

## Pregnancy and Fetal Loss Reported by Methamphetamine-Using Women

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**ABSTRACT:** To better understand substance use disorder treatment needs of pregnant and parenting women who use methamphetamine (MA), this paper describes pregnancy histories and fetal losses for women who were treated for MA use (N = 153) with reference to a national sample, and describes their drug use, sexual risk behaviors, and mental health status. MA users reported an average of 4.6 total pregnancies and 2.1 fetal losses, whereas women in a general population survey reported 3.2 and 1.2, respectively. Higher numbers of pregnancies and fetal losses were correlated with specific substance abuse and mental health problems including early sexual abuse and cognitive problems. The combination of MA users' especially high numbers of pregnancies, fetal losses, and rates of risk behaviors suggest high social and health care costs for this population. Prenatal care may provide a vector through which women can be connected to risk reduction interventions and gender-responsive treatment services addressing substance use and mental health needs.

**KEYWORDS:** methamphetamine, pregnancy, fetal loss, substance abuse treatment

**CITATION:** Brecht and Herbeck. Pregnancy and Fetal Loss Reported by Methamphetamine-Using Women. *Substance Abuse: Research and Treatment* 2014;8:25–33 doi: 10.4137/SART.S14125.

**RECEIVED:** January 8, 2014. **RESUBMITTED:** February 19, 2014. **ACCEPTED FOR PUBLICATION:** February 21, 2014.

**ACADEMIC EDITOR:** Gregory Stuart, Editor in Chief

**TYPE:** Original Research

**FUNDING:** This research was supported by a grant from the National Institute on Drug Abuse (R01-DA11020 and DA025113).

**COMPETING INTERESTS:** Authors disclose no potential conflicts of interest.

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The impact of methamphetamine (MA) use on women warrants attention because of its deleterious physical and psychological effects and related social costs.<sup>1,2</sup> Increases in MA use over the past two decades have created an imperative to better understand its use context, its impact on women's health, and potential social implications in order to form a basis for modification and development of prevention and intervention efforts.<sup>2,3</sup> This imperative is especially important for pregnant women, because the consequences of maternal drug use and related life style are experienced by both the user and the developing fetus. A study of illicit drug use overall found drug use among women escalates more rapidly to addiction than does drug use among men, and women are at greater risk for relapse than men.<sup>4</sup> Specific to MA, women may be at risk for more severe MA dependence compared to men, as indicated in a study by Maxwell<sup>2</sup> that showed women became dependent on MA sooner than men, initiated MA use to attempt to alleviate depression, and had higher rates of

childhood sexual abuse than men. Rawson et al<sup>5</sup> found that young women reported more MA use, became dependent on MA within a shorter period of time, and suffered more adverse effects than did young men; in addition, after controlling for age and race, more women than men were dependent on MA and identified MA as their primary drug of choice.

Moreover, recent research indicates MA use is associated with fetal problems and poorer birth and childhood outcomes; for example, findings from the IDEAL study show prenatal exposure to MA was associated with increased physiological stress, lower arousal, and childhood neurobehavioral disinhibition.<sup>6,7</sup> However, little has been published about female MA users' reproductive histories and related context. This study contributes to the needed knowledge base by describing self-reported numbers of pregnancies and fetal losses among MA-using women, and compares this sample of women with national statistics. In addition, we examine the association of reproductive history with drug use severity



and related problems, in order to identify subgroups of women who may be at higher risk for poor health and child welfare outcomes. Our findings provide information on the health and treatment needs of MA-using pregnant and parenting women, and help define the magnitude of potential health and child welfare problems related to MA use. Results may inform the development and refinement of gender-sensitive treatment programs that provide services to MA-using women and their children.

MA is now labeled a principal drug threat because of epidemic increases in its use<sup>8</sup>; after a short period of decline in 2005–2007, MA use has again increased in the United States.<sup>9,10</sup> Although MA use had long been considered a regional (West Coast) phenomenon in the US, with dramatic increases in that region in the mid-1990s, its use has continued to spread to other areas of the country, including rural, urban, and suburban sections of the South and Midwest.<sup>11,12</sup> Analysis of the treatment episode data set (TEDS) confirms this geographical pattern, and indicates that a shift in use from an initial concentration of predominantly white women to an increasing proportion of Hispanic women has been observed.<sup>13</sup> These data show MA treatment admissions for pregnant women rose from 8% in 1994 to 24% in 2006, leading the authors to conclude that MA is the primary substance of abuse for which pregnant women seek care. Worldwide, as many as 56 million individuals globally are estimated to be users of amphetamine-type substances,<sup>14</sup> ranking this group of drugs (of which MA is the primary example) as second in worldwide illicit drug use. Its use has been documented in 110 countries, with greater prevalence in East and South East Asia, North America, South Africa, New Zealand, Australia, and several European countries<sup>15</sup>; MA has been identified as the primary illicit drug threat in Asia.<sup>16</sup>

Owing to MA-related behaviors such as initiation of use during adolescence, increased sexuality, and injection use, MA users are at increased risk for HIV, hepatitis, risky sexual behaviors, teenage pregnancy, and potentially high rates of pregnancy.<sup>17–21</sup> Pregnant women dependent on MA are at risk for multiple complications including preterm delivery, cesarean delivery, and neonatal mortality.<sup>22</sup> Beyond the potential for contributing to negative fetal and birth outcomes, MA use by women also contributes to high-risk environments for their children.<sup>23,24</sup>

Self-report data from a larger study of the natural history and outcomes of treatment for MA use allow description of reproductive history, including pregnancy incidence and fetal loss, reported by a diverse sample of women with a history of MA use and treatment. This paper also compares lifetime pregnancy rates reported by these women across ethnic groups and to national rates. To provide some context for these figures, we also describe their sexual risk behaviors, drug use history, mental health status, and the extent to which pregnancy is reported as a reason for changing MA use or for entering treatment. The aggregate picture of reproductive

history and its context in this MA-using sample is compelling in its illustration of high risk and potential social cost.

## Methods

**Sample.** Data are from the 153 female participants in a study of the natural history of MA use and substance use disorder (SUD) treatment outcomes. Interviews were conducted in 1998–2000, with clients who had been treated for MA use in publicly funded Los Angeles County treatment programs. The parent study selected a stratified (by gender, ethnicity, and type of treatment [residential or outpatient]) random sample of MA-related admission records in the California state SUD data system (California Alcohol and Drug Data System [CADDSS]), primarily from 1996, with a few in late 1995 or early 1997 to allow adequate cell sizes for underrepresented subgroups). These clients were invited to participate in the study by their treatment providers. A 76% interview rate was achieved from sampled admissions who could be located: 350 usable interviews were obtained, 15 had incomplete interviews, 88 declined participation, 28 expressed interest but did not schedule or complete interviews, 6 had died; an additional 151 sampled admissions could not be located. A comparison of data available from admission records for the interviewed and not-interviewed subgroups showed no significant differences in gender, education, age of first MA use, age at sampled treatment episode admission, number of prior treatment episodes, employment status, whether homeless, pregnant, or under legal supervision. (Additional descriptions on study and interview procedures and sample characteristics appear in Brecht et al and von Mayrhauser et al.<sup>25,26</sup>) The Institutional Review Board at the University of California, Los Angeles approved this study, and participants provided written informed consent.

**Instrument.** Face-to-face interviews were conducted using the Natural History Interview (NHI) protocol, which has over 30 years of use in substance abuse research with acceptable levels of reliability.<sup>27–29</sup> The NHI assesses socio-demographic and other background characteristics; substance use, sexual risk, and criminal behaviors; and physical and mental health characteristics. A timeline followback segment collects detailed life history of substance use, treatment utilization, criminal behavior, and legal status.

**Measures.** The NHI provided self-report data for this analysis from questions including total number of pregnancies, number that ended in live births, number that terminated without a live birth (labeled “fetal loss” in this paper), and the number that terminated before six months, and at or after six months. Respondents were not asked to distinguish between induced abortion and other fetal loss. Women were also asked whether any of their biological children had a physical, mental, or learning disability (however, specific disabilities were not assessed). To keep interviews at a feasible length, participants were asked for additional detail on up to five of their children; thus more detailed data were available for a total of



362 children. As this was not a clinical study, women were not asked detailed questions about each pregnancy; thus data represent a general picture of occurrences during a life period that involved MA use. Sexual risk items included number of partners and use of condoms in the 30 days preceding the interview. Items from the timeline followback segment provided data on reasons for changes in MA use patterns and for treatment entry.

Substance use behaviors were assessed, including past month use of MA, any past regular use of crack/cocaine (categorized as no/yes), age of MA initiation, and age of initiation of regular MA use. To further assess drug use severity, an overall poly-drug indicator was calculated, indicating the number of types of drugs ever used (from cocaine, crack, ecstasy, phencyclidine, inhalants, hallucinogens, opiates including heroin, tranquilizers, and downers). A composite MA problem score (possible range 0–7) was calculated to indicate the number of physical/mental health problems women reported as resulting from their MA use (ie, weight loss, sleeplessness, paranoia, hallucinations, dental problems, skin problems, and high blood pressure).

Regarding mental health status, respondents reported whether they had experienced specific mental health problems that were not a direct result of drug or alcohol use prior to their treatment episode for sampling or in the past 30 days, including serious depression or anxiety that lasted two or more weeks, trouble concentrating/understanding/remembering (ie, cognitive problems) that lasted two or more weeks, and trouble controlling violent behavior. Respondents were also asked whether they ever seriously considered committing suicide, and those who did were asked whether they ever attempted suicide. Lastly, respondents were asked whether they experienced physical abuse (ie, having been hit or beaten so hard that you had cuts or bruises, had to stay in bed, or had to see the doctor) and sexual abuse (ie, forced or pressured to do any sexual acts against your will), and how many times this happened before age 15 (labeled “early physical abuse” and “early sexual abuse” in this paper).

**Analysis.** Analyses include percentages or means as appropriate of distributional characteristics. Ethnic subgroup comparisons were made using ANOVA. Comparisons were made against national figures using one-sample *t*-tests or goodness-of-fit chi square.<sup>30</sup> National data used for comparison purposes are from the National Center for Health Statistics.<sup>31</sup> Comparison data were selected for 1995 as representative of the broader time frame covered by the study participants’ MA use and reproductive histories. Statistics from this report used for comparison are estimated lifetime pregnancy and live birth rates; the difference between these two indicate rate of pregnancies not resulting in a live birth (including induced abortions and other fetal loss).

To examine the association of sexual risk behaviors, drug use, and mental health status with pregnancy outcomes (total number of pregnancies and pregnancies that did and

did not end in live birth), Pearson correlation analyses were conducted for continuous variables and independent samples *t*-tests were conducted for categorical variables. Unless otherwise indicated, the significance level (two-tailed) was set at  $P < 0.05$ .

## Results

**Sample description.** This diverse sample of 153 women was 11% African-American, 29% Hispanic, 55% non-Hispanic white, and 5% multiracial or other ethnicity. The group was split almost equally into three education categories: less than high school (31%), high school graduate (35%), and at least some college (33%). A wide range of income was represented (\$0–289,000); however, the median was \$16,000. Of these women, 88% have children. At the time of the interview, 40% had never been married and 19% were married. The average age at the time of the interview was 31.7 years (range 18–51). The average age of first MA use was 18.5 years and of regular MA use was 20.0 years. About one-third (32%) had used one or more illicit drugs during the month preceding the interview; 16% had used MA. Sixty-nine percent were current smokers at the time of interview.

**Pregnancies, fetal losses, births.** Among the 151 of the women who reported pregnancy data, there were a total of 697 pregnancies over their reported lifetimes, 398 (56%) of which resulted in live births; 285 (41%) were lost before six months, and 14 (2%) were late-term losses. (Note that two women did not answer the items relating to pregnancy.)

The sample of 153 women reported a total of 402 children, including 8 sets of twins; 4 children had died. The mother’s age at the child’s birth (for the set of 362 children with detailed data) ranged from 14 to 40, with an average of 23.5 years. Seventy-nine percent of these children were born after the mothers had initiated MA use. Forty percent of these children were born when mothers were 20–24, a high MA-use period (considering the average age of regular MA use of 20 and an additional average of 7.3 years until first treatment). Among women with children in this sample, 31% reported having a child with a physical, mental, and/or learning disability.

**Comparison of pregnancies and fetal losses to national statistics.** While 1995 national statistics show an overall lifetime pregnancy rate of 3.2 per woman,<sup>31</sup> the MA sample showed a significantly higher ( $t = 4.63$ ,  $df = 150$ ,  $P < 0.001$ ) overall average of 4.6 even though 82% of the study sample were still under age 40 and thus may not have completed their fertility period. In this MA sample, Hispanics and non-Hispanic whites had somewhat similar pregnancy rates of 4.4 and 3.9, respectively, while African-Americans had a rate of 8.2 ( $F = 10.04$ ,  $df = 2,141$ ,  $P < 0.001$ ). These figures contrast sharply with national figures for non-Hispanic whites (MA sample 3.9 vs. national average 2.7,  $t = 3.89$ ,  $df = 83$ ,  $P < 0.001$ ) and African-Americans (MA sample 8.2 vs. national average 4.6,  $t = 2.03$ ,  $df = 16$ ,  $P = 0.029$ ), while no significant difference was seen for Hispanics (MA sample 4.4



vs. national average 4.6). The MA sample also had higher than usual average number of pregnancies that ended without a live birth: 2.1 per woman vs. a national lifetime average of 1.2 ( $t = 3.40, df = 150, P < 0.001$ ). Results showed ethnic differences ( $F = 6.68, df = 2,141, P = 0.002$ ) with African-Americans having the highest rate, of 4.1 per woman, of pregnancies ending without a live birth; Hispanic (1.3) and non-Hispanic white (1.9) rates were each significantly lower than that of African-Americans. Comparison to national figures shows a significantly higher average number of losses for non-Hispanic whites (MA sample 1.9 vs. national average 0.9;  $t = 2.39, df = 83, P = 0.009$ ). A higher (but not significantly) average also resulted for African-Americans (MA sample 4.1 vs. national average 2.4;  $t = 0.87, df = 16, P = 0.200$ ); note that this is a small subgroup in the MA sample with large variability for this variable. Figure 1 shows the average number of pregnancies per woman for each ethnic group, as well as the average per woman of pregnancies that ended without a live birth. While the fetal loss average per woman differs among ethnic groups, the overall percentages of fetal loss of total pregnancies show a slightly different picture: similar at 50% for African-Americans and 49% for non-Hispanic whites, and the lowest for Hispanics at 28%. In our sample overall, no significant differences were seen in pregnancy rates, fetal losses, or live births by MA users' educational level or income level.

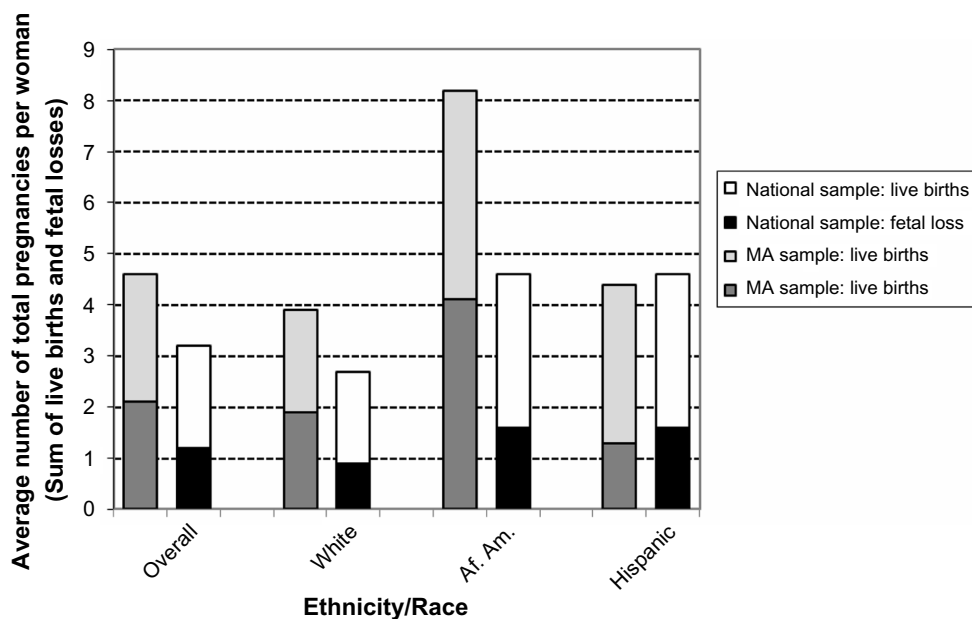
**Sexual risk behaviors and reasons for changing MA use.** Although these women had all been admitted to SUD treatment at least once, there were still high levels of sexual risk behaviors at the time of the interview. Of the two-thirds of the women who were sexually active in the month preceding the interview, only 5% reported always using a condom during this month. Condom use varied by age group and marital

status: among those married, 13% of those 18–29 years of age and 0% of those 30 years or older reported always using a condom; among those not married, 8% of those 18–29 years, 3% of those 30–39, and 0% of those 40 and older reported always using a condom. Of the 57 women who reported drug use and/or alcohol intoxication during the month preceding the interview, 28% reported combining substance use with sex at least half the time.

Only 44% of women mentioned pregnancy as a reason for changing their pattern of MA use. Fewer women reported entering SUD treatment because of a pregnancy: of the 143 women who been pregnant, 84% said that pregnancy had no effect on their decisions to enter treatment, 15% said that it encouraged them to enter treatment, and 1% to stay out. All but three women resumed or increased MA use after at least one of their pregnancies, with about one-third of explanations of relapse being associated with pregnancy, including to “lose baby fat,” to “have energy for kids,” because “I wasn’t pregnant anymore,” and “I felt so bad about my baby being taken away.”

Anecdotal evidence from a supplemental in-depth qualitative interview exemplifies one intersection of MA use, pregnancy, and treatment entry. For example, one woman reported 20 pregnancies, 17 of which ended with abortion: with her first pregnancy at age 14, she stopped using all substances and “the baby was ok”; with the two other pregnancies she carried to term, she “used everything” until the last two months. She indicated abstaining from MA for brief periods before her health care visits during pregnancy because she did not want her substance abuse detected.

**Pregnancy outcomes related to sexual risk, drug use, and mental health status.** Pregnancy outcomes based on



**Figure 1.** Average number of pregnancies, live births, and pregnancies ending without live birth. (General population data from Ventura et al.<sup>31</sup>).

**Table 1.** Mean (SD) number of reported pregnancies, live births and fetal losses based on whether drug use or mental health problems were reported.

	MEAN NUMBER OF PREGNANCIES	MEAN NUMBER OF LIVE BIRTHS	MEAN NUMBER OF FETAL LOSSES
<b>Used crack/cocaine regularly</b>			
No	3.7 (2.1) <sup>a</sup>	2.7 (1.8)	0.9 (1.1) <sup>c</sup>
Yes	5.2 (4.5) <sup>a</sup>	2.6 (2.1)	2.6 (3.4) <sup>c</sup>
<b>Used MA in past month</b>			
No	4.6 (3.9)	2.6 (2.0)	1.8 (3.0)
Yes	4.6 (2.8)	2.5 (1.6)	2.1 (1.8)
<b>Ever considered suicide</b>			
No	4.6 (2.5)	3.0 (1.9) <sup>b</sup>	1.5 (1.7)
Yes	4.5 (4.8)	2.2 (1.9) <sup>b</sup>	2.3 (3.6)
<b>Ever attempted suicide</b>			
No	4.5 (2.7)	2.8 (1.9)	1.6 (2.0)
Yes	4.7 (5.7)	2.2 (2.0)	2.5 (4.2)
<b>Mental health problem prior to treatment:</b>			
<b>Anxiety</b>			
No	4.5 (2.8)	2.6 (1.9)	1.7 (2.0)
Yes	5.0 (5.1)	2.7 (2.0)	2.2 (3.9)
<b>Depression</b>			
No	4.0 (2.9) <sup>a</sup>	2.2 (1.9) <sup>b</sup>	1.7 (2.1)
Yes	5.3 (4.5) <sup>a</sup>	3.1 (1.9) <sup>b</sup>	2.1 (3.4)
<b>Cognitive problems</b>			
No	4.2 (2.6) <sup>a</sup>	2.6 (1.9)	1.5 (1.9) <sup>c</sup>
Yes	6.5 (6.1) <sup>a</sup>	3.0 (2.3)	3.3 (4.7) <sup>c</sup>
<b>Violent behavior problems</b>			
No	4.2 (2.6)	2.5 (1.9)	1.6 (1.8)
Yes	5.8 (5.9)	3.0 (2.1)	2.8 (4.6)
<b>Mental health problem in past month:</b>			
<b>Anxiety</b>			
No	4.2 (3.1)	2.6 (1.9)	1.6 (2.1) <sup>c</sup>
Yes	7.4 (6.5)	2.9 (2.2)	4.5 (5.5) <sup>c</sup>
<b>Depression</b>			
No	4.6 (3.5)	2.6 (2.0)	1.9 (2.6)
Yes	4.5 (5.2)	2.6 (1.9)	1.9 (3.8)
<b>Cognitive problems</b>			
No	4.0 (2.6) <sup>a</sup>	2.5 (1.9)	1.4 (1.7) <sup>c</sup>
Yes	8.4 (7.0) <sup>a</sup>	3.1 (2.3)	5.0 (5.5) <sup>c</sup>
<b>Violent behavior problems</b>			
No	4.2 (2.9)	2.5 (1.8) <sup>b</sup>	1.6 (2.2)
Yes	8.4 (7.7)	4.1 (2.4) <sup>b</sup>	4.4 (5.7)

**Notes:** Independent samples *t*-tests indicate differences were significant at  $P < 0.05$  for: <sup>a</sup>Number of pregnancies. <sup>b</sup>Number of live births. <sup>c</sup>Number of fetal losses by whether the drug use or mental health problem was reported.

whether specific drug use and mental health problems were reported are shown in Table 1. Having more sexual partners was associated with more fetal losses but fewer live births (Table 2). However, more sexual partners was also associated

with greater drug use severity as indicated by significant correlations with poly-drug use ( $r = 0.22$ ) and number of MA-related problems ( $r = 0.19$ ; results not shown in table). Likewise, a higher number of fetal losses was associated with greater



drug use severity; in contrast, more live births were associated with lower drug use severity. Regarding early sexual abuse, greater severity was associated with more total pregnancies, and correlations were in the same direction for number of live births ( $P = 0.068$ ) and number of fetal losses ( $P = 0.194$ ).

## Discussion

In this sample of women with MA-use histories, we see a high average number of pregnancies per woman overall, 44% higher than the national figure, and specifically for African-Americans and non-Hispanic whites. We also see higher average numbers of pregnancies that terminated without a live birth. Furthermore, there was a high rate of late-term fetal loss (2% of pregnancies, representing 4.8% of those pregnancies that ended without a live birth). These high rates are cause for concern, as we see epidemic spread of MA use to previously low-prevalence areas of the US.<sup>11,12</sup>

The concurrence of sexual risk-taking behaviors and high frequencies of pregnancies is of particular interest: risk behaviors, including the low rate of condom use, may not only explicate the high number of pregnancies but also further endanger the health of those women and fetuses. In a US national sample of adult women, rates of condom use during the past 10 vaginal intercourse events and during the most recent intercourse event were 18.4 and 21.8%, respectively.<sup>32</sup> These rates varied by age and relationship status, with older women and those with a relationship partner (ie, spouse, partner, boyfriend, significant other or dating partner) having lower rates of condom use than younger women and those with casual partners; among women with relationship partners, rates ranged from 20.0% for younger women (age 18–24) to 10.9% for older women (age 40–49); among women with casual partners, rates ranged from 41.5% for younger women (age 25–29) to 19.8% for older women (age 40–49). While these rates are lower than US national goals for increasing condom use,<sup>33</sup> they are markedly higher than the overall rate of 5% observed in our study and within marital status and age categories.

Combining drug use with pregnancy suggests a public health problem with potentially high social and health care costs. Indeed, we note that 31% of women in this sample with

child(ren) report that they have children with physical, mental, and/or learning disabilities. Furthermore, results show continuing use of illicit drugs by many of the women; and more than two-thirds were smokers at the time of interview. Thus, the continuation of risk-taking behaviors implies the persistence of social and health care costs.

As pregnancy offers a specific motivation to discontinue drug use and an avenue for interaction between MA-using women and health services, prenatal care should afford an opportunity to identify SUD treatment and risk reduction needs and connect women to appropriate interventions. Participation in SUD treatment has been shown to be effective in reducing substance use in general,<sup>34–37</sup> and results are beginning to accumulate that treatment also has positive outcomes for MA users.<sup>38–41</sup> Moreover, among pregnant substance users who screened positive for any of several substances including amphetamines, SUD treatment integrated with prenatal visits has been associated with a positive effect on both maternal and newborn health.<sup>42</sup> While not specific to MA users, SUD treatment during pregnancy has been shown to improve birth outcomes among heroin and cocaine users.<sup>43</sup> Programs designed specifically for women have shown positive outcomes, particularly in improving psychological factors.<sup>44</sup>

However, results indicate the complexity of the relationship among MA use, pregnancy, and SUD treatment entry. As some pregnant women decreased or paused MA use but few entered SUD treatment because of pregnancy, results suggest that pregnant women may face barriers to SUD treatment entry. For example, some report decreasing rather than completely refraining from use, suggesting that treatment requirements of abstinence may impede treatment entry. Also, relatively few women were motivated to enter treatment due to pregnancy. This appears consistent with earlier work showing low rates of perceived need for treatment among pregnant arrestees, similar to non-pregnant women arrestees.<sup>45</sup> The anecdote described above indicates that women may fear reporting MA use to medical authorities, which may be a major barrier to substance abuse treatment access. Future research must explore barriers to treatment so that intervention strategies can be designed accordingly. Treatment must also account

**Table 2.** Correlations of total number of pregnancies, live births, and fetal losses with sexual risk, drug use, and mental health characteristics.

	NUMBER OF PREGNANCIES	NUMBER OF LIVE BIRTHS	NUMBER OF FETAL LOSSES
Number of sexual partners	0.01	-0.18*	0.17*
Age of 1st MA use	0.19*	0.23**	0.08
Poly-drug use <sup>a</sup>	-0.01	-0.23**	0.19*
Number of MA-related physical/mental health problems	-0.14	-0.32**	0.04
Early sexual abuse <sup>b</sup>	0.17*	0.15	0.11
Early physical abuse <sup>b</sup>	0.01	0.06	-0.01

**Notes:** <sup>a</sup>Respondents reported the number of illicit substances used. <sup>b</sup>Respondents reported the number of times the abuse happened prior to age 15. \* $P < 0.05$ ; \*\* $P < 0.01$ .



for the concurrence of giving birth and increasing drug use; shortly following birth, women appear to be at a high risk for relapse, consequently, this may be an optimal time to implement relapse prevention plans and interventions. Furthermore, research must examine reasons why more women do not alter MA use behaviors during pregnancy. Of particular interest may be women's knowledge of MA's effect on fetuses.

Our findings also indicate women who had more severe substance abuse problems, used crack/cocaine, had more sexual partners, and had cognitive and/or anxiety problems suffered a greater number of fetal losses than women without these problems. Whether fetal losses were the result of spontaneous or induced abortions (not distinguished in this study), the women in this sample may have experienced substantial adverse physical and/or psychological consequences prior to, or due to these losses. Studies have shown that pregnancy loss per se, whether abortion or miscarriage, increases the risk of a range of substance use disorders and psychiatric problems.<sup>46–48</sup> Thus, efforts to assist women in accessing reproductive health care resources may reduce unintended pregnancies and facilitate improved health outcomes. To reduce unintended pregnancy, McEaney and Hong<sup>49</sup> suggest health care professionals foster a supportive, non-judging environment to address reproductive health issues, provide counseling about common misconceptions about contraception, and create an individualized birth control plan. This approach may be especially important for MA-using women, who may also benefit from on-going follow-up and assistance accessing emergency contraception (eg, “morning after pill”) if needed; a study by Trussell et al<sup>50</sup> indicates emergency contraception is effective whether provided when the emergency arises or in advance to be used as needed, and can reduce the considerable medical and social costs of unintended pregnancies.

Similar to findings on fetal loss, having a greater number of children was associated with specific mental health problems. Women who had more live births were more likely to report serious depression prior to substance abuse treatment and had trouble controlling violent behavior. They were also somewhat more likely to have experienced more severe early sexual abuse than women with fewer live births. Previous studies indicate women with children have a need for comprehensive, enhanced substance abuse treatment programs that respond to the range of social service needs of women, and provide services including outreach and integrated care, ie, services that include on-site child-related services with addiction services.<sup>51,52</sup> Our findings suggest women with more children may have an even greater need than women with fewer children for mental health care services addressing sexual abuse/trauma, violence, and depression.

Interpretation and generalization of study results must consider limitations including: (1) population specificity of MA-using women who have presented for SUD treatment; (2) geographic limitation to one large metropolitan county in

the US; however, the population magnitude and ethnic and socio-demographic diversity of the target geographic area supports the relevance of results and the sample itself is diverse and representative of the county's treatment population; (3) inability to link MA use to specific pregnancy outcomes, since the study did not collect clinical records that would allow direct association of specific individual pregnancy characteristics and birth outcomes; (4) inability to distinguish reason for fetal loss from data collected in this study. Future research should be undertaken to provide additional detail on specific pregnancies, fetal losses, risk behaviors, and temporal linkage to substance use patterns.

This study is also limited in that the data were collected in 1998–2000 with reference to an index treatment episode in 1996; accordingly the women in our sample participated in substance abuse and medical treatments that may have changed or improved in recent years. However, treatment for MA use has remained psychosocial in nature; and while some approaches have been specialized to MA users with improved outcomes, treatment outcomes across the broad range of substance use treatment systems have shown less change.<sup>37,53</sup> Despite these limitations, this study provides a useful general picture of MA-using women who come in contact with the substance use treatment system, a picture not widely available in the literature. This contact with treatment services remains an important vector to link them with appropriate medical, mental health, and other services. Studies indicate MA use has increased overall<sup>8,9</sup> and specifically among pregnant women, and the adverse effects of MA on women's overall health and on the health and welfare of their children are not only continuing but may be worsening in more recent years.<sup>13</sup> For example, the number of women MA users admitted to treatment for substance abuse increased nearly six-fold from 1996 to 2011<sup>54</sup>; and current reports indicate an upswing in MA prevalence indicators in many areas of the US in 2012–2013.<sup>55</sup> Terplan et al<sup>13</sup> further report that MA has been the primary drug of abuse among pregnant women admitted to drug treatment since 2003, and MA-related treatment admissions are rising among pregnant women, as are accompanying burdens of medical and social comorbidities.

Results show compelling differences between this sample of women treated for MA use from national statistics, and as such support the need for additional attention to prevention and treatment efforts. Men and women differ markedly with regard to their use of, and responses to MA,<sup>56</sup> and addressing the specific needs of women may improve gender-responsive treatment strategies and health and welfare outcomes for women and their children.

### Acknowledgments

We thank C. von Mayrhauser, PhD and A. O'Brien, project directors; L. Greenwell, PhD and A. Tzu-Hui Lu, PhD for data preparation and analysis; and P. Sheaff, L. Guzman, R. Lua, and M. Frias for their interviewing work.



## Author Contributions

Conceived and designed the experiments: MLB. Analyzed the data: MLB, DH. Wrote the first draft of the manuscript: MLB. Contributed to the writing of the manuscript: MLB, DH. Agree with manuscript results and conclusions: MLB, DH. Jointly developed the structure and arguments for the paper: MLB, DH. Made critical revisions and approved final version: MLB, DH. All authors reviewed and approved of the final manuscript.

## DISCLOSURES AND ETHICS

As a requirement of publication the authors have provided signed confirmation of their compliance with ethical and legal obligations including but not limited to compliance with ICMJE authorship and competing interests guidelines, that the article is neither under consideration for publication nor published elsewhere, of their compliance with legal and ethical guidelines concerning human and animal research participants (if applicable), and that permission has been obtained for reproduction of any copy-righted material. This article was subject to blind, independent, expert peer review. The reviewers reported no competing interests.

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