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Original Research

HOSPITAL OUTCOMES FOR NEONATES EXPOSED TO METHAMPHETAMIN PRENATALY

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Abstract: **Objective:** Methamphetamine use remains a problem with a reported prevalence of 14 to 57 million of all 15-64-year-olds in the United States. However, there is limited knowledge about neonatal outcomes following *in utero* exposure to methamphetamine. This study describes the short-term outcomes of infants born with a confirmed methamphetamine exposure.
Study Design: A retrospective chart review was conducted and a total of 51 neonates were found to have a positive drug screen.
Result: Neonatal subjects had an average gestational age of 38 weeks and an average birth weight of 3.142 kg. Twenty-six neonates (50.98%) were admitted to the NICU with an average stay of 11.12 days. Maternal subjects were primarily Caucasian, had not obtained a high school diploma, frequently used tobacco, and had public insurance.
Conclusion: Many of our findings were similar to the 2014 Infant Development, Environment, and Lifestyle Study (IDEAL). A large percentage of our patient population required NICU admission. However, the infants were of average size and gestational age.

Keywords: Neonatal outcome, methamphetamine, prenatal care, methamphetamine-exposed infant's financial burden

INTRODUCTION Methamphetamine is a central nervous system stimulant that acts to release dopamine and serotonin, block monoamine reuptake mechanisms, and inhibit monoamine oxidase [1]. Methamphetamine-use in young people, including women of reproductive age, remains a problem with a reported prevalence of 14 to 57 million among 15-64-year-olds [2]. The Infant Development, Environment, and Lifestyle Study (IDEAL) found that approximately 5.2% of pregnant women used methamphetamine at some point during their pregnancies [1].

In older populations, methamphetamine is associated with increased wakefulness and physical activity, hypertension, tachycardia, altered mental status, anorexia, and weight loss [3]. Prenatal methamphetamine exposure is associated with congenital diseases and malformations, such as cleft lip or palate, cardiac anomalies, low birth weight, cerebral hemorrhage, and increased risk of infant mortality [3]. Methamphetamine also has vasoconstrictive properties and can decrease placental oxygen and nutrient delivery to fetuses [4]. Neonatal abstinence syndrome is traditionally associated with opioid exposure *in utero*; however, a retrospective study from 2003 reported that withdrawal symptoms were observed in 49% of their subject population and 4% of this population required pharmacologic intervention [5,6].

These infants are frequently born to mothers of lower socio-economic status, with histories of mental illness, and additional substance abuse [3]. Due to the risk of significant complications, these infants are frequently admitted to the NICU for observation and management. A 2012 study found that 35% of methamphetamine-exposed infants were admitted to the NICU [3].

Although methamphetamine use during pregnancy remains a problem, there have been very few recent studies to categorize and describe the hospital course and

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outcomes of infants exposed to methamphetamine prenatally [7]. One of the largest of these studies was the IDEAL study published in 2014 [2] The purpose of our study was to describe the outcomes of infants born at our hospital with a confirmed methamphetamine exposure.

MATERIALS AND METHODS

Study Design and Inclusion Criteria: This study was a retrospective chart review. All cases of newborns possibly affected by substance abuse at our hospital between January 1, 2014, through December 31, 2017, were identified by searching ICD-9 and ICD-10 codes consistent with substance abuse diagnoses. This study has been approved by our IRB.

Study Procedure: Approximately 150 charts were identified by medical records using the following ICD codes: P961 (neonatal withdrawal symptoms from maternal use of drugs of addiction), P0449 (newborn affected by maternal use of other drugs of addiction), P048 (newborn affected by other maternal noxious substances), P049 (newborn affected by maternal noxious substance, unspecified), and F1510 (other stimulant abuse, uncomplicated), F1511 (other stimulant abuse, in remission), F15120 (other stimulant abuse with intoxication, uncomplicated), F12121 (other stimulant abuse with intoxication, delirium). The chart was included in the study if a positive urine or meconium drug screen was found. Fifty-one neonatal subjects and 41 maternal subjects met inclusion criteria. Following subject selection, maternal subjects were categorized based on the following: maternal type of health insurance, maternal level of education, race, age, number of prenatal visits, and any additional prenatal substance-use such as alcohol- and tobacco-use during pregnancy. Neonatal characteristics were categorized by estimated gestational age, birth weight, birth length, head circumference, length of stay, signs of withdrawal, neonatal abstinence syndrome, and any NICU admission.

RESULTS A total of 51 neonatal subjects and 41 maternal subjects were included in this descriptive study. Average estimated gestational age was 38 weeks. Average birth weight was 3.15 kg. Average birth length was 49.08 cm. Average birth head circumference was 33.66 cm. Of the 51 neonatal subjects, 26 (50.98%) were admitted to the ICU. The average number of days spent in the nursey was 3.2 days, and the average number of days spent in the NICU was 11.12. Primary and subsequent diagnoses for those requiring NICU admission are shown in Table 1.

Diagnosis	***Number of Cases***
Sepsis	8
Sepsis Evaluation	8
Pending Child Protective Services Disposition	7
Respiratory Distress Syndrome	7
Transient Tachypnea of the Newborn	5
Hypoglycemia	5
Neonatal Abstinence Syndrome	4
Difficulty with Feeding	4
Hypoxia	1
Apnea and Bradycardia	1
Melena	1
Hypothermia	1
Perinatal HIV Transmission	1
Elevated Magnesium	1
Herpes Simplex Virus Infection	1
Prematurity	1
Right-sided Pneumothorax	1
Right-sided Pneumomediastinitis	1
Meconium Aspiration Syndrome	1
Infant of a Diabetic Mother	1
Physiological Hyperbilirubinemia	1
Congenital Heart Disease	1
Gastrointestinal Bleed	1
Gastroschisis	1

Table 1. The number of cases for primary and subsequential diagnoses requiring NICU admission.

Of the 51 neonates included in the study, 31 underwent Finnegan Scoring. Only 4 neonates received 3 consecutive scores >8 indicating that they would require treatment for neonatal abstinence syndrome.

Maternal demographics are presented in Table 2.

Maternal Demographics		***Number***	***Percentage***
Race	Caucasian	33	80.49%
	African American or Black	2	4.88%
	Asian	1	2.44%
	Hispanic	0	0%
	Other	5	12.20%
Education	Less than high school		
	High school diploma	6	14.63%
	Some college	8	19.51%
	Associate degree	1	2.44%
	Bachelor's degree	0	0.00%
	Post-graduate education	0	0.00%
	No document-tation of education	0	0.00%
	Total	26	63.41%
Age (years)	M±SD	27.37	26

Table 2. Maternal demographics, including ethnicity, education level, and age in years.

The average number of prenatal visits was 3.59. Additional perinatal substance-use included 0 cases of alcohol-use (0%), 28 cases of tobacco-use (68.29%), 12 cases of marijuana-use (29.27%), and 5 cases of other substance-use (12.20%). Tobacco-use was the most frequent substance used in addition to methamphetamine. Most maternal subjects (39 [95.12%]) had access to Medicare/Medicaid. Only one maternal subject had no health insurance, and one mother had access to other types of health insurances such as PPO, POS, or HMO.

DISCUSSION This study found that neonates exposed to methamphetamine *in utero* were frequently admitted to the NICU (50.98%) and remained there for an extended amount of time (11.12 days). Of the 26 infants admitted to the NICU, 7 infants (26.92%) remained in the NICU due to Child Protective Services' (CPS) decisions on placement of the children. Neonates with a positive drug screen require a social services consult, and likely involvement of CPS. Typically, infants cannot be discharged until CPS establishes a plan of care for the infant. As a result, these days spent in the NICU were likely a direct outcome of maternal substance-abuse. These NICU stays add to the financial burden, costing an average of $25,000-29,000 per baby [8]. In our hospital, these babies ended up in the NICU due to social services status. With the number we have in this study, our NICU would average 6-7 babies admitted per year for this reason, an estimated cost of $162,500 per year. However, as will be stated in the study limitations, this study might have missed several babies because of the way the data were collected. The annual cost could be higher.

Four of the infants requiring NICU admission were diagnosed with Neonatal Abstinence Syndrome. While other studies have observed 49% of their populations exhibiting withdrawal symptoms and up to 4% requiring pharmacological intervention, only 15.38% of our population exhibited withdrawal symptoms. These NICU admissions were a direct outcome of maternal substance-abuse, so at least 11 of the 26 infants who were admitted to the NICU were admitted as a direct consequence of methamphetamine-use during pregnancy.

Like the IDEAL study, the anthropometric measurements of the babies in our study are shown to be appropriate for their gestational age [2]. Although other studies demonstrated growth restrictions, our population did not support this finding [7,9]. Additionally, the average

gestational age of the babies in our study was consistent with a normal pregnancy, and our results do not support findings that methamphetamine is associated with prematurity [7,9].

Other studies found that prenatal methamphetamine exposure was associated with significant congenital diseases and malformations, such as cleft lip or palate, cardiac anomalies, low birth weight, cerebral hemorrhage, and increased risk of infant mortality [3]. Our study had two infants with congenital defects (congenital heart disease and gastroschisis), but we were unable to say if prenatal methamphetamine-exposure resulted in these findings.

While the IDEAL study found that 45% of methamphetamine-exposed maternal subjects had not received a high school diploma, the demographics of the mothers in our study showed approximately 14.63% had not received a high school diploma [2]. The average and median number of prenatal visits were 3.58 and 3, respectfully. Of the 41 maternal subjects, 36 used additional substances throughout their pregnancies with tobacco being the most frequent additional substance, followed by marijuana, other drugs included opiates, and benzodiazepines. These findings are also similar to the IDEAL study which reported 80% of their methamphetamine-exposed maternal subjects also used tobacco products.

There are a few limitations that may have impacted the results of our study. The exposed group of subjects were selected using ICD-9 and ICD-10 codes. This could potentially have left out qualified subjects who did not have the correct ICD-9/ICD-10 codes added to their charts. In addition, failure to document certain characteristics, such as maternal level of education or race, may have impacted the results found in this study.

CONCLUSION Overall, many of our maternal and infant findings were similar to those of the 2014 IDEAL study. We found that a large percentage of our patient population required NICU admission, however the infants in our study were average in size and gestational age, and the majority were born without birth defects.

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