Association Between Maternal Alcohol Consumption in Early Pregnancy and Pregnancy Outcomes

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OBJECTIVE: To investigate the association between alcohol consumption and binge drinking before and during early pregnancy and adverse pregnancy outcomes.

METHODS: We used data from 5,628 nulliparous pregnant participants recruited to the Screening for Pregnancy Endpoints (SCOPE) study, a prospective cohort study. Participants were interviewed at 15 weeks of gestation and information on alcohol intake before pregnancy and until the time of interview was obtained using a standardized questionnaire. Alcohol intake was classified as occasional (1–2 units per week), low (3–7 units per week), moderate (8–14 units per week), and heavy (greater than 14 units per week). Binge alcohol consumption was defined as consumption of 6 or more alcohol units in one session.

RESULTS: Of the 5,628 participants, 1,090 (19%) reported occasional alcohol consumption, 1,383 (25%) low alcohol consumption, 625 (11%) moderate alcohol consumption, and 300 (5%) heavy alcohol consumption. Overall, 1,905 (34%) participants reported binge alcohol consumption in the 3 months before pregnancy, and 1,288 (23%) of these participants reported binge alcohol consumption during the first 15 weeks of pregnancy. Participants who consumed occasional to heavy amounts of alcohol in early pregnancy did not have altered odds of a small-for-gestational-age neonate, reduced birth weight, preeclampsia, or spontaneous preterm birth. Similarly, those who binge drank in early pregnancy did not have altered odds of these adverse pregnancy outcomes.

CONCLUSION: Alcohol consumption in early pregnancy was prevalent in this nulliparous cohort. There was no association between alcohol consumption before 15 weeks of gestation and small for gestational age, reduced birth weight, preeclampsia, or spontaneous preterm birth.

(Obstet Gynecol 2013;0:1–8)

DOI: 10.1097/AOG.0b013e3182a6b226

LEVEL OF EVIDENCE: II

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Funded by New Enterprise Research Fund, Foundation for Research Science and Technology; Health Research Council; Evelyn Bond Fund, Auckland District Health Board Charitable Trust (New Zealand Screening for Pregnancy Endpoints [SCOPE] Study); Premier's Science and Research Fund, South Australian Government (Australian SCOPE Study); Health Research Board (Ireland SCOPE Study); National Health Service NEAT Grant, Manchester Biotechnology and Biological Sciences Research Council, University of Manchester Proof of Concept Funding (University of Manchester, Manchester, United Kingdom); Guy's and St Thomas' Charity (King's College London, London, United Kingdom); and Tommy's Charity (King's College London, London, and University of Manchester, Manchester, United Kingdom).

The authors thank the study participants; Eliza Chan for contributions to the creation of the Screening for Pregnancy Endpoints database; Rennae Taylor, Nicolai Murphy, Annette Briley, and Denise Healy for coordinating the Screening for Pregnancy Endpoints studies in each country; and all other study midwives.

Presented at the Society for Gynecologic Investigation 60th Annual Scientific Meeting, March 20–23, 2013, Orlando, Florida.

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Financial Disclosure

The authors did not report any potential conflicts of interest.

ISSN: 0029-7844/13

Up to 50% of women continue to drink alcohol in pregnancy despite many advisory bodies recommending alcohol avoidance.[1,2] The United Kingdom's

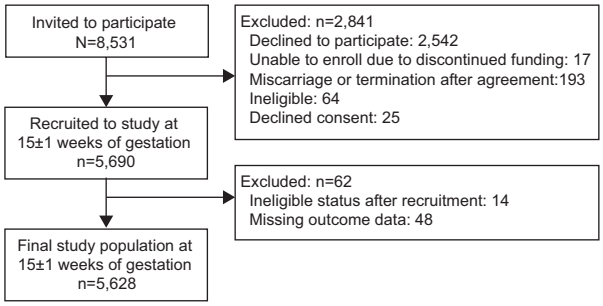

Fig. 1. Participants recruited.
McCarthy. Alcohol Consumption and Pregnancy Outcomes. Obstet Gynecol 2013.

Royal College of Obstetricians and Gynecologists advises that although an increasing body of evidence suggests harm to the fetus from alcohol consumption during pregnancy, there is no evidence of harm from low levels of alcohol consumption (defined as 1–2 units of alcohol once or twice a week).[3] The Royal College of Obstetricians and Gynecologists report highlighted that binge drinking in early pregnancy may be particularly harmful. Furthermore, long-term prospective cohort studies to investigate the effect of alcohol exposure in pregnancy were recommended.[3] The American College of Obstetricians and Gynecologists recommends that obstetricians give "compelling and clear advice to avoid alcohol use" in pregnancy and women at risk of pregnancy.[4] These strict recommendations come despite other advisory bodies such as the National Institute for Health and Clinical Excellence acknowledging that there is no consistent evidence of adverse effects from low to moderate prenatal alcohol consumption.[5] As a result, the National Institute for Health and Clinical Excellence takes the more modest approach of suggesting that women limit alcohol consumption to no more than 1 standard unit per day, whereas the Department of Health in the United King-

Table 1. Characteristics by Degree of Maternal Alcohol Consumption in the First Trimester

Characteristic	Abstinent (n=2,230)	Occasional (n=1,090)	Low (n=1,383)	Moderate (n=625)	Heavy (n=300)	*P**
Age (y)						
14–24	624 (28)	187 (17)	231 (17)	124 (20)	120 (40)	<.001
25–29	669 (30)	308 (28)	389 (28)	162 (26)	80 (27)	
30–34	667 (30)	455 (42)	568 (41)	251 (40)	76 (25)	
35–45	270 (12)	140 (13)	195 (14)	88 (14)	24 (8)	
Education						
More than 12 y	1,160 (52)	739 (68)	1,003 (73)	416 (67)	186 (62)	<.001
Marital status						
Single	169 (8)	76 (7)	125 (9)	96 (15)	74 (25)	<.001
Ethnicity						
Asian	124 (6)	24 (2)	13 (1)	8 (1)	1 (0.3)	<.001
White	1,863 (84)	1,009 (93)	1,319 (95)	599 (96)	271 (90)	
Other	243 (11)	57 (5)	51 (4)	18 (3)	28 (9)	
Study center						
Adelaide	718 (32)	144 (13)	160 (12)	80 (13)	62 (21)	<.001
Auckland	956 (47)	366 (18)	468 (23)	176 (9)	66 (3)	
Cork	353 (20)	427 (24)	603 (34)	266 (15)	125 (7)	
United Kingdom	203 (31)	153 (23)	152 (23)	103 (16)	47 (7)	
BMI (kg/m^2)						
18.5 or less	43 (2)	16 (2)	15 (1)	4 (1)	6 (2)	<.001
18.6–24.9	1,191 (53)	601 (55)	820 (59)	351 (56)	160 (53)	
25–29.9	577 (26)	334 (31)	398 (29)	179 (29)	88 (29)	
35 or higher	419 (19)	139 (13)	150 (11)	91 (15)	46 (15)	
Smoking status†						
Nonsmoker	1,857 (83)	893 (82)	1,029 (74)	374 (60)	110 (37)	<.001
Quit during pregnancy	146 (7)	115 (11)	232 (17)	160 (26)	105 (35)	
Smoker	227 (10)	82 (8)	122 (9)	91 (15)	85 (28)	
Hard drug use†	9 (0.4)	7 (1)	10 (1)	16 (3)	14 (5)	<.001
Marijuana use†	66 (3)	29 (3)	48 (4)	36 (6)	38 (13)	<.001

BMI, body mass index.
Data are n (%) unless otherwise specified.
* Using Student *t* test or $\chi 2$ test, $P<.05$.
† At time of 15-week interview.

Table 2. Adverse Pregnancy Outcomes and Quantity of Maternal Alcohol Consumption in the First Trimester

Outcome	Abstinent* (n=2,230)	Occasional to Low (n=2,473) n	Occasional to Low (n=2,473) Estimate (95% CI)	Occasional to Low (n=2,473) Adjusted Estimate (95% CI)	Moderate to Heavy (n=925) n	Moderate to Heavy (n=925) Estimate (95% CI)	Moderate to Heavy (n=925) Adjusted Estimate (95% CI)
Birth weight (g)	3,371 (604)	2,473	52 (−3 to 107)	−13 (−52 to 26)	925	41 (−32 to 114)	−31 (−149 to 88)
SGA	240 (10.9)	275	1.03 (0.77–1.39)	1.09 (0.86–1.38)	118	1.21 (0.83–1.76)	1.10 (0.80–1.52)
Spontaneous preterm birth	109 (4.9)	93	0.76 (0.48–1.20)	0.82 (0.62–1.07)	34	0.74 (0.39–1.39)	0.75 (0.55–1.03)
Preeclampsia	138 (6.2)	103	0.66 (0.43–1.00)	0.73 (0.51–1.06)	37	0.63 (0.35–1.14)	0.66 (0.39–1.14)

CI, confidence interval; SGA, small for gestational age.

All end points, except for birth weight, were analyzed using logistic regression and results are presented as odds ratios (95% CIs). Birth weight was analyzed using linear regression with robust variance estimation and is presented as adjusted mean difference in grams (95% CIs). The reference group was women who did not drink alcohol during pregnancy. All regression models were adjusted for maternal age, smoking, education, ethnicity, body mass index, neonatal sex, marital status, family income, and drug use in pregnancy. All analyses were adjusted for potential clustering effect of study centers. Birth weight models were also adjusted for gestational age at delivery.

* Data are mean (standard deviation) or n (%).

dom now recommends that women trying to conceive should avoid drinking alcohol, and during pregnancy women should drink no more than 1–2 units of alcohol once or twice a week and avoid getting drunk.[6]

A recent systematic review and meta-analysis examined the dose–response relationship between alcohol consumption before and during pregnancy and the risks of low-birth-weight, preterm birth and delivery of a small-for-gestational-age (SGA) neonate (less than the 10th percentile of gestational age-adjusted birth weight) and demonstrated that consumption of more than 10 g or 1.25 units alcohol per day during pregnancy increased the risk of all three outcomes. The greater the exposure to alcohol, the greater the risk; eg, a twofold increase in SGA when the mother consumed more than 52 g of alcohol per day and a 23% increase in preterm birth with more than 36 g of alcohol per day. In contrast, lower levels of alcohol consumption were not associated with an increased risk of a preterm birth or SGA neonate.[7] This meta-analysis was limited by significant heterogeneity across studies and poor quality study design with some studies not controlling for confounders. Publication bias is also a recognized limitation.[8]

We performed this study to clarify the association between early pregnancy alcohol consumption and pregnancy outcomes. We hypothesized that increased exposure to alcohol in early pregnancy would result in an increased risk of SGA neonates, low-birth-weight neonates, and spontaneous preterm birth. Secondary aims were to investigate whether those who engaged in binge drinking in early pregnancy were at any increased risk of adverse pregnancy outcomes and whether cessation of alcohol consumption in the first

Table 3. Adverse Pregnancy Outcomes and Maternal Alcohol Consumption Classified by Status at 15 Weeks

Outcome	Quit Before Conception (n=937) n	Quit Before Conception (n=937) Estimate (95% CI)	Quit Before Conception (n=937) Adjusted Estimate (95% CI)	Quit Before 15 Wk (n=2,865) n	Quit Before 15 Wk (n=2,865) Estimate (95% CI)	Quit Before 15 Wk (n=2,865) Adjusted Estimate (95% CI)
Birth weight (g)	937	94 (14–175)	33 (−83 to 148)	2,865	91 (28–154)	−1 (−73 to 71)
SGA	87	0.78 (0.50–1.22)	0.83 (0.42–1.66)	326	0.97 (0.70–1.36)	1.02 (0.77–1.34)
Spontaneous preterm birth	40	0.78 (0.41–1.48)	0.79 (0.64–0.99)	108	0.68 (0.41–1.12)	0.73 (0.56–0.94)
Preeclampsia	50	0.77 (0.43–1.37)	0.84 (0.56–1.27)	116	0.57 (0.36–0.91)	0.65 (0.41–1.02)

CI, confidence interval; SGA, small for gestational age.

All end points, except for birth weight, were analyzed using logistic regression and results are presented as odds ratios (95% CI). Birth weight was analyzed using linear regression with robust variance estimation and is presented as adjusted mean difference in grams (95% CI). The reference group was women who did not drink alcohol during pregnancy. All regression models were adjusted for maternal age, smoking, education, ethnicity, body mass index, neonatal sex, marital status, family income, and drug use in pregnancy. All analyses were adjusted for potential clustering effect of study centers. Birth weight models were also adjusted for gestational age at delivery.

15 weeks of pregnancy was associated with any observed adverse pregnancy outcomes.

MATERIALS AND METHODS

Ethical approval was obtained from local ethics committees (New Zealand AKX/02/00/364, Australia REC 1712/5/2008, London and Manchester 06/MRE01/98, and Cork ECM5(10)05/02/08) and all participants provided written informed consent. Screening for Pregnancy Endpoints (SCOPE) is a prospective, multicenter cohort study with the principal aim of developing screening tests to predict preeclampsia, SGA neonates, and spontaneous preterm birth.[9] Participants were healthy nulliparous females with singleton pregnancies recruited between November 2004 and January 2011 in Auckland, New Zealand; Adelaide, Australia; Cork, Ireland; and Manchester, Leeds, and London, United Kingdom, and were recruited as previously described (Fig. 1).[10,11] Exclusion criteria were high risk of preeclampsia, delivery of a SGA neonate, or spontaneous preterm birth because of underlying medical conditions, gynecologic history, three or more previous miscarriages, three or more terminations of pregnancy, or had received interventions such as aspirin that might modify pregnancy outcome.[9]

Study participants were interviewed and examined by study research midwives at 14 6/7 to 15 6/7 weeks of gestation. At the time of interview, data were entered on an Internet-accessed central database with a complete audit trail (MedSciNet). Pregnancy information and pregnancy outcome data were collected prospectively by research midwives. All data entries were individually checked (including data entry errors in the lifestyle questionnaire) and a customized software program used to detect any systematic data entry errors. Outcomes were spontaneous preterm birth, SGA neonate, preeclampsia, and birth weight.

Alcohol consumption was reported as units consumed per week. At the 15-week interview, participants were asked "were you drinking alcohol before pregnancy?"; "were you drinking alcohol earlier in the pregnancy?"; and finally, "are you still drinking alcohol?" If the participants answered yes to any of these, the amount of alcohol then was quantified. Participants who confirmed that they had consumed alcohol during pregnancy were asked when they stopped drinking.

One unit of alcohol was defined as 8 g or 10 mL (1 dL) of pure alcohol. The number of units was calculated by multiplying the volume drank (mL) by the percent of alcohol (by volume) and dividing by 1,000. One unit of alcohol was equivalent to one glass of wine (approximately 125 mL), one small glass of sherry, a single nip of spirits, or a half pint of lager (regular strength). A can or small bottle of regular-strength beer (300–330 mL, 4–5% alcohol) was equivalent to 1.5 units of alcohol and a bottle of alcohol pop was equivalent to 2 units of alcohol. Binge alcohol consumption was defined as 6 or more units per drinking session. For example, if the participant had only one drink per month, 0.25 units per week was recorded; two drinks per month was recorded as 0.5 units per week. If the patient had one binge drinking session (6 or more units) per month and no other drinking during the month, 6 units over 4 weeks is 1.5 units per week. If the participant had a regular alcohol intake of 5 units per week plus one episode of binge drinking per month, the total number of units per month was divided by 4, ie, (20+6)/4=6.5 units per week. The timing of cessation of alcohol consumption was also recorded. For the purpose of this study, alcohol intake was classified as occasional (1–2 units per week), low (3–7 units per week), moderate (8–14 units per week), and heavy (greater than 14 units per week). In addition, information about the number and duration of binges

	Continued at 15 Wk (n=572)		
Outcome	n	Estimate (95% CI)	Adjusted Estimate (95% CI)
Birth weight (g)	572	95 (1–189)	−1 (−100 to 98)
SGA	74	1.13 (0.70–1.82)	1.12 (0.83–1.52)
Spontaneous preterm birth	20	0.63 (0.28–1.43)	0.64 (0.43–0.95)
Preeclampsia	26	0.65 (0.31–1.33)	0.78 (0.34–1.79)

Table 4. Adverse Pregnancy Outcomes and Maternal Alcohol Consumption by Antenatal Binge Drinking Status

	Binge Drinking Prepregnancy Only (n=617)			
Outcome	n	Estimate (95% CI)	Adjusted Estimate (95% CI)	n
Birth weight (g)	617	86 (5–167)	12 (−45 to 69)	448
SGA	64	0.97 (0.62–1.52)	0.99 (0.86–1.14)	59
Spontaneous preterm birth	20	0.69 (0.32–1.48)	0.78 (0.33–1.80)	13
Preeclampsia	31	1.02 (0.54–1.90)	1.11 (0.65–1.89)	20

CI, confidence interval; SGA, small for gestational age.

All end points, except for birth weight, were analyzed using logistic regression and results are presented as odds ratios (95% CI). Birth weight was analyzed using linear regression with robust variance estimation and is presented as adjusted mean difference in grams (95% CI). The reference group was women who did not binge drink prepregnancy or during pregnancy. All regression models were adjusted for maternal age, smoking, education, ethnicity, body mass index, neonatal sex, marital status, family income, and drug use in pregnancy. All analyses were adjusted for potential clustering effect of study centers. Birth weight models were also adjusted for gestational age at delivery.

before 15 weeks of gestation was recorded separately. Hard drug use was defined as the consumption of any of cocaine, substance P, amphetamines, or opiates.

Small for gestational age was defined as birth weight below the 10th customized centile adjusted for maternal weight, height, parity, ethnic group, gestational age, and neonatal sex (www.gestation.net).[12] Spontaneous preterm birth was defined as spontaneous onset of labor (before 37 weeks of gestation) resulting in preterm birth at less than 37 weeks of gestation. Preeclampsia was defined as systolic blood pressure 140 mm Hg or more, diastolic blood pressure 90 mm Hg or more, or both on at least two occasions 4 hours apart after 20 weeks of gestation but before the onset of labor or postpartum with proteinuria (24-hour urinary protein 300 mg or more or spot urine protein-to-creatinine ratio 30 mg/mmol creatinine or urine dipstick protein 2+ or more) or any multisystem complication of preeclampsia.[13] Birth weight was measured to the nearest gram.

Analysis of variance was used to compare continuous variables and χ^2 was used to compare categorical variables in relation to quantity of alcohol consumed per week. In all the statistical tests, participants with either no alcohol intake before or during pregnancy or those with no binge drinking before or during pregnancy represented the reference group. Logistic regression and linear regression was used to analyze the binary (all outcomes excluding birth weight) and continuous (birth weight) outcome measures, respectively. Logistic regression models were adjusted for maternal age, smoking, ethnicity, body mass index (calculated as weight (kg)/[height (m)]^2), neonatal sex, marital status, family income, and drug use. All analyses were adjusted for the potential clustering effect of study centers. The linear regression for birth weight was adjusted for the same variables as the logistic models in addition to gestational age at delivery. Analyses were further adjusted for multiple testing. Because 32 tests were planned in the initial analyses, $P<.002$ was considered statistically significant. Results are interpreted using this multiple testing adjusted P value.

Initial analysis examined the association between the amount of alcohol consumed during pregnancy and pregnancy outcome. For clarity of presentation and interpretation, results are presented as two groups (occasional and low combined and moderate and heavy combined). The separate groupings are presented in the Appendix, available online at http://links.lww.com/AOG/A432.

Two further analyses were performed to assess the association between further classifications of exposure to alcohol during or before pregnancy and the outcome. The first examined alcohol consumption status at 15 weeks of gestation. This was done by generating a four-category variable: 1) abstinent (reference group); 2) quit before conception; 3) quit before 15 weeks of gestation; and 4) continued at 15 weeks of gestation. The effect of binge drinking in pregnancy was examined by generating a three-category variable: 1) participants with no history of binging prepregnancy or during pregnancy (reference group); 2) binge drinking prepregnancy but stopped during pregnancy; and 3) prepregnancy binge drinking and binge drinking in pregnancy before 15 weeks of gestation. Binge drinking in pregnancy was further stratified into those with one binge before 15 weeks of gestation and those with two or more binge episodes before 15 weeks of gestation.

One further subgroup analysis was performed. Participants who reported binge drinking in pregnancy were excluded from the initial analysis. This ensured any alcohol effects observed did not occur secondary to

	Binge Drinking Prepregnancy and Before 15 Wk (n=1,288)				
	One Binge (n=448)		Two or More Binges (n=840)		
Outcome	Estimate (95% CI)	Adjusted Estimate (95% CI)	n	Estimate (95% CI)	Adjusted Estimate (95% CI)
Birth weight (g)	30 (−63 to 123)	−20 (−118 to 78)	840	12 (−59 to 83)	−41 (−108 to 27)
SGA	1.27 (0.79–2.03)	1.29 (0.75–2.23)	114	1.31 (0.91–1.88)	1.22 (0.94–1.57)
Spontaneous preterm birth	0.61 (0.24–1.54)	0.68 (0.23–2.06)	31	0.79 (0.42–1.48)	0.90 (0.70–1.16)
Preeclampsia	0.89 (0.42–1.91)	0.96 (0.50–1.83)	43	1.03 (0.60–1.79)	1.09 (0.54–2.19)

binge drinking and allowed us examine the chronic effects of alcohol exposure in pregnancy.

RESULTS

Of the 5,628 participants in the study cohort, 2,230 (40%) participants reported no alcohol consumption in pregnancy, 1,090 (19%) occasional alcohol consumption, 1,383 (25%) low alcohol consumption, 625 (11%) moderate alcohol consumption, and 300 (5%) heavy alcohol consumption in pregnancy when interviewed at 15 weeks of gestation. Overall 1,905 (34%) participants reported binge alcohol consumption in the 3 months prepregnancy. Of these, 1,288 (23%) participants also reported binge alcohol consumption during the first 15 weeks of pregnancy. Of these 1,288 participants, 840 (15%) reported at least two episodes before 15 weeks of gestation.

Participants who consumed greater amounts of alcohol in early pregnancy were more likely to be younger, white, single, smokers, and admit to a history of drug use compared with those who did not consume any alcohol in pregnancy. Significant geographical variation was observed between study centers; 65–80% of participants in the United Kingdom and Ireland consumed some alcohol in pregnancy compared with 38% in Australia and 53% in New Zealand (Table 1).

Overall there was no association between the level of alcohol consumption and the odds of a SGA or reduced birth weight neonate (Table 2). The timing of early pregnancy exposure to alcohol did not influence the odds of SGA or affect birth weight (Table 3). Furthermore, females who binge drank in pregnancy did not have an increased risk of a SGA or reduced birth weight neonate (Table 4).

The consumption of occasional to low and moderate to heavy amounts of alcohol in early pregnancy was not associated with any significant reduction in the odds of spontaneous preterm birth (adjusted odds ratio [OR] 0.82, 95% confidence interval [CI] 0.62–1.07 and OR 0.75, 95% CI 0.55–1.03 for occasional to low and moderate to heavy alcohol consumption, respectively) compared with those who did not consume any alcohol in pregnancy (Table 2). Similarly, binge drinking before pregnancy or continuing during the first trimester of pregnancy was not associated with altered odds of spontaneous preterm birth (adjusted OR 0.78, 95% CI 0.33–1.80 and adjusted OR 0.90, 95% CI 0.70–1.16, respectively) (Table 4).

The consumption of occasional to low and moderate to heavy amounts of alcohol in early pregnancy was not associated with any significant change in the odds of developing preeclampsia (adjusted OR 0.73, 95% CI 0.51–1.06 and adjusted OR 0.66, 95% CI 0.39–1.14 for occasional to low and moderate to heavy alcohol consumption, respectively) compared with those who did not consume any alcohol in pregnancy (Table 2). The timing of exposure to alcohol in pregnancy did not alter these findings (adjusted OR 0.65, 95% CI 0.41–1.02 and adjusted OR 0.78, 95% CI 0.34–1.79 for those who quit alcohol before conception and those who continued to drink at 15 weeks of gestation, respectively) (Table 3). No association was observed between participants who developed preeclampsia and those exposed to binge drinking either before conception (adjusted OR 1.11, 95% CI 0.65–1.89) or those who continued to binge drink in pregnancy (adjusted OR 1.09, 95% CI 0.54–2.19).

Subgroup analyses were then performed. Participants who reported binge drinking in pregnancy were excluded from the analysis shown in Table 2. The results were unchanged (see Appendix, http://links.lww.com/AOG/A432).

DISCUSSION

Using predefined quantities and timings of exposure to alcohol, this study provides a detailed assessment of the variable associations between alcohol intake in the first 15 weeks of pregnancy and major adverse pregnancy

outcomes. The majority of participants (60%) consumed some alcohol in pregnancy with more than 20% admitting to binge drinking in pregnancy. These figures are significantly higher than reported in other research in a North American setting (any alcohol use among pregnant women 12%, range 10–16%; binge drinking among pregnant women 2%, range 1–3%). This may reflect differences in patterns of alcohol consumption by young women and the varying advice on alcohol consumption while pregnant in different countries.[14]

The strengths of our study are that information about the timing of and degree of exposure to alcohol in pregnancy was recorded in a detailed standardized fashion with birth outcomes then collected prospectively. This allowed us to examine multiple exposures and timing of exposure. Pregnancy outcome data were available in more than 99% of participants. Pregnancy outcome was assigned according to prespecified criteria and stringent data monitoring protocols ensured the quality of the data. Access to a wide range of potential confounders missing in other studies such as smoking, income, education, and drug use were available on all participants. Recall bias may have resulted in an underreporting of alcohol consumption because no objective test or measure exists to record alcohol exposure over a long period of time. However, all data were collected in a careful standardized sensitive manner in an effort to limit this potential bias.[15] Our study specifically examined exposure to alcohol in early pregnancy and did not provide habitual drinking data for the whole of pregnancy. Although every effort was made to cautiously interpret the data where numbers were limited, some of our groupings did have small numbers and may have been underpowered to examine specific outcomes.

Comparisons with other studies must be interpreted with caution because the majority of other studies reflect exposure to alcohol in pregnancy at any gestation. In contrast, this study specifically examined early pregnancy exposure to alcohol. In a systematic review that did not address specific timing of exposure, Petra et al[7] showed no effect of alcohol consumption up to10 g pure alcohol per day (an average of approximately one drink per day) and low-birthweight and SGA neonates. Our study did not demonstrate a strong association between the level of alcohol consumption in early pregnancy and SGA neonates. Petra et al also demonstrated an increased association between alcohol consumption and preterm birth but not until more than 18 g pure alcohol per day (an average of 1.5 drinks per day). However, our study did not demonstrate any association between either alcohol consumption or binge drinking in pregnancy and spontaneous preterm birth, whereas other studies have reported a reduction in spontaneous preterm birth in women who consumed alcohol in pregnancy.[16–18] The difference from the report by Petra et al may relate to their inclusion of preterm birth resulting from all causes (spontaneous and iatrogenic). In contrast with other studies, we did not demonstrate occasional to low amounts of alcohol to be protective against growth restriction.[16,19,20] Our findings concur with those of another systematic review by Henderson et al,[21] which found no significant association between occasional to low amounts of alcohol exposure and adverse pregnancy outcomes including low birth weight and SGA.

It remains unclear whether any safe level of alcohol consumption in pregnancy exists, and there is currently inadequate information to determine whether there are discrete gestational windows of vulnerability for different adverse outcomes. Longitudinal studies are required to assess interaction with the influences of cessation, continuous consumption, or binge drinking in the second and third trimesters. The variation in alcohol consumption across study centers was significant with 65–80% of participants in the United Kingdom and Ireland consuming some alcohol in pregnancy compared with 38–53% in Australia and New Zealand. This may reflect different recommendations for alcohol consumption in pregnancy by country (abstinence in Australia compared with avoiding heavy alcohol intake in pregnancy in the United Kingdom).[5] Despite demonstrating significant associations between alcohol consumption and adverse pregnancy outcomes, interpretation of any causal effect is not possible and further studies are needed to examine this.

Although the effects of alcohol consumption in pregnancy are likely to be varied depending on quantity consumed and timing of exposure, this study did not demonstrate a strong association between occasional to heavy amounts of alcohol consumption in early pregnancy and increased risks of SGA neonates, preeclampsia, spontaneous preterm birth, or reduced birth weight neonates. This study did not evaluate the association between alcohol consumption in pregnancy and long-term neurocognitive outcomes of children exposed as fetuses to alcohol. This potential for neurocognitive dysfunction remains one of the single most important reasons for pregnant women to avoid alcohol intake during pregnancy.

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