



Stimulants: How big is the problem and what are the effects of prenatal exposure?



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ABSTRACT

Globally, cocaine use increased by 7%–18.2 million people in 2016 or 0.4% of the world population aged 15–64. In 2016, over 34 million (0.7%) people aged 15–64 used amphetamines and a further 0.4% used MDMA (Ecstasy). Women of child bearing age worldwide are increasingly using and becoming dependent on stimulants; and are, in turn, more vulnerable to sexually transmitted diseases, sexual violence, unplanned pregnancies and mental health problems. Stimulant use during pregnancy increases obstetric complications for the mother, increases the rate of preterm birth and decreases birth weight, length and head circumference for the exposed infant. No consistent signs of neonatal abstinence syndrome requiring pharmacological treatment have been identified for cocaine or methamphetamine, however, infants exposed to one or both drugs exhibit disorganized neurobehaviour at birth. Increased efforts worldwide are needed to determine the extent of maternal stimulant use and to prevent or identify and treat substance use early during pregnancy.

1. Introduction

Significant public health concerns for stimulant use by women in their child bearing years have emerged over the past three decades [1]. The two stimulants that have captured the attention of scientists, health care professionals and the media globally are cocaine and methamphetamine [2–4]. Cocaine and methamphetamine are central nervous system (CNS) stimulants with high abuse potential [5]. They both act on the monoamine neurotransmitters, dopamine, norepinephrine and serotonin in the CNS and peripheral nervous system, and on presynaptic monoamine reuptake transporters albeit in different ways. Cocaine blocks the action of the reuptake transporter, allowing more neurotransmitters to stay active in the synapse, whereas methamphetamine increases neurotransmitter levels in the synapse by reversing the direction of the transporter and by displacement from vesicular stores [5–7].

Cocaine is a naturally occurring alkaloid in the leaves of the coca plant and available on the street in both acidic (salt) and basic forms. Cocaine hydrochloride (common street names, “snow”, “nose candy”, “blow”) is a powder that can be used intranasally (“snorted”) or dissolved in water for intravenous injection. Its peak subjective effect ranges from approximately 15 min when used intranasally or “snorted” to 3 min when injected intravenously [8]. Base cocaine (street names,

“crack” or “rock”) has a lower melting point and is usually vaporized and inhaled. The wide-spread use of crack-cocaine use during the 1980s in the U.S. has been credited to its low cost (\$2.00–5.00 for street doses) and the short duration to its peak psychoactive effect (1–2 min) [5].

The potential impact of the illicit use of cocaine by women of child bearing age was brought to the attention of scientists by a small study of 23 cocaine-using mothers published in the *New England Journal of Medicine* in 1985 [9]. This report along with widespread public health concerns about the spread of cocaine use in the U.S. spurred further investigations of maternal cocaine use that reported seemingly catastrophic consequences [2]. Fuelled by the findings in these studies, media reports such as, “*Cocaine Claims its Tiniest Victims: Babies Born Addicted*” [10] gave rise to the myth that mothers who used crack were ‘unfit’ to parent and were creating a generation of ‘crack’ babies. These claims have largely been disproved by a number of well-designed cross-sectional and prospective longitudinal studies [11,12].

Following swiftly on the heels of the crack-cocaine epidemic, methamphetamine became a significant health issue for women in the 1990s. Methamphetamine (street names, “speed”, “crystal”, “meth”, “P” in New Zealand, “tik” in South Africa and “yaba” in Thailand) is a synthetic stimulant that can be easily manufactured from products containing ephedrine or pseudoephedrine. It is available in three chemical forms, base, powder, and crystalline or ICE which is the most

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commonly abused form. Like cocaine, it can be injected intravenously or used intranasally (insufflated) or “snorted”. It can also be taken in tablet form. Its peak psychoactive effect is nearly the same whether it is injected (10–15 s) or smoked (6–8 s) whereas intranasal use produces euphoria in 3–5 min and oral use occurs more slowly with concentrations reaching peak levels at 180 min. Methamphetamine has a half-life of 10–12 h compared to cocaine's half-life of 0.5–2 h. Amphetamine type stimulants have a long history in the U.S. and Japan, predating World War II. However, the widespread use of methamphetamine didn't emerge until the 1990s coinciding with the increased manufacture of methamphetamine in Mexico, large-scale “super labs” in Southern California and “mom and pop” labs in regions of the West Coast and Midwest of the U.S [3]. The evidence for the effects of antenatal exposure to methamphetamine is limited in comparison to cocaine, however, early reports of serious consequences for the fetus, the neonate and the developing child have, like the cocaine evidence, been moderated by well controlled prospective studies [13,14].

Much of what we have learned about the effects of cocaine and methamphetamine use during pregnancy has come from North America. However, there is emerging evidence that the use of stimulants in women of child bearing age is becoming a problem worldwide. The purpose of this review is twofold: first, to examine the extent of this problem globally, and explore the role biological, social and cultural factors play in the escalation of stimulant use by women of child bearing age; and, second to briefly review what we have learned about maternal stimulant use, the outcomes for the developing child and the challenges to identifying and treating women who use stimulants during pregnancy.

1.1. The toxic effects of cocaine

Short-term use of stimulants results in increased energy and libido, reduced fatigue and appetite and increased self-confidence and alertness. With escalating doses, however, there is an increased chance of insomnia, anxiety, confusion paranoia, irritability, and panic attacks [3,5]. When large dopamine increases are triggered by stimulants that occur over a short period of time (< 10 min), they are associated with rewards. Therefore, routes of administration such as injecting and smoking that deliver faster and higher drug levels to the brain, along with the longer duration of the psychoactive effects of cocaine, and more so with methamphetamine, may explain why these drugs are more rewarding and addictive [15].

The long-term use of stimulants usually occurs through cycles of bingeing followed by abstinence. Both human and animal studies have shown that binge-abstinent cycles in cocaine users are usually shorter (around 12 h) compared to methamphetamine (several days). Ongoing stimulant use affects multiple organ systems and is linked to cardiovascular events such as arrhythmias, hypertension, cardiomyopathy and acute myocardial infarction [3]. Other neurological complications include movement disorders, repetitive or stereotyped behaviours and cognitive deficits, particularly those related to executive functions, memory and attention. Frequent presentations to emergency departments are for mental health problems, the most common being anxiety, depression and psychotic symptoms that mimic schizophrenia [16].

1.2. The global extent of stimulant use

Worldwide, the misuse of illicit substances remains a significant public health concern. In 2016, it is estimated 275 million people (range: 204 to 346 million) aged 12–65 used a substance in the previous year, an increase of 20 million from 2015. Although a significant proportion of this increase is related to the increased use of cannabis, a number of reports and indicators suggest a surge in the use of stimulants worldwide [4,17]. The most worrying trends are for cocaine and amphetamine type stimulants, particularly methamphetamine.

Globally, cocaine use increased by 7%–18.2 million people in 2016

or 0.4% of the population aged 15–64. The use of cocaine remains the highest in North (1.91%) and South America (0.95%), Western and Central Europe (1.2%) and Oceania (2.19%) predominantly Australia followed by New Zealand. Markets for cocaine and methamphetamine have expanded beyond their usual regions; this expansion is mirrored by reports of increased morbidity and mortality associated with these stimulants [4]. Global cultivation of coca bush has increased by 76% since 2013 to reach a record level of 1410 tons in 2016. Global seizures of cocaine has also reached record levels increasing by 23% in 2016 from the previous year to 1129 tons. Most increases occurred outside the main cocaine destinations of North America and Western and Central Europe, evidence of the ongoing spread of emerging cocaine markets globally. Growth areas were mainly East and South-East Asia where seizures increased ten-fold. Seizures of cocaine in the Near and Middle East/South-West Asia doubled over the same period [4].

In 2016, over 34 million (0.7%) people aged 15–64 used amphetamines and a further 0.4% used MDMA (Ecstasy). Methamphetamine (2.02%) was reported to be the second greatest threat in the U.S. after heroin [4]. Growth in amphetamine markets, based on increases in consumption, manufacturing capacity and in the amounts seized, are also evident in East and South-East Asia and Oceania (1.34%), where the use of crystalline methamphetamine is of particular concern [4]. Contributing to this concern is the reported decrease in price in some markets and the increase in the purity from 39% in 2007 to 93.5% in U.S. markets [18,19] and reports that the purity is approaching 100% in South-East Asian markets. In the period, July 2007 through September 2010, the price per pure gram of methamphetamine in the U.S. decreased 61%, from \$270.10 to \$105.49 [20].

Evidence of drug transactions on the darknet (the part of the “deep web” containing information that is only accessible using special web browsers) is limited so far. However, studies carried out by the European Monitoring Centre for Drugs and Drug Addiction (EMCCDDA), Europol and RAND Europe have found that 62% of the transactions on the darknet are for drugs or drug-related chemicals. Of those transactions 77% are for illicit drugs, predominantly stimulants and 15% for drug-related chemicals [4].

The above expansion of markets and growth in the use of stimulants are reflected in the number of people presenting for treatment and in the increasing rates of overdoses reported for stimulant use worldwide [4,21]. In Malaysia, 20% of people seeking drug treatment was for crystalline methamphetamine use, and in Brunei Darrussalam almost all (94%) were seeking treatment for methamphetamine use. The mortality rate in Australia related to stimulants including cocaine and methamphetamine has quadrupled since 1999 [22], and in the US, drug overdose deaths increased from 2010 to 2015 for cocaine (11%–13%) and doubled (5%–11%) for methamphetamine [17].

2. Women of child bearing age and stimulant use

Historically, men have outnumbered women in substance use and progression to substance dependence, however, recent reports suggest the gap between these differences may be narrowing, and that, if drugs were equally available to both males and females, there would be no gap [23–25]. Although the prevalence of use in males and females may be converging, the effect of stimulants on women and the path to dependence is associated with both gender (social) and sex (biological) differences. These differences are complex and cut across multiple biological, psychological and social systems and are often specific to the drug [23,26].

2.1. Motivation and initiation of stimulant use

Evidence from the World Health Organization World Mental Health Surveys [24] found female substance use and attitudes about the appropriateness of substance use both change as female roles become more similar to male roles and in cultures where gender roles are more

equal. Since 2004, stimulants, particularly methamphetamine, have been equally attractive to men and women under the age of 25, however, women who use illicit stimulants often initiate use and continue to use them for different reasons. An early study investigating the initiation and continued use of crack cocaine in a study of predominantly African-American women reported associations between family drug use, first age of sexual abuse, age of first depressive symptoms and age of first illicit drug use as contributing factors [27].

In a study of gender differences of 350 former clients of a treatment system (44% female) in California, females were significantly more likely to report early sexual abuse (before age 15) than males (44% vs 24%), respectively, but there was no difference in physical abuse (32% vs 34%). Significantly more women than men reported initiation of methamphetamine use to lose weight (36% vs 7%) [28]. A more recent qualitative study of women incarcerated in Missouri, an area where manufacturing of methamphetamine is prevalent, found women initiated methamphetamine for similar reasons, including being the recipient of early sexual abuse. Significant were reports that living in an environment where methamphetamine was manufactured and where siblings, parents and in one case grandparents used methamphetamine normalized the use of methamphetamine and their own transition to drug use [29]. However, some personal agency around the initiation of drug use was also reported, particularly around the use of methamphetamine for energy and weight loss.

In the 1950s and 1960s, 80% of prescriptions for amphetamines in the U.S. were to women for appetite suppression and as a 'pick-me-up'. As reported above, female use of illicit stimulants is often for similar anorectic and invigorating properties [28,29] as well as a desire to maintain a relationship with a partner or "fit in" [29]. A further reason for the initiation and continued use of methamphetamine is its sexually enhancing properties. Notable are the number of reports in developed and developing countries that have consistently reported high rates of methamphetamine use associated with sexual risk taking, particularly in female sex workers [30]. Stimulants, particularly methamphetamine are reported to enhance sexual intercourse [31,32] making sex a common currency for women to obtain these drugs and to engage in more risk taking behaviours [30,33,34].

Reported consequences are increased risk of sexually transmitted diseases through lack of condom use and increased numbers of sexual partners. In two consecutive surveys of 1320 drug users in the Shandong province of China, methamphetamine was the predominant drug used (96.4%), and the prevalence of HIV (0.2%) and syphilis (8.3%) was independently associated with being female. Approximately 63.8% of participants reported having commercial sex with 93.0% reporting inconsistent condom use in the past year [33]. Female sex workers in three cities in Vietnam reported that they used amphetamines because they were considered 'stylish', higher class' and much less addictive, but they also reported multiple sexual risks including sex with multiple partners or clients, unprotected sex and increased likelihood of group sex in the context of drug pooling [34]. A study of 1295 female sex workers from 13 cities in Iran where use in the general population is just emerging found 15% of female sex workers used crystalline methamphetamine [35]. Social factors associated with their use were housing instability, and a history of forced sex. A high proportion of these women reported using methamphetamine in conjunction with opiates to increase functionality so that they could work long hours and maintain high volumes of sexual transactions and partners and also to cope with their working circumstances [36].

Similar findings have been reported in the cocaine literature [37–39]. Female sex workers in Mexico were significantly more likely to have a lifetime history of cocaine, crack, methamphetamine or heroin use and more likely to test positive for a sexually transmitted disease [37]. In two studies in different regions of Brazil, more women cocaine users were at greater risk for sexually transmitted diseases, more sexual violence and more self-reported mental health problems than men. In one study more women tested positive for syphilis (27.2%

vs 9.2%) than men, and significantly more women were at risk of sexual violence (38% vs 8.2%) [38]. In a further study women cocaine users were 5 times more likely to test positive for HIV, and only 32% rated their mental health as good. Of those who reported problems related to mental health, 71% reported they would like to receive medical attention. Compulsive cocaine use in this study was significantly higher for women (70.6%) than for men (52.0%) [39].

Reports of cocaine and methamphetamine use in the U.S. suggest women initiate cocaine at an earlier age than males, but there was no difference in the mean age (males = 18.98 vs females = 19.34) of initiation of methamphetamine use or initiation of drug use in general (11.82 vs 11.34 years) [28]. However, females reported transitioning to regular use more quickly than males (1.60 vs 2.56 years) and required longer time in treatment (3.90 vs 2.76 months) than males. In Myanmar, results of a survey of 1362 (775 male and 587 female) revealed that 73% of males and 60.5% of females initiated methamphetamine use before their 18th birthday [40]. A steep increase in initiation occurred at 14 years for males and 15 years for females. The peak age of initiation for males was 16 years (age range 10–29) compared to 18 years for females (age range 9–27). A study in Thailand found males in a treatment setting had an earlier age of onset for methamphetamine use (17.7 vs 19.7 years) and dependence (20.4 vs 22.2 years) than females, respectively [41]. However, females were more likely to be dependent (79% vs 60.5%), and to experience withdrawal (65.3% vs 48.9%), fatigue (77.5% vs 70.3%), and psychomotor retardation (64.5% vs 57.0%). In addition, females reported heavier use (largest daily amount), more frequent and greater lifetime episodes of methamphetamine use than males.

2.2. The mediating role of neural mechanisms

Although the sex differences in the neural mechanisms mediating addiction is beyond the scope of this article, it is worth noting that a number of studies suggest differential effects for women, particularly stimulants (for a review see, Becker and Chartoff, 2018 [26,42]). Women may metabolize drugs differently, report subjective differences in the rewarding effects of substances, have differences in brain volume and function in response to different substances and respond differently to substance related cues (e.g., images of drugs) [26,42,43].

The subjective effects of most drugs do not differ between males and females, however, cocaine and amphetamine are the exception [44]. These differences have been linked with ovarian hormones and their fluctuation across the menstrual cycle. The mood altering effects of acute doses of cocaine have been found to be greater during the follicular phase than the luteal phase with women reporting more positive subjective drug effects on measures of feeling high, wanting more drug and euphoria. One explanation for these more positive subjective effects is that estrogen facilitates the release of dopamine, the neurotransmitter most strongly linked to the rewarding effects of stimulants.

Drugs of abuse exert their differential reward-related effects by mimicking the phasic firing of dopamine neurons located in the ventral tegmental area (VTA) of the brain and projecting to the nucleus accumbens. Originally it was thought that dopamine signalling in the brain encoded just for reward, more recent research has shown that it also encodes for an expected reward whereby phasic firing is triggered by cues associated with expected reward value and its probability of delivery [15]. Research examining substance-related cues, such as images of drug paraphernalia, has shown that women demonstrate greater neural activation to cocaine cues relative to men [43,45].

3. The impact of maternal stimulant use

Reports on the prevalence and effects of stimulant use during pregnancy have come predominantly from the U.S., however, given the evidence that these drugs are increasingly being used by women of child bearing age worldwide [4], it is not unexpected that there have

also been reports of increasing use of stimulants in pregnant women globally [4,46–49]. Cocaine and methamphetamine use during pregnancy has typically been associated with social disadvantage, multiple drug use, domestic violence and significant health and mental health problems [46,49–51]. Cocaine use that continues throughout pregnancy has been associated with higher levels of alcohol, tobacco and marijuana use [52,53]. Patterns of methamphetamine use during pregnancy vary across cultures but are also associated with higher levels of alcohol, tobacco and marijuana use [50]. These drugs are often used during attempts at abstinence to control symptoms of withdrawal, but are also often linked to poor development for the child and increased risks of co-morbid substance abuse and psychiatric disorders for the mother [50].

Cocaine has been shown to cause maternal hypertension, vasoconstriction, and decreased uterine blood flow, leading to impaired nutrient delivery and oxygen exchange for the fetus. During the early months of pregnancy, there is an increased risk of miscarriage, and continued use can cause placental abruption leading to severe bleeding, preterm birth and fetal death [54]. However, the longer half-life and the broader target sites in the CNS of methamphetamine mean there may be more severe outcomes for the mother and the exposed fetus and developing child. A recent U. S. epidemiological study comparing birth outcomes of methamphetamine (N = 18,050) and opioid-affected (N = 50,011) births with other hospital births (N = 7,545,380) found methamphetamine-affected births had the highest rates of preeclampsia (9.3% vs 4.4% opioid, 4.8% other) placental abruption (4.3% vs 3.1% opioid vs 1.0% other), preterm delivery < 37 weeks (16.7% vs 12.6% opioid vs 5.5% other), caesarean delivery (37.4% vs 34.5% opioid vs 32.6% other) and severe maternal morbidity and mortality (3.8% vs 2.4% opioid vs 1.6% other) [55].

Early reports of fetal malformations and anomalies due to antenatal exposure to cocaine and methamphetamine, have largely been disproved. However, in addition to preterm birth, both have been associated with being born preterm, decreased birth weight, length and head circumference [11–14]. Catch-up growth in cocaine exposed children has been reported by 6 years of age [14]. Reports of growth in methamphetamine-exposed children indicate catch-up in weight and head circumference but not height. A cross-national study found a stronger negative effect of methamphetamine on infant and child length/height in U.S. children compared to New Zealand (NZ) children in the Infant Development, Environment and Lifestyle (IDEAL) studies [56]. No clear withdrawal syndrome has been identified, but both cocaine and methamphetamine are associated with disturbed neurobehaviour at birth and 1 month postnatally that suggest poorer state regulation, quality of movement, lower arousal and increased CNS stress on the Nicu Network Neurobehavior Scale (NNNS) [14,57]. Disturbed neurobehaviour in both cocaine- and methamphetamine-exposed infants has been shown to be predictive of later medical, cognitive, motor and behavioural outcomes. A subsample of infants in the Maternal Lifestyle Study exposed to a combination of both cocaine and opiates with the most extreme neurobehavioural disturbance at 1 month had poorer medical, behavioural, cognitive and motor problems at 12, 24, 36 and 48 months [58]. Intravenous use of methamphetamine by mothers in the methamphetamine-exposed infants in the NZ IDEAL Study with asymmetrical reflexes and poor self-regulation at 1 month had poorer motor development at 12 months of age. Infants requiring more soothing and settling to allow them to maintain a quiet alert state and with poor quality of movement at 1 month had poorer cognitive development at 12 months [59].

Long-term follow-up of antenatal cocaine exposure extends into adolescence. Whereas very little evidence of the development of methamphetamine exposed children is available beyond middle childhood with the exception of an early Swedish study that investigated antenatal exposure to amphetamines [60]. Early cognitive outcomes of both cocaine and methamphetamine exposure have generally been associated with lower scores on global IQ tests compared to scores of non-exposed

children, but any differences were often explained by other adverse environmental and drug exposures. However, more recent tests of specific neuropsychological capabilities have shown a range of adverse effects on executive function, inhibitory control, working memory and attention [14]. The effects of cocaine exposure in adolescence is associated with more delinquent behaviour, more externalizing behaviour, poorer mood, a greater risk for substance use related problems and early onset and riskier sexual behaviours by age 17 [61]. The cocaine studies made it clear that cocaine alone did not determine developmental outcomes for exposed children, but the interplay between the drug and the postnatal environment. Although the evidence is less extensive for methamphetamine-exposed children, this conclusion has been supported by the U. S. and NZ (IDEAL) studies [13].

4. Challenges of identifying and treating stimulant use during pregnancy

4.1. Screening for stimulant use

Although health professionals are confident discussing the use of legal drugs such as tobacco and alcohol, they may fail to inquire about illicit stimulant use because of the stigma that may arise for the woman and her child or because their health care system has limited resources or no clear pathway to treat the complex needs of these women [62–64]. Equally, women may not report the use of drugs or the level of use due to concerns of stigma and child protection involvement [65]. In the Maternal Lifestyle Study of cocaine exposure 38% of mothers who denied use had neonates with positive meconium assays for cocaine and/or opiates [66]. Of the 8527 new born meconium analyses performed in this study the prevalence of cocaine and opiate exposure was 10.7%. In a study of 5231 mothers attending antenatal clinics in the Cape Town region of South Africa, the prevalence of self-reports of illicit drug use was 3.6% [48]. A urinalysis to test for the prevalence of drug use in this sample was obtained from a randomly selected subsample of 684 mothers. Urinalyses showed 8.8% of this subsample met standardized cut-off criteria to test “positive” for at least one illicit drug and 8.1% tested positive for methamphetamine exposure. In a further study carried out in 7 antenatal care clinics in public hospitals in Southern Thailand, 3578 women attending the clinic for the first time were screened for substance use by self-report and a random subsample (488) by urinalysis. The proportion who tested positive overall was highest for benzodiazepines followed by methamphetamine, cannabis, and opiates. Of women who reported no drug use, 2.7, 4.6, 2.0 and 8.0% had positive urine test results for cannabis, methamphetamine, opiates and benzodiazepines, respectively [47].

4.2. Antenatal and postnatal services

Reluctance to report stimulant use in pregnancy means that women often do not receive adequate antenatal or postnatal services due to financial or drug-related social barriers. Indeed, the use of illicit substances has repeatedly been linked to infrequent antenatal visits and presenting late in pregnancy for care. The result is inadequate antenatal care which is associated with maternal and neonatal risks including a lack of postnatal care [67], lower rates of breastfeeding, well-child visits and immunizations and increased likelihood of loss of custody [65]. One of the most reported barriers to adequate antenatal care is the belief that reporting illicit drug use will lead to referrals to child protection services. In a cross-national study of 378 US women (182 methamphetamine-exposed and 196 comparison) compared with 219 NZ women (107 methamphetamine exposed and 112 comparison) [65]. US women were significantly more likely to have inadequate antenatal care compared to NZ women and a much higher rate of child protection referral (62% vs 36%, respectively). These differences are likely consistent with the US policy for mandatory reporting of drug use during pregnancy compared to the “harm minimisation” policy of drug use

management in NZ.

One of the 8 Millennium Development Goals set out by the UN was to “Achieve by 2015 universal access to reproductive health”. The targets for this goal included reducing maternal mortality by 75% and increasing the proportion of women receiving at least 4 antenatal visits. A review of this goal by the World Health Organization (WHO) in 2015 found the number of women dying due to complications during pregnancy decreased by only 45% from 523,000 in 1990 to 289,000 in 2014. The leading causes of death were haemorrhage (27%), hypertensive diseases of pregnancy (14%), and sepsis (11%). Worldwide the percentage of women receiving antenatal care at least once was 83%, however, only 64% received the recommended minimum of 4 visits [68]. Little published evidence outside the U.S. is available regarding the association of stimulant use during pregnancy and access to antenatal care services, with the exception of an early study in Bangkok, Thailand. Of the 23 women interviewed in this study who used methamphetamine during pregnancy, 96% had inadequate (< 5 visits) or no antenatal care [69]. An improved understanding in cause-specific trends of poor reproductive health needs to include research that examines the expanding use of not only stimulants but all legal and illegal substances by women of child bearing age if the goals of improving maternal reproductive health globally are to be achieved.

In summary, a number of indicators suggest a surge in the use of cocaine and methamphetamine by women of child bearing age worldwide. Of particular concern is the social, biological and psychological factors that suggest women are more at risk of using and becoming dependent on stimulants, and more vulnerable to sexually transmitted diseases, sexual violence, unplanned pregnancies and mental health problems. The use of stimulants during pregnancy and the associated environmental stressors of maternal drug use increases the risk to the mother, the fetus and the developing child. However, some of these outcomes are likely to be culturally determined and reflect the legal, social and health care systems of individual countries. Therefore, further research that is specific to those regions where women are increasingly using cocaine and methamphetamine is warranted.

Conflicts of interest

Neither author has any personal or financial relationship with other people or organisations that would influence the content of this manuscript.

Practice points

The following practice points are consistent with the recently released “WHO Recommendations on antenatal care for a positive pregnancy experience”. http://www.who.int/substance_abuse/publications/pregnancy_guidelines/en/

- Identifying drug use during pregnancy as early as possible is important for the mother and her baby, therefore, ask about past and present drug use at every antenatal visit.
- Mothers who report drug use are likely to be living in poverty, struggling with co-morbid mental illness or at risk of domestic violence, so be prepared to offer respite services.
- Pregnant women should be advised of the potential health risks of drugs to themselves and their babies. Be prepared to offer information, a brief intervention or a referral to rehabilitation.

Research directions

- The role drug use policy, legal and healthcare systems play in providing reproductive health services for women who use stimulants and other drugs.
- The long term health of women who use stimulants.
- The development of children globally who are exposed to

stimulants, particularly methamphetamine.

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