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Light drinking in pregnancy and mid-childhood mental health and learning outcomes

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ABSTRACT

Objective To investigate whether light drinking in pregnancy is associated with adverse child mental health and academic outcomes.

Design Using data from the prospective, population-based Avon Longitudinal Study of Parents and Children (ALSPAC), we investigated the associations between light drinking in pregnancy (<1 glass per week in the first trimester) and child mental health (using both parent and teacher rated Strengths and Difficulties Questionnaires (SDQs)) and academic outcomes based on Key Stage 2 examination results at age 11 years.

Participants 11-year-old children from ALSPAC with parent (n=6587) and teacher (n=6393) completed SDQs and data from Key Stage 2 examination results (n=10 558).

Results 39% of women had consumed <1 glass per week and 16% \geq 1 glass per week of alcohol during the first trimester (45% abstaining). After adjustment, relative to abstainers, there was no effect of light drinking on teacher-rated SDQ scores or examination results. In girls, although there was a suggestion of worse outcomes (adjusted regression coefficient=0.38; 95% CI 0.01 to 0.74) on the parent-rated total SDQ score in those exposed to light drinking compared to abstainers, no dose–response relationship was evident.

Conclusions Although the pattern of findings involving parent ratings for girls exposed to light drinking is consistent with earlier findings from this cohort, the overall lack of any adverse effects of light drinking is similar to findings from other recent cohort studies. Light drinking in pregnancy does not appear to be associated with clinically important adverse effects for mental health and academic outcomes at the age of 11 years.

Current guidance about alcohol consumption in pregnancy from the Department of Health in England (2009) is open to ambiguous interpretation as it allows for pregnant women to drink up to 1–2 units of alcohol once or twice a week.¹ In terms of the available research evidence, heavy or binge pattern alcohol consumption in pregnancy is known to be associated with childhood behavioural, learning and developmental problems.^{2–4} There is also considerable evidence that moderate drinking, involving an average of one drink per day during pregnancy, is associated with an increased risk of learning and mental health problems.^{5–7} However, it is less clear whether light or occasional drinking during pregnancy is associated with risk. Given this uncertainty, a precautionary stance advises against any drinking in pregnancy.⁸ However, international variation in government

What is already known on this topic

- ▶ High levels of alcohol consumption during pregnancy are a risk factor for childhood mental health and learning problems.
- ▶ There are contradictory findings on whether occasional or light drinking in pregnancy carries risk for later mental health or learning problems.
- ▶ Inconsistent findings from recent studies and their media reporting make it difficult to provide clear advice for women and health professionals about drinking in pregnancy.

What this study adds

- ▶ Light drinking in pregnancy does not appear to be associated with adverse mental health or academic consequences at the age of 11 years.
- ▶ Multiple assessment of long-term outcome following light drinking in pregnancy was carried out using measures from three different sources: parent, teacher and school examination results.

and professional body guidance on drinking in pregnancy means that considerable public and professional uncertainty remains as to whether it is safe to drink during pregnancy and, if so, whether there is a safe threshold.⁹

There are contradictory findings in the literature in relation to mental health and cognitive outcomes following exposure to light drinking in utero. Sood *et al* found that children exposed to three to four drinks per week in utero had worse behavioural outcomes at age 6–7 years.¹⁰ Using data from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort, occasional drinking in pregnancy (less than one drink per week during the first trimester) was associated with an increased risk of parent- and teacher-rated mental health problems up to the age of 8 years.¹¹ In contrast, reviews and a number of recent studies that have examined the effects of light drinking (less than one drink per day on average) have found no evidence of adverse effects.^{7 12–14} However, some contradictory findings emerged from analyses using data from the Western Australian Pregnancy Cohort.¹⁵ Occasional drinking at 34 weeks gestation (involving one or



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less drinks per week compared to abstaining) was associated with higher scores on measures of externalising behaviour and total mental health problems, assessed up until the age of 14 years. In contrast, using outcomes based on cut-offs, two to six drinks per week were associated with lower risk of internalising, externalising and total mental health problems. These findings suggest that it is not inevitable that a dose-response association can be demonstrated in epidemiological studies. Using data from the Millennium Cohort Survey, Kelly *et al* found a 'J-shaped' association between drinking in pregnancy and childhood mental health and cognitive outcomes at age 3 years, that is, worse outcomes were apparent in offspring of abstainers and heavy drinkers.¹⁶ In particular, relative to abstainers, the consumption of one to two drinks per week was associated with better mental health outcomes among boys. A follow-up of this sample at the age of 5 years also suggested a favourable outcome among boys following exposure to light drinking during pregnancy.¹⁷ The presence of some inconsistencies in these recent findings from large birth cohorts and associated reporting in the media can lead to difficulties in providing clear messages for women who are planning pregnancy or who are currently pregnant, as well as for professionals whom they might approach for advice on this issue.

Given these discrepancies, we aimed to investigate whether light drinking in pregnancy is associated with adverse consequences for child mental health and academic achievement as assessed according to three different sources (parent, teacher and examination results) at the age of 11 years.

METHODS

Sample

The ALSPAC is a prospective, population-based birth cohort.¹⁸ Further details are available at <http://www.alspac.bris.ac.uk>. All pregnant women in the Avon area (England) with an expected delivery date between April 1991 and December 1992 were invited to take part; the resulting cohort of 14 541 pregnancies was broadly representative of the local population of mothers with infants. Participating mothers were slightly more likely to be married or cohabiting, home owner-occupiers, and have a car in the household. Census data indicate that home ownership rates were slightly higher in Avon than in the whole of Great Britain but that the proportion of married couples was similar (<http://www.bristol.ac.uk/alspac/researchers/resources-available/cohort/represent/>). Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the local research ethics committees.

Measures

Exposure variables

Information on the mother's alcohol consumption during the first trimester was obtained by questionnaire completed at 18 weeks gestation. The mother was asked about her frequency of drinking alcoholic drinks; response categories were 'never', 'less than 1 glass per week', 'at least 1 glass per week', '1–2 glasses a day', '3–9 glasses a day' or 'more than 10 glasses a day'. Examples were given to specify that one glass was equivalent to one unit (8 g) of alcohol. For the analyses, the groups consuming ≥ 1 glasses per week were combined.

Outcome variables

Child mental health outcomes were assessed using both the parent and teacher completed Strengths and Difficulties Questionnaire (SDQ) at the age of 11 years.¹⁹ This widely used dimensional measure of childhood mental health has been

validated in a large, nationally representative, community sample.²⁰ The SDQ includes four sub-scales relating to emotional problems, conduct problems, hyperactivity/inattention, and peer relationships; higher scores (scale of 0–10) indicate greater levels of severity. These are summed to provide a total problems score (0–40). Our analyses focus on the two behavioural problem sub-scales (conduct problems and hyperactivity/inattention) as well as the total problems score (which takes both emotional and behavioural problems into account).

Academic outcomes were assessed using standardised, age-adjusted total scores from results on the Key Stage 2 (KS2) examinations taken during the final year at primary (elementary) school, at ages 10–11 years. These scores provide an objective real world measure of academic performance. In England, the national curriculum at KS2 relates to the school years 3–6, covering ages 7–11. Formal mandatory assessments involving examinations in English, Mathematics and Science take place at the end of this KS2 period. Further details are available at <http://curriculum.qcda.gov.uk/key-stages-1-and-2/index.aspx>.

Confounder variables

Potential confounding factors associated with alcohol consumption and child mental health and learning problems that were measured in ALSPAC were included in the analyses. Maternal and socio-demographic factors collected during pregnancy included: maternal age (≤ 20 , 21–34 or ≥ 35 years); parity (none or at least one); use of cannabis and other illicit drugs in the first trimester (both yes/no); highest level of maternal education (dichotomised to university degree or not); housing tenure (home ownership or not); and whether currently married. Maternal smoking was assessed using an ordinal scale of the number of times per day she smoked during the first trimester (response categories were 0, 1–4, 5–9, 10–14, 15–19, 20–24, 25–29 and 30+ times). Maternal mental health was measured at 18 weeks gestation using the well validated Edinburgh postnatal depression scale.²¹ High scores (> 12) are highly associated with a diagnosis of a depressive disorder.²² Child factors included gestational age (≤ 36 or ≥ 37 weeks), birth weight and gender.

Analysis

The main focus of the analyses is the relationship between alcohol consumption (exposure) in the first trimester and child mental health and learning outcomes at age 11. To minimise confounding and clustering effects, the sample for analysis was restricted to women of white-European ethnicity and children from singleton births alive at 1 year of age ($n=13\ 171$).²³ The following four-stage analysis plan was followed:

1. Using χ^2 tests, we investigated whether response status at age 11 years was associated with prenatal alcohol consumption (exposure) and other maternal and child factors. The associations between the exposure and maternal and child factors were then examined.
2. The univariable relationships between prenatal alcohol consumption (comparing, in turn, < 1 and ≥ 1 glasses per week against none (baseline)) and SDQ and KS2 scores were examined. We then adjusted for the maternal and child factors listed above to provide adjusted regression coefficients.
3. As our previous work has shown an association between prenatal alcohol exposure and higher levels of problems on the parent-rated SDQ in girls,¹¹ we tested for gender interaction within the unadjusted models and, for parent-rated SDQs, repeated the univariable and multivariable linear regression analyses by gender.

4. To address the possibility of the child's gestational age and birth weight being on the causal pathway between prenatal alcohol exposure and mental health and learning problems, the linear regression analyses were repeated after omitting these variables from the model.

RESULTS

Information about alcohol consumption was provided by 12 286 (93%) mothers in the sample (where full data were available, non-response was associated with younger age and lower level of education). In terms of the three exposure groups, analysis of alcohol use during the first trimester of pregnancy indicated that 45% (n=5547) of mothers had not consumed any alcohol, 39% (n=4776) less than one glass per week and 16% (n=1963) one or more glasses per week (including 2% (n=238) of the sample who reported daily drinking). An increasing intake of alcohol was related to higher maternal age, parity and level of education; use of cannabis and other illicit drugs; smoking; depression; and being unmarried (table 1). No association was found between alcohol intake and child characteristics in terms of gestational age at delivery, gender and birth weight.

At 11 years of age, parent-completed SDQs were available on 6587 (54%) children. Mothers who had consumed less than one glass per week were most likely to provide SDQs (57% vs 52% (both other exposure groups); $\chi^2=27.62$, $p<0.001$). Teacher SDQ response rates (52%; n=6393) showed no association with maternal alcohol consumption. Although KS2 scores were available on 10 558 (86%) children, their availability was slightly higher for children whose mothers had consumed less than one glass per week during pregnancy (87% vs 84–86%; $\chi^2=7.54$, $p=0.023$). Maternal correlates of non-response of parent-rated SDQs included lower age, higher parity, smoking,

use of cannabis and other illicit drugs, depression, being unmarried, rented tenure and lower level of education. Child correlates included male gender and lower gestational age and birth weight. Non-availability of teacher-completed SDQs and KS2 scores were associated with maternal use of cannabis, being unmarried, rented tenure and higher level of education. In addition, KS2 non-availability was also associated with maternal smoking and depression.

Relationships between prenatal alcohol exposure and outcomes

In relation to parent-completed SDQs, unadjusted analyses suggested that exposure to less than one glass a week, relative to abstainers, during the first trimester was associated with higher levels of hyperactivity/inattention and total problems in girls. After adjustment for confounders there was a suggestion of slightly worse outcomes (adjusted regression coefficient=0.38; 95% CI 0.01 to 0.74; $p=0.044$) on parent-rated SDQ scores in girls exposed to light drinking compared to the offspring of abstainers (table 2). However there was no evidence of any dose–response in individual domains or overall.

Univariable analysis showed no association between light drinking and teacher SDQ ratings (table 3). However, after adjustment, there was a suggestion of a weak association involving lower levels of teacher-rated total problems among the offspring of mothers who consumed one or more glasses per week during the first trimester compared to abstainers. Unadjusted analysis of KS2 outcomes showed a strong association with higher scores among the offspring of mothers who were light drinkers. This association attenuated considerably after adjusting for known confounders, including paternal highest level of education. Across all analyses, the overall patterns of associations persisted after excluding gestational age and birth weight from the multivariable model.

DISCUSSION

After adjustment for confounders, there was no effect of light drinking on teacher-rated SDQ scores or Key Stage 2 scores. In girls, there was a suggestion that there were slightly more problems on the parent-rated total SDQ score in those exposed to light drinking compared to abstainers. Although this finding is consistent with previous findings on this cohort up until the age of 8 years,¹¹ this effect is small and there is no dose–response relationship when comparing offspring of light drinkers with those of mothers who drink one or more units of alcohol per week. Given earlier findings from this cohort,¹¹ we were interested in whether possible adverse effects persist into later childhood and also whether prenatal exposure to light drinking has any impact on academic achievement. In the UK, this is an important age developmentally as it signifies a greater requirement for independence with the transition from primary (elementary) to secondary (senior) school. The overall lack of any adverse effects of light drinking is broadly similar to other studies.^{7 17} Unlike some findings from recent studies,^{14 16} we found no evidence of any protective effect following light drinking during pregnancy. However, there was a suggestion of a weak association between the consumption of more than one glass per week during the first trimester and lower levels of teacher-rated total problems. This finding is consistent with findings from one of three international birth cohorts utilised to investigate the relationship between prenatal alcohol exposure and childhood hyperactivity/inattention.²⁴ There was variation in the social patterning of drinking in pregnancy across the three countries and, in one cohort, there were lower teacher

Table 1 Relationship of maternal and child characteristics to alcohol consumption during the first trimester of pregnancy

	None, n=5547 %	<1 glass a week, n=4776 %	≥1 glass a week, n=1963 %	χ^2 (2 df)	p Value
Prenatal factors					
Maternal age (≥35 years)	8	11	15	67.20	<0.001
Any smoking	22	24	37	175.37	<0.001
Cannabis use	2	3	5	85.05	<0.001
Illicit drug use	0.3	0.4	1	17.56	<0.001
Parity (≥1)	53	59	55	35.24	<0.001
Highest maternal education (degree)	10	14	14	38.66	<0.001
Own home	73	77	72	24.95	<0.001
Currently married	78	79	70	73.29	<0.001
Current maternal depression	14	12	16	13.77	0.001
Child factors					
Gestational age (≤36 weeks)	6	5	5	5.36	0.069
Gender (male)	51	51	53	1.89	0.388
Birth weight (kg)*	3.42 (0.56)	3.43 (0.53)	3.41 (0.55)	–	0.315†

*Mean (SD).

†One-way ANOVA, $F=1.16$.

Table 2 Relationships between frequency of alcohol consumption during the first trimester of pregnancy and mean differences in parent-rated SDQ scores

	Unadjusted (95% CI)	p Value	Adjusted† (95% CI)	p Value	p for gender interaction*
Whole sample					
Conduct problems (0–10)					
<1/week	0.04 (–0.03 to 0.12)	0.256	0.06 (–0.02 to 0.14)	0.151	0.372
≥1/week	0.06 (–0.04 to 0.16)	0.252	0.04 (–0.07 to 0.15)	0.462	
Hyperactivity/inattention (0–10)					
<1/week	0.13 (0.01 to 0.25)	0.028	0.11 (–0.01 to 0.23)	0.066	0.704
≥1/week	0.15 (–0.01 to 0.31)	0.062	0.11 (–0.06 to 0.28)	0.191	
Total problems (0–40)					
<1/week	0.11 (–0.15 to 0.38)	0.391	0.13 (–0.14 to 0.40)	0.347	0.096
≥1/week	0.18 (–0.17 to 0.54)	0.314	0.04 (–0.33 to 0.42)	0.825	
Boys					
Conduct problems (0–10)					
<1/week	0.00 (–0.12 to 0.11)	0.963	0.02 (–0.10 to 0.13)	0.787	0.786
≥1/week	0.00 (–0.15 to 0.15)	0.985	0.02 (–0.14 to 0.18)	0.786	
Hyperactivity/inattention (0–10)					
<1/week	0.08 (–0.09 to 0.26)	0.339	0.09 (–0.09 to 0.27)	0.331	0.262
≥1/week	0.14 (–0.09 to 0.37)	0.238	0.14 (–0.11 to 0.39)	0.262	
Total problems (0–40)					
<1/week	–0.17 (–0.56 to 0.21)	0.378	–0.11 (–0.51 to 0.29)	0.588	0.840
≥1/week	–0.04 (–0.56 to 0.47)	0.871	–0.06 (–0.60 to 0.49)	0.840	
Girls					
Conduct problems (0–10)					
<1/week	0.09 (–0.01 to 0.19)	0.081	0.10 (0.00 to 0.21)	0.049	0.412
≥1/week	0.12 (–0.02 to 0.25)	0.096	0.06 (–0.09 to 0.21)	0.412	
Hyperactivity/inattention (0–10)					
<1/week	0.17 (0.02 to 0.32)	0.029	0.14 (–0.02 to 0.30)	0.089	0.520
≥1/week	0.11 (–0.10 to 0.32)	0.289	0.07 (–0.15 to 0.30)	0.520	
Total problems (0–40)					
<1/week	0.39 (0.05 to 0.74)	0.027	0.38 (0.01 to 0.74)	0.044	0.623
≥1/week	0.36 (–0.12 to 0.84)	0.144	0.13 (–0.39 to 0.65)	0.623	

Reference group—no drinking in 1st trimester.

*In unadjusted model.

†Adjusted for: maternal age, parity, highest level of maternal education, daily frequency of smoking, use of cannabis and/or other illicit drugs during the first trimester, home ownership, whether currently married, high scores (>12) on the Edinburgh Postnatal Depression Scale, and child gestational age, birth weight and gender.

SDQ, Strengths and Difficulties Questionnaire.

Table 3 Relationships between frequency of alcohol consumption during the first trimester of pregnancy and mean differences in teacher-rated SDQ and KS2 scores

	Unadjusted (95% CI)	p Value	Adjusted* (95% CI)	p Value
Teacher SDQs				
Conduct problems (0–10)				
<1/week	–0.01 (–0.10 to 0.08)	0.807	0.00 (–0.09 to 0.08)	0.960
≥1/week	0.04 (–0.08 to 0.15)	0.528	–0.05 (–0.17 to 0.07)	0.388
Hyperactivity/inattention (0–10)				
<1/week	–0.09 (–0.23 to 0.06)	0.236	–0.02 (–0.16 to 0.12)	0.750
≥1/week	0.00 (–0.19 to 0.19)	0.972	–0.10 (–0.29 to 0.10)	0.339
Total problems (0–40)				
<1/week	–0.22 (–0.53 to 0.09)	0.167	–0.06 (–0.37 to 0.26)	0.731
≥1/week	–0.07 (–0.49 to 0.35)	0.215	–0.45 (–0.89 to –0.01)	0.043
Key Stage 2				
<1/week	0.90 (0.50 to 1.29)	<0.001	0.38 (–0.02 to 0.78)	0.065
≥1/week	0.60 (0.07 to 1.13)	0.026	0.45 (–0.11 to 1.01)	0.117

*Adjusted for: maternal age, parity, highest level of maternal education, daily frequency of smoking, use of cannabis and/or other illicit drugs during the first trimester, home ownership, whether currently married, high scores (>12) on the Edinburgh Postnatal Depression Scale, and child gestational age, birth weight and gender.

†After additionally adjusting for highest level of paternal education.

SDQ, Strengths and Difficulties Questionnaire.

ratings of hyperactivity/inattention problems in those exposed to one to four drinks per week during pregnancy compared to abstainers.²⁴

Strengths and limitations

The strength of the ALSPAC dataset includes the large sample size with consequential small CIs suggesting a high level of certainty of our findings. The prospective nature of the data collection reduces the likelihood of recall bias and of systematic differential misclassification. However the lack of associations in this analysis might be due to the large sample attrition and associated selection bias in the long-term collection of outcome measures, and in the choice of the actual outcome measures. The comparison of characteristics between responders and non-responders shows the potential for selection bias which might have occurred due to this being a complete case analysis. Despite this possibility, previous analyses involving behavioural data from the ALSPAC cohort suggest that sample attrition and selection bias do not affect the strength of prediction involving these outcomes.²⁵ As with all epidemiological studies, it is difficult to adequately capture all the dimensions of socioeconomic position in a few measures. Therefore we cannot rule out the effects of residual confounding by socioeconomic position and this may account for the absence of an effect in the final model. To investigate this further we are also using the strategy of Mendelian randomisation to estimate unconfounded estimates of effect.²³

Implications

Given the lack of clarity from Department of Health guidance and conflicting findings from recent studies, there is a need to provide a clear message to pregnant women about drinking during pregnancy. Our findings suggest that, if pregnant women choose to drink, occasional light drinking (less than one glass per week) does not appear to be associated with adverse mental health or academic consequences at the age of 11 years. In terms of policy implications, it remains unclear whether guidance suggesting that light drinking during pregnancy may be safe has an impact on heavier drinking. Furthermore, as no dose-response association was demonstrable, these findings do not provide empirical evidence of a safe threshold for drinking during pregnancy.

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