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Prevalence of fetal alcohol spectrum disorder and its relationship with levels and patterns of alcohol consumption: a scoping review

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ABSTRACT

Objective To explore prevalence estimates of fetal alcohol spectrum disorder (FASD) in high-income countries and the relationships between levels and patterns of alcohol consumption during pregnancy and FASD.

Methods Two scoping reviews of observational studies. We searched Medline, EMBASE, Maternity and Infant Care, and the Incidence and Prevalence Database until June 2024. Two reviewers screened studies independently using predefined criteria to address our two questions and extracted data on study design, diagnostic criteria, methods of collecting drinking history and details about levels and drinking patterns.

Results We identified 41 relevant studies. Most were conducted in the Americas region (n=15) and had a cross-sectional design (n=26). The US Institute for Medicine diagnostic criteria were most frequently used for case ascertainment (n=22). Prevalence ranged from 5.8 (95% CI 4.6 to 7.1) to 170 000 (95% CI 161 000 to 178 000) per 1 000 000 general population. Estimates of associations between drinking levels/patterns and having a child diagnosed with FASD varied substantially. The lowest OR (95% CI) was 1.8 (0.3 to 12.2) for women who drank 1–1.9 drinks per drinking day compared with no alcohol and the highest was 61 (18.9 to 195.5) for women who drank any amount of alcohol during pregnancy compared with women who did not drink at all.

Conclusions FASD prevalence estimates in high-income countries and the risk of different levels and drinking patterns varied widely due to the use of different diagnostic criteria, sampling and alcohol consumption collection methods. Improving alcohol consumption collection methods will help enhance diagnostic certainty and the identification of at-risk groups.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The global prevalence of fetal alcohol spectrum disorder (FASD) in the general population is estimated to be 7.7 per 1000 people, with the European Region having the highest prevalence.
⇒ Although FASD is linked to alcohol during pregnancy, relationships between the level and patterns of drinking during pregnancy and FASD remain unclear.

WHAT THIS STUDY ADDS

⇒ We identified wide variation in study design, sampling methods, diagnostic criteria for case ascertainment and drinking history collection methods, all of which affect the precision and accuracy of the prevalence and risk estimates.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Future research and practice should focus on improving alcohol consumption collection methods because these are key for an FASD diagnosis and establishing whether there is a level of alcohol consumption during pregnancy under which the risk of FASD is almost zero.

INTRODUCTION

The WHO[1] recommends that pregnant women should not drink any alcohol to minimise risks to their baby. The guidelines highlight potentially negative lifelong impacts of alcohol on a developing fetus, known under the term of 'fetal alcohol spectrum disorder' (FASD). FASD presents as a very heterogeneous combination of physical, mental and behavioural problems, including learning difficulties, being the main feature neurodevelopmental impairments.[2] This results in individuals with FASD needing more healthcare and educational support and may lead to disproportionately appearing in the criminal justice system.[2] The severity and nature of FASD are associated with the frequency, quantity and timing of alcohol consumption, but as research on the effects of low levels of drinking in pregnancy is difficult to interpret, national guidance takes a 'precautionary' approach that advocates total abstinence.[3]

The UK has high rates of alcohol consumption, binge drinking and prenatal alcohol exposure. In 2023, the Organisation for Economic Co-operation and Development (OECD) reported that UK women were the biggest binge drinkers among all member states, with 26% of adult women drinking at least six drinks in a single session at least once a month.[4] A 2015 study suggested that three-quarters of women in the UK consumed some alcohol during pregnancy, with a third reporting binge drinking at least once.[5] The scale and impact of FASD in the UK are believed to be 'grossly under-recognised',[6] and this has prompted discussion about whether and

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how to undertake a new study to estimate the UK prevalence of FASD.

To inform this discussion, we were commissioned by UK policymakers to conduct two scoping reviews of research: estimating the prevalence of FASD in high-income countries (review 1) and exploring the relationship between levels and patterns of alcohol consumption during pregnancy and FASD (review 2).

METHODS

Our two scoping reviews follow the principles of the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) statement.[7]

Search strategy, selection of studies and data extraction

We conducted a search in December 2022 and updated it in June 2024, using Medline (1946 onwards), EMBASE (1974 onwards), Maternity and Infant Care (1971 onwards), and the Incidence and Prevalence Database (IPD). Maternity and infant care is a database compiled by the Midwives Information and Resource Service and provided through OvidSP. The Incidence and Prevalence Database provides epidemiological data for over 4500 diseases and is accessible through subscription only via Clarivate.

The search had three facets: the outcome (fetal alcohol spectrum disorder), the exposure (drinking during pregnancy) and the aim of the study (aetiology or epidemiology of FASD). We reviewed the reference lists of reviews identified in our search for potentially eligible studies. The search strategies used are available in the online supplemental material.

We retrieved all records and entered them into an EndNote library for removing duplicates, and then imported them into Covidence for screening. We took a two-stage approach to screening. At the first stage, we reviewed titles and abstracts against predefined criteria, and labelled records as to whether they would answer the question for review 1 or review 2. The full selection criteria are provided in table 1. In summary, for review 1 we included observational studies in high-income countries that had sampled the general population to determine the prevalence of FASD using any diagnostic criteria available (see online supplemental table S1 for reference). For review 2, we included observational studies that sampled participants from the general population, had assessed maternal alcohol consumption during pregnancy and their offspring had been assessed for FASD. At the second stage, we screened the full text of all potentially eligible studies. In both stages we used two independent reviewers with differences arbitrated by a third reviewer.

For review 1, we extracted information on the country where the study was conducted, sample size, years of recruitment, diagnostic guidelines, methods of sampling, case ascertainment (ie, active, passive surveillance), collection of maternal drinking history and whether assessors were blinded to maternal drinking history. For review 2, we additionally extracted details on level and patterns of drinking during pregnancy. Two independent reviewers conducted all data extraction. Quality assessment of the included studies was not conducted as the focus of this review was to scope the current literature.

We summarise, for illustrative purposes, the FASD prevalence estimates of the included studies (including subgroups such as pFAS, ARND and ARBD when available) using all children initially screened as the denominator. This is because some studies implemented a tiered approach to screening, reporting only the prevalence for those children who consented to participate, and assuming those who did not consent had a prevalence of zero cases.

RESULTS

We identified 4014 unique records (3759 unique records from the first search plus 255 unique records from the updated search) that were screened at the title and abstract stage, reviewing 203 full-text papers and including 41 eligible articles. Of these, 20 reported prevalence estimates and 21 reported associations between drinking levels and patterns and FASD (figure 1).

Table 1 Inclusion and exclusion criteria

	Inclusion	Exclusion
Review 1: Synthesising prevalence studies		
Population	General population	Specific subgroups of populations, such as people who have been convicted or children in alternative care
Outcomes	Diagnosis of FASD, or disaggregated as FAS, pFAS, ARND and ARBD where the diagnostic guideline or case definition used to ascertain cases is specified	No prevalence data, reports on the prevalence of traits or conditions related to FASD (eg, the prevalence of externalisation behavioural problems without reaching a diagnosis of FASD)
Study designs	Observational studies reporting the prevalence and a measure of uncertainty or the necessary information to calculate uncertainty (such as sample size or the number of cases)	Case reports, case series, editorials, letters and pre-print reports
Setting	High-income countries	Low- and middle-income countries
Review 2: Synthesising studies of the association between levels and patterns of consumption and FASD		
Population	Pregnant women sampled from the general population	Subgroups of high-risk pregnant women such as those with drug addiction
Exposure	Levels of alcohol consumption and patterns of drinking during pregnancy, including (but not limited to) binge drinking, daily drinking or occasional drinking	Patterns or levels of alcohol consumption before pregnancy
Outcomes	Offspring with a diagnosis of FASD, FAS, pFAS and/or ARBD	Measures of detrimental effects of alcohol exposure without a diagnosis of FASD. Studies only reporting cases of FAS.
Study designs	Original research. Observational studies	Case reports, case series, editorials, letters and pre-print reports.
Setting	Any country	No exclusion
Both reviews		
Limits	Published after 2000. English language.	Animal or laboratory studies.

ARBD, alcohol-related birth defects; ARND, alcohol-related neurodevelopmental disorder; FAS, fetal alcohol syndrome; FASD, Fetal Alcohol Spectrum Disorder; pFAS, partial fetal alcohol syndrome.

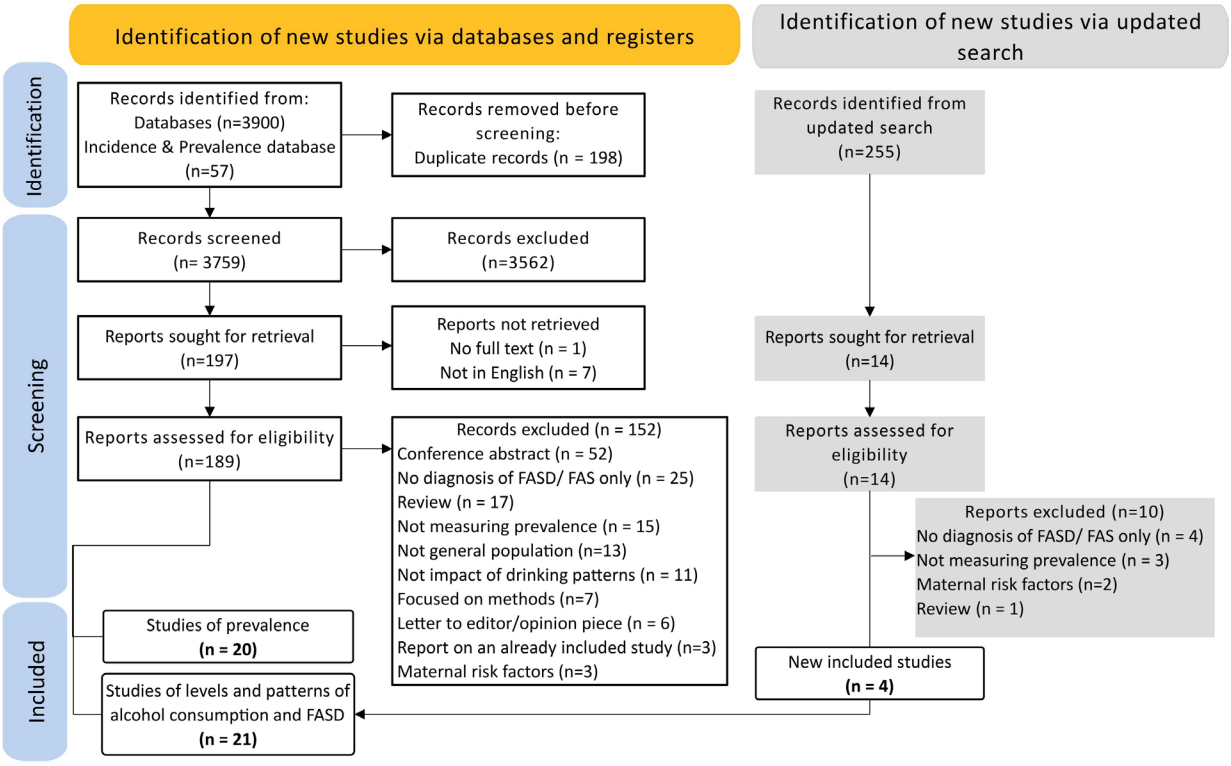

Figure 1 PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) flow diagram. FAS, fetal alcohol syndrome; FASD, fetal alcohol spectrum disorder.

Study characteristics and findings

Review 1: prevalence studies

Most of the 20 included studies were conducted in the Americas region (n=9),[8–16] followed by the European region (n=8)[17–24] and the Western Pacific region (n=3).[25–27] Most studies (n=11)[10–16 19 20 22 24] used a cross-sectional design, five[17 18 21 26 27] were retrospective registry-based, two used passive surveillance,[8 9] while one used active surveillance.[25] Only one study was based on a prospective cohort.[23]

Online supplemental table S2 reports the characteristics of the included prevalence studies. Methods of sampling, collecting data on drinking during pregnancy and diagnostic guidelines used in the included studies are reported in the online supplemental tables S3 and S4. The US Institute for Medicine diagnostic criteria (editions 1996,[28] 2005[29] and 2016[30]) were most commonly used (n=7).[12–15 19 20 25] This was followed by the most recent 2016 FASD Canadian guidelines [31](n=4)[10 22–24] and the 4-digit diagnostic code [32](n=2).[16 26] The remaining studies each used a different diagnostic guideline (n=7).[8 9 11 17 18 21 27]

Twelve studies[9–16 19 20 22 24] assessed children between the ages of 4 and 9 years old, five studies[8 23 25–27] included a wider range of ages from newborns to 17 years old, two studies[17 18] included only children under 1 year old and one did not report the age of children included.[21]

Five studies[8 9 17 18 25] included national samples, 10 studies included regional samples,[12–16 19 20 22 26 27] four city-wide samples,[10 21 23 24] while one study specified the country but not at what level sampling had been conducted.[11]

Considering the variation in study design, diagnostic criteria used, age of children assessed and methods used to collect drinking history, prevalence figures ranged from 5.8 (95% CI 4.6 to 7.1)[25] to 170 000 (95% CI 161 000 to 178 000)[23] per 1 000 000 population (figure 2).

Review 2: studies of associations between levels and patterns of drinking during pregnancy and FASD

Most of the studies identified were conducted in the African region (n=10),[33–42] followed by the Americas (n=5)[43–47] and Europe (n=4).[48–51] One study was conducted in the Western Pacific region (Australia),[52] and one compared samples from South Africa and the USA.[53]

The characteristics of the included studies are reported in online supplemental table S4, while details of sampling methods and diagnostic criteria used are in online supplemental table S5. Most studies (n=15)[33–41 44 46–48 51 53] used a cross-sectional design, while three[45 50 52] were registry-based and another three[42 43 49] were prospective cohorts.

Similar to prevalence estimates, editions of the US Institute for Medicine diagnostic criteria were the most commonly used (n=15).[33–42 44 46 51–53] Each of six studies[43 45 47–50] used a different diagnostic guideline (see online supplemental table S1).

Methods of measuring alcohol exposure are summarised in table 2. Most studies (n=13)[33–40 42 44 45 51 53] reported whether the participant drank at any point during pregnancy followed by measures of quantity expressed as either drinks per drinking day (n=9)[35–41 44 53] or average number of drinks per week (n=4).[33 35 36 49] Others reported drinking frequency, for example, the number of drinking days per week (n=6). Generally, drinking patterns were described using a combination of quantity and frequency measures (see online supplemental tables S6 and S7).

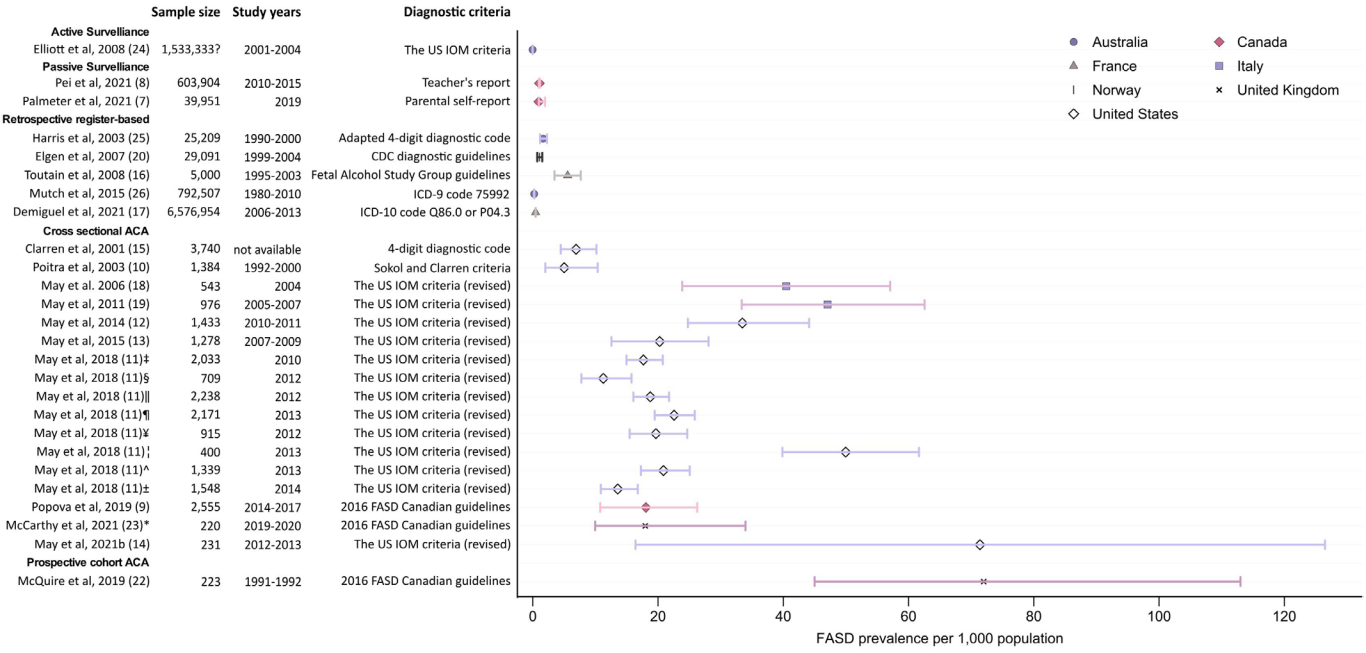

Figure 2 Prevalence of fetal alcohol spectrum disorder (FASD) estimates reported by the included studies. ACA, active case ascertainment; CDC, Centers for Diseases Control and Prevention; IOM, Institute of Medicine. *Analysis of confirmed FASD cases. ‡Analysis of sample 1 from Midwestern region. §Analysis of sample 2 from Midwestern region. ‖Analysis of sample 1 from Pacific Southwestern region. ¶Analysis of sample 2 from Pacific Southwestern region. ¥Analysis of sample 1 from Rocky Mountains region. ¦Analysis of sample 2 from Rocky Mountains region. ^Analysis of sample 1 from Southeastern region. ±Analysis of sample 2 from Southeastern region.

There was substantial variation in estimates of the association of having a child diagnosed with FASD and drinking levels and pattern (figure 3). The lowest OR (95% CI) reported was 1.8 (0.3 to 12.2) for women who drank 1–1.9 drinks per drinking day compared with never drinking,[38] and the highest was 61 (18.9 to 195.5) for women who drank any amount of alcohol during pregnancy compared with none.[33] Five studies[38–40 44 53] reported increased odds of having a child with FASD when alcohol consumption during pregnancy was two or more drinks per drinking day. Additionally, three studies[35–37] found increased odds of having a child with FASD when alcohol consumption was three or more drinks per occasion.

Table 2 Number of studies per type of drinking behaviour measure

	Total no. of studies reporting measure	No. of studies reporting measure by trimester
Did you drink any alcohol?		
Yes/no	13	11
Quantity		
Average number of drinks per week	4	0
Average number of drinks per day	1	0
Average number of drinks before or after pregnancy recognition	2	0
Units per week or grams per day	2	0
Drinks per drinking day	9	6
Frequency		
Drinking days per week	6	4
Drinking days (categorised daily, per month)	2	2
Binge drinking		
Yes/no	6	4
Number of binge episodes	1	0
Other risk classification	4	1

FASD, fetal alcohol spectrum disorder.

DISCUSSION

Prevalence

Our first review found a wide range of estimates of FASD prevalence in the general population of high-income countries, notably affected by study methodology. Large sample studies based on surveillance (passive or active) or analysis of birth registries (which assessed children aged <1 year) estimated FASD prevalence to be less than 1 per 1000 children. These low estimates may reflect substantial under-reporting. Birth registry and cohort studies benefit from prospective data collection across a wide range of indicators of health and well-being, but the diverse range of symptoms of FASD requires detailed assessment and specialist interpretation, which would be unfeasible in a large-scale study of a country's general population. Active case ascertainment studies of smaller samples of school-aged children enable detailed assessment, with specialists looking specifically for FASD markers, and thus generally estimated a much higher prevalence, although prevalence estimates still varied from 6 per 1000 to 80 per 1000 population.

The method of collection of maternal drinking history and data imputation explain some of this variation. Only one active case ascertainment study collected drinking history prospectively and assessed children between the ages of 0 and 15 years old, finding a prevalence estimate of 72 cases per 1000 children.[23] In contrast, studies that collected maternal drinking history retrospectively reported prevalence estimates between 5.05[11] and 50 cases[12] per 1000 children. Imputation methods also affect estimates, for example, assuming zero cases of FASD among participants who did not consent yielded much lower prevalence estimates than assuming an average probability of FASD in the non-consenting population.[10 13 14 19 20]

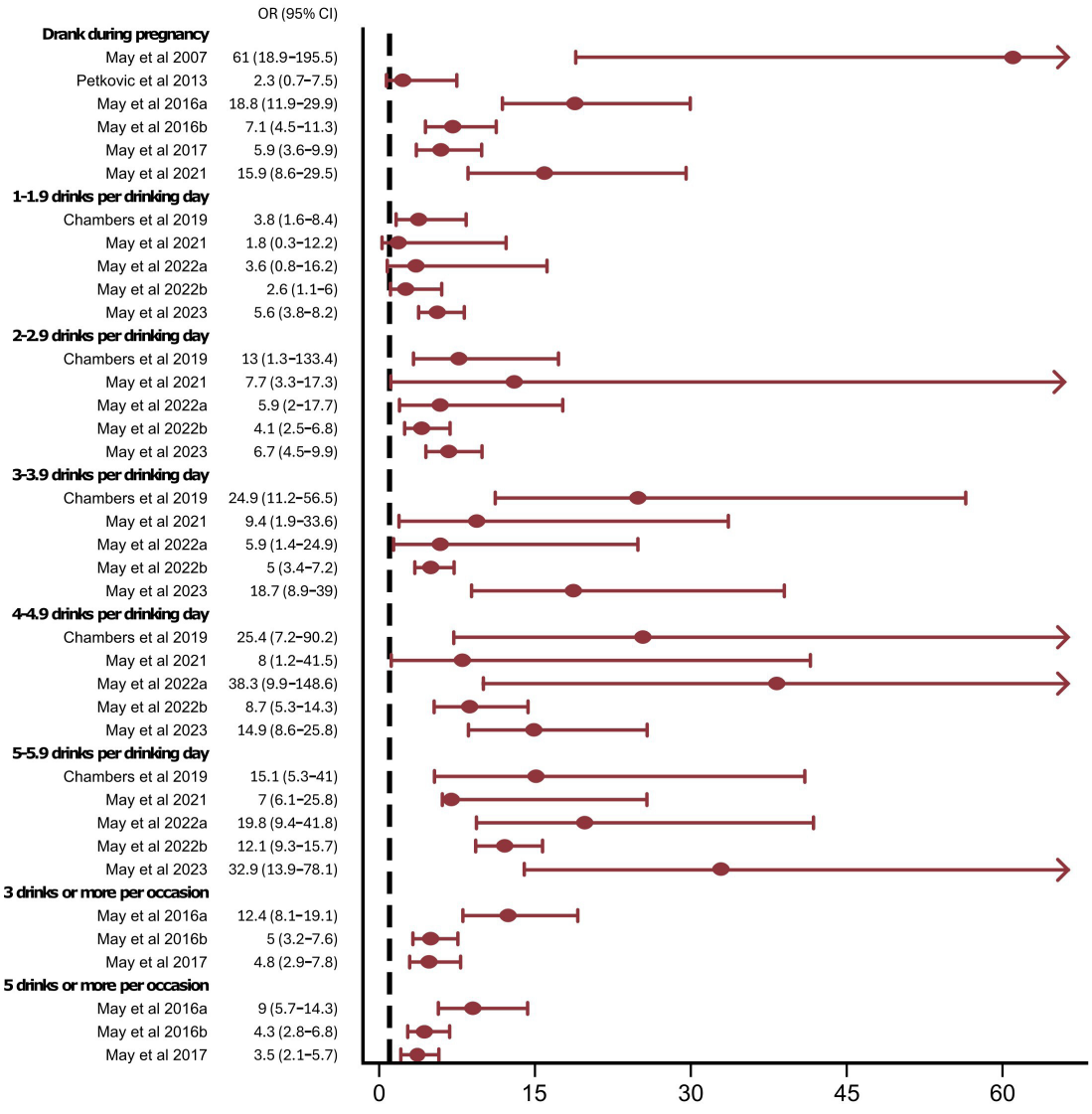

Figure 3 OR (95% CI) of fetal alcohol spectrum disorder by level and pattern of drinking.

Estimates also vary by the populations being sampled and sampling methods. A clear example of their impact on prevalence estimates is provided by two studies that were excluded from this review because they included high-risk populations. For instance, the FASD prevalence estimate of children in foster care is reported to be 188 (95% CI 123 to 281) per 1000 people[54]; and among children and young people in alternative child care settings, it is reported as 169 (95% CI 109 to 238) per 1000 people.[55] In comparison, the estimate for the general population is 7.7 (95% CI 4.9 to 11.7) per 1000 people.[56] Although this estimate has multiple limitations, such as combining prevalence estimates derived from rates of alcohol consumption in pregnancy and prevalence estimates derived from active case ascertainment studies, if we take this number as a good approximation to the prevalence of FASD in the general population, the estimates in foster care and alternative child care settings are at least 20 times higher. In the case of the first review, most studies sampled children from mainstream schools without mentioning whether attempts were made to recruit children from settings with a higher risk of FASD such as those in alternative child-care settings or those attending schools for children with special needs. This implies that many of the prevalence estimates reported in this review may be underestimates, and future prevalence studies should make every effort to include populations with different risks of FASD. The neurodevelopmental impairments that are characteristic of FASD are more evident as children age, and therefore, the age of children sampled also has an impact on estimates. Considering that this review included prevalence studies of children of any age, the prevalence estimates here presented are at best minimum estimates.

For this prevalence review, we included any study measuring prevalence of FASD as a diagnosis or as an umbrella term, as long as the diagnostic guideline or the case definition used to identify cases was specified. As a consequence, we identified six different sets of FASD diagnostic criteria (see online supplemental table S1), which makes comparing and interpreting estimates of prevalence of FASD difficult. Coles *et al* compared five methods for diagnosing FASD in a sample of 1581 individuals attending a clinic for alcohol and drug exposed children.[57] The prevalence of FASD in this sample ranged from 4.7% when using the CDC criteria[58] to 59.6% when using the revised IOM criteria.[29] Additionally, Coles *et al* found a fair agreement (Cohen's kappa: 0.37) between the two most used diagnostic criteria (ie, revised IOM criteria[30] and the Canadian FASD guidelines).[31] In a later study, Coles *et al* compared the most recent versions of these two clinical guidelines,[30 31] finding 'slight agreement' based on a Fleiss Multi-rater Kappa of 0.12.[59] In light of this,

future studies should focus on using or developing a standardised diagnostic guideline that could in future be used worldwide.

Association between levels and patterns of drinking during pregnancy and FASD

Our second review found a wide range of risk estimates for levels and patterns of drinking during pregnancy and an FASD diagnosis. Again, this was related to the substantial variation in the methods used in the studies. Only three studies collected maternal drinking history prospectively[42 43 49]; and they were all conducted in different countries and measured drinking patterns differently. Among the remaining studies, exposure to alcohol was measured as the quantity of alcohol consumed (eg, grams/'units'/drinks), frequency (daily/weekly/monthly/binge), and timing during the pregnancy. In three studies,[47 48 52] a risk category was used.

Although alcohol consumption during pregnancy is key for a diagnosis of FASD, all the studies relied on self-report of drinking, which is affected by guilt, social desirability and memory bias. The most reported measure was collected retrospectively as a 'yes or no' answer to the question 'did you drink during pregnancy'. Not only does this question not inform the relationship between levels and patterns of drinking and FASD, but it could be interpreted very differently between individuals.

The variation in measures of alcohol exposure makes it difficult to estimate a threshold below which there is no risk of FASD. This is in line with the findings of a previous review in 2018.[60] However, as figure 3 shows, five studies found that the odds of having a child with FASD were statistically significantly higher in women who drank two or more drinks per drinking day; however, this is not associated with a measure of frequency or timing, and therefore, it is not possible to make an evidence-based recommendation.

Although there is uncertainty about a threshold of prenatal alcohol consumption above which the offspring is more likely to be diagnosed with FASD, it is plausible that higher alcohol consumption during pregnancy may be associated with more severe cognitive and behavioural impairments. Evidence from a systematic review of 23 quasi-experimental studies found that prenatal alcohol exposure had a likely causal detrimental effect on cognitive outcomes.[61] Jacobson *et al*, pooling data from six longitudinal cohort studies including 2236 pregnant women and their offspring,[62] found evidence of an inverse relationship between alcohol consumption and cognitive function, executive function and IQ. Levels of alcohol consumption were also positively associated with behavioural problems.[62] The effect of alcohol consumption was smaller in middle-class participants, however, indicating that there are other mediating factors in this relationship such as maternal nutrition, drinking patterns and the postnatal environment.

More recent studies have shown inconsistent evidence on the relationship between low-to-moderate prenatal alcohol exposure (ie, most common definition is less than seven units per week, but countries define units in different ways[63]) and neurodevelopmental outcomes,[63–65] which can be at least partially attributed to methodological differences in how exposure and outcomes are measured. This highlights the need for consensus on the best method to collect an accurate alcohol drinking history[66] and standardised diagnostic criteria for FASD ascertainment.

Strengths and limitations

Our article focuses on informing the debate around how FASD prevalence is measured and the association between drinking levels and patterns and risk of FASD. Considering the comprehensive search we conducted, we are confident that we have not missed eligible studies. However, because of the study design, it is not possible to provide pooled estimates for prevalence or risk of FASD for different levels and drinking patterns. Additionally, the quality of included studies was not assessed, and therefore, should be interpreted with caution. One limitation of our study was that the definition of FASD cases was based on what the included studies reported, and in consequence, case definition was variable across studies.

Implications for practice, research and policy

The question as to whether there is a 'safe' limit for alcohol consumption during pregnancy remains unanswered. Therefore, focus should be placed on helping women who are finding limiting their alcohol consumption difficult, equipping healthcare professionals to have an informed discussion about alcohol consumption as early as possible during the pregnancy and reinforcing the message of alcohol risks.[67–69] Research exploring what pregnant women ask about alcohol drinking in social media shows areas where advice could be focused: the risk of drinking before pregnancy recognition, the tension between the public health message of complete abstinence and their real-life experience of 'a pregnant friend who drank throughout and their child is fine', how to deal with social situations where drinking alcohol is expected (eg, weddings, celebrations, Christmas), and the uncertainty about consuming alcohol by mistake in food or low-alcohol content drinks.[70]

This paper focuses on ways to describe the size of the problem and the risk associations. Future research could also focus on the development and refinement of effective, cost-effective and acceptable interventions to reduce alcohol consumption during pregnancy. Popova *et al* conducted a systematic review and meta-analysis, finding a moderate effect of brief interventions on achieving/maintaining abstinence at any point (OR 1.56; 95% CI 1.15 to 2.13), but no statistical difference in AUDIT scores or drinks per week.[71]

Our paper, while failing to provide a precise estimate of FASD or a clearly defined relationship between level and patterns of drinking and FASD, nevertheless reveals the substantial scale of this problem. Although there may be value in improving the precision of the estimates, for example using statistical modelling to account for the effect of different methodological choices, investment in researching effective ways of helping pregnant women to reduce or abstain from drinking is likely to yield better health and societal benefits.

Contributors KB, HE, KP and TAS conceptualised and designed the study. SG designed and conducted the searches. HE, SG, LJ, VMD and ACC-A conducted the screening. VD and ACC-A extracted data and carried out the initial analyses. ACC-A drafted the initial manuscript. All authors critically reviewed initial drafts, approved the final manuscript and agreed to be accountable for all aspects of the work. ACC-A is responsible for the overall content as guarantor.

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REFERENCES

1 World Health Organization. Global alchohol action plan 2022-2030. 2024.
2 Streissguth AP, O'Malley K. Neuropsychiatric implications and long-term consequences of fetal alcohol spectrum disorders. *Semin Clin Neuropsychiatry* 2000;5:177–90.
3 Department of Health. UK chief medical officers' low risk drinking guidelines. 2016.
4 OECD. Alcohol consumption. Health at a glance 2023. Available: https://www.oecd.org/health/health-at-a-glance/ [Accessed 04 Apr 2024].
5 O'Keeffe LM, Kearney PM, McCarthy FP, *et al*. Prevalence and predictors of alcohol use during pregnancy: findings from international multicentre cohort studies. *BMJ Open* 2015;5:e006323.
6 Schölin L, Mukherjee RAS, Aiton N, *et al*. Fetal alcohol spectrum disorders: an overview of current evidence and activities in the UK. *Arch Dis Child* 2021;106:636–40.
7 Tricco AC, Lillie E, Zarin W, *et al*. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med* 2018;169:467–73.
8 Palmeter S, Probert A, Lagacé C. FASD prevalence among children and youth: results from the 2019 Canadian Health Survey on Children and Youth. *Health Promot Chronic Dis Prev Can* 2021;41:272–6.
9 Pei J, Reid-Westoby C, Siddiqua A, *et al*. Teacher-Reported Prevalence of FASD in Kindergarten in Canada: Association with Child Development and Problems at Home. *J Autism Dev Disord* 2021;51:433–43.
10 Popova S, Lange S, Poznyak V, *et al*. Population-based prevalence of fetal alcohol spectrum disorder in Canada. *BMC Public Health* 2019;19:845.
11 Poitra BA, Marion S, Dionne M, *et al*. A school-based screening program for fetal alcohol syndrome. *Neurotoxicol Teratol* 2003;25:725–9.
12 May PA, Chambers CD, Kalberg WO, *et al*. Prevalence of Fetal Alcohol Spectrum Disorders in 4 US Communities. *JAMA* 2018;319:474–82.
13 May PA, Baete A, Russo J, *et al*. Prevalence and characteristics of fetal alcohol spectrum disorders. *Pediatrics* 2014;134:855–66.
14 May PA, Keaster C, Bozeman R, *et al*. Prevalence and characteristics of fetal alcohol syndrome and partial fetal alcohol syndrome in a Rocky Mountain Region City. *Drug Alcohol Depend* 2015;155:118–27.
15 May PA, Hasken JM, Hooper SR, *et al*. Estimating the community prevalence, child traits, and maternal risk factors of fetal alcohol spectrum disorders (FASD) from a random sample of school children. *Drug Alcohol Depend* 2021;227:108918.
16 Sanderson M, Fineman RM. Screening for fetal alcohol syndrome in primary schools: a feasibility study. *Teratology* 2001;3–10.
17 Toutain S, Lejeune C. Family Management of Infants with Fetal Alcohol Syndrome or Fetal Alcohol Spectrum Disorders. *J Dev Phys Disabil* 2008;20:425–36.
18 Demiguel V, Laporal S, Quatremere G, *et al*. The frequency of severe Fetal Alcohol Spectrum Disorders in the neonatal period using data from the French hospital discharge database between 2006 and 2013. *Drug Alcohol Depend* 2021;225:108748.
19 May PA, Fiorentino D, Phillip Gossage J, *et al*. Epidemiology of FASD in a Province in Italy: Prevalence and Characteristics of Children in a Random Sample of Schools. *Alcohol Clin Exp Res* 2006;30:1562–75.
20 May PA, Fiorentino D, Coriale G, *et al*. Prevalence of children with severe fetal alcohol spectrum disorders in communities near Rome, Italy: new estimated rates are higher than previous estimates. *Int J Environ Res Public Health* 2011;8:2331–51.
21 Elgen I, Bruaroy S, Laegreid LM. Lack of recognition and complexity of foetal alcohol neuroimpairments. *Acta Paediatr* 2007;96:237–41.
22 Okulicz-Kozaryn K, Borkowska M, Brzózka K. FASD Prevalence among Schoolchildren in Poland. *J Appl Res Intellect Disabil* 2017;30:61–70.
23 McQuire C, Mukherjee R, Hurt L, *et al*. Screening prevalence of fetal alcohol spectrum disorders in a region of the United Kingdom: A population-based birth-cohort study. *Prev Med* 2019;118:344–51.
24 McCarthy R, Mukherjee RAS, Fleming KM, *et al*. Prevalence of fetal alcohol spectrum disorder in Greater Manchester, UK: An active case ascertainment study. *Alcohol Clin Exp Res* 2021;45:2271–81.
25 Elliott EJ, Payne J, Morris A, *et al*. Fetal alcohol syndrome: a prospective national surveillance study. *Arch Dis Child* 2008;93:732–7.
26 Harris KR, Bucens IK. Prevalence of fetal alcohol syndrome in the Top End of the Northern Territory. *J Paediatr Child Health* 2003;39:528–33.
27 Mutch RC, Watkins R, Bower C. Fetal alcohol spectrum disorders: notifications to the Western Australian Register of Developmental Anomalies. *J Paediatr Child Health* 2015;51:433–6.
28 Stratton K, Howe C, Battaglia F, *et al*. *Fetal alcohol syndrome: diagnosis, epidemiology, prevention, and treatment*. 1996.
29 Hoyme HE, May PA, Kalberg WO, *et al*. A Practical Clinical Approach to Diagnosis of Fetal Alcohol Spectrum Disorders: Clarification of the 1996 Institute of Medicine Criteria. *Pediatrics* 2005;115:39–47.
30 Hoyme HE, Kalberg WO, Elliott AJ, *et al*. Updated Clinical Guidelines for Diagnosing Fetal Alcohol Spectrum Disorders. *Pediatrics* 2016;138:e20154256.
31 Cook JL, Green CR, Lilley CM, *et al*. Fetal alcohol spectrum disorder: a guideline for diagnosis across the lifespan. *CMAJ* 2016;188:191–7.
32 AstleySJ, Clarren SK. *Diagnostic guide for fetal alcohol syndrome and related conditions: the 4-digit diagnostic code*. 1999.
33 May PA, Gossage JP, Marais A-S, *et al*. The epidemiology of fetal alcohol syndrome and partial FAS in a South African community. *Drug Alcohol Depend* 2007;88:259–71.
34 May PA, Blankenship J, Marais A-S, *et al*. Maternal alcohol consumption producing fetal alcohol spectrum disorders (FASD): quantity, frequency, and timing of drinking. *Drug Alcohol Depend* 2013;133:502–12.
35 May PA, de Vries MM, Marais A-S, *et al*. The continuum of fetal alcohol spectrum disorders in four rural communities in south africa: Prevalence and characteristics. *Drug Alcohol Depend* 2016;159:207–18.
36 May PA, Marais A-S, de Vries MM, *et al*. The continuum of fetal alcohol spectrum disorders in a community in South Africa: Prevalence and characteristics in a fifth sample. *Drug Alcohol Depend* 2016;168:274–86.
37 May PA, De Vries MM, Marais A-S, *et al*. Replication of High Fetal Alcohol Spectrum Disorders Prevalence Rates, Child Characteristics, and Maternal Risk Factors in a Second Sample of Rural Communities in South Africa. *Int J Environ Res Public Health* 2017;14:522.
38 May PA, Marais A-S, De Vries MM, *et al*. The prevalence, child characteristics, and maternal risk factors for the continuum of fetal alcohol spectrum disorders: A sixth population-based study in the same South African community. *Drug Alcohol Depend* 2021;218:108408.
39 May PA, de Vries MM, Marais A, *et al*. The prevalence of fetal alcohol spectrum disorders in rural communities in South Africa: A third regional sample of child characteristics and maternal risk factors. *Alcohol Clin Exp Res* 2022;46:1819–36.
40 May PA, Hasken JM, de Vries MM, *et al*. Maternal and paternal risk factors for fetal alcohol spectrum disorders: Alcohol and other drug use as proximal influences. *Alcohol Clin Exp Res* 2023;47:2090–109.
41 May PA, Hasken JM, de Vries MM, *et al*. Maternal risk factors for fetal alcohol spectrum disorders: Distal variables. *Alcohol Clin Exp Res* 2024;48:319–44.
42 Wynn A, Rotheram-Borus MJ, Davis E, *et al*. Identifying fetal alcohol spectrum disorder among South African children at aged 1 and 5 years. *Drug Alcohol Depend* 2020;217:108266.
43 Barr HM, Streissguth AP. Identifying Maternal Self-Reported Alcohol Use Associated With Fetal Alcohol Spectrum Disorders. *Alcohol Clin Exp Res* 2001;25:283–7.
44 Chambers CD, Coles C, Kable J, *et al*. Fetal Alcohol Spectrum Disorders in a Pacific Southwest City: Maternal and Child Characteristics. *Alcohol Clin Exp Res* 2019;43:2578–90.
45 Kvigne VL, Leonardson GR, Borzelleca J, *et al*. Alcohol Use, Injuries, and Prenatal Visits During Three Successive Pregnancies Among American Indian Women on the Northern Plains Who have Children with Fetal Alcohol Syndrome or Incomplete Fetal Alcohol Syndrome. *Matern Child Health J* 2008;12:37–45.
46 Oh SS, Kang B, Park J, *et al*. Racial/Ethnic Disparity in Association Between Fetal Alcohol Syndrome and Alcohol Intake During Pregnancy: Multisite Retrospective Cohort Study. *JMIR Public Health Surveill* 2023;9:e45358.
47 Popova S, Lange S, Temple V, *et al*. Profile of Mothers of Children with Fetal Alcohol Spectrum Disorder: A Population-Based Study in Canada. *Int J Environ Res Public Health* 2020;17:7986.
48 Grzywacz E, Brzuchalski B, Śmiarowska M, *et al*. Significance of Selected Environmental and Biological Factors on the Risk of FASD in Women Who Drink Alcohol during Pregnancy. *JCM* 2023;12:6185.
49 Kesmodel US, Nygaard SS, Mortensen EL, *et al*. Are Low-to-Moderate Average Alcohol Consumption and Isolated Episodes of Binge Drinking in Early Pregnancy Associated with Facial Features Related to Fetal Alcohol Syndrome in 5-Year-Old Children? *Alcohol Clin Exp Res* 2019;43:1199–212.

50 Mullally A, Cleary BJ, Barry J, *et al*. Prevalence, predictors and perinatal outcomes of peri-conceptional alcohol exposure - retrospective cohort study in an urban obstetric population in Ireland. *BMC Pregnancy Childbirth* 2011;11:27.
51 Petković G, Barišić I. Prevalence of Fetal Alcohol Syndrome and Maternal Characteristics in a Sample of Schoolchildren from a Rural Province of Croatia. *IJERPH* 2013;10:1547–61.
52 O'Leary CM, Nassar N, Kurinczuk JJ, *et al*. Prenatal alcohol exposure and risk of birth defects. *Pediatrics* 2010;126:e843–50.
53 May PA, Hasken JM, Marais AS, *et al*. Comparative Analysis of Physical Traits of Children with Fetal Alcohol Spectrum Disorders in South Africa and the United States and the Likelihood of FASD Births. *Neuromethods* 2022;188:119–41.
54 Engesether B, Hoffner M, Johnson E, *et al*. Prevalence of fetal alcohol spectrum disorder in foster care: A scoping review. *Alcohol Clin Exp Res (Hoboken)* 2024;48:1443–50.
55 Lange S, Shield K, Rehm J, *et al*. Prevalence of Fetal Alcohol Spectrum Disorders in Child Care Settings: A Meta-analysis. *Pediatrics* 2013;132:e980–95.
56 Lange S, Probst C, Gmel G, *et al*. Global Prevalence of Fetal Alcohol Spectrum Disorder Among Children and Youth: A Systematic Review and Meta-analysis. *JAMA Pediatr* 2017;171:948–56.
57 Coles CD, Gailey AR, Mulle JG, *et al*. A Comparison Among 5 Methods for the Clinical Diagnosis of Fetal Alcohol Spectrum Disorders. *Alcohol Clin Exp Res* 2016;40:1000–9.
58 Bertrand J, Floyd LL, Weber MK, *et al*. Guidelines for identifying and referring persons with fetal alcohol syndrome. *MMWR Recomm Rep* 2005;54:1–14.
59 Coles CD, Bandoli G, Kable JA, *et al*. Comparison of three systems for the diagnosis of fetal alcohol spectrum disorders in a community sample. *Alcohol Clin Exp Res (Hoboken)* 2023;47:370–81.
60 Roozen S, Peters G-JY, Kok G, *et al*. Systematic literature review on which maternal alcohol behaviours are related to fetal alcohol spectrum disorders (FASD). *BMJ Open* 2018;8:e022578.
61 Mamluk L, Jones T, Ijaz S, *et al*. Evidence of detrimental effects of prenatal alcohol exposure on offspring birthweight and neurodevelopment from a systematic review of quasi-experimental studies. *Int J Epidemiol* 2021;49:1972–95.
62 Jacobson JL, Akkaya-Hocagil T, Ryan LM, *et al*. Effects of prenatal alcohol exposure on cognitive and behavioral development: Findings from a hierarchical meta-analysis of data from six prospective longitudinal U.S. cohorts. *Alcohol Clin Exp Res* 2021;45:2040–58.
63 Bandoli G, Hayes S, Delker E. Low to Moderate Prenatal Alcohol Exposure and Neurodevelopmental Outcomes: A Narrative Review and Methodological Considerations. *ARCR* 2023;43:01.
64 Muggli E, Halliday J, Hearps S, *et al*. Low to moderate prenatal alcohol exposure and neurodevelopment in a prospective cohort of early school aged children. *Sci Rep* 2024;14:7302.
65 Chu JTW, McCormack J, Marsh S, *et al*. Impact of prenatal alcohol exposure on neurodevelopmental outcomes: a systematic review. *Health Psychol Behav Med* 2022;10:973–1002.
66 Ujhelyi Gomez K, Goodwin L, Chisholm A, *et al*. Alcohol use during pregnancy and motherhood: Attitudes and experiences of pregnant women, mothers, and healthcare professionals. *PLoS ONE* 2022;17:e0275609.
67 Jones SC, Telenta J, Shorten A, *et al*. Midwives and pregnant women talk about alcohol: what advice do we give and what do they receive? *Midwifery* 2011;27:489–96.
68 Schölin L, Watson J, Dyson J, *et al*. Midwives' views on alcohol guidelines: A qualitative study of barriers and facilitators to implementation in UK antenatal care. *Sex Reprod Healthc* 2021;29:100628.
69 Crawford-Williams F, Steen M, Esterman A, *et al*. "If you can have one glass of wine now and then, why are you denying that to a woman with no evidence": Knowledge and practices of health professionals concerning alcohol consumption during pregnancy. *Women Birth* 2015;28:329–35.
70 Frennesson NF, Barnett J, Merouani Y, *et al*. Analyzing Questions About Alcohol in Pregnancy Using Web-Based Forum Topics: Qualitative Content Analysis. *JMIR Infodemiology* 2024;4:e58056.
71 Popova S, Dozet D, Pandya E, *et al*. Effectiveness of brief alcohol interventions for pregnant women: a systematic literature review and meta-analysis. *BMC Pregnancy Childbirth* 2023;23:61.