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Alcohol-use disorders during and within one year of pregnancy: a population-based cohort study 1985–2006

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Objectives To examine alcohol-use disorders in pregnant women and the extent of under-reporting.

Design Population-based cohort study.

Setting Western Australia.

Population Women with a birth recorded on the Western Australian Midwives Notification System (1985–2006).

Methods Mothers with an International Classification of Diseases 9/10 alcohol-related diagnosis, indicating heavy alcohol consumption, recorded on population-based health datasets (non-Aboriginal n = 5839; Aboriginal n = 2583) were identified through the Western Australian data-linkage system. This 'exposed' cohort was frequency matched (on maternal age, year of birth of offspring, Aboriginal status) with comparison mothers without an alcohol-related diagnosis (non-Aboriginal n = 33 979; Aboriginal n = 8005).

Main outcome measures Trends in maternal alcohol diagnoses in relation to pregnancy for non-Aboriginal and Aboriginal women. The proportion of children diagnosed with fetal alcohol syndrome (FAS) who had a mother with an alcohol diagnosis recorded during pregnancy.

Results The proportion of Aboriginal mothers in Western Australia with an alcohol diagnosis (23.1%) is ten times greater than for non-Aboriginal mothers (2.3%). There has been a six-fold increase in the percentage of non-Aboriginal births with a maternal alcohol diagnosis recorded during pregnancy and a 100-fold increase for Aboriginal births. Around 70% of the mothers of children diagnosed with FAS did not have an alcohol diagnosis recorded during pregnancy and 18% of the mothers had no record of an alcohol diagnosis.

Conclusions Maternal alcohol exposure during pregnancy is significantly under-ascertained. Given the severe risks to the fetus from heavy prenatal alcohol exposure, assessment and recording of alcohol use should be routinely undertaken in maternity and other health settings.

Keywords Aboriginal, alcohol and pregnancy, alcohol-use disorders, data linkage cohort, epidemiology, fetal alcohol syndrome.

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Introduction

Alcohol-use disorders[1] in women, including intoxication and dependence, often go unrecognised in the healthcare setting.[2–4] This is in spite of the high and increasing prevalence of harmful drinking patterns among women of childbearing age.[5–8] The reported prevalence of alcohol-use disorders in women varies depending upon the population and study design, ranging from around 3[9] to 5.0%[10] in Australian and 16% in UK[11] population-based surveys to between 7 and 28% in hospital and primary-care studies in the USA.[2] Although the evidence indicates that alcohol use, including binge drinking (50+ g alcohol per occasion) by pregnant women is prevalent,[12–16] health professionals do not routinely ask pregnant women about alcohol consumption,[2, 17–19] even though this is recommended practice.[20, 21]

These trends, coupled with the high rate of unplanned pregnancies,[22] contribute to the high prevalence of prenatal

alcohol consumption in many countries,[6,22,23] increasing the risk of harm to the fetus.[24,25] Many of the fetal alcohol effects are classified within the umbrella term fetal alcohol spectrum disorders (FASD) and include fetal alcohol syndrome (FAS), birth defects, intellectual disability, mental health problems and a range of alcohol-related neurodevelopmental disorders.[24] Estimates of the prevalence of FASD vary depending upon the method of ascertainment, the population and the country.[26] In Australia, the estimate of FAS in the non-Aboriginal population is 0.02/1000 and in the Aboriginal population 2.76/1000[27] with the highest estimate of 4.7/1000 reported for FASD in Aboriginal children in the Northern Territory.[28] Estimates of FAS and the broader FASD in Australia[4,27,29] and the UK[19] are lower than those reported in other countries[26] and are likely to under-represent the true prevalence.[19,30]

The focus of these prevalence data for FAS is on children and not the mother. We are unaware of any population-based evidence about the mothers of children with FAS and whether they have had their alcohol-use disorders recognised in the health system or received health services addressing their drinking problems.

The question remains about the extent of recognition of maternal alcohol-use disorder in the hospital or other health setting during pregnancy. This study uses population-based Western Australian linked health data to examine the presence of an alcohol-related diagnosis on health data sets, a proxy for alcohol-use disorders, in pregnant women (1985–2006), the extent of under-reporting of maternal alcohol-related diagnoses during pregnancy, and the differences in characteristics of mothers with an alcohol-related diagnosis compared with mothers without this diagnosis.

Methods

Study design and data sources

This study is a population-based cohort study using linked, longitudinal, health, mental health, and drug and alcohol data sets. Mothers with an alcohol-related diagnosis, a proxy for maternal alcohol-use disorder indicating heavy alcohol consumption, and a comparison cohort of mothers without an alcohol-related diagnosis, were identified through record linkage of routinely collected population-based birth, hospital, mental health outpatient and drug and alcohol services data.[7,28] The data linkage was undertaken through the Western Australian Data Linkage Unit, using probabilistic matching.[31] After linkage, a unique identifier replaces identifying information and researchers are provided with de-identified data files. Researchers sign a confidentiality document stating that they will not attempt to identify any individual within the data set. Western Australian ethics committees require that researchers using linked data are not permitted to report numbers where the number of cases within a stratum is <5, to prevent the likelihood of identification of individuals.

All women with a birth recorded on the Western Australian Midwives Notification System (1985–2006) were eligible for selection into the study. The Midwives Notification System is a statutory notification system that records all Western Australian births of at least 20 weeks gestation or 400 g birthweight. The Midwives Notification System contains information on maternal demographic characteristics, pregnancy profile, labour and delivery and characteristics of the baby, which are forwarded to the Western Australian Department of Health within 2 days following birth.[32]

For our study the data from the Midwives Notification System were linked with birth data from the Western Australian Data Linkage System: Hospital Morbidity Data System, Mental Health Outpatients data set, the Perth-based Drug and Alcohol treatment services data set and the Register for Developmental Anomalies.[33] The Hospital Morbidity Data System is a statutory collection of demographic and clinical information on all inpatient acute care hospitalisations in Western Australia, including psychiatric services and contains up to 21 variables coding for the admission diagnoses. The Mental Health Outpatient data set collects information on all mental health outpatient contacts in Western Australia and the Drug and Alcohol service data set collects information on all alcohol and other drug treatment services provided by the Western Australian government in the Perth metropolitan region.

Birth data for the children were linked to the Western Australian Register of Developmental Anomalies[33] (previously called the Western Australian Birth Defects Register), which collects information for the Western Australian population on birth defects diagnosed in stillbirths, terminations of pregnancy, and live births up to 6 years of age, using multiple sources of ascertainment.[27,34] Each birth defect is coded according to the British Paediatric Association International Classification of Diseases system (9th revision).

Cohort selection

The exposed cohort comprises women who have an alcohol-related diagnosis (International Classification of Diseases, revision 9 or 10 (ICD-9 and/or ICD-10) recorded on the routinely collected Western Australian administrative Hospital Morbidity Data System (hospital inpatients), Mental Health Outpatients, and Perth-based Drug and Alcohol Office data sets. These women and all their offspring whose birth is recorded on the Midwives Notification System 1985–2006, comprised the exposed cohort for this study. The presence of an alcohol-related diagnosis was used as a proxy for heavy levels of maternal alcohol consumption. The diagnoses covered acute alcohol intoxica-

tion, alcohol dependence, alcohol-related psychiatric conditions, alcohol-related disease, and fetal harm in the offspring (recorded on the maternal record) (Table 1). Full details of the cohort selection and the ICD alcohol codes have been published previously.[35,36]

A comparison cohort of randomly selected mothers who had never had an alcohol-related diagnosis recorded on any of the hospital, mental health, or drug and alcohol data sets were identified from the Midwives Notification System. The comparison cohort was frequency matched to the exposed cohort on maternal age within maternal race (non-Aboriginal ≅3 comparison:1 exposed; Aboriginal ≅2 comparison:1 exposed) and year of birth of her child (Figure 1). We undertook frequency matching for selecting the comparison cohort to ensure that the comparison cohort had similar proportions of individuals to the exposed cohort with regard to important characteristics. The three variables that we frequency matched were maternal age, maternal Aboriginal status and year of birth of the baby. We expected that a high proportion of Aboriginal women would have an alcohol-related diagnosis and a high proportion of Aboriginal mothers are young. We also frequency matched on year of birth of the child as the recording of alcohol-use disorders in women has changed over time; frequency matching on this variable ensured that the comparison mothers had the same opportunity to have received an alcohol diagnosis. The high proportion of Aboriginal mothers with an alcohol diagnosis prevented frequency matching at 3:1. The comparison cohort for this study comprised these mothers and all their children whose births were recorded on the Midwives Notification System (1985–2006).

Hospital morbidity, mental health outpatients, and drug and alcohol service data were available from 1983 to 2007

Table 1. Type, frequency and timing of maternal alcohol-related diagnoses recorded on the hospital morbidity and/or the mental health outpatient data sets in relation to pregnancy 1985–2006, for non-Aboriginal and Aboriginal births

Maternal alcohol diagnoses*	Non-Aboriginal births		Aboriginal births	
	Timing of alcohol diagnoses		Timing of alcohol diagnoses	
	During pregnancy (*n* = 467) *n* (%)	Before or after; not during pregnancy (*n* = 12 000) *n* (%)	During pregnancy (*n* = 760) *n* (%)	Before or after; not during pregnancy (*n* = 8109) *n* (%)
Mental and behavioural disorders				
Acute alcohol intoxication	156 (33.4)***	6422 (53.5)	494 (65.0)***	5923 (73.0)
Alcohol dependence syndrome	56 (12.0)	1380 (11.5)	92 (12.1)	924 (11.4)
Alcohol withdrawal	5 (1.1)***	318 (2.7)	11 (1.4)	168 (2.1)
Alcohol psychotic disorder	<5	181 (1.5)	<5	182 (2.2)
Alcohol amnesic syndrome	0	0	0	0
Residual and late-onset alcohol psychiatric disorder	<5	22 (0.2)	0	28 (0.3)
Other	5 (1.1)	10 (0.1)	10 (1.3)	6 (0.1)
Alcohol-related disease**	19 (4.0)	393 (3.3)	27 (3.6)***	459 (5.7)
'Other' alcohol disorders				
Infant damage due to alcohol (recorded on maternal record)	<5	<5	5 (0.7)****	18 (0.2)
Other (elevated blood alcohol; alcohol intoxication)	147 (31.5)	3909 (32.6)	118 (15.5)	1315 (16.2)
Encountering health services due to alcohol problems	129 (27.6)****	1576 (13.1)	113 (14.9)****	974 (12.0)
Counselling/rehabilitation for alcohol use disorder	43 (9.2)****	268 (2.2)	18 (2.4)	130 (1.6)

*Women may have more than one diagnosis.
**Alcohol-related disease includes alcoholic Cushing syndrome, alcoholic nervous system degeneration, alcoholic polyneuropathy, alcoholic myopathy, alcoholic cardiomyopathy, alcoholic gastritis, alcoholic liver disease, alcoholic pancreatitis; a small number of women had more than one alcohol-related disease (non-Aboriginal $n = 6$; Aboriginal $n = 9$).
***Significantly less likely to be recorded during pregnancy chi-square test $\rho < 0.05$.
****Significantly more likely to be recorded during pregnancy; chi-square test $\rho < 0.05$.

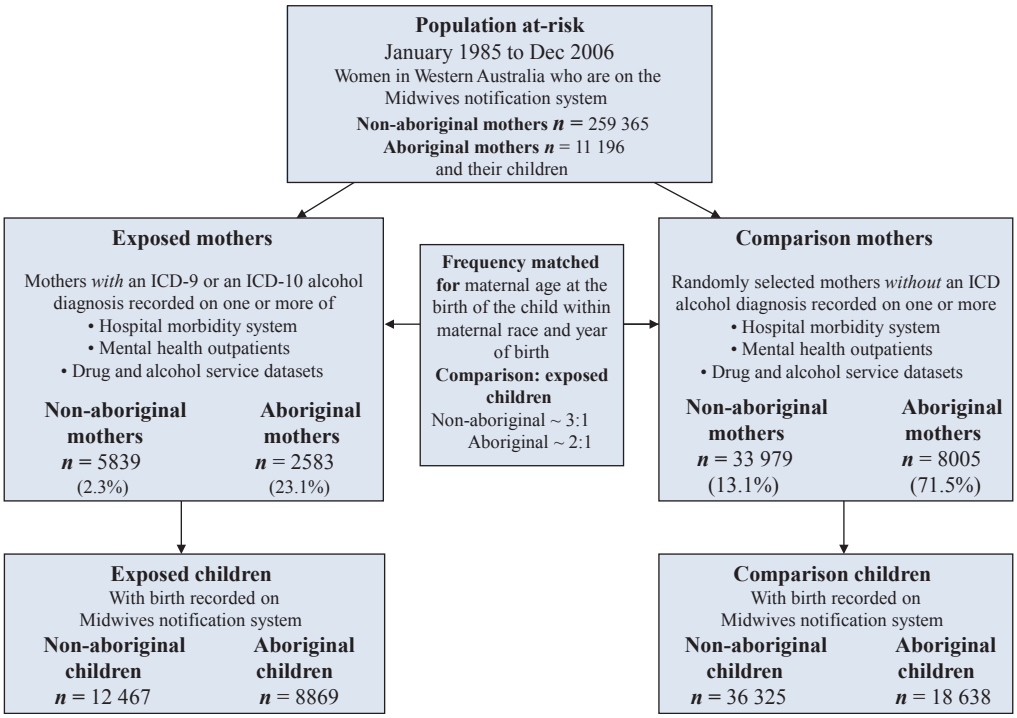

Figure 1. Cohort selection of mothers with an alcohol-related diagnosis, randomly selected comparison mothers without an alcohol-related diagnosis, and the children of these mothers, 1985–2006.

inclusive, which ensured that all mothers had at least 1 year of follow up before and following pregnancy.

Children with FAS were identified through linkage of the offspring data with the Western Australian Register of Developmental Anomalies.[33] Cases of FAS in Western Australia are diagnosed by individual clinicians and not through a centralised clinic so we were unable to verify the diagnosis.

Classification of the timing of maternal alcohol diagnosis

The pregnancy period was estimated by subtracting gestational age[16] at birth from date of birth to give the date of conception. Mothers with any alcohol diagnosis recorded during pregnancy, which may also include an alcohol-related diagnosis before and/or after pregnancy, were classified as:

1 During pregnancy
   For women without a diagnosis during pregnancy, we also examined diagnoses recorded within 1 year of pregnancy
2 Within 1 year before pregnancy (may include alcohol diagnoses occurring >1 year before pregnancy or after pregnancy)
3 Within 1 year after pregnancy (may include alcohol diagnoses occurring >1 year before or after pregnancy).[35]

Maternal characteristics

Maternal sociodemographic factors at the birth of the child were identified on the Midwives Notification System and included maternal age (stratified into five age groups), marital status (married, single), parity (0, 1, 2, 3+), Western Australian health region at the birth of the child (Perth metropolitan, rural/remote regions), illicit drug use (any ICD-9/10 code), mental health diagnoses other than for substance use (any ICD-9/10 code), socio-economic status at time of birth based on Australian census data collected at the census district level (approximately 200 households)[20] stratified into quintiles and maternal smoking during pregnancy (Yes/No), which has only been collected on the Midwives Notification System since 1998. Differences in sociodemographic factors between exposed and comparison mothers were assessed using logistic regression. Analyses were conducted separately by Aboriginal status and adjusted for the frequency matching variables maternal age and birth year using SPSS version 19.0 (SPSS Inc., Chicago, IL, USA) (Table 2 & 3).

Results

There were 5839 non-Aboriginal mothers and 2583 Aboriginal mothers with a birth recorded on the Midwives Notification System 1985–2006 and who had an alcohol-related

Table 2. Characteristics of non-Aboriginal mothers at each birth, as recorded on the Midwives Notification System 1985–2006, by maternal alcohol-related diagnosis

	Non-Aboriginal births				
	Alcohol diagnosis during pregnancy (*n* = 467) (%)	Comparison (*n* = 36 325) (%)	Alcohol diagnosis during pregnancy versus comparison OR* (95% CI)	Alcohol diagnosis not during pregnancy (*n* = 12 000) (%)	Alcohol diagnosis not during pregnancy versus comparison OR* (95% CI)
Maternal age					
<20 years	9.9	12.0	1.04 (0.7–1.5)	12.1	0.99 (0.92–1.06)
20–24 years	22.9	29.1	1.0	29.5	1.0
25–29 years	29.3	29.6	1.26 (0.98–1.6)	29.4	0.98 (0.93–1.04)
30–34 years	21.4	19.8	1.37 (1.0–1.8)	19.8	0.99 (0.93–1.05)
35+ years	16.5	9.5	2.19 (1.6–2.9)	9.2	0.95 (0.88–1.03)
Marital status					
Married	59.5	86.4	1.0	74.2	1.0
Single**	39.4	13.6	4.19 (3.5–5.1)	25.8	2.20 (2.09–2.32)
Parity					
0	41.8	49.2	1.0	38.3	1.0
1	25.3	31.3	0.95 (0.8–1.2)	30.5	1.25 (1.19–1.32)
2	18.4	13.2	1.64 (1.3–2.1)	17.6	1.71 (1.61–1.81)
3+	14.6	6.2	2.75 (2.1–3.6)	13.6	2.80 (2.61–3.01)
Western Australian Health Region					
Perth metro	73.4	72.3	1.0	71.4	1.0
Rural/remote	26.6	27.7	0.97 (0.8–1.2)	28.6	1.05 (1.00–1.10)
Illicit drug diagnosis					
Yes	38.3	1.5	41.4 (37.8–45.3)	38.5	40.0 (36.48–43.77)
Mental health diagnosis***					
Yes	49.5	9.3	9.54 (7.9–11.5)	53.3	11.10 (10.56–11.68)
Socio-economic status					
Most advantaged	4.7	7.0	1.0	4.0	1.0
10 to <25%	7.3	12.8	0.84 (0.5–1.5)	9.2	1.26 (1.12–1.41)
25 to <50%	16.3	22.2	1.09 (0.7–1.8)	18.8	1.48 (1.33–1.65)
50 to <75%	26.3	24.5	1.60 (1.0–2.5)	25.1	1.79 (1.61–1.99)
75 to <90%	21.8	15.5	2.09 (1.3–3.3)	19.5	2.19 (1.96–2.44)
Most disadvantaged	16.7	9.1	2.72 (1.7–4.4)	15.0	2.87 (2.57–3.22)
Unknown	6.9	8.8	1.16 (0.7–2.0)	8.3	1.66 (1.47–1.87)
Smoking******					
Yes	67.9	20.5	8.21 (6.5–10.4)	49.1	2.37 (2.17–2.60)

*Analyses adjusted for frequency matching variables maternal age and birth year.
**Single includes separated, widowed or divorced.
***Mental health diagnoses other than substance-use diagnoses.
****Smoking during pregnancy collected on the Midwives Notification System since 1998.

diagnosis recorded on one or more of the hospital morbidity, mental health outpatients, or drug and alcohol data sets (Figure 1). The proportion of all non-Aboriginal mothers on the Midwives Notification System (1985–2006) who had an alcohol diagnosis was 2.3% and ten-fold higher for Aboriginal mothers (23.1%). Non-Aboriginal mothers with an alcohol-related diagnosis had 12 467 births and Aboriginal mothers had 8869.

Acute alcohol diagnoses, including mental and behavioural disorders, acute alcohol intoxication and 'other' alcohol intoxication combined, were the most frequently recorded diagnoses (Table 1). Of the non-Aboriginal women with an alcohol-related diagnosis recorded during pregnancy, 33.4% had a diagnosis of acute alcohol intoxication and 31.5% had a diagnosis of 'other' alcohol intoxication, compared with 53.5 and 32.6% of mothers with an alcohol diagnosis not during pregnancy. For Aboriginal mothers the percentages were 65.0 and 15.5% for during pregnancy and 73.0 and 16.2% for not during pregnancy, respectively. The proportions of mothers with an alcohol

Table 3. Characteristics of Aboriginal mothers at each birth, as recorded on the Midwives Notification System 1985–2006, by maternal alcohol-related diagnosis

	Aboriginal births				
	Alcohol diagnosis during pregnancy (n = 760) (%)	Comparison (n = 18 638) (%)	Alcohol diagnosis during pregnancy versus comparison OR* (95% CI)	Alcohol diagnosis not during pregnancy (n = 8109) (%)	Alcohol diagnosis not during pregnancy versus comparison OR* (95% CI)
Maternal age					
<20 years	12.0	25.9	0.51 (0.4–0.7)	27.1	1.04 (0.97–1.11)
20–24 years	30.5	33.6	1.0	33.7	1.0
25–29 years	27.1	23.1	1.29 (1.1–1.6)	22.6	0.98 (0.91–1.05)
30–34 years	19.5	12.3	1.74 (1.4–2.2)	12.1	0.98 (0.89–1.07)
35 + years	10.9	5.1	2.38 (1.8–3.1)	4.6	0.90 (0.79–1.02)
Marital status					
Married	58.9	65.5	1.0	59.2	1.0
Single**	40.5	34.0	1.34 (1.2–1.6)	40.8	2.20 (2.09–2.32)
Parity					
0	18.9	29.6	1.0	24.9	1.0
1	18.6	23.5	1.24 (0.98–1.6)	21.9	1.11 (1.03–1.20)
2	17.9	18.4	1.52 (1.2–1.9)	19.1	1.24 (1.14–1.34)
3+	44.6	28.5	2.45 (2.0–3.0)	34.1	1.43 (1.33–1.53)
Western Australia Health Region at birth					
Perth metro	30.0	32.5	1.0	29.8	1.0
Rural/remote	70.0	67.5	1.13 (0.96–1.3)	70.2	1.13 (1.07–1.20)
Illicit drug diagnosis					
Yes	26.6	4.8	6.19 (5.7–6.7)	22.6	5.77 (5.30–6.28)
Mental health diagnosis* **					
Yes	33.4	11.9	3.70 (3.2–4.3)	29.8	3.13 (2.93–3.34)
Socio-economic status					
Most advantaged	$n \leq 5$	0.5	1.0	0.2	1.0
10 to <25%	0.8	1.8	0.58 (0.1–2.3)	0.9	1.04 (0.6–1.78)
25 to <50%	4.2	7.1	0.78 (0.2–2.6)	5.0	1.50 (0.91–2.45)
50 to <75%	11.8	17.1	0.90 (0.3–2.9)	13.6	1.66 (1.02–2.70)
75 to <90%	18.2	22.2	1.07 (0.3–3.4)	19.8	1.86 (1.15–3.02)
Most disadvantaged	29.3	30.5	1.26 (0.4–4.0)	30.2	2.07 (1.27–3.36)
Unknown	35.3	20.8	2.22 (0.7–7.0)	30.2	3.04 (1.88–4.94)
Smoking** **					
Yes	73.2	44.9	3.35 (2.7–4.1)	65.9	2.37 (2.17–2.60)

*Analyses adjusted for frequency matching variables maternal age and birth year.
**Single, includes never married, separated, widowed or divorced.
***Mental health diagnoses other than substance-use diagnoses.
****Smoking during pregnancy collected on the Midwives Notification System since 1998.

diagnosis during pregnancy that had used a health service as a result of their alcohol problems were 27.6% for non-Aboriginal and 14.9% for Aboriginal mothers, while 9.2 and 2.4%, respectively, had a record of counselling or rehabilitation services. Few mothers had a maternal ICD code identifying fetal damage because of prenatal alcohol exposure (Table 1).

The characteristics for non-Aboriginal mothers with an alcohol diagnosis recorded on the Midwives Notification System at the birth of the children are shown in Table 2. Mothers with an alcohol diagnosis recorded during pregnancy were more likely to be 30–34 years of age (odds ratio [OR] 1.37; 95% confidence interval [95% CI] 1.0–1.8) or 35 years or older than comparison mothers (OR 2.19; 95% CI 1.6–2.9), whereas there were no age differences between mothers with an alcohol diagnosis recorded only outside of pregnancy and comparison mothers. All non-Aboriginal mothers with an alcohol diagnosis were more likely than comparison mothers to be of parity 2 or higher, to be single, to have a mental health disorder (other than substance use), an illicit drug diagnosis and to be in the lowest 50% of the socio-economic bands. All mothers with an alcohol diagno-

sis were more likely to smoke during pregnancy. However, non-Aboriginal mothers with an alcohol-related diagnosis recorded during pregnancy were eight times more likely to smoke than comparison mothers (OR 8.21; 95% CI 6.5–10.4); for Aboriginal mothers there was a two-fold increase in the odds ratio (OR 2.37; 95% CI 2.17–2.60) (Table 2).

The characteristics of Aboriginal mothers with an alcohol-related diagnosis showed similar features to the non-Aboriginal exposed mothers including being older at the birth of the child, single, of higher parity, likely to smoke during pregnancy and to have a mental health or illicit drug diagnosis (Table 3). Aboriginal mothers with an alcohol-related diagnosis recorded during pregnancy were more likely to be in the 'unknown' socio-economic category and mothers with an alcohol-related diagnosis not recorded during pregnancy were more likely to be in the lowest 50% of socioeconomic bands than comparison mothers.

Of the non-Aboriginal exposed births, 467 (3.7%) had a mother with an alcohol diagnosis recorded during pregnancy (Table 2), as did 760 (8.6%) of the Aboriginal exposed births (Table 3). These equate to 0.08% and 2.3% of all births recorded on the Midwives Notification System 1985–2006, respectively. The majority of non-Aboriginal (94.4%) and Aboriginal (82.5%) mothers with an alcohol diagnosis during pregnancy had only one pregnancy where this occurred, with 4.5% and 14.1% (respectively) having an alcohol diagnosis recorded during two pregnancies. Of the births where the mother had an alcohol diagnosis recorded during pregnancy, no alcohol diagnosis was recorded outside of pregnancy in half (49.9%) of the non-Aboriginal and 25.2% of the Aboriginal cases and 38.8% and 50.7% (respectively) had an alcohol diagnosis recorded both during and before pregnancy (results not tabled).

There has been a substantial increase in the proportion of births with an alcohol diagnosis recorded during pregnancy across the 22 years for all mothers, but this was most marked for Aboriginal mothers (Figure 2). There has been a six-fold increase in the percentage of non-Aboriginal births with a maternal alcohol diagnosis recorded during pregnancy, from 0.03% in 1985 to 0.18% in 2006, whereas for Aboriginal mothers there was a 100-fold increase, from 0.04 to 3.9%. For both non-Aboriginal and Aboriginal mothers, around 80% of the pregnancy alcohol diagnoses were recorded for births occurring from 1995 to 2006.

There was an eight-fold increase in the percentage of births where a maternal alcohol diagnosis was recorded within 1 year before conception over the five time periods, whereas there was a three-fold increase in the percentage of births where the mother received an alcohol diagnosis within 1 year after pregnancy (Figure 2).

In this study 114 children had a diagnosis of FAS, equating to 68% of the 167 children with FAS recorded on the Western Australian Register for Developmental Anomalies in the study period (Table 4), the majority of whom were Aboriginal (n = 105; 92%). One-third (33.3%) of the mothers of the children with FAS had an alcohol diagnosis recorded during pregnancy, 8.8% had an alcohol diagnosis within 1 year prepregnancy and 19 (18.1%) of their mothers were in the comparison cohort. The remaining 37 (32%) children with FAS had a mother with an alcohol diagnosis recorded more than 1 year prepregnancy or postpregnancy (Table 4).

Discussion

The proportion of Aboriginal mothers in Western Australia with an alcohol diagnosis (23.1%) is ten times greater than for non-Aboriginal mothers (2.3%) and the increasing trend for women to have an alcohol diagnosis recorded during pregnancy was more striking for Aboriginal than for non-Aboriginal mothers. This probably reflects the higher percentage of Aboriginal women who report binge drinking during pregnancy (22%)[37] compared with 4% of non-Aboriginal women.[22] However, we are unable to determine from this study if this difference is due solely to a higher prevalence of alcohol-related problems in Aboriginal women. The study design does not allow us to examine the possibility that health professionals are more likely to ask and record alcohol use during pregnancy for Aboriginal women than they are for non-Aboriginal women. The evidence of an increasing prevalence of harmful alcohol consumption patterns among non-Aboriginal women of childbearing age in Australia[5] tends to support this possibility.

This study demonstrates that maternal alcohol-related problems during pregnancy are markedly underascertained in the health system, as shown previously by other studies.[2–4,38,39] The majority (70%) of mothers in this study who had a child diagnosed with FAS did not have an alcohol diagnosis recorded during pregnancy and 18% of the mothers had never had their alcohol-related problems recognised in the health data sets accessed for this study. Significantly, this study design has not identified all 167 children with a diagnosis of FAS recorded on the Western Australian Register of Developmental Anomalies for 1985–2006,[33] indicating that the alcohol problems of a further 53 mothers of children with FAS have not been recorded on the health data sets accessed for this study. This suggests that regular cross-database audits warrant consideration. These findings raise the question of whether any health or alcohol services have been provided to address the alcohol-related problems of these women and to reduce the likelihood of further alcohol-exposed pregnancies.[40]

Of the mothers with an alcohol diagnosis recorded during pregnancy 39% of non-Aboriginal and 51% of Aboriginal mothers also had an alcohol diagnosis recorded before pregnancy. This indicates relatively high contact with

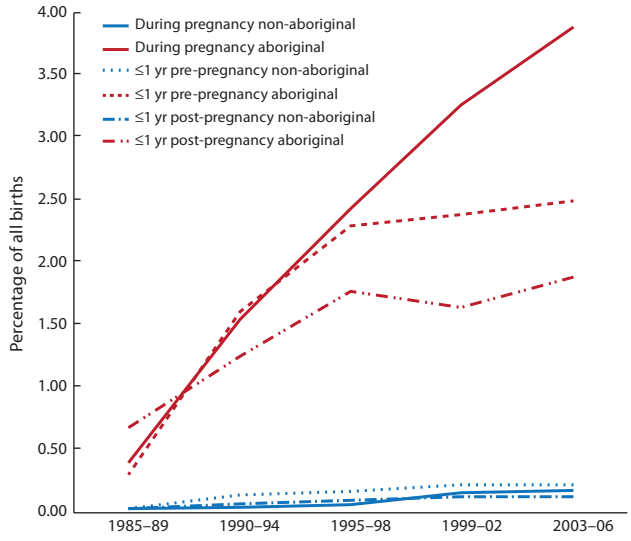

Figure 2. Trends in timing of alcohol-related diagnoses recorded on the hospital morbidity, mental health outpatients, or drug and alcohol data sets, in relation to pregnancy by maternal Aboriginal status 1985–2006.

Table 4. The distribution of the timing of the alcohol-related diagnosis for mothers of children with a diagnosis of FAS recorded on the Western Australian Register of Developmental Anomalies 1985–2006

	FAS* (n = 114)
Comparison mothers	19 (16.7)
Timing of maternal alcohol diagnosis	
During pregnancy	38 (33.3)
≤1 year prepregnancy	10 (8.8)
≤1 year postpregnancy	10 (8.8)
>1 year prepregnancy and/or postpregnancy	37 (32.4)

*There were only nine cases of FAS reported for non-Aboriginal children so the results are not stratified by Aboriginal status.

healthcare services and that health professionals would have opportunities to provide interventions addressing alcohol use and/or pregnancy prevention.[40] The mothers with an alcohol diagnosis in this study would have had overt and serious alcohol problems in order for these to have been recognised and documented. Therefore, it is concerning that fewer than 10% of non-Aboriginal and only 2.4% of Aboriginal mothers with an alcohol-related diagnosis recorded during pregnancy had an ICD code indicating counselling/rehabilitation, the first step in addressing alcohol-use disorders. Integrated services are also needed to address the complex health and social disadvantage of these women and their children.

Strengths and limitations

One of the strengths of the study was the range of population-based, routinely collected administrative health data sets we were able to access and as a population-based sample the results are likely to be generalisable to other similar populations. The mothers with an alcohol-related diagnosis were identified through accessing multiple data sources in the Western Australian data linkage system and we are confident that the women who received an alcohol diagnosis were drinking heavily. The Western Australian data linkage system has been demonstrated as a valid means of identifying cases admitted to hospital for a health-related condition.[41] However, given that there is a lack of routine questioning by health professionals of pregnant women[42] and mental health patients[43] about their alcohol consumption, many women in the comparison cohort are likely to have alcohol-related problems not identified in the health datasets accessed for this study. Indeed, the prevalence of alcohol-use disorders in non-Aboriginal women in this study is lower than the reported population estimate of 5% for these disorders in Australian women.[10] This is likely to be similar for Aboriginal mothers although we are not aware of any published estimates of alcohol-use disorders for pregnant Aboriginal mothers.

Our finding that 0.09% of non-Aboriginal pregnancies had a maternal alcohol diagnosis is similar to the 0.08% found in a New South Wales study for all mothers and the 23% of Aboriginal mothers in our study is similar to that reported in New South Wales (21%).[44] The lower prevalence of FAS in this study than reported for other populations[26] was not unexpected as under-diagnosis of FAS in Western Australia is well recognised.[27]

Interpretation

The reasons for the increase in recognition and documentation of alcohol problems, particularly during pregnancy, are likely to be multifactorial. The inclusion of alcohol and pregnancy in the Australian national policy agenda first occurred in 2001[45,46] and generated considerable debate,[47] resulting in a change in the guideline for drinking in 2009 to abstinence during pregnancy.[48] The development of Australian policy and guidelines has been accompanied by an increase in health promotion resources,[49,50] research[4,25,27] and media coverage[51] about alcohol and pregnancy. In spite of these developments, the majority of health professionals do not routinely ask pregnant women about alcohol consumption or provide advice about the risks of prenatal alcohol exposure.[17,18] Given the risk to maternal health from heavy alcohol consumption and the irreversible and severe consequences of FAS and FASD, routine assessment and recording of maternal alcohol use should become stan-

dard practice in maternity and other health services, along with guidelines for referral to alcohol services.

Conclusions

In spite of the marked increase in alcohol-related diagnoses recorded during pregnancy between 1985 and 2006 there is widespread under-recognition of heavy maternal alcohol consumption during pregnancy. Routine assessment and recording of maternal alcohol use should become standard practice in maternity and other health services. Pregnant women identified with an alcohol-use disorder and the mothers of children diagnosed with FAS should be offered counselling and treatment for their alcohol-use disorder and advice on contraception to prevent further alcohol-exposed pregnancies;[40] they should also be provided with supportive antenatal and postnatal services.

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Disclosure of interest

The authors declare that they do not have any conflict of interest in regard to this paper.

Contribution to authorship

All authors have contributed to the study and approved the final version of this manuscript. The original cohort design was developed by CMO and CB; CMO designed this study, analysed the data, and drafted the manuscript; CMO, CB, JH and AB provided expertise on alcohol and pregnancy; ABartu provided expertise on maternal alcohol use disorders; HD provided expertise on Aboriginal issues. CMO has access to all study data.

Details of ethics approval

Ethics approval for the conduct of this study was granted by the Princess Margaret Hospital Research Ethics Committee (#1244/EP), the Western Australian Confidentiality of Health Information Committee, Western Australian Department of Health (#2006/18) (now called the Health Research Ethics Committee), the Western Australian Aboriginal Health Information Ethics Committee (#134-04/06) and the Curtin Human Research Ethics Committee (#39/2010).

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