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Research Article

Methamphetamine Use in Pregnancy: Maternal and Neonatal Outcomes from A Specialist Drug and Alcohol Service (Western Australia)

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Abstract

Aim: The aim of this study was to determine maternal and neonatal outcomes following methamphetamine use in pregnancy in women attending a specialist drug and alcohol service.

Methods: Women were prospectively recruited in pregnancy if they identified Methamphetamine (MA) as their primary drug of use at the state-wide Women and Newborn Drug and Alcohol Service (WANDAS). A standardised drug and alcohol assessment was undertaken at each trimester. Complications of pregnancy, birth, psychosocial risk and Child Protection and Family Support involvement (CPFS), as well as basic neonatal data, were analysed to investigate the maternal and neonatal outcomes associated with MA use in pregnancy.

Findings: One hundred and fifteen women from 220 women who attended the service consented to the study. There was one maternal death which occurred in the postnatal period from a drug overdose. The heaviest MA use (59.7%) was during the first trimester with intravenous being the most popular route (79.5%) and polysubstance use was common. Maternal characteristics found to be significant from MA use included complications of placenta praevia, hepatitis, renal issues, cardiac issues and psychosocial risk factors. Family and domestic violence (FDV) was common (86.6%) as were complex mental health issues (64%). Neonatal complications including prematurity, small for gestational age (SGA) 23.6%, lower Apgar scores and frequent admission to Special Care Nursery were evident.

Conclusions: Our results highlight the complexities associated with MA use in pregnancy. MA use is associated with complex medical and psychosocial issues in the mother and results in significant issues for the neonate. Early multidisciplinary specialist care is vital to address these issues and optimise outcomes for the woman, her baby and her family.

Keywords: *Methamphetamine; Pregnancy; Maternal Outcomes; Neonatal Outcomes; WA*

Background

Methamphetamine (MA) is the primary drug of choice for pregnant women attending a high -risk multidisciplinary service in Perth Western Australia. This has been the trend for the service over the past decade. The Women and Newborn Drug and Alcohol Service

(WANDAS) is midwifery-led multidisciplinary service with a philosophy of harm reduction, stabilisation and harm minimisation dedicated to caring for pregnant women with current alcohol and other drug use (AOD). The service offers midwifery care, addiction and drug and alcohol counselling, obstetric, social work, psychological medicine and neonatology care. MA is a highly addictive drug and is available in a crystalline form or as a white powder. The most common method of use is to smoke, swallow, inhale or inject, and it is widely available in WA [1]. Studies over the past two decades reported methamphetamine has replaced opiates as the primary substance used by pregnant women attending specialist drug and alcohol antenatal services [2,3]. MA use continued popularity worldwide [4] with Western Australia ranked as having the highest usage [5] poses serious concern for health providers. The shift to crystal MA use in Australia has seen mental health problems associated with drug substantially worsen. Women who use (MA) regularly, often experience symptoms of worsening of their mental health issues [6]. These include symptoms of drug-induced psychosis, depression, anxiety and also cognitive deficits. There are many complex health and social problems associated with MA use. These include fetal and infant disorders, obstetric and medical complications, homelessness, and domestic violence [7]. Women with MA use consistently report higher levels of emotional, physical and sexual abuse histories [8]. If pregnancy is a prime motivator for recovery, access to antenatal care by specialist teams are required to reduce poor outcomes [9].

There is a lack of knowledge about MA effects in pregnancy and by the limited amount of research compounded by using predominately retrospective study designs [8,10]. The 2016 National Drug Strategy Household Survey reported that 6.3% of Australian women over the age of 18 used amphetamines in pregnancy with MA being the most potent. The women reported higher doses compared to other drug use, earlier initiation of use and increase in risk-taking behaviours. This places the woman and her fetus at increased risk of poorer maternal and neonatal outcomes [1,5,11].

The studies focusing on pregnancy outcomes with MA use have been conflicting. There is limited information in the literature regarding pregnancy outcomes, specifically of outcomes in utero exposure [8,12-14]. The co-occurrence between mental health and substance use has not been clearly described. Existing research has demonstrated an association between maternal MA use and hospitalisation for complications during pregnancy [15], an increased risk for small for gestational age, low birth weight and premature births for infants [1,9,10,16,17]. Two small studies that evaluated the effects of methamphetamine use among pregnant women have found a statistically significant decrease in birth weight and head circumference among neonates who were born to women using MA compared with control subjects [18,19]. However, many of these studies were small and resulted in limited outcomes. One study, which was published in 2010 and examined 276 pregnant MA users, reported an association with preterm birth, low Apgar scores and increased risk for caesarean section and neonatal death. The US-based Infant Development, Environment, and Lifestyle (IDEAL) study followed the largest cohort of methamphetamine-using pregnant women and their children to date [20] and found an increased risk of small for gestational age (SGA), smaller head circumference and length and admission to SCN but had limited results from maternal outcomes.

Given this background that includes predominately MA use in our service, we sought to measure the associations between MA use in pregnancy and maternal and neonatal outcomes.

Methods: Design and Setting

Women who attended WANDAS and identified as using MA were approached and asked to participate in the study. The study was explained and informed consent was provided by all participants. Recruitment occurred from July 2015 to 2017. Women who consented to the study had basic socio-demographic information collected at the time of booking for antenatal care. A self- reported detailed drug and alcohol history was taken during the first second and third trimester of pregnancy using a validated assessment tool and an Audit C screen was undertaken [21,22]. No routine drug screening was performed because women were encouraged to engage in early antenatal care with the team, however, some women were urine drug-screened by Child Protection and Family Support (CPFS) and Drug court and the results were available to the team. Women were grouped according to their level of MA use: mild use 0-2 points per day, moderate use 3-5 points per day or heavy use 10 points (1 gram). Antenatal risk factors recorded included: smoking status; alcohol use;

substance use (methamphetamines, cannabis, and benzodiazepine); polysubstance use (use of 2 or more illicit drug); intravenous drug use; mental health diagnosis; criminal involvement requiring incarceration and family and domestic violence (FDV). Antenatal complications included, pre-eclampsia; antepartum haemorrhage, epilepsy, pregnancy-induced hypertension, hepatitis C status, cholestasis, cardiac issues including endocarditis, anaemia, threatened preterm labour; premature rupture of membranes; placenta praevia; gestational diabetes. Delivery data included induction of labour (IOL), gestational age at delivery and type of delivery. Neonatal outcomes included birth weight, head circumference, Apgar score, resuscitation (including any respiratory or cardiac assistance), admission to Special Care Nursery (SCN), Neonatal Abstinence Syndrome (NAS) and stillbirth. Developmental Outcomes using Griffith Developmental Scale was conducted at 12 months with results published elsewhere. Data were entered into a RedCap database [23].

Ethics approval was granted by Western Australia's Women and Newborn Health Service Human Research Ethics Committee, the Western Australian Aboriginal Health Ethics Committee, the University of Western Australia Human Research Ethics Committee and Child Protection and Family Support Ethics Committee. Exclusion criteria were intellectual disability, significant mental health issues affecting competence, and current treatment with methadone or Subutex for opiate dependence.

Statistical analysis

SPSS statistical software was used in data analysis (version 22.0, IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp). All hypothesis tests were two-sided and p-values < 0.05 were considered statistically significant. All analyses were adjusted for covariates, Pearson correlations, ANOVA and regression analysis results. Data were summarized by descriptive statistics. The associations between MA use and maternal and neonatal outcomes in the areas of interest, including maternal complications, preterm birth and small for gestational age (SGA) infants were adjusted for important covariates. Using the Australian Bureau of Statistics' Index of Relative Socio-economic Advantage and Disadvantage, the score corresponding to each mother's address was determined. This provided an additional measure of socioeconomic status for use in our analysis [24].

Findings: Maternal outcomes

Of 220 pregnancies 112 women were recruited including one twin pregnancy (dichorionic twins). Two women suffered fetal deaths in utero, and there was one stillbirth secondary to fetal abnormality and chorioamnionitis. One infant died at six weeks postnatal of Sudden Infant Death Syndrome (SIDS). There was one maternal death within 6 months post-birth.

MA use was the heaviest in the first trimester; 49.5% of women attended drug and alcohol counselling and tried to reduce their use in the second and third trimester. Smoking rates were high throughout pregnancy with 87.5% smoking between 5 and 20 cigarettes per day. Demographics are presented in table 1. The average age of women in this group was 29.6 years. Women in our group with heavy MA use had higher gravidity and parity, were more likely to suffer maternal complications such as blood-borne virus, placental abruption, preeclampsia and anaemia with 30.4% of the women requiring iron infusions during pregnancy for chronic iron deficiency. MA and nicotine are both powerful vasoconstrictors and their use in pregnancy has been shown to cause vasospasm increasing the risk of placental malfunction which has the potential to contribute to maternal complications [17].

Maternal Complications are reported in table 2. Aboriginal women were overrepresented in the group (52.7%) and were at higher risk of infant removal (30.8%). Overall 52.3% of our women had CPFS involvement for support and were mandated to perform urine drug screens and attend drug rehabilitation. The majority of the women (86.6%,) reported living in an environment where there were FDV and intergenerational drug and alcohol use. Socioeconomic disadvantage was consistent and homelessness a recurring theme with 12% of the sample reporting homelessness and another 12.5% seeking refuge support for FDV. Only 7.3% of our population was employed. Review of antenatal complications secondary to maternal drug use showed that 30.4% had detectable RNA pos Hepatitis C and were referred for follow up post-birth. Anxiety, depression and PTSD were more common with heavy MA use in pregnancy with 85% of the women were referred to psychological medicine and were commenced on SSRI treatment for their anxiety and depression (Figure 1). 34% of women reported a history of childhood sexual assault. There was a significant incidence of pregnancy-induced hypertension (PIH) with over

25.5% requiring treatment and monitoring of symptoms. The rate of essential hypertension was 13.6%. Cardiac issues-particularly endocarditis from IV use accounted for 33.6% of the women who required physician review and monitoring. Of the women who were treated for E-coli urinary tract infections, 21.8% had pyelonephritis which required hospital admission.

Maternal Data	M	SD and Percentages
Maternal age (Range 18-41)Gravida (Range 1-15) Parity (Range 1-6)	29.6 4 2	5.5 2 2
	N	**Percentages %**
Ethnicity		
Aboriginal	59	52.7
Caucasian	50	44.6
Other	3	2.7
Marital status		
Single	57	50.9
De Facto	38	33.9
Married	3	2.7
Separated	14	12.5
Education[a]		
Year 10 or above	102	91.1
Year 12	7	6.3
Higher education	1	0.9
Employment[b]		
Employed	8	7.1
Unemployed	100	89.3
Accomodation		
Rented	42	37.5
Living with family/friends	28	25.0
Owned	2	1.8
Refuge	14	12.5
Homeless	13	11.6
Prison	13	11.6
Delivery Method[c]		
SVD	64	57.1
C/S in labour	20	17.9
C/S no labour	20	17.9
Vacuum extension (venthouse)	5	4.5
IRSAD[d]		
< 1000	65	57.5
>= 1000	44	38.9
Child Protection		
CPFS involved	60	53.6

Apprehension	33	29.5
Discharged with parent	18	16.1
Smoking during pregnancy		
Yes	98	87.5
No	14	12.5
Alcohol intake[f]		
2-3 times per week	10	8.9
4+ times per week	4	3.6
2-4 times per month	3	2.7
Monthly or less	17	15.2
Never	76	67.9
Methamphetamine use		
Mild	28	25.0
Moderate	57	50.9
Heavy	27	24.1
Polysubstance		
Yes	48	42.9
No	64	57.1
Mental Health		
Effect on mental or psychological health	24	21.4
Diagnosed with a mental health condition	52	46.4
Anxiety issues or problems	23	20.5
Mood swings	22	19.6
Anger management	6	5.4
Other (i.e. Depression)	33	29.5

Table 1: *Maternal Data.*

[a]: The numbers add up to 110 because two were not stated.

[b]: The numbers add up to 108 because four were not stated.

[c]: The numbers add up to 109 due to two fetal deaths in utero and one still birth.

[d]: The numbers add up to109 because four were not stated.

[e]: The numbers add up to 111 because one was not stated.

[f]: The numbers add up to 110 because two were not stated.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.825[a]	.681	.679	3.292	.681	235.258	1	110	4.37E-29
a. Predictors: (Constant), EPDS At Booking									

The model shows that the independent variable (EPDS At Booking) statistically significantly predict the dependent variable (EPDS At 28 – 30 Weeks), F (1, 110) = 235.258, p < .0005.

EPDS At Booking vs EPDS At 28 – 30 Weeks Linear Graph

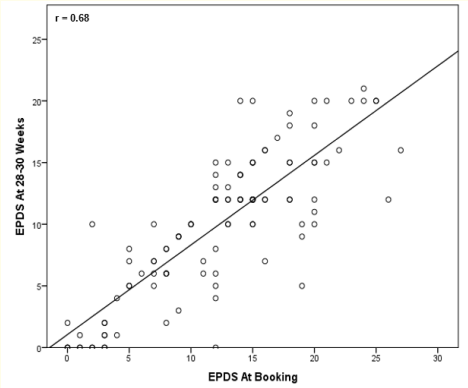

Figure 1: *EPDS at booking and 28 weeks.*

Maternal Complications	Frequency	Percent
Hepatitis C, PCR Pos	40	35.7
Pregnancy Induced Hypertension	28	25.5
Essential Hypertension	15	13.6
Gestational Diabetes	12	10.9
Placenta Praevia, APH	14	12.7
Anaemia and iron infusion	50	44.6
Intrauterine Growth Restriction (SGA)	15	13.3
Epilepsy	27	24.5
Endocarditis, cardiac issues including a heart murmur	37	33.6
Asthma	10	8.9
Pyelonephritis, Renal Issues, including UTI	24	21.8
Cholestasis	13	11.8
Chorioamnionitis	2	1.8
Threatened Preterm Labour	5	4.5

Table 2: *Maternal complications.*

In line with the national perinatal data approach to reporting, the onset of labour was categorised as spontaneous, induced, or no labour where a caesarean section was performed before labour had started [25,26]. In our sample, the onset of labour was spontaneous for 57.1% of women, and there was no labour as they had caesarean section 17.9% of mothers. The women attended the clinic on average for eight antenatal appointments, and ambulance cover was paid for by the team especially when the women had disclosed heavy use. The women were provided with contraception prior to discharge with the majority consenting to Implanon. Two women had hysterectomies as a result of maternal complications and 2% of women returned for tubal ligation.

Neonatal outcomes

Birth outcomes are reported in table 3. The mean Apgar score at 1 minute was 7.40 with an SD ratio of 2.33 and at 10 minutes the mean Apgar score was 8.64 with an SD of 1.4. The differences between MA use and pregnancy outcomes, such as preterm birth rates were high

(24.5%) and incidence of neonatal complications such as (SGA) 23.6% as a result of MA use was evident. Infants who required SCN admission for respiratory distress accounted for 37.5% of the sample. Resuscitation was required for 26.8% of our infants. One infant suffered from *E. coli* meningitis in the neonatal period requiring a longer SCN stay.

Number N = 112	Number (%)/Mean ↑Standard Deviation
Sex	
Male	61 (54.0%)
Female	52 (46.0%)
Gestation	37+6 weeks (1.7)
Term	83 (75.5%)
Preterm	27 (24.5%)
Birth Growth Parameter Centile	
Weight	29th
Head Circumference	31.5 th
Length	29th
Birth Weight	
Small for Gestational Age	26 (23.6%)
Appropriate for Gestational Age	77 (70%)
Large for Gestational Age	7 (6.4%)
Special Care Nursery Admission	
Yes	43 (41.0%)
No	62 (59.0%)
Department of Child Protection and Family Support (CPFS)	
No Involvement	18 (16.5%)
Involved with CPFS but Child under Maternal Care	58 (53.2%)
Child Removed under a Section 37 Order and removed from maternal care	33 (30.3%)
Footnote: SD Except for Growth parameter	Where median is given

Table 3: *Neonatal data.*

All infants were provided with a postnatal stay of five days as per guidelines and they were monitored for signs of Neonatal Abstinence Syndrome using the Finnegan's scale. The mean NAS score was 2.99 and mothers were encouraged to commence early and frequent feeding of their infant. A common issue in the postnatal period for these infants was poor weight gain which required a longer inpatient stay 27.7% of infants had an increased length of stay for feeding issues and failure to gain weight. Nine of our infants returned to maximum-security prison once delivered.

Breastfeeding rates at birth were (58%) and a combination of breast and bottle was used by a small percentage. The remaining 38.4% of women bottle-fed their infants. MA is excreted significantly in breast milk [27]. The half-lives of MA in breast milk are 13.6 hours [28]. Women were counselled in safety planning around MA use and breastfeeding [29] as per WHO guidelines.

Discussion

This study from a Specialist Drug and Alcohol service has experienced an overall prevalence of MA use in pregnancy. The women in this cohort likely represent the most complex and severe end of the spectrum where antenatal MA use is concerned. Our study demonstrated many characteristics associated with high-risk pregnancy outcomes (both maternal and neonatal) [8,30-33].

In our study, we found that MA use places the women and infant at increased risk from psychosocial and potential poorer outcomes which compares well with the IDEAL study [20,34]. Our birth outcomes especially normal delivery and lower caesarean rates, when compared to IDEAL study, were reassuring. Maternal complications correlated with MA use in our sample, including pregnancy-induced hypertension, Hep C, mental health issues, placental abnormalities and cardiac and renal issues can impact fetal growth and developmental outcomes.

Significantly fewer women in our study (17.9%) had a caesarean section compared to the national birthing population. Nationally, nearly 12% of mothers had an instrumental vaginal birth where either forceps or vacuum extraction was used, compared to 4.5% for our cohort The caesarean section rate in Australia continues to rise [35] existing research demonstrates women living in major cities, married and more educated women, and those who were less stressed about money were more likely to have an elective caesarean, but not an emergency caesarean, compared to vaginal delivery [35], higher maternal age and holding private health insurance were each associated with having a caesarean section. Women who had caesarean sections for their first births were also more likely to be short-statured, overweight, or obese while our cohort is generally underweight, unemployed and live in socially disadvantaged areas. Despite the low prevalence of diabetes, it was significantly associated with having a caesarean section with caesarean rates increasing nationally to 32.3% in 2016 [36].

Neonatal complications were common with MA use. We found that prenatal exposure places the neonate at risk of growth restriction which is consistent with IDEAL study and others [14,16,37]. Of the live-born infants in our study 24.8%, were premature (< 37 weeks gestation at birth). The mean birth weight was 2.994 grams and mean head circumference was 33.4 cms which compares to IDEAL study. The factors contributing to infant outcomes are that our women used MA more frequently on average during pregnancy (95.5% using at least weekly vs. 60.8% in the IDEAL cohort). Of the 41% of neonates who were admitted to SCN, 26.6% required Continuous Positive Airway Pressure (CPAP). Birth weight for 23.8% of the infants was below the 10th centile for gestational age. Figure 2 demonstrates how persistent MA use was associated with birth weight, gestational age and prematurity on regression analysis when compared to maternal dose calculated as heavy use throughout each trimester.

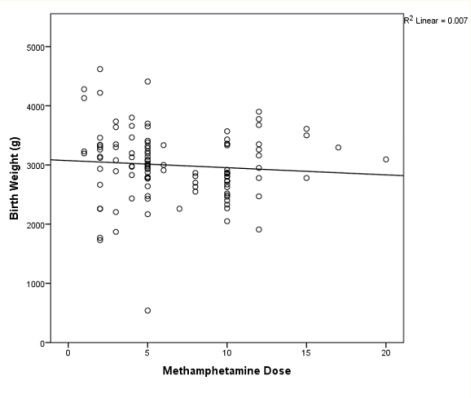

Figure 2: *Birth Weight Vs Methamphetamine Dose.*

Neonatal complications were not solely limited to clinical outcomes but demonstrated the potential breakdown of mother-infant bonding as demonstrated with the high rates of CPFS involvement, and high rates of infant removal into out of home care. Many of our women had previous children removed from their care and feared CPFS intervention.

A key to improving outcomes is engagement in antenatal care with a specialist multidisciplinary team. The psychosocial risks of poor mother-infant bonding due to higher rates of CPFS involvement, prison terms, and removal of infants with maternal mental health issues, FDV, MA use and trauma was very evident within our cohort. Studies have suggested that a multidisciplinary team is a gold standard for the provision of care to vulnerable women, and access to care is seen to improve outcomes [38]. MA using mothers have been identified by the National Institute for Health and Clinical Excellence as needing supportive and coordinated care during pregnancy [39,40]. Many authors [39,41-44] found that pregnant women were reluctant to access care due to perceived barriers including difficulties identified around access, fear of judgement and shame, fear of child protection agencies and removal of children from the family. Department of Health and Aging [45-47]; recommends that a multidisciplinary approach would enable the provision of ongoing care to ensure access to specialist medical services that can occur seamlessly while maintaining continuity of care for high-risk women in pregnancy and follow up of women and their children into the post natal period.

Limitations

The limitations of this study were the lack of a comparable control group; the reason for this is the availability of only one Specialist drug and alcohol service in WA, providing care to this discrete group. As a single-site study which may limit generalisability to other populations. There was no systematic urine drug screening done on the women by the team, as the philosophy for antenatal engagement is seen as a priority to this vulnerable group and engagement with the team imperative. High polysubstance use, confounding psychosocial variables and smoking tobacco makes it difficult to conclude that MA use alone correlates to poorer maternal and neonatal outcomes.

Conclusion

MA use in pregnancy is associated with significant obstetric and neonatal risk factors. Our study emphasised the complexity of continued MA use, which exposed the women to higher risk pregnancies with potential poorer outcomes such as psychosocial and obstetric risk and preterm/SGA infants. Resources are required to ensure access to perinatal care by providing wrap-around care from a specialised drug and alcohol service with long term follow up and referral to specialist services in order to detect and manage poorer outcomes in this vulnerable group.

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