingc</th>
<th>Weeks consuming &gt;7 drinks²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prepregnancy confirmation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>31 (16.3)</td>
<td>55 (29)</td>
<td>104 (54.7)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>M (SD) g/fortnight</td>
<td>0.0</td>
<td>8.27 (4.89)</td>
<td>94.57 (74.55)</td>
<td>2.85 (2.65)</td>
<td>1.25 (1.30)</td>
</tr>
<tr>
<td><strong>Postpregnancy confirmation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n (%)</td>
<td>23 (12.1)</td>
<td>125 (65.79)</td>
<td>42 (22.11)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>M (SD) g/fortnight</td>
<td>0.0</td>
<td>8.64 (9.99)</td>
<td>38.49 (31.06)</td>
<td>3.59 (3.55)</td>
<td>1.40 (2.11)</td>
</tr>
<tr>
<td>n reporting ≤6 fortnights drinking (%)d</td>
<td>—</td>
<td>77 (89.5)</td>
<td>9 (10.5)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>n reporting 7 fortnights drinking (%)d</td>
<td>—</td>
<td>21 (72.4)</td>
<td>8 (27.6)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>n reporting ≥10 fortnights drinking (%)d</td>
<td>—</td>
<td>27 (51.9)</td>
<td>25 (48.1)</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*Numbers exclude complete abstainers and women who abstained throughout the entire pregnancy (n = 58).

Based on the more lenient 2001 Australian Guidelines for pregnant women that were active during study data collection, recommending <2 standard drinks in 1 day and <7 drinks in 1 week.5

Means calculated for those drinking outside of 2001 Australian Guidelines.

Comparing % for drinkers within vs. outside 2001 Guidelines.

**Table 2. Mean Total Alcohol Consumption and Mean Difference 95% CI for Consecutive Fortnights for Women Who Drank before and after Pregnancy Confirmation**

<table>
<thead>
<tr>
<th>Gestational week</th>
<th>Mean g alcohol</th>
<th>SD</th>
<th>Mean differenceb</th>
<th>Mean difference 95% CIf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepregnancy</td>
<td>109.63</td>
<td>96.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 1–2</td>
<td>80.95</td>
<td>82.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 3–4</td>
<td>54.34</td>
<td>67.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 5–6</td>
<td>22.75</td>
<td>34.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 7–8</td>
<td>12.69</td>
<td>24.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 9–10</td>
<td>12.41</td>
<td>22.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 11–12</td>
<td>11.867</td>
<td>21.78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 13–14</td>
<td>14.87</td>
<td>22.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 15–16</td>
<td>15.98</td>
<td>24.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 17–18</td>
<td>16.15</td>
<td>23.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 19–20c</td>
<td>21.94</td>
<td>33.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 21–22</td>
<td>22.69</td>
<td>37.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 23–24</td>
<td>20.28</td>
<td>32.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 25–26</td>
<td>20.92</td>
<td>29.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 27–28</td>
<td>21.04</td>
<td>27.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 29–30</td>
<td>18.97</td>
<td>28.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 31–32</td>
<td>18.31</td>
<td>25.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 33–34</td>
<td>16.17</td>
<td>23.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeks 35–36</td>
<td>13.35</td>
<td>21.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*In varies from 136 to 120 based on the number of women who had reached the time of gestation.

Comparison with previous fortnight.

Fortnight following change in data collection method.
after T1 questionnaire completion. (Correlation matrix and chi-square results can be obtained by contacting the researchers.) Both prepregnancy drinking ($r = 0.31, p < 0.001$) and midpregnancy intention ($r = 0.44, p < 0.001$) correlated significantly with whether women were drinkers vs. abstainers after T1 questionnaire completion; the more women drank prepregnancy and intended to drink during pregnancy, the more likely they were to be drinkers.

In a sequential logistic regression analysis, a model containing income and prepregnancy drinking as predictors produced a reliable change in the model fit chi-square $(2, n = 248) = 33.04, p < 0.001$, accounting for 17.2% of variance in drinking group (Table 3). In the first step, income was a significant predictor, with women being 14.2% more likely to be drinkers for every AUD$10,000 earned. Although a significant predictor, for every extra intended 10 g of alcohol consumed during pregnancy, there was little change in likelihood that women would be drinkers. In the second step, when midpregnancy intention was added to the model, there was a reliable improvement in the model fit, chi-square $(3, n = 248) = 76.70, p < 0.001$, and a large increase in amount of variance predicted by the model, pseudo $R^2 = 0.49$. Midpregnancy intention was a significant predictor above that of the other predictors, with every extra intended 10 g of alcohol increasing the likelihood that women would be drinkers by 40.8%. The overall predictive success of the model, including all predictors, was 77.8%, with 71.2% of drinkers and 87.6% of abstainers correctly classified.

Next, multiple regressions were conducted with the subset of women who were drinkers after pregnancy confirmation ($n = 167$). To assess what demographic variables to control for, correlations were first conducted. Family income (transformed by reflection and square root) was the only demographic variable that approached significance with prepregnancy drinking ($r = -0.21, p = 0.05$) and midpregnancy intention to drink ($r = -0.17, p = 0.02$) and correlated significantly with late pregnancy drinking ($r = -0.15, p < 0.01$). The higher the family income, the more women tended to consume 12 months prepregnancy and intended to drink during pregnancy and the more likely they were to drink during pregnancy. (Correlation matrix can be obtained by contacting the authors.) Greater pregnancy drinking ($r = 0.41, p < 0.001$) and greater midpregnancy intention to drink ($r = 0.69, p < 0.001$) were also correlated significantly with consumption during pregnancy after T1 completion.

A multiple regression analysis (Table 4) predicting midpregnancy intended alcohol consumption in this subset of postconfirmation drinkers indicated in step 1 that income was a significant predictor, $F(1,162) = 5.25, p = 0.02$. In step 2, prepregnancy drinking explained 20.5% of the variance in midpregnancy intended consumption, $F(1,161) = 43.29, p < 0.001$. The more women reported drinking 12 months before conception, the more they intended to drink during pregnancy (measured at 17–20 weeks). In a further multiple regression analysis predicting actual consumption, at step 1 income was a significant predictor, $F(1,162) = 7.1, p < 0.01$, explaining 4.2% of the variance in average fortnightly alcohol consumption in late pregnancy.

When prepregnancy drinking was added to the model, it explained an additional 14.8% of the variance in average fortnightly alcohol consumption in late pregnancy, $F(1,161) = 29.43, p < 0.001$. When midpregnancy intention was added, it predicted an additional 30.8% of the variance in late pregnancy alcohol consumption, $F(1,160) = 98.32, p < 0.001$ (Table 3).

### Table 3. Summary of Logistic Regression for Full Sample ($n = 248$) Predicting Drinker Status (Drinker vs. Abstainer) During Pregnancy

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Step</th>
<th>Predictor</th>
<th>Ba</th>
<th>SE</th>
<th>Wald z-ratio</th>
<th>$p^b$</th>
<th>95% CI $p^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinker status</td>
<td>1</td>
<td>Family income</td>
<td>0.13</td>
<td>0.05</td>
<td>7.48**</td>
<td>1.14</td>
<td>1.04, 1.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepregnancy drinking</td>
<td>0.01</td>
<td>0.00</td>
<td>17.61***</td>
<td>1.01</td>
<td>1.00, 1.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(constant)</td>
<td>-1.09</td>
<td>0.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Family income</td>
<td>0.09</td>
<td>0.06</td>
<td>2.36</td>
<td>1.09</td>
<td>0.98, 1.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepregnancy drinking</td>
<td>0.00</td>
<td>0.00</td>
<td>2.36</td>
<td>1.00</td>
<td>0.99, 1.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(constant)</td>
<td>-1.33</td>
<td>0.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepregnancy intention</td>
<td>0.34</td>
<td>0.07</td>
<td>23.24***</td>
<td>1.41</td>
<td>1.23, 1.62</td>
</tr>
</tbody>
</table>

*aB, unstandardized coefficient; SE, standard error; CI, confidence interval; $p^b$, odds ratio.  
*bDrinker indicates reporting any alcohol consumption from T1 questionnaire completion until birth.  
**p < 0.01; ***p < 0.001.

Discussion

The high prevalence of alcohol consumption within the current sample demonstrates the need to increase awareness of recommendations (new in Australia but long-standing elsewhere) for abstinence during pregnancy and the need for effective interventions to reduce fetal exposure. Only 35.6% and 32.7% of women abstained prepregnancy and postpregnancy confirmation, respectively, and only 23.4% of women abstained throughout their entire pregnancy. Results correspond with previous Australian 2001 Drug Strategy Household Survey findings that only 36% of women reported completely abstaining during pregnancy (cited in ref. 1).

Women who drank consistently throughout pregnancy reported a reduced quantity of alcohol consumed in the first 2 weeks of pregnancy compared with prepregnancy levels. This finding might be the result of predominantly planned pregnancies (82.4%). Whether this finding is replicated when a larger sample of unplanned vs. planned pregnancies is examined would be useful to explore in future research. As expected, total consumption levels gradually decreased across gestational weeks 1–8. Although previous studies have shown prenatal drinking is lower than prepreg-
employment and other socioeconomic status factors, such as education, are related to increased risk of maternal alcohol consumption. The higher the quantity of alcohol women reported at conception, the more likely they were to be drinkers (vs. abstainers) in late pregnancy from T1 completion until birth. Further, for those who continued to drink postconfirmation, the more they intended to drink measured midpregnancy, the higher the quantity they actually consumed. Although prepregnancy drinking did not enhance the prediction of amount consumed by postconfirmation drinkers above that of midpregnancy intention to drink, it did significantly predict intention to drink in midpregnancy. This finding suggests that prepregnancy drinking has a direct influence on midpregnancy intention to drink, which in turn is a strong predictor of quantity consumed later in pregnancy. This is also consistent with research showing abstinence goals were related significantly to achieving abstinence or reducing consumption during pregnancy and that past alcohol use was related to intention to drink in nonpregnant samples. These findings highlight the important role of intention in predicting alcohol consumption during pregnancy, a finding previously demonstrated in nonpregnant samples. Given the importance of intention to drink in predicting pregnancy drinking (even though pregnancy is a special time in which intentions are likely to change dramatically from prepregnancy patterns), this finding supports the idea that prepregnancy drinking behavior is a potential risk factor for drinking in pregnancy and that heavier drinkers should be particularly targeted for educational efforts.

Prepregnancy drinking as a predictor of later pregnancy drinking in population-based samples may not be as strong a predictor as other variables (such as intention to drink in pregnancy). Midpregnancy intention to drink may have arisen as a stronger predictor because it possibly reflected a behavioral pattern that was already established by the point at which intention was measured (17–20 weeks of gestation) or because of the greater time difference between late pregnancy drinking and prepregnancy (12 months prior to conception) drinking compared with midpregnancy intention to drink. Previous findings that demonstrated prior drinking behavior was a relatively strong predictor may have been inflated, however, because of problem drinking samples and measures inclusive of problem drinking history, early

### Table 4. Summary of Multiple Regression Analyses Calculated for Women Who Were Drinkers after Pregnancy Confirmation (n = 167) to Predict Intention to Drink and Average Fortnightly Alcohol Consumption

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Step</th>
<th>Predictor</th>
<th>$\beta^b$</th>
<th>Partial $r$</th>
<th>$sr^2$</th>
<th>$R^2$</th>
<th>$\Delta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to drink (log)</td>
<td>1</td>
<td>Income (reflect.)</td>
<td>-0.18*</td>
<td>-0.18</td>
<td>0.03</td>
<td>0.03*</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Income (reflect.)</td>
<td>-0.11</td>
<td>-0.12</td>
<td>0.01</td>
<td>0.21***</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepregnancy drinking (log)</td>
<td>0.46***</td>
<td>0.46</td>
<td>0.21</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Fortnightly alcohol consumption (T1 completion until birth)</td>
<td>1</td>
<td>Income (reflect.)</td>
<td>-0.21**</td>
<td>-0.21</td>
<td>0.04</td>
<td>0.04**</td>
<td>—</td>
</tr>
<tr>
<td>(log)</td>
<td>2</td>
<td>Income (reflect.)</td>
<td>-0.15*</td>
<td>-0.16</td>
<td>0.02</td>
<td>0.15***</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepregnancy drinking (log)</td>
<td>0.39***</td>
<td>0.39</td>
<td>0.15</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Income (reflect.)</td>
<td>-0.08</td>
<td>-0.11</td>
<td>0.01</td>
<td>0.31***</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prepregnancy drinking (log)</td>
<td>0.10</td>
<td>0.12</td>
<td>0.01</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intention (log)</td>
<td>0.64***</td>
<td>0.62</td>
<td>0.31</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

*Log transformed versions of variables were included for intention to drink, prepregnancy drinking, and fortnightly alcohol consumption, and reflected square root (.) transformations were used for family income.

$^a$p < 0.05; $^{**}$p < 0.01; $^{***}$p < 0.001.

$^b$Standardized coefficients; $R^2\Delta$, $R^2$ change for step; $sr^2$, semipartial correlation.
pregnancy, and preconception periods.\textsuperscript{32,33} Nonetheless, the prediction of midpregnancy intention from prepregnancy drinking suggests (1) that targeting prevention efforts particularly to women who are drinking more alcohol prepregnancy and (2) encouraging them to reduce their level of alcohol consumption while attempting to conceive could potentially assist in reducing women’s later intentions to drink during pregnancy and, subsequently, the prevalence and level of prenatal alcohol consumption in the population.

Women should be screened for previous alcohol use and, importantly, be asked about quantity they intend to drink during pregnancy, as these are easily measured by health professionals and will help identify those who are at risk of prenatal alcohol consumption and in need of brief interventions. Psychological variables may be more important predictors of later pregnancy alcohol consumption than behavioral factors, as midpregnancy intention was found to be the stronger predictor. In addition, identifying possible antecedent factors to intention to drink during pregnancy, which may mediate the relationship between prepregnancy drinking and intention, may be important to inform interventions to reduce prenatal alcohol consumption. Likely antecedents of intention include perceived behavioral control, societal norms, and attitudes or expectancies, as described by the Theory of Planned Behavior (TPB) and supported in empirical research.\textsuperscript{35–38,52} It should be noted that the intention measure used here (which assessed amount women intended to drink) differed somewhat from that used in most TPB research, in which intention is measured via the likelihood that participants expect to drink specific frequencies or quantities using Likert scales and predictor measures generally match more closely the outcome variables.\textsuperscript{53} Therefore, future research should explore whether using intention measures in line with the TPB improve the prediction of prenatal drinking.

Substantial changes in consumption rates across pregnancy also have implications for designing and interpreting research studies informing health recommendations and interventions. Single measures and those averaging consumption over long time periods are likely inadequate, particularly for dose-response research. Drinking level classification should ensure that early pregnancy consumption and late pregnancy consumption are taken into account separately. During early pregnancy, it is particularly important to include multiple measures across time to avoid inaccurate grouping of women based on quantity consumed. When assessing later pregnancy consumption after week 8 or after pregnancy confirmation, however, single measures are likely to be reasonably reliable estimates.

Replication in future research is necessary to determine if the current results are time or context limited as a result of recent changes in guideline recommendations and use of an Australian population. Given the reported levels of alcohol consumption, the risk for serious fetal effects was generally low, and generalizations cannot be made to heavy-drinking samples. Generalizations to lower socioeconomic status groups are also limited. Unfortunately, the small number of women did not allow for a comparison between those who ceased consumption postconfirmation and those who commenced drinking postconfirmation. Predictors of early pregnancy drinking were also not assessed within the current study because of the focus on late pregnancy alcohol consumption. Prenatal health advice or counseling was not assessed, which may have inflated decreases in consumption levels or associations with drinking intentions. Finally, despite multiple measurement time points and provision of standard drink scales, several factors may have reduced the accuracy of alcohol consumption, including inconsistencies in the term standard drink,\textsuperscript{3} seasonal variations, selective or intentional underreporting,\textsuperscript{54} and regular contact, which may have reduced anonymity.\textsuperscript{55}

In summary, findings demonstrate the changing patterns of prenatal alcohol consumption across time, confirming previous research findings and highlighting the need for future research to use multiple measurement time points, particularly in the first 8 gestational weeks. Whereas some women abstained completely and many others reduced their intake following pregnancy confirmation, most drank prior to their pregnancy’s being confirmed and exceeded recommended guidelines.\textsuperscript{3,5} This indicates the need for increased health promotion and advice by health providers to educate women about reducing alcohol consumption when planning to become pregnant. Further, women’s intention to drink during pregnancy, measured in midpregnancy, was associated with drinking in later pregnancy. This confirms an easily measurable factor to assist identification of those at risk for prenatal alcohol consumption who may benefit from preventive intervention. Identification of the antecedent predictors to intention to drink and factors mediating the relationship between prepregnancy drinking and intention may highlight additional areas for specific interventions.

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Disclosure Statement

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