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Sociodemographic and Drug Use Characteristics, Sex Behaviors, and Motivations for
Drug Use among HIV-Seronegative, Heterosexual, Methamphetamine Users in San
Diego, CA.

A dissertation submitted in partial satisfaction of the requirements
for the degree Doctor of Philosophy

in

Public Health (Epidemiology)

by

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2009

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Co-Chair

Chair

University of California, San Diego

2009

DEDICATION

To Charlotte and Bob,

With a grateful heart

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Cheng WS, Garfein RS, Semple SJ, Strathdee SA, Zians J, Patterson TL Differences in Sexual Risk Behaviors among male and female among HIV-seronegative heterosexual methamphetamine users in San Diego. *Am J Drug Alcohol Abuse* (in press).

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Gresham L, Cheng WS. Integration of tribal governments in the national emergency response and homeland security infrastructure: a community collaboration of

academia, government and private entities. 2006, California State University Service Learning Conference, San Francisco, CA, April, (oral presentation).

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ABSTRACT OF THE DISSERTATION

Sociodemographic and Drug Use Characteristics, Sex Behaviors, and Motivations
for Drug Use among HIV-Seronegative, Heterosexual, Methamphetamine Users
in San Diego, CA.

by

Wei-Woon Susan Cheng

Doctor of Philosophy in Public Health (Epidemiology)

University of California, San Diego, 2009

San Diego State University, 2009

Professor Richard Garfein, Chair

Professor Steffanie Strathdee, Co-Chair

Background: Despite the recent attention in the literature and the media regarding methamphetamine (MA) abuse, particularly among men who have sex with men (MSM), there still exists a paucity of MA studies among heterosexual populations. From general drug use populations and among MSM, MA has been found to be associated with greater HIV-risk through drug use and sex behaviors. This study aims to contribute key areas of research to the existing literature on heterosexual MA-using populations regarding differences in sociodemographic characteristics, drug use and sex behaviors, and motivations for initiation and current use of MA use by (1) binge MA use, (2) gender, and (3) injection drug use.

Methods: Between 2001 and 2005, data were collected on 452 HIV-negative MA users aged 18 and older in San Diego, CA, who had used MA at least twice and had engaged in unprotected sex in the previous 2 months. Separate logistic regression models identified significant factors associated with binge MA use, gender, or injection drug use.

Results: Of 452 participants, mean age was 36.6 years; 68% were male; ethnicity was 49.4% Caucasian, 26.8% African-American, and 12.8% Hispanic; 55% were never married; and 58% never attended college. Binge MA use was associated with greater frequency of MA use, ever treated for MA use, injection drug use, higher Beck Depression Inventory (BDI) score, initiating MA “to experiment”, and engaging in sex marathons while high on MA. Men were more likely to engage in sex marathons and to use MA “to enhance sexual pleasure,” whereas females were younger, and more likely to be married, report a recent sexually transmitted infection (STI) diagnosis, introduced to MA by a sex partner, higher BDI scores, and to use MA “to lose weight.” Use of MA by injection was associated with being Caucasian, homeless, more years and quantity of MA use, history of felony conviction, and a recent STI.

Conclusions: HIV-negative heterosexual MA users are not a homogeneous group. Differences in gender, route of MA administration and pattern of MA use should be considered in the design and implementation of interventions for decreasing HIV risks associated with MA use.

I. INTRODUCTION

A. Background

History of Methamphetamine Use

According to Harvard Professor Patricia Case, methamphetamine (MA) use in the United States is endemic, not epidemic, punctuated by cyclic outbreaks. Despite recent claims of the “emerging” MA epidemic in the US and California specifically, MA use and abuse has been documented for over a century. In a review of the history of MA use by Anglin et al., MA was first synthesized in Germany in 1887, MA was introduced originally as a nasal inhaler as a component of cold remedies in the early 1930’s (1). MA was also prescribed to treat attention deficit, depression, obesity, and ironically, addiction to other drugs (namely heroin) and alcohol. The first reports of MA addiction were published in 1938. Shortly thereafter, despite the potential for addiction, World War II soldiers were supplied with MA on both sides of the war to remain sharp and alert for long durations (18+ hours). After the war, MA supplies became readily available commercially. Used by women especially to enable weight loss and the energy required to be a multi-tasking “super-mom” and homemaker, use of MA became widespread in the US. Between 1930 and 1950, early evidence surfaced linking MA use to increased sexual desirability and arousal, as well as lowering inhibition towards sexual and homosexual acts.

Starting in the 1960's, a social backlash against widespread abuse of MA, and reports of overdose from MA use, led to MA confiscation from homes, and reclassification of MA as a prescription drug. Motorcycle gangs and homegrown labs started synthesizing MA illegally to meet the demand of non-medicinal MA from the general public. In the mid 1990's, the precursor to MA became strictly regulated leading many homegrown labs to switch to pseudoephedrine (a component of common over the counter decongestants) as the precursor (2;3). Ironically, production of MA from pseudoephedrine was found to be more efficient than the original precursor chemicals, and the new product was more pure and thus much stronger, leading to an increase in accidental and lethal overdoses of MA.

Current day/San Diego

With mountains on the north and east providing rural settings to hide clandestine, home labs, MA remains prevalent and accessible in San Diego, and the 70 miles of coastline and the 80-mile border with Mexico create difficulties in controlling MA production and trafficking. Before 1989 many small labs existed in San Diego; however, two bills in 1988 and 1993 (Chemical Diversion and Trafficking Act and the Chemical Control Diversion Act) decreased access to precursors for MA production and promoted new networks, especially across the border in Mexico, to pick up production of MA and took advantage of existing drug networks to distribute the new product (2). In the mid 1990's, the crackdown on homegrown MA labs and the "war on drugs" lead to the migration of MA production to Mexican border towns.

Especially in California, which has been well-documented as a hotspot for MA use and trafficking, Tijuana became a major point of entry into the US and San Diego County (4). Clandestine labs in Tijuana have used psuedophedrine as the precursor for MA production, synthesizing stronger MA than had been previously available in the US. Increased purity of MA in Mexico (80% vs. 48% in the US) has lead to increased chances of health-related problems and side effects of MA intoxication including agitation, violence, and accidental, lethal overdoses. Mexico now controls 70-90% of the MA produced and smuggled into the US; crackdowns on MA labs in Mexico have been recent so are still relatively rare (2). A recent report shows MA to be most often implicated in association with violent crimes, second to cocaine, and the primary contributor to property crimes; in the Pacific region, MA use (more than cocaine use) contributed to 86.3% of violent crimes and 80.2% of property crimes (5).

Currently, it is estimated that 15 million individuals (over 5%) in the US have ever tried MA with 1.4 million estimated MA users in 2004 (6). In comparison, the percentages of individuals who have tried other illicit substances in their life include: 40.6% for marijuana, 14.7% for cocaine, 1.6% for heroin, and 4.3% for Ecstasy (MDMA) (7). The incidence of first time MA use has remained constant from 2002 through 2004 at an estimated 300,000 individuals. However, a trend of increased dependence and/or abuse has been noted with 27.5% of MA users in 2002 compared to 59.3% of MA users in 2004 qualifying for a diagnosis of MA dependence/abuse. The average age of MA users in the US has also been increasing over time (2002: $\mu=18.9$ yrs; 2003: $\mu=20.4$ yrs; 2004: $\mu=22.1$ yrs). In addition, there is evidence that MA

use disproportionately affects men who have sex with men (MSM), individuals from a disadvantaged background (lower social and economic status), and minorities who use MA as an anti-depressant.

Epidemiology of MA Use

MA acts by releasing high levels of dopamine, a stimulatory neurotransmitter, in the brain that induces feelings of euphoria and enhances physical stimuli and movement (8;9). Over time however, the neurotoxic effect damages the brain cells with receptors for dopamine and other similar neurotransmitters like serotonin, leading to a desensitization and decreased levels of natural dopamine produced by the body, increasing the potential dependence on the synthetic effects of MA use (8-11). The effects of MA on subjects has been well documented. An early study in 1970 by Martin et al found that MA raised blood pressure, body temperature, pupillary dilation, increased heart rate, appetite suppression, and lowered perceptions of required sleep-time(12). In addition, the researchers noted that the subjects also experienced “pleasure” and elation from taking the drugs as well as “relaxed,” while feelings of nervousness and anxiety were dose-dependent. More recently, studies have found MA also results in enhanced self-confidence, aggression, loquaciousness, increased initiative, physical activity, enhanced sexual pleasure, and decreased inhibition (11;13-15). Serious consequences of acute and long-term MA use also include irritability, anxiety, paranoia, aggression, confusion, tremors, convulsions, and insomnia (8;16-18). The increased heart rate and blood pressure noted in earlier research, has been

shown to induce irreversible blood vessel damage in the brain and elsewhere, leading to potential cardiovascular collapse, strokes, tachycardia, respiratory problems, and potentially death (11;13;15). In addition, social and legal consequences have been noted such as loss of relationships, financial consequences, arrests and incarceration for possession and/or dealing or for crimes related to obtaining funding to purchase MA.

MA use has become increasingly popular among younger adults and men who have sex with men who are drawn to the drug due to effects of increased wakefulness, decreased inhibition, and enhanced sexual pleasure. In California, where concentrations of MA labs and drug use networks have been noted, Gibson et al reported that the average user tends to be non-Hispanic white, under the age of 40, with an unstable living environment including periods of unemployment, lack of steady relationships and/or domiciles, potential history of incarceration, and socially and sexually active (16). MA is also especially prevalent among workers in monotonous, repetitive jobs with long hours. However, the use of MA, have been on the rise among Hispanic, African-American, and Asian communities, especially among men who have sex with men in some communities (16;19-23). Due to the effects of MA and the behaviors related to acquiring the drug, chronic users also tend to be periodically unemployed, unmarried or in unstable relationships often with another MA user, and to have a history of incarceration or other drug use/addiction. Several studies have also reported a history of being the victim of non-consensual sex preceding initiation of MA use (18;24;24;25).

Injection drug use is also common among MA users (26), who are also social with a tendency to use MA with friends, dealers, or a significant other (27). In addition, MA IDUs are more likely to share needles and other works (26;27). Overlaps between drug using and syringe sharing networks and sex partners have also been reported in the literature (28-30). The density of these networks leads to greater risks of exposure to HIV and other blood borne and sexually transmitted infections.

In addition to the rush experienced while getting high on MA, the drug also increases libido, while decreasing sexual inhibition (31;32). This combination leads to the increased STI-risk behaviors associated with MA use in the literature. Female MA users are especially at risk of HIV and other blood borne infections through unprotected sexual intercourse. Studies involving female MA users have found MA use to be associated with the following HIV sex risk behaviors: anonymous and casual partners, unprotected sexual intercourse, trading sex for money or drugs, multiple sex partners, and previous or ongoing history of sexually transmitted infections(33-36). HIV(+) or unknown status sex partners were common, as were sex partners who were fellow MA users and/or injection drug users (IDU); therefore, male sex partners of female MA users also served as a potential bridge to higher risk populations. Among adolescents, MA use has been found to be associated with younger age at sexual initiation, greater number of sex partners, higher rate of unprotected sex, and more casual or anonymous sex partners (18;28;37;38). In addition, adolescent female MA users were more likely to report engaging in sex (and unprotected sex) while intoxicated (with MA or alcohol or another drug) and having sex partners who were

also MA users and/or IDU (28;38). Female MA users were also more likely to be from a minority background and either unemployed or earning a low income (<\$25,000)(39).

MA use has been associated with STI-risk sex behaviors in many studies. STI-risk sex behaviors that have been studied include: reporting multiple partners, risky partner types (casual/anonymous), unprotected sex acts, group sex, or sex with partners of HIV(+) or unknown status or partners who inject drugs. It is important to tease out the factors that are associated with MA use as a target for intervention in decreasing both MA use and STI-risk sexual behaviors to prevent the transmission of blood-borne infections. *Although many studies have focused on populations of men who have sex with men and drug use, fewer studies have been conducted on heterosexual populations and specifically targeted MA use.* MA has been reported to be used in gay and bisexual populations for sexual enhancement, but this may differ in heterosexual populations, and between men and women. Gender differences need to be addressed in order to understand potential variability in the motivation for use by men and women and potential differences in risky behavior by gender. Differences in drug use and high risk sex behavior have also been noted between IDUs and MA users who prefer to smoke or snort the drug (40).

Summary of Background

Although MA abuse has been reported in the literature for decades, the recent rise in injection and use of MA is of special concern. Current MA use centers around physical and psychological motivating factors as well as potential sensation-seeking

and sexual desires compared to past MA use that may have been due to the need for more energy, to lose weight, or to get high. The complexity of the motivations for MA use, coupled with the increased HIV and STI-risk drug use and sex behaviors suggest greater research on MA users, especially heterosexual populations, are still warranted.

B. Literature Review

Gender Differences

A review of the literature among men who have sex with men showed that high risk sex and drug use behaviors were often correlated with MA use. Several studies noted that MA use or overall drug use were associated with riskier sex. Unprotected anal intercourse was also common among MA using MSM (21;41-45); serodiscordant UAI, among partners with different HIV serostatus, was also more likely among MA users (46-50). HIV and/or STIs (such as rectal gonococcal infections) were more common among MA users compared to non-MA users (43;51). A study of 736 HIV(-) MSM in San Francisco reported that periods of drug use were associated with riskier sex (unprotected sex with an HIV(+) or unknown status partner) compared to periods of no drug use, regardless of frequency of drug use (46). Perceptions of more pleasurable and more acts of sex were also reported by MSM who used MA to enhance sexual encounters, as compared to cocaine which was reported to enhance sociability in a cohort of 300 HIV (+/-) MSM in San Francisco (21); MA was also reported to be commonly used either before or during sexual intercourse

(47;49;52). Depression and suicidal/homicidal ideation have also been reported among populations of drug or MA using MSM (43) and MA was utilized to self-medicate against the negative affect of having an HIV(+) status (52); in addition, binge use of MA was also associated with greater physical and/or psychological consequences (53).

A few studies in the literature examined MA use among heterosexual populations; however, most of these studies only examined IDU or NIDU, only male or female MA users, or included only drug use or STI-risk sex behaviors, without also examining the motivations for MA use. Larger studies among both male and female MA users, examining STI-risk sex behaviors along with drug use behaviors (especially injection drug use) and motivations for MA use are warranted. The findings of the few studies among heterosexual, MA-using populations in the literature are summarized below.

Among heterosexual populations, MA use is also associated with higher risk sex behaviors. Men who use MA are more likely to engage in unprotected sex, to report anonymous or casual partners, to trade sex for money or drugs, and sex partners who are also MA users or IDU (54;55). Heterosexual men who used MA were also more likely to inject the drug, share/borrow needles or equipment, and to use other drugs (polydrug users) compared to non-MA using men (54;55).

Female MA users have been more likely to report STI-risk sex and drug use behaviors compared to non-MA users. A study of 199 female inmates in Oregon reported that 47% of the incarcerated population had used MA prior to imprisonment, 50% had injected drugs at some point, and a significant proportion had traded sex for

money or drugs and had a history of sexual and physical abuse (56). Additionally, a cross-sectional study of 98 MA using women in San Diego also reported unprotected sex and experimentation while high, trading sex for money or drugs, and a partner who was also a MA user (36).

In studies including both heterosexual men and women, MA use was also associated with STI-risk sex behaviors and drug use behaviors. Overall MA use was associated with higher levels of unprotected sex, anonymous or casual sex partners, sex marathons, recent sexually transmitted infections, HIV sero-discordant sex partners, meeting partners on the internet, using Viagra, and having greater number of sex partners (19;35;40;57;58). Injection drug use, sharing or borrowing needles, having a partner who was also a MA or injection drug user, and polydrug use were also significantly associated with MA use (35;57). Injection drug use of MA was also associated with more unprotected sex by male IDU or male partners of female IDU (30). MA use was also positively associated with the act of sex where both male and female MA users reported using MA to improve sexual performance, to engage in risky (unprotected) sex while high, and an obsession with sex (59). In addition, lower self-perceptions and higher impulsivity among MA users were also found to be associated with higher risk behaviors (39;60). Psychological (depression, alcohol abuse), social (detention, arrests, unemployment, and lower incomes), and physical (seizures, weight loss) consequences were also associated with MA use among men and women (18;61).

In studies that compared male and female MA users, several interesting differences were reported. Men were more likely to have greater numbers of sex partners and to be younger at initiation of drug use (38). Women were more likely than men to use MA to lose weight and to deal with childhood abuse (62). Men were more likely than women to be IDU, to have a history of arrests, and to report polydrug use (62). In contrast, women were more likely to share needles or equipment, to have an injection drug using sex partner, to use or inject MA with someone else (dealer, partner, friend), and a greater overlap and density between sexual and drug use networks in women (28;29;63;64). However, a California study of 320 IDU reported that women were also more likely to participate in needle exchange or to clean their syringe/equipment than the men, imbuing safer practices among women despite multiple networks consisting primarily of IDU (65); women were also more likely to engage in secondary syringe exchange (trading for someone else) compared to men (63). In a study of 1445 men and women who reported drug use in California, men were more likely to report condom use due to HIV(+) status versus women who used condoms when trading sex for money or drugs; multiple sex partners were associated with MA use and unprotected sex was associated with STI in men and not in women (33). Another study in Baltimore of 1051 drug users reported an association between condom use and peer norms regarding condoms use, and women were less likely than men to report friends who used condoms (66). Women were more likely to report depression and unemployment/lower income, although men were more likely to report a history of arrests and crimes (61). In a US multi-city arrestee population of 4644 of

adolescents, female drug users are also more likely than male drug users to report drug dependence and need for treatment and may be more amenable to encouragement and counseling (67); a prospective arrestee population in Sacramento also reported MA use to be more likely among males rather than females (68). Therefore, although female MA users may be at higher risk due to integrated drug use and sex networks, they may also be more open to risk-reduction interventions and treatment options. Whereas the younger age at initiation among male MA users may suggest adolescent targets may be appropriate for prevention measures as a means of overall drug use and sex behavior risk-reduction.

Injection Drug Use

Studies have reported several demographic characteristics associated with injection drug use. Younger age has been reported to be associated with injection drug use along with lower educational attainment, unemployment, and never being married (69-74). Homelessness and bisexual or homosexual identity has also been associated with injection drug use (32;73-75). In addition, injection drug use has been associated with increased frequency or amount of MA use, more years of use, sharing of needles or equipment, increased risk of overdose, history of participation in a drug treatment program, and polydrug use (32;69;70;72-74;76-80). In Wisconsin, a study of 593 HIV(+) and 338 HIV(-) drug users reported that needles sharing or borrowing was most common due to safer injection fatigue (81). Additionally, a study of 47 IDU in California also reported that secondary syringe exchange (trading syringes for

someone else) occurred in established social networks, usually frequented by women for their male IDU sex partners (82).

STI-risk sex behaviors were also common among IDU. Unprotected sex was commonly reported in injection drug using populations and in a study of 1445 IDU recruited from a syringe exchange program in California (71;81), condom use was correlated with riskier sex behavior such as reporting multiple sex partners, no steady sex partner, trading sex for money or drugs (33). The same study also reported that heterosexual anal sex was associated with MA use among IDU as well as risky drug use and sex behaviors among men and younger age in women. Several studies also reported increased rates of HIV among IDU compared to non-injection drug users (NIDU) as well as increased rates of hepatitis C and other sexually transmitted infections (69;70;73;74;78;81;83). However, baseline rates of sexually transmitted infections among NIDU suggest a sexual route of transmission for STI compared to the potential increased risk of exposure to blood-borne infections of HIV or hepatitis among IDU (73), especially in light of the association between HIV(+) status and needle sharing among IDU (73;74;78;83). Additional STI-risk sex behaviors correlated with injection drug use include reporting multiple sex partners and trading sex for money (33;69;72;76). For women, an injection drug using sex partner, younger age at sexual debut, and history of sex abuse were also correlated with injection drug use (69;73;74); trading sex for money was also more common among female IDU than male IDU in a cohort of 1024 IDU in New York City (76).

Physical, psychological, and social or legal consequences were also reported by several studies on injection drug use populations. Physical consequences that were reported include hallucinations, psychotic episodes, and seizures (70;71;84).

Depression and suicidal ideation was reported more often in IDU versus NIDU as well as lower emotional support, experience with rejection, and impulsivity (70;71;75).

Finally, several studies also reported history of felonies or arrests among injection drug use populations (69-72).

In a cross-sectional study of 609 IDU comparing long-term to new-injectors in Brazil, risky behavior was more common among long-term injectors (85). New injectors were more likely to seek treatment and to participate in needle exchange; borrowing and sharing of needles/equipment increased over time. In addition, among long-term male injectors, HIV(+) status was most strongly predicted by history of STI, sharing needles, engaging in sex with another man, and previous imprisonment.

Thus the literature shows that IDU and NIDU differ among drug using populations. Injection drug use was shown to be associated with increased sharing polydrug use and increased STI-risk behaviors (e.g unprotected sex, multiple partners), and sharing of injection equipment was commonly reported. Injection drug use is also associated with increased physical and psychological consequences, including greater depressive symptoms. Therefore, it is important to study the characteristics, behaviors, consequences, and motivations of injection drug use among a heterosexual population to improve upon the existing intervention and prevention programs for MA abuse.

Initiation of MA Use

Early initiation of MA use has been associated with being a minority in a mostly minority neighborhood with lower education, family history of alcoholism, parental absence, history of criminal behavior and/or conviction/imprisonment, binge drug use, injection drug use, and use of another drug or alcohol consumption (84;86-88). In addition, younger age at initiation has also been associated with STI-risk sex behaviors such as reporting multiple sex partners, early sexual debut, trading sex for money or drugs, and history of HIV or STI's (38;87;88). In Taiwan, girls were more likely to initiate MA as their first drug used compared to boys, and earlier onset among boys was also associated with use of more drugs before MA than later onset of drug use (89). A few studies have also noted an overlap between drug use (and injection drug use) and sex networks among women, potentially acting as a gateway between sexual debut and initiation of drug use, as well as a bridge for STI transmission between risky networks (29;65;79;90). For instance, in a cohort of 175 female and 356 male IDU in California, women were more likely to engage in secondary syringe exchange and to report sex partners who were also IDU (63).

Motivations for MA Use

Several motivations for initiation and current use of MA have been reported in the literature including the following: to get high, to get more energy, to lose weight, to feel more confident, to cope with mood, to enhance sex, to meet sex partners, or for sensation seeking. To get high was the most common motivation cited in the literature

as a motivation for MA use, followed by social reasons such as to have fun or to party (35;36;62). Physical motivations were also common including the desire to increase energy levels, to stay awake, and to lose weight; women were more likely to report the desire to lose weight as motivation for MA use than men (35;36;62). Sensation seeking was also reported as a motivation for MA use including the desire to experiment (59;62;86). Some individuals also attributed the use of MA to enhance the quality or quantity of sex (21;36;59;62); a study of 1730 MA users in San Francisco reported an association between MA use and Viagra use (58). In addition, several studies also reported MA use for the purpose of escaping and to cope with mood (36;62). MA was also used as a substitute or replacement for another drug (86).

Among men who have sex with men, a study of 48 active MA users in New York City reported a difference in motivation for use by HIV serostatus. HIV(+) MSM were more likely to site sexual motivations for MA user compared to HIV(-) MSM who attributed more social reasons for MA use; Caucasian participants were also more likely to report physical reasons for MA use compared to men of non-Caucasian backgrounds (91). Similar motivations were also cited by a study of MSM in Florida regarding MA use attributed to fears of loneliness and physical attractiveness, and the desire to decrease sexual inhibition. Unfortunately, chronic use of MA also contributed to the loss of relationships and friendships, unemployment, and STI-risk sex behaviors, thus sustaining the cycle of MA use (92). Finally, a study of 25 HIV(+) MSM in San Diego also reported MA use to enhance sex as well as ameliorating the negative affect of their HIV seropositive status through MA use (52).

Current intervention programs for MA cessation are based on behavioral modification models. Therefore, identification of motivations for initiating and current use of MA and distinguishing motivations by gender, injection drug use, or binge use are vital to the efficacy of current and new intervention programs. Individuals who use MA for psychological or physical reasons (e.g. to lose weight, to feel more confident, to escape) would be motivated differently than those individuals who attribute sensation seeking desires (e.g. to experiment, to get high), and these associations between gender or drug use behavior with motivations for use may also be associated with increased STI-risk behaviors. More studies are needed to examine motivations for MA use among heterosexual populations.

Binge MA Use

Except for the classification of “chronic” vs. “binge” use by Halkitis et al, there are currently no definitions of “binge use” in the MA literature (93). The available literature on alcohol use conveys the difficulty in definitions of “binge use.” Gender differences are often either unaccounted for in “binge” definitions or gender-specific thresholds are not universally observed (94;95). Also, several studies have shown the lack of correlation between the “binge” drinking definition and actual blood alcohol concentration (BAC) levels, suggesting that participants classified as “binge drinkers” are not necessarily comprised exclusively of the heaviest drinkers and those most at risk of injury and health consequences (95;96). Finally, “binge” drinking definitions do not account for time elapsed during an event which specifically impacts BAC levels and sobriety of the individual (95;96). Therefore, it would be helpful to

examine the different components necessary in identifying a potential definition for the binge use of MA (Appendix 1).

Binge use of alcohol and illicit drugs in the literature has shown correlations with HIV-risk behaviors such as unprotected sex, poly-drug use, and equipment sharing among IDU. Similar to the abuse of alcohol and other illicit drugs studied in the literature, binge use is fairly common among MA users. However, very few studies have examined binge use of MA, and there are no current studies examining binge use of MA in a heterosexual population. The few studies that have examined binge use of MA report binge use in 40 – 67% of the study population (52;53;93). However, there are only two studies specifically on binge use of MA, both of which focused exclusively on men who have sex with men or men who have sex with men and women.

In a study of 90 HIV(+) MSM, Semple et al observed that binge users were more likely to be minority, lower SES, younger at initiation, to report higher HIV risk behaviors (injection drug use, more likely to use heroin, more frequent use, more sex with HIV(+/unknown) partner), and to experience higher psychological/physical consequences (weight loss, sleeplessness, hallucinations, and paranoia) (53). Semple et al also reported a greater desire to increase attractiveness, gain self-confidence, increase energy, and enhance sexual pleasure as motivations to initiate MA use among binge users compared to non-binge users, and an increased desire to meet sexual partners as a motivation to continue MA use among binge users compared to non-binge users. In another study of 49 MSM and MSMW, Halkitis et al noted that the

greatest predictor of increased frequency of MA use was avoidant coping, where binge users (1-12 times of MA use/90 days) were compared to chronic users (use greater than “binge use” definition) (93). Given potential increased HIV risk factors involved with binge use of MA, it is important to look at subgroup analysis by binge use in a heterosexual population for differences in characteristics, consequences, and HIV risk factors.

A few other studies noted the correlations between MA use and increased drug use behaviors or consequences. In a sample of female MA users, Semple et al noted a correlation between intensity of MA use and behavioral consequences, although “binge use” was not specifically examined (36). In a separate study, Semple et al also noted an association between binge use and greater intensity of MA use with impulsivity and risky drug use behaviors such as poly-drug use, MA dependence, and HIV risk sex behaviors (39). Two large, national cross-sectional studies in 17,709 adolescents (97) and 54,079 adults (98) both independently observed associations between MA or stimulant use with sensation seeking, poly-drug use, and binge drinking.

In a prospective study of 1013 HIV(-) IDU, Miller et al noted an association between binge drug use and HIV seroconversion, where binge drug use was also associated with sharing of injection equipment, poly drug use, and trading sex for money or drugs (99). However, Miller et al did not study MA specifically. Binge use of illicit drugs other than MA was also observed in other studies to be associated with early initiation into injection drug use, syringe sharing, non-fatal overdoses, and binge

drinking (87;99-101). The literature on binge use of alcohol also reports the use of alcohol to lower inhibitions and as a coping mechanism, similar to trends noted by Semple et al and Halkitis et al in the MA studies noted above (102).

Although binge MA use has not been studied among heterosexual populations, binge MA use has been associated with greater HIV-risk behaviors including unprotected sex or trading sex for drugs and sharing of injection equipment. Binge MA use has also been associated with the desire ‘to escape’ or ‘to cope with mood’ as a motivation for MA use, and with greater depressive symptoms and more consequences of MA use. Given the increased HIV-risks and physical and psychological effects of MA use, it is important to examine binge MA use among heterosexual populations to compare the findings with those reported in the literature among men who have sex with men.

Significance

Although there are several MA studies in the literature, this is an area of increasing concern and many questions about MA use and its consequences remain unanswered. There is a paucity of research on the potential associations between MA and HIV-risk behaviors among heterosexual populations. Few studies among heterosexual populations highlight potential differences in MA use characteristics stratified by gender, method and pattern of MA use, and no studies have looked specifically at both drug use and HIV-risk sex behavior along with motivations for use among heterosexual MA using populations, especially comparing men to women.

Despite the handful of studies of heterosexual populations, few studies specifically compared male and female MA users and of those studies, none reported a comprehensive comparison of drug use and HIV-risk sex behavior, or consequences of or motivations for MA use. Understanding the motivations for initiation and current use of MA is important in identifying targets for effective prevention and intervention programs. The few studies that examined injection drug use either did not include HIV-risk sex behaviors, took place in other countries where the context of MA use might not be comparable to the US, did not include MA use, or only included MSM, men or women, or only IDU. Finally, the literature on binge use of drugs has focused primarily on alcohol or illicit drugs other than MA. Currently, the two studies available on binge use of MA focus on MSM or MSWM populations; thus very little is known about binge use of MA in heterosexual populations.

This dissertation focuses on these identified gaps in the literature and the three papers aim to contribute to the literature by identifying and examining the relationships between gender, method and pattern of MA use with the characteristics, behaviors, consequences, and motivations of MA use. Further exploration of gender, injection drug use, and binge MA use differences need to focus on not only the STI-risk sex and drug use behavioral differences, but more importantly, the motivations that drive initiation and continued use of MA. A thorough examination of the differences in risk by gender and method and patterns of MA use, as well as a better understanding of the motivations that drive MA use, will lead to more effective

intervention methods to decrease rates of MA initiation and minimize the risk of HIV and STIs among current MA users.

C. Rationale, Specific Aims, and Hypotheses

Although several MA studies existed among populations of men who have sex with men, there were significantly fewer studies among populations of heterosexual men and/or women. In addition, HIV-seronegative MA-using populations provided a unique target population for prevention measures. The association between MA use and the increased risk of acquiring HIV or STIs through drug use and sex behaviors was of special concern among heterosexual MA users. The three manuscripts contained in this dissertation expanded the existing literature and provided novel findings among heterosexual MA-using populations.

The primary objective was to explore the differences in sociodemographic characteristics, drug use and sex risk behavior, and motivations for MA use by gender and drug use behaviors (injection drug use and binge drug use) in a cohort of HIV-seronegative, heterosexual MA users in San Diego. These differences in characteristics and behaviors by gender and drug use behaviors were explored to elucidate potential targets for developing and adapting more effective prevention and intervention efforts in the future.

SPECIFIC AIM/STUDY 1

To identify characteristics among heterosexual MA users that differed by whether or not MA was used in binges. To describe and compare background characteristics, drug use and STI-risk sex behaviors, and motivations for MA use.

Hypothesis 1: Binge MA users differ from non-binge MA users in terms of sociodemographic characteristics and experience more psychological, social, and physical consequences of MA use.

Hypothesis 2: Binge user differ from non-binge MA users in drug use behaviors and history including more injection drug use, polydrug use, amount and frequency of MA use in the previous month, and IDU who binge MA differ from IDU who do not binge MA in sharing of injection equipment. In addition, mean age at MA initiation and mean years of MA differ by binge use status.

Hypothesis 3: Sex behaviors differ between binge MA use and non-binge MA users including partner type, number of partners, recent STI diagnosis, and engaging in marathon sex while high on MA.

Hypothesis 4: Motivations for initiating and current use of MA differ between binge and non-binge users of MA including the following motivators: to get high, to escape, to lose weight, for sexual enhancement.

SPECIFIC AIMS/STUDY 2

To compare background characteristics, drug use and STI-risk sex behaviors, motivations for and consequences of MA use between 306 male and 146 female MA users.

Hypothesis 1: Background sociodemographic characteristics differ by gender, including age, race, education, and marital status.

Hypothesis 2: Drug use behaviors differ by gender in greater use (amount, frequency, years of use, binge-use) and riskier patterns of drug use (injection drug use, poly-drug use, co-use of drugs other than alcohol and marijuana).

Hypothesis 3: STI-risk sex behaviors differ by gender. Men and women report statistically significant differences in higher STI-risk behaviors including riskier partner types (sex partners who were also MA users, IDU, or with HIV(+)/unknown status), increased rates of sexually transmitted infections, more anonymous/casual sex partners and a greater number of partners.

Hypothesis 4: Motivations for MA use differ by gender. The literature suggested that women differ from men in their use of MA to lose weight, to feel more attractive, to escape, or to enhance sexual pleasure.

SPECIFIC AIMS/STUDY 3

To explore potential associations between injection drug use and STI-risk behaviors. To describe and compare background characteristics, including felony history and consequences of MA use, drug use and STI-risk sex behaviors, and motivations that underlie MA initiation and current use between 133 IDU and 319 NIDU.

Hypothesis 1: Sociodemographic characteristics differ by injection drug use status. IDU differ from NIDU in age, race, homelessness, and history of felony convictions.

Hypothesis 2: IDU differ from NIDU in drug use behavior and history including: age at MA initiation and who initiated MA use (friend, family, or lover), years of MA use, amount and frequency of MA use in the last month, and binge use of MA.

Hypothesis 3: Sex behaviors differ between IDU and NIDU including mean number of sex partners and mean number of unprotected vaginal sex acts, sex partners with HIV-seropositive or unknown serostatus, STI in the last 60 days, and engaging in sex marathons while high on MA.

Hypothesis 4: Motivations for initiating and current use of MA differ by injection drug use status including the following motivations: to get high, to escape, to cope with mood, to feel more confident, and to meet sex partners.

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II. Methods

This study used existing data from the FASTLANE dataset to explore potential differences in background characteristics and history, drug-use and sex behavior and history, and motivations for initiating and current MA use. Three manuscripts form the basis of this dissertation and examine the sociodemographic characteristics, drug use and STI-risk sex behaviors, and consequences of and motivations for initiation and current use of MA. The first manuscript compared binge to non-binge users; the second examined differences between male and female MA users, and the third manuscript studied injection drug use status. Two additional analyses examined the correlation between “intensity” of MA use and binge MA use (Appendix 1), and compared MA-only IDU to polydrug IDU (Appendix 2). Baseline data used in these analyses were collected by audio-CASI between 2001 and 2005. Statistical analyses were performed using STATA 8 E (StataCorp, College Station, Texas, USA). Statistical tests included t-tests, ANOVA, χ^2 tests, receiver operating characteristic (ROC) analysis, logistic regression, and polychotomous logistic regression.

A. Study Design

Baseline data for the FASTLANE Research Project in San Diego were collected between June 2001 and February 2005. The project was designed to test the efficacy of a 4-session sexual risk reduction intervention for a cohort of MA users in San Diego. Participants were divided into three arms of the study. Two intervention groups received the 4-session sexual risk reduction intervention, and the third control group received a 4-session control counseling session. Then one of the intervention groups and the control group received an additional 4-session booster. The intervention was based on the concepts of social cognitive theory and theory of reasoned action.

Baseline and follow-up data was collected using a 90-minute (approximately) audio-CASI (computer-assisted self-interviews) and included the following: socio-demographic data, alcohol and drug use, MA use patterns, sexual risk behaviors, social cognitive factors, social network factors, physical health variables, and psychiatric health variables. Follow-up visits consisted of four weekly 90-minute individual counseling sessions, then four monthly 90-minute “booster” sessions; three follow-up audio-CASI assessments were conducted at months 6, 12, and 18. The counseling based on motivational interviewing and social cognitive theory; focused on: context of MA use and unsafe sex, condom use, negotiation safer sex practices, and the enhancement of social support. Participants were compensated \$30 for their first baseline survey assessment and for the first counseling session.

B. Recruitment and Screening of Participants

Subjects were recruited from the community, with a focus on pre-identified target areas with high concentrations of MA users (geography and peak use times of day). Participants were recruited in person by community outreach workers. In addition, recruitment efforts also included community posters and ads in newspapers and magazines; the remainder was referred by family and friends and enrolled participants.

C. Study Population

The study population consisted of heterosexual, HIV(-) adults (> 18 years old) who had used MA at least twice in the previous 2 months prior to screening. In addition, participants were required to have engaged in unprotected anal, vaginal, or oral sex in the previous two months with a partner of the opposite sex to be eligible. HIV negative status was tested and confirmed prior to entry into the study and verified with the OraSure HIV-1 Oral Collection Specimen Device (reliability=99.9%, George et al. 1997). The study sample consisted of 306 men and 146 women; of whom 133 had injected drugs at some point or were current injection drug users, and 319 had never injected drugs, and 183 self-reported binge MA use versus 268 self-reported no binge MA use. Although minorities were over-sampled to increase representation of other ethnic groups in the study population, the majority of the population was Caucasian (49%), followed by African-Americans (27%) and Hispanics (13%). The average age at baseline was 37 years old and the majority of participants (55%) had never been married, are currently unemployed (70%), have never attended college (58%), and report an annual income less than \$20,000 (65%). The majority of participants (99%) had engaged in unprotected vaginal sex (an inclusion criteria of the study), although fewer participants (35%) reported unprotected anal sex in the previous two months. MA using sex partners were common among all partner types (spouse, steady, casual, and anonymous). One fifth of participants reported having a past STI at baseline.

D. Measures

Participants in the FASTLANE study were surveyed at baseline and again at follow-up at 6, 12, and 18 months. Seven different types of interviews were incorporated into the survey covering the following topics: MA and drug use, HIV/STI history and sex behavior, sensation seeking, drug dependence/abuse scale, Beck depression and social inventory, and the attitudes and perception survey. In addition, an initial screening questionnaire ascertained eligibility for the study and background characteristics. Of all the measures that were collected at the baseline questionnaire, a subset was examined in this study. The following types of measures were analyzed: background demographics and history of felony conviction; physical, psychological, and social/legal consequences of MA use; drug use characteristics; sex behavior and history; motivations regarding initiation and current use of MA.

Demographics

Demographic characteristics and relevant background measures were analyzed for differences between gender, binge, and injection drug use. The following demographic variables were considered: 1) gender (male/female); 2) age at baseline interview (yrs); 3) ethnicity (Caucasian/non-Caucasian); 4) income (<\$20,000/≥\$20,000); 5) employment (currently employed/unemployed); 6) educational attainment (≤ high school graduate, some college and higher); and 7) marital status (not/never married/married). In addition, history of felony conviction (ever vs. never), and number of consequences (physical, psychological, and social/legal) of MA use were also examined.

Drug Use Behavior and History

Several drug use and drug history variables will be examined in this study.

Drug use behavior in the two months prior to the baseline interview to be analyzed include: 1) amount of MA used (grams/month); 2) frequency of MA use (# days/month); History of drug use characteristic included: 1) injection drug use (ever vs. never); 2) treatment for MA use (ever vs. never); 3) completion of treatment program for MA use (yes vs. no); 4) age at MA initiation (in years); 5) number of years of MA use (in years); and 6) other drug injected with MA (yes vs. no).

Participants were also asked who initiated their MA use from the following: family member, friend, or lover. Binge use was assessed as “yes” or “no” depending on participant response to the question, “Are you a binge user? By binge user, I mean you keep using large quantities of meth for a period of time, until you run out or just can’t physically do it anymore.” The definition for binge use was derived through in-depth qualitative interviews, and key components of binge were identified through thematic analyses (see manuscript 1). For binge users, additional variables regarding a “typical binge” included: 1) # of days of the binge, and 2) reason for terminating binge.

Sex Behavior and History

Sex history and STI-risk sex behaviors in the two months prior to the interview were ascertained at the baseline questionnaire. The following sex behaviors from the prior two months were surveyed: 1) total number of partners (continuous); 2) traded sex for MA (ever vs. never); 3) self-reported STI (yes vs. no); 4) number of unprotected vaginal sex acts (continuous); 5) consume MA with sex partner (yes vs. no); and 6) engaging in sex marathons (yes vs. no).

Participants were also asked about the following variables in the two months prior to the baseline interview with a spouse or a steady sex partner: 1) type of sex partner (yes vs. no); 2) unprotected vaginal sex (always vs. sometimes); 3) unprotected anal sex (always vs. sometimes); 4) sex partner with HIV-positive or unknown serostatus (yes vs. no); 5) sex partner with STI (yes vs. no); and 6) sex partner who used MA (yes vs. no); these same variables were also collected and examined for a casual or anonymous sex partner.

Motivations

Multiple scales and variables pertaining to motivations for initiation and current use of MA were available in the existing data. The following motivations for a) initiation of MA use and b) current use of MA were examined in the manuscripts included in this dissertation: 1) to escape; 2) to enhance sexual pleasure; 3) to lose weight; 4) to get high; 5) to cope with mood; 6) to feel more confident; 7) to meet sex partners; 8) to stay awake/get more energy; and 9) to experiment.

E. Power Calculations

The analyses for this dissertation were performed using an existing dataset with a fixed sample size. Therefore, power calculations were performed to determine minimal differences in exposure variables of interest that would be required for such differences to be statistically significant. A total of 452 participants completed the baseline questionnaire for the study, of whom, 306 are male and 146 are female. Overall, 133 participants self-reported injection drug use and 319 have never injected drugs, and 183 self-reported binge MA use and 268 have never binged on MA.

The distribution of traits examined varied by characteristics, but an a priori plan for analysis included collapsing of categories with less than 10% prevalence of a trait in the study population. For the first objective examining characteristic differences between 183 binge MA users and 268 non-binge MA users, there was 80% power to detect a statistically significant odds ratio above 2.27 or below 0.32 for a prevalence of 10%, assuming α -level of 0.05 and a two-sided hypothesis (Table 2-1).

The power calculation for study 2 comparing 146 female MA users to 306 male MA users indicated the ability to detect a statistically significant odds ratio above 2.24 or below 0.30 for a low prevalence of 10%, at 80% power with a two-sided hypothesis and an α -level of 0.05 (Table 2-2).

For the third objective, examining 133 injection drug users to 319 non injection drug users, a prevalence of 10% of the independent variable allowed for the ability to statistically detect a statistically significant odds ratio above 2.29 or below 0.29, at 80% power with a two-sided hypothesis and an α -level of 0.05 (Table 2-3).

F. Analysis Plan

Descriptive statistical analyses examined variables using means or medians for continuous measures, and frequencies and percentages for categorical variables. Differences by subgroup (gender, injection drug use, binge drug use) were examined using chi-square tests for categorical variables, and t-tests or Wilcoxon rank-sum tests for continuous variables depending upon whether or not the data were normally distributed. Logistic regression was used to assess the bivariate and multivariate associations of factors with the dependent variable (gender, injection drug use, and binge drug use). All variables found to be significant ($P < 0.05$) through bivariate analysis were considered for inclusion in multivariate analysis. Backward stepwise regression was performed manually to produce the most parsimonious model. Factors that were independently associated with being a the dependent variable ($P < 0.05$) in multivariate analysis were retained in the final model, based on likelihood ratio tests comparing full to reduced models. Two additional analyses were also performed and described in the appendices. A receiver operating characteristic (ROC) analysis was performed comparing “intensity” (the product of frequency and amount of MA use) and “binge” drug use to determine the statistically significant overlap between the two variables and to decide which variable to examine in the study (Appendix 1). Finally, a polychotomous logistic regression was performed to compare NIDU with IDU who either a) injected MA only or b) injected MA with another drug (e.g. cocaine or heroin) to examine potential differences between MA-injectors with polydrug-injectors (Appendix 2).

Table 2-1: Detectable Odds Ratios for a sample size of 183 binge and 268 non-binge MA users by prevalence of exposure variable (e.g. STD history, partner types, etc.), with an α -level of 0.05 and a two-side hypothesis test

<i>Power</i>	<i>Prevalence</i>	Detectable Significant Odds Ratio	
		OR <	OR >
80	10	0.32	2.27
90		0.24	2.51
80	15	0.41	2.04
90		0.33	2.26
80	20	0.47	1.94
90		0.39	2.11
80	25	0.51	1.86
90		0.44	2.04
80	30	0.53	1.83
90		0.47	1.98
80	35	0.55	1.80
90		0.49	1.96
80	40	0.57	1.78
90		0.50	1.94
80	45	0.58	1.79
90		0.52	1.95

* Sample sizes generated using UCLA sample size calculator for binomial distributions (<http://calculators.stat.ucla.edu/powercalc/binomial/case-control/index.php>).

Table 2-2: Detectable Odds Ratios for a sample size of 306 men and 146 women by prevalence of exposure variable (e.g. IDU, binge-use, etc.), with an α -level of 0.05 and a two-side hypothesis test

<i>Power</i>	<i>Prevalence</i>	Detectable Significant Odds Ratio	
		OR <	OR >
80	10	0.30	2.24
90		0.23	2.50
80	15	0.39	2.02
90		0.32	2.24
80	20	0.45	1.91
90		0.38	2.10
80	25	0.49	1.84
90		0.43	2.02
80	30	0.51	1.80
90		0.46	1.97
80	35	0.53	1.77
90		0.48	1.94
80	40	0.55	1.76
90		0.49	1.93
80	45	0.56	1.76
90		0.51	1.93

* Sample sizes generated using UCLA sample size calculator for binomial distributions (<http://calculators.stat.ucla.edu/powercalc/binomial/case-control/index.php>).

Table 2-3: Detectable Odds Ratios for a sample size of 133 IDU and 319 non-IDU by prevalence of exposure variable (e.g. STD history, partner types, etc.), with an α -level of 0.05 and a two-side hypothesis test

<i>Power</i>	<i>Prevalence</i>	Detectable Significant Odds Ratio	
		OR <	OR >
80	10	0.29	2.29
90		0.22	2.56
80	15	0.38	2.06
90		0.31	2.29
80	20	0.43	1.95
90		0.37	2.14
80	25	0.47	1.88
90		0.41	2.06
80	30	0.50	1.83
90		0.44	2.01
80	35	0.52	1.81
90		0.47	1.98
80	40	0.54	1.79
90		0.48	1.97
80	45	0.55	1.79
90		0.50	1.97

* Sample sizes generated using UCLA sample size calculator for binomial distributions (<http://calculators.stat.ucla.edu/powercalc/binomial/case-control/index.php>).

III. MANUSCRIPT 1

Binge Use and Sex and Drug Use Behaviors among HIV(-), Heterosexual Methamphetamine Users in San Diego

A. Abstract

This study identified sociodemographic factors, drug using practices, sexual behaviors, and motivational factors associated with binge (a period of uninterrupted) methamphetamine (MA) use among heterosexual MA users. *Sample and Method:* The FASTLANE study provided cross-sectional data collected by audio-CASI between June 2001 and August 2004 from 451 HIV-negative MA users in San Diego, CA USA who had engaged in unprotected sex and used MA in the previous two months.

Results: The study sample was 67.8% male, 49.4% Caucasian, 26.8% African-American, and 12.8% Hispanic with a mean age of 36.6 years; 183 (40.5%) reported binge use in the past 2 months. Compared with non-binge users, binge users of MA were more likely to report risky drug use and sex behaviors and differed in motivations to initiate and currently use MA. The final logistic regression model for binge use included more days of MA use in the last month, ever treated for MA use, injection drug use, higher Beck Depression Inventory score, “experimentation” as a motivation for initiating MA use, and engaging in sex marathons while high on MA. HIV prevention efforts should differentiate and address these differences in motivations for MA use and the associated HIV-risk sex and drug use behaviors as key targets for effective intervention.

B. Introduction

Despite prevention efforts of the last few decades, methamphetamine (MA) use remains a major public health concern (3;12;118-122). Long-term use of MA, which acts on the dopamine centers of the brain, depletes the normal, physiological supply of dopamine leading to a “crash” from a MA-induced high and subsequent increased use of MA. A subgroup of MA users may binge on the drug in order to prolong euphoria and delay the inevitable crash (7-9;57;123). Although studies have shown a link between increasing years of MA use, increased tolerance to the drug’s effects, and greater amounts or frequency of MA use (7;124), it is unclear whether binge use is also associated with length of the history of use. Binge use is often either self-classified or dichotomized as heavy versus light (108), and an established definition of “binge use” of MA is currently lacking in the existing literature.

Chronic use of MA leads to commonly reported social, physical, and psychological consequences (7;43;57;70;81;82;86;99;107;125;126). MA use has also been associated with HIV-risk behaviors such as unprotected sex, greater numbers of sex partners, casual or anonymous sex partners, engaging in marathon sex while high, and injection drug use (20;37;43;44;53;57;58;65;82;92;100;118;127;128). Studies have also shown a link between MA use and increased libido, as well as associations to a desire to enhance sexual pleasure or to lower inhibitions in order to seek sex partners, thus potentially leading to greater numbers of partners and engaging in marathon sex (22;56;70;124) with concomitant increases in STIs and HIV infection (124;129-131).

In a study of HIV-positive men who have sex with men (MSM) in San Diego, California, USA, binge use of MA was associated with higher levels of unprotected anal intercourse with HIV negative or unknown-status sex partners as well as with more MA-related consequences (57). Binge users were also more likely to cite injection drug use as the possible transmission mode of their HIV infection. In a different study of 98 female MA users in the same city, Semple et al. (37) noted an association between intensity of MA use and behavioral consequences, although “binge use” was not specifically examined. In a prospective study of 1013 HIV-negative injection drug users (IDU) in Vancouver, British Columbia, Canada, although MA was not specifically examined, Miller et al. (111) noted an association between binge use and HIV seroconversion, where bingeing was also associated with sharing of injection equipment, polydrug use, and trading sex for money or drugs. In addition, studies have also shown MA use to interfere with antiretroviral therapies and other HIV treatments (124).

To date, there have been no studies of drug use patterns among heterosexual MA users. To address this gap in the literature, this study aims to: 1) describe the background characteristics, drug use and sex behaviors, and motivations for and consequences of MA use among binge users; and 2) to identify correlates of binge use in a sample of HIV-negative, heterosexual MA users. Results from this study will add to the growing body of literature regarding MA use among heterosexual populations and may help guide the development of future interventions.

C. Methods

The sample consisted of 451 HIV-negative, heterosexual, male and female MA users who were enrolled in the FASTLANE sexual risk reduction intervention study at the University of California, San Diego. Data were collected between June 2001 and August 2004 using a 90-minute Audio Computer-Assisted Self-Interview (ACASI) that queried socio-demographic characteristics, alcohol and drug use, MA use patterns, sexual risk behaviors, social cognitive factors, social network factors, and physical and psychiatric health variables. Participants were compensated \$30 for their baseline assessment and first intervention counseling session.

Setting and Sample

Recruitment and Screening of Participants

Subjects were recruited predominantly from target areas with known high concentrations of MA users at specific peak times of day (e.g., Saturday night after 11 p.m.) (43). Participants were approached and recruited in person by community outreach workers. Recruitment efforts also utilized a social marketing approach through posters in public areas and ads in newspapers and magazines, and through referrals by family, friends, and previously-enrolled participants (43).

Study Population

The study population consisted of heterosexual, HIV(-) adults (≥ 18 years old) who had used MA at least twice in the 2 months prior to screening. Participants were also required to have engaged in unprotected anal, vaginal, or oral sex in the previous 2 months with a partner of the opposite sex. HIV-negative status was tested and

confirmed prior to entry into the study and verified with the OraSure HIV-1 Oral Collection Specimen Device (reliability=99.9%) (132).

Measures

Of the data collected by the FASTLANE baseline assessment, this study examined variables that had been found in previous studies to be correlated to either binge use or increased HIV risk.

Binge Use

Self-reported binge use was assessed as “yes” or “no” depending on participant response to the question, “Are you a binge user? By binge user, I mean you keep using large quantities of meth for a period of time, until you run out or just can’t physically do it anymore.” The definition for binge use was derived through in-depth qualitative interviews, and key components of binge were identified through thematic analyses (Semple et al, 2002). Participants were also asked to describe a “typical binge,” including number of days of a “typical binge” and reason(s) for terminating the binge.

Demographic Characteristics

The following demographic characteristics were examined: gender (male or female); age at baseline interview (years); ethnicity (Caucasian or non-Caucasian); and educational attainment (no college or some college and beyond).

Drug Use

Drug-use characteristics included: polydrug use in last 30 days (yes or no); number of years of drug use (years); age at MA initiation (years); injection drug use (ever or never); ever been in treatment for MA (yes or no), and, consequently,

completion of treatment program (completed or never completed). The amount (in grams) and frequency (number of days used) of MA use in the last 30 days were also examined.

Sex History and Behavior

Participants were asked the following questions regarding their sex behaviors in the previous two months: if they had a spouse or steady sex partner (yes or no); casual or anonymous sex partner (yes or no); total number sex partners (continuous); any STI in the last 60 days (yes or no); unprotected vaginal sex with (spouse or steady, and/or casual or anonymous) partners (always or sometimes); and engaged in sex marathons (prolonged sexual activity with genital contact for hours and hours, yes or no).

Psychosocial Measures

The following psychosocial variables were examined. number of consequences (physical, psychological, and social or legal) associated with MA use; level of depressive symptoms as measured by the Beck Depression Inventory (BDI) Score (133;134); and the following motivations to initiate and to currently use MA: to lose weight or feel more attractive, stay awake or get more energy, enhance sex or meet sex partners, experiment, and to escape or cope with mood.

Analysis

We compared correlates of binge use of MA. Descriptive statistics were calculated for the entire sample. Univariate logistic regression analyses were performed for all variables; subsequently, multivariate analyses for each grouping of

variables (demographic, drug use, sex behavior, consequences of MA use, and motivations) were performed. A full multivariate regression model included significant variables ($p < 0.05$) from the multivariate analysis by group, and manual backwards elimination was conducted to produce a final multivariate model that identified factors independently associated with binge use ($p < 0.05$). Variables were checked for normal distribution, and variables which deviated were log-transformed. Covariates were also checked for collinearity. Potential effect modification by gender or by injection drug use status with drug use and sex behaviors was identified from the literature and examined.

D. Results

Among the 451 participants were 306 men and 145 women (Table 3-1). Although minorities were over-sampled to increase representation, most participants were Caucasian (49%), followed by African-Americans (27%) and Hispanics (13%). The average age at baseline was 36.6 years, and most participants had never attended college (58%). Demographic characteristics did not differ significantly between binge and non-binge users.

Drug Use Behavior

Of the 451 participants, 183 self-reported binge use of MA in the past 2 months. The average MA binge lasted 6.6 days (Table 3-2). The most commonly reported reasons for stopping a binge were to “get some sleep” (35%), having “crashed, burned out” (21%), depletion of drug supply (18%), onset of paranoia (15%), and hallucinations (6%).

In the previous month, participants consumed on average 9.4g (SD=17.4) and used MA on 14.6 days (SD=9.1). As shown in Table 3-1, binge users reported a higher mean frequency of MA use (OR=1.29, 95%CI=1.17, 1.42) and a higher mean amount of MA used (OR=1.02, 95%CI=1.00, 1.03) compared to non-binge users. Study participants reported an average of 13.6 years of MA use (SD=8.9; range 0–42 years), and almost half (47.5%) of participants reported polydrug use; neither mean years of MA use nor polydrug use differed by binge status. The average age for MA initiation was 22.9 years, and binge users were significantly younger than non-binge users (OR=0.97, 95%CI=0.95, 0.99). Injection drug use was reported by 29.5% of

participants and was associated with binge use (OR=1.93, 95%CI=1.28, 2.91). Among the subsample of participants who had ever been treated for MA use (N=156), only 52.3% had completed the treatment program. Past treatment for MA use was significantly associated with binge use (OR=2.32, 95%CI=1.56, 3.45).

Sex Behavior

During the two-month period prior to the interview, participants reported having had the following: an average of 4.7 (SD=6.1) sex partners; a spouse or steady sex partner (93.1%); a casual or anonymous sex partner (88.9%); unprotected vaginal sex (an inclusion criterion) with a spousal or steady sex partner (85.4%) or casual or anonymous partner (69.0%); unprotected anal sex with a spousal or steady partner (32.8%) or a casual or anonymous partner (26.2%); and sex marathons while high on MA (64.7%). In addition, 20% of participants reported having had an STI in the 60 days prior to the interview (Table 3-1). Unprotected vaginal sex with a casual or anonymous sex partner (OR=1.68, 95%CI=1.11, 2.56), unprotected anal sex with a spousal or steady sex partner (OR=1.64, 95%CI=1.10, 2.44), and engaging in marathon sex while high (OR=1.75, 95%CI=1.16, 2.62) were the only sexual behaviors that were significantly correlated with binge use.

Consequences of MA Use

The most commonly reported consequences of MA use were sleeplessness (95.4%), weight loss (87.4%), financial problems (87.4%), family problems (86.2%), and dehydration (81.6%) (data not shown). The majority reported physical problems such as lesions, dehydration, or diarrhea (85.3%), social consequences such as

financial, legal, family, or relationship problems (76.9%), and psychological effects such as paranoia or hallucinations (53.4%) due to MA use (Table 3-3). Compared to non-binge users, binge users reported significantly higher rates of physical (OR=1.90, 95%CI=1.06, 3.40), social (OR=2.39, 95%CI=1.46, 3.91), and psychological problems (OR=1.95, 95%CI=1.33, 2.87). Study participants reported 6.2 (SD = 4.22) consequences on average (range = 0–13 consequences). The mean BDI score was 15.3 (SD = 10.2; range = 0–51); assuming commonly used cut-off scores (135), participants could be classified with BDI scores of 0-13 “minimal” (50.4%), 14-19 “mild” (17.3%), 20-28 “moderate” (19.9%), or 29-63 “severe” (12.4%) depression. Binge use was also associated with each unit increase of both greater number of consequences due to MA use (OR=1.11, 95%CI=1.06, 1.16) and a higher mean BDI score (OR=1.03, 95%CI=1.01, 1.05).

Motivations for Initiating and Currently Using MA

Participants most often reported the following motivations to initiate MA use: “to lose weight” (20.4%), “to stay awake or get more energy” (41.0%), “to enhance sex or meet sex partners” (30.8%), “to experiment” (42.1%), and “to escape or avoidant coping” (25.5%) (Table 3-3). Using MA “to experiment” and “to escape or avoidant coping” were associated with binge use.

Motivations for current use of MA differed from motivations for initiating MA use. Fewer participants attributed current MA use to their desire “to lose weight or feel more attractive” (12.7%), or “to experiment” (4.0%); however, the motivation “to enhance sex or meet sex partners” (30.6%) and “to escape or avoidant coping”

(24.4%) remained similar. Binge use itself was correlated with the motivation “to escape or avoidant coping” and the desire “to enhance sex or meet sex partners.”

Factors Independently Associated with Binge Use

Multivariate logistic regression modeling was performed for variables in each of the following groups: demographics, drug use behavior, sex history and behavior, and motivations or consequences. The following variables that were significantly associated with binge use ($p < 0.05$) in univariate analyses also emerged as significant in the multivariate analyses within one of the four groups of variables and were thus entered into the full multivariate model: number of days of MA use in last 30 days, injection drug use, ever enrolled in a MA treatment program, and age at MA initiation (drug use variables); unprotected vaginal intercourse with a casual or anonymous partner, involvement in sex marathons while high on MA (sex behavior variables); number of consequences of MA use and BDI score (consequences); initiating MA use in order “to experiment” or “to escape or avoidant coping” (motivations to initiate use); and a desire to “enhance sex experiences or get sex partners” or “to escape or avoidant coping” (motivations for current use). The final multivariate model identifying factors independently associated with binge use ($p < 0.05$) included number of days of MA use in last 30 days, ever treated for MA use, injection drug use, higher BDI score, engaging in sex marathons while high on MA, and initiating MA use due to a desire “to experiment,” and the full model explained 10% of the total variance (pseudo $R^2 = 0.10$) (Table 3-4). No significant effect modification by gender or by injection drug use status was detected.

E. Discussion

In this study of HIV-negative MA users, binge users did not differ significantly from non-binge users on any of the demographic characteristics that were assessed. Several drug use and sex behaviors differed by binge use including higher amounts and number of days of MA use, injection drug use, unprotected vaginal sex with a casual or anonymous partner, and engaging in marathon sex while high on MA. Binge use was also associated with a higher number of consequences, higher BDI score, and differences in motivations for MA use. The final multivariate model included more days of MA use in the last 30 days, prior treatment for MA use, injection drug use, engaging in marathon sex, higher BDI score, and the desire “to experiment” in initiating MA use.

Binge users reported significantly higher quantity and frequency of MA use compared to non-binge users. However, unlike intensity of drug use, which has been reported in the literature to increase with duration of use, binge use was not associated with average years of MA use. Therefore, binge use should be examined in both chronic, long-term MA users and in relatively new MA users. Binge use was also associated with a younger age at MA initiation; taken together, these findings suggest that incorporating awareness of the increased dangers associated with binge use into prevention programs adapted for younger adults is warranted. In a study of 90 HIV(+) MSM, Semple et al. (2003) also reported an association between binge use and younger age at MA initiation; injection drug use was reported by 40% of the study

population, but it was not associated with binge use, unlike in the present study. The association of binge use with IDU in this study highlights a potential difference in drug use behavior between MSM and heterosexual binge use populations and reflects the importance of subgroup behaviors in HIV and STI prevention programs.

Consistent with the existing literature on MA-using populations (20;37;43;44;53;57;58;65;82;92;100;118;136;137), this study found that both binge and non-binge users of MA reported several STI-associated risk behaviors, including anonymous or casual sex partners, multiple sex partners, an STI in the last sixty days, unprotected vaginal sex, and engaging in sex marathons while high on MA. However, only engaging in sex marathons while high on MA, unprotected vaginal sex with a casual or anonymous partner, and unprotected anal sex with a spouse or steady sex partner were independently associated with binge status; no other sex behaviors differed by binge status. The participants in this study were recruited specifically for their higher HIV-risk behavior, and a majority reported engaging in unprotected vaginal intercourse with anonymous, casual, or steady partners. The combination of unprotected sex with the increased duration of (and the potentially greater number of partners during) sex marathons suggests that binge users may experience a higher risk of acquiring an STI or HIV. Therefore, binge MA use should be addressed in the design of STI prevention measures.

Previous studies have found an association between MA use and social, physical, and psychological consequences (7;43;57;70;81;82;86;99;107;125;138). We found that binge users reported a greater number of consequences of MA use and

higher Beck Depression Inventory scores, a finding that may help intervention programs address the overall well-being of treatment clients as well as reduce their HIV-risk in sex and drug use behaviors. In a study of MA binge use among HIV-positive men who have sex with men, Semple et al. (57) suggested that clinicians should discuss the consequences of MA with clients and encourage them to change or cease drug using behavior as a way to decrease the undesirable consequences.

Associated with binge use, the motivation “to escape” (avoidant coping) was cited as a motivation in initiating and currently using MA, and it may be that MA was used to mitigate the negative consequences surrounding the environments of MA users. Intervention programs that fail to address the consequences and lifestyle factors or environment of MA users may leave participants in a cycle of MA use, negative consequences, and further MA use to cope with the consequences. The motivations to escape that were cited by binge users may be addressed by incorporating counseling regarding negative self-perceptions or attitudes into current treatment modalities. Despite the significant number of participants who reported past enrollment in and even completion of a MA treatment program, all participants were still using MA at the time of their baseline interview (which was an inclusion criterion for the study). However, the cross-sectional nature of the data prohibits the causal examination of the consequences and the motivations “to escape” associated with binge use.

The differences in motivations for starting vs. continuing MA use on the part of binge users could be helpful in targeting vulnerable MA-using subpopulations. The association between binge use and the motivation “to experiment” in initiating MA

use, and the prevalence of polydrug use in our study population, suggest that prevention and intervention programs targeting other drugs and alcohol may include discussion of the consequences and STI risks associated with MA use for a population potentially curious about and at risk for starting MA use. The desire “to experiment” may also suggest a propensity towards impulsivity or sensation seeking; in a previous study of this same FASTLANE population, impulsivity (including sensation seeking) was associated with binge use (Semple et al., 2005). Prevention strategies may wish to identify young individuals at risk for initiating MA use who report other impulsive or sensation seeking behaviors.

For current MA users, the increase in libido from MA (139-141) may explain binge users’ increased desire to enhance sexual experiences or the desire to meet sex partners, which is particularly concerning when combined with the increased odds among binge users of engaging in sex marathons while high and the prevalence of unprotected sex in this study. A similar finding was reported by Semple et al. (2003) among their MSM population; total number of unprotected sex acts with HIV-negative or unknown status sex partners was also reported. The desire to use MA “to enhance sex” may provide extra challenges for prevention and intervention efforts; however, this observation also suggests that MA-using populations may serve as suitable targets for condom self-efficacy and negotiation interventions to encourage and improve safer sex behaviors. It is therefore important to note not only the differences in motivations to initiate (for prevention programs) and to currently use MA (for intervention efforts) but also the differences in motivations by binge use status.

The findings of this study are limited by the subjective data collection of behaviors and history of the participants. However, short recall periods and consistent reassurances of confidentiality were employed to limit potential recall and reporting bias. Another limitation is that “binge use” status was collected from self-classified and self-reported data; however, no established quantitative definitions are available for “binge use” in the literature, and corresponding studies of binge alcohol use and blood alcohol concentrations (BAC) highlight the difficulty in quantifying this concept. Several studies have shown the lack of correlation between “binge” drinking and blood alcohol concentration (BAC) levels, suggesting that those classified as “binge drinkers” are not necessarily the heaviest drinkers nor the ones most at risk of injury and health consequences from their alcohol use (115-117). The definition of “binge use” as the use of “large quantities of meth for a period of time—until you run out or just can’t physically do it anymore” prevents examination of the overlap between the reasons for ending a binge and binge criteria.

To further describe patterns of MA use, amount (in grams) and frequency (number of days) of MA use in the last 30 days were included in the multivariate model, which may produce an overly conservative estimate of binge use due to a potential overlap of amount and frequency of MA use with the definition of “binge use” in this study. Another potential limitation of the study may be in the generalizability of the data, since unprotected sex was an inclusion criterion. Finally the lack of a control group of non-users of MA prevents analysis of the binge use of other drugs (e.g., cocaine or heroin) as opposed to binge use of MA. It would be of

interest to examine the drug use and sex behaviors of participants when they were high on MA versus when they consumed alcohol or other drugs. Also, it would be useful to examine if weekend or infrequent binge users differ from chronic or “weekday” binge users. Future studies may wish to examine whether motivations for MA use, including potential sensation-seeking behaviors, vary by binge use. Further “event-level” examination of drug use (amount and frequency of MA use, injection drug use) and sex behaviors during a binge may also be warranted. The increased HIV risk in drug-use behavior (injection drug use) and sex behavior (unprotected, multiple partners) may not be MA-specific. Further studies are required to differentiate the effects of MA versus other drugs on behaviors correlated with binge use.

In spite of these limitations, this study adds to the growing literature on MA use, especially among heterosexuals. Binging behavior may be an appropriate, distinct target of prevention and intervention strategies, especially given the associated risks of HIV and Hepatitis B or C infection and the potential for overdose with injection drug use (80;81;85;111;112;142-144). The findings regarding increased HIV-risk behaviors associated with binge use will improve current knowledge of heterosexual populations and of the correlated behaviors and consequences of binge use, and it is to be hoped that they will also guide and improve current prevention and intervention programs tailored for MA users. In addition to increased HIV risk, binging on MA may be correlated with an increase in the number of physical, psychological, and social problems, while cessation or change in binge behavior may prove a reasonable goal of

treatment. Future studies on the effects of binge use in other populations are warranted to complement these findings.

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G. Chapter Acknowledgement

This chapter has been accepted in part as a manuscript for publication in Substance Use and Misuse and is in press as of the completion of this dissertation. The author of this dissertation, Wei-Woon S. Cheng, will appear as the primary author on this manuscript in publication; Richard S. Garfein from the Department of Family and Preventive Medicine at the University of California, San Diego (UCSD), and Chair of this dissertation, will appear as second author; Shirley J. Semple from the Department of Family and Preventive Medicine at UCSD will appear as third author; Steffanie A. Strathdee from the Department of Family and Preventive Medicine at UCSD, Head of Division of Cross-Cultural Medicine, Harold Simon Chair, will appear as fourth author; James K. Zians from the Department of Family and Preventive Medicine at UCSD will appear as fifth author; and Thomas L. Patterson from the Department of Psychiatry at the University of California, San Diego will appear as the senior author.

Table 3-1: Univariate associations between sociodemographic, drug use, and sexual behavior characteristics and binge use (yes or no) among 268 non-binge and 183 binge methamphetamine (MA) users in San Diego, CA, 2001-2004.

Characteristic	All		Non Binge Use		Binge Use		OR	95%CI
	%	(n)	%	(n)	%	(n)		
Gender: female (vs. male)	32.2	(145)	33.6	(90)	30.1	(55)	0.85	n.s.
Mean age (years) at interview (SD)*	36.6	(9.9)	37.2	(10.1)	35.6	(9.5)	0.98	n.s.
Ethnicity: Caucasian (vs. other minority)	49.4	(223)	48.5	(130)	50.8	(93)	1.1	n.s.
Education: ≤ high school (vs. ≥ college)	57.9	(259)	57.5	(153)	58.6	(106)	0.96	n.s.
Mean amount MA used in last 30 days in grams (SD)*	9.4	(17.4)	7.5	(16.2)	12.3	(18.7)	1.02	(1.00, 1.03)
Mean number of days on which MA was used in last 30 days (SD)*	14.6	(9.1)	13.4	(9.3)	16.3	(8.5)	1.04	(1.01, 1.06)
Injection drug use: ever (vs. never)	29.5	(133)	23.9	(64)	37.7	(69)	1.93	(1.28, 2.91)
Polydrug use: yes (vs. no)	47.5	(213)	45.5	(122)	50.6	(91)	1.09	n.s.
Mean years of MA use (SD)*	13.6	(8.9)	13.2	(8.9)	14.2	(8.9)	1.01	n.s.
Mean age of MA initiation (SD)*	22.9	(9.2)	24.0	(9.3)	21.4	(8.9)	0.97	(0.95, 0.99)
Ever treated for MA: yes (vs. no)	34.7	(156)	27.0	(72)	46.1	(84)	2.32	(1.56, 3.45)
Completed treatment: yes (vs. no)	52.3	(68)	51.7	(30)	52.8	(38)	1.04	n.s.
Types of sex partners in last 60 days:								
Spouse or steady: yes (vs. no)	93.1	(420)	92.9	(249)	93.4	(171)	1.09	n.s.
Casual or anonymous: yes (vs. no)	88.9	(401)	86.9	(233)	91.8	(168)	1.68	n.s.
Mean # of sex partners in last 60 days (SD)*	4.7	(6.1)	4.9	(6.8)	4.3	(5.0)	0.99	n.s.
Any STIs in last 60 days: yes (vs. no)	20.0	(89)	17.8	(47)	23.2	(42)	1.39	n.s.

Table 3-1 (cont.): Univariate associations between sociodemographic, drug use, and sexual behavior characteristics and binge use (yes or no) among 268 non-binge and 183 binge methamphetamine (MA) users in San Diego, CA, 2001-2004.

Unprotected vaginal sex (last 60 days):								
With spouse or steady: always (vs. sometimes)	85.4	(385)	82.8	(222)	89.1	(163)	1.69	n.s.
With casual or anonymous partner: always (vs. sometimes)	69.0	(311)	64.6	(173)	75.4	(138)	1.68	(1.11, 2.56)
Unprotected anal sex (last 60 days):								
Spouse or steady: always (vs. sometimes)	32.8	(148)	28.4	(76)	39.3	(72)	1.64	(1.10, 2.44)
Casual or anonymous: always (vs. sometimes)	26.2	(118)	23.1	(62)	30.6	(56)	1.47	n.s.
Marathon sex while high on MA: yes (vs. no)	64.7	(292)	59.7	(160)	72.1	(132)	1.75	(1.16, 2.62)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; n.s. = not significant (95%CI includes 1.0); OR = odds ratio; CI = confidence interval

Table 3-2: Characteristics of binge use among 183 binge methamphetamine (MA) users in San Diego, CA, 2001-2004.

Characteristic	% (n) or Mean (SD)
Mean days of typical binge	6.6 (5.8)
Most common method of MA use:	
Smoke	54.6 (100)
Snort	20.8 (38)
Inject	24.6 (45)
Reported reasons for stopping a binge:	
To get some sleep	35.0 (64)
Crashed, burned out	20.8 (38)
Depletion of drug supply	17.5 (32)
Onset of paranoia	14.8 (27)
Hallucinations	6.0 (11)

Table 3-3: Univariate associations between consequences of current methamphetamine (MA) use and motivations for initiating MA use and binge use among 451 MA users in San Diego, CA, 2001-2004.

Characteristic	All		Non Binge		Binge Use		OR	95%CI
	%	(n)	%	(n)	%	(n)		
Consequences of MA use:								
Social problems (e.g. relationship loss)	76.9	(350)	71.6	(192)	85.8	(157)	2.39	(1.46, 3.91)
Psychological problems (e.g. paranoia)	53.4	(243)	47.0	(126)	63.3	(116)	1.95	(1.33, 2.87)
Physical problems (e.g. lesions, diarrhea)	85.3	(388)	82.8	(222)	90.2	(183)	1.90	(1.06, 3.40)
Mean # of consequences of MA use (SD)*	6.2	(4.22)	5.5	(4.1)	7.3	(4.2)	1.11	(1.06, 1.16)
Mean Beck Depression Inventory Score (SD)*	15.3	(10.2)	14.0	(10.1)	17.2	(10.1)	1.03	(1.01, 1.05)
Motivations for starting MA use:								
To lose weight	20.4	(92)	18.7	(50)	22.9	(42)	1.30	n.s.
To stay awake / get more energy	41.0	(185)	40.7	(109)	41.5	(76)	1.04	n.s.
To enhance sex / meet sex partners	30.8	(139)	29.1	(78)	33.3	(61)	1.22	n.s.
To experiment	42.1	(190)	35.4	(95)	51.9	(95)	1.95	(1.33, 2.87)
To escape / avoidant coping	25.5	(115)	22.0	(59)	30.6	(56)	1.56	(1.02, 2.39)
Motivations for current MA use:								
To lose weight / feel more attractive	12.7	(57)	12.0	(32)	13.8	(25)	1.18	n.s.
To stay awake / get more energy	33.9	(153)	35.4	(95)	31.7	(58)	0.84	n.s.
To enhance sex / meet sex partners	30.6	(138)	26.5	(71)	36.6	(67)	1.60	(1.07, 2.40)
To experiment	4.0	(18)	4.5	(12)	3.3	(6)	0.73	n.s.
To escape / avoidant coping	24.4	(110)	20.2	(54)	30.6	(56)	1.75	(1.13, 2.70)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; n.s. = not significant (95%CI includes 1.0); OR = odds ratio; CI = confidence interval

Table 3-4: Multivariate analysis of sociodemographic, drug use, and sexual behavior characteristics by binge use (yes or no) among 451 methamphetamine (MA) users in San Diego, CA, 2001-2004.

Characteristic	Binge Use (yes/no)		
	Odds Ratio	95% Confidence Interval	P-value
Number of days in last 30 used MA (in days)	1.02	(1.00, 1.05)	0.042
Ever treated for MA use: Yes (vs. No)	2.36	(1.55, 3.61)	<0.001
Injection drug use: Yes (vs. No)	1.81	(1.17, 2.82)	0.008
BDI score (1 unit increase)	1.02	(1.00, 1.04)	0.023
Marathon sex while high on MA: Yes (vs. No)	1.86	(1.21, 2.87)	0.005
Starting MA use motivations: To experiment	2.01	(1.33, 3.03)	0.001

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IV. MANUSCRIPT 2

Differences in Sexual Risk Behaviors among Male and Female HIV-Seronegative Heterosexual Methamphetamine Users

A. Abstract

Background: Despite increased awareness and attention towards methamphetamine (MA) use among men who have sex with men (MSM), few studies have examined behaviors and effects of MA use among heterosexual populations.

Objective: To learn whether behaviors and effects of MA use among heterosexuals differ according to gender.

Methods: We examined gender differences in sociodemographic characteristics, drug use practices, sexual behaviors, and consequences and motivations for MA use among 452 HIV-negative MA users (306 men, 146 women) who had engaged in unprotected sex and used MA in the previous two months.

Results: Females in the sample were younger and more likely to be married, to have been diagnosed with an STI in the last two months, and to report having been introduced to MA by a sexual partner. Women were also more likely to experience depressive symptoms and to report using MA “to lose weight.” Men were more likely to engage in sex marathons while high on MA and to use MA “to enhance sexual pleasure.”

Conclusion: These differences suggest the importance of crafting gender-specific intervention messages, and they may contribute to identifying individuals at risk for initiating MA use.

Scientific Significance: Our findings contribute to our knowledge of gender differences in behaviors and effects of MA use among heterosexuals. Future studies would benefit from collection of longitudinal data (to assess causal relationships) and use of a control group (to distinguish correlates of MA use from those of drug use in general).

B. Introduction

Despite increased awareness and attention towards methamphetamine (MA) use among men who have sex with men (MSM), few studies have examined behaviors and effects of MA use among heterosexual populations. Available research on heterosexual MA users reports associations between MA use and the tendency to have greater numbers of multiple (41;145;146) and casual or anonymous sex partners (36;43;63;65;88;147), unprotected sex with partners (20;36;44;66;77;147-149), engaging in sex marathons while high on MA (36), trading sex for MA or money (37;44;61;65;147), and a recent diagnosis of or a partner with a sexually transmitted infection (STI) (36;44;63;148).

Studies focusing on heterosexual MA users have reported several differences in sociodemographic characteristics by gender. Female MA users were more likely to be younger (150), have lower educational levels (151), and to have ever been married (68). Research also shows a greater overlap between sexual and drug use networks among female MA users, who are more likely to report a MA-using sex partner (44;72-75;147;150), MA initiation by (70) and consumption with a sex partner (37;70;72-75;77;150), and needle sharing (70;72-75). Female MA users also appear more likely than males to suffer a greater number of consequences from MA use, including depressive symptoms (37;68;151), and to cite the desire “to lose weight” or “to feel more attractive” as a motivation for using MA (36;152).

Our study team previously published data on 98 female MA users who reported personal and social disadvantages, more high risk sexual behaviors (e.g.

multiple partners, anonymous sex partners, and unprotected vaginal and oral sex), and greater levels of psychiatric symptoms compared to 237 male MA users (5); additional gender differences included greater perceived behavioral consequences of MA use and motivations “to lose weight” in women, and imprisonment following a felony conviction in men. However, these results were limited by the univariate analysis of these gender differences.

Our purpose here is to expand upon our earlier studies by examining potential gender differences in terms of patterns of MA use, sexual behavior and consequences, and motivations for MA use in a heterosexual, HIV-negative population of MA users. We hypothesize that gender differences in these domains will persist after adjusting for potential confounders such as age, race, education, and marital status. We further hypothesize that female MA users will present with higher levels of depressive symptoms.

C. Methods

The sample consisted of 452 HIV-negative, heterosexual, male and female MA users who were enrolled in a sexual risk reduction intervention study. We examined baseline data collected between June 2001 and August 2004 using a 90-minute Audio Computer-Assisted Self-Interview (ACASI) that covered socio-demographic characteristics, alcohol and drug use, MA use patterns, sexual risk behaviors, social cognitive factors, social network factors, and physical and psychiatric health variables. Participants were compensated \$30 for their baseline assessment and first intervention counseling session. The Human Research Protections Program of the University of California, San Diego approved this study.

Setting and Sample

Recruitment and Screening of Participants

Participants were recruited primarily in areas with known high concentrations of MA users at specific peak times of day (e.g., Saturday night after 11 p.m.) (43). Community outreach workers approached and recruited potential study subjects in person. Social marketing approaches were also utilized including posters in public areas and ads in newspapers and magazines. Participants were also referred by family, friends, and previously enrolled participants (43).

Study Population

The inclusion criteria were: (1) self-identified heterosexual; (2) HIV-seronegative; (3) age \geq 18 years; and, in the 2 months prior to screening, having (4) used MA at least twice and (5) engaged in unprotected vaginal, anal or oral sex with

an opposite-sex partner. Criteria (4) and (5) were imposed because the study in which these subjects were enrolled aimed at reducing high-risk sexual behaviors. The OraSure[®] HIV-1 Oral Collection Specimen Device was used to confirm HIV-seronegative status prior to enrollment.

Measures

Demographics

The following characteristics were examined: gender (male vs. female); age at baseline (years); race (Caucasian vs. non-Caucasian); marital status (married vs. divorced or separated vs. never married); and educational attainment (no college vs. some college and beyond).

Drug use

Variables included: amount of MA used (grams) in the last month; number of days of MA use in the last month; injection drug use (ever vs. never), and if an IDU, sharing of needles or equipment (ever vs. never).

Sexual behavior

Participants were asked about the following sexual behaviors in the previous 60 days: total number sex partners (continuous); traded sex for MA (ever vs. never); received an STI diagnosis (yes vs. no); had a sex partner with an STI (yes vs. no); engaged in sex marathons (prolonged sexual activity with genital contact for hours and hours, yes or no); and consumed MA with a sex partner (yes vs. no). Participants were also asked if they had a spouse or steady, or casual or anonymous sex partners (yes vs. no). Data on unprotected vaginal sex with a spouse, steady, casual, or anonymous sex

partner and on having a sex partner with an HIV-positive or unknown serostatus were originally collected as never, rarely, sometimes, or always, but both these variables were re-coded as always vs. sometimes. Participants were also asked who introduced them to MA use: friend, family, or sex partner.

Psychosocial measures

Two additional groups of variables were examined: consequences of and motivations for MA use. We presented a list of 14 different consequences (physical, psychological, and social or legal) associated with MA use and created a score by summing the number of consequences reported. We also evaluated participants' level of depressive symptoms (range = 0-63) using the Beck Depression Inventory (BDI) (133;134). Finally, motivations for initiating use of MA and for currently using MA were solicited, and the most commonly reported (>20% of participants) were examined: to lose weight or feel more attractive, to enhance sexual pleasure, and to escape or cope with mood. Each of these motivating factors was analyzed separately (yes or no).

Statistical Analysis

We examined individual variables and groups of variables potentially associated with MA use by gender. Descriptive statistics were performed using chi-square and t-tests. Univariate logistic regression analyses were performed to examine the odds associated with MA use by gender. Subsequently, multivariate analyses for each grouping of variables (demographic, drug use, sex behavior, consequences of MA use, and motivations for MA use) were performed. Variables that were

significantly ($p < 0.05$) associated with female gender in univariate analyses were entered into the multivariate analyses. Manual backwards elimination was conducted to produce a final multivariate model that included factors independently associated with female gender ($p < 0.05$).

D. Results

Among the 452 participants were 306 men and 146 women. A plurality was Caucasian (49%), followed by African-Americans (27%) and Hispanics (13%). The average age was 36.6 years (SD=9.9); most participants had never attended college (58%); and fewer than half had ever married (46%). Compared to men, women were more likely to be divorced or separated rather than never married (OR=1.72, 95%CI=1.35, 2.19). No other demographic characteristics significantly differed between men and women (Table 4-1).

Drug Use Behavior

As shown in Table 4-1, in the previous month, participants consumed on average 9.4g of MA (SD=17.4) and used MA on 14.6 days (SD=9.1); on average, women were more likely to report more days of MA use in the previous month than men (OR=1.03, 95%CI=1.01, 1.06). Injection drug use was reported by 29.9% of participants, of whom 49.2% had ever shared needles or equipment; needle sharing was more common among women than men (OR=1.61, 95%CI=1.01, 2.42).

Sexual Behavior

As shown in Table 4-2, participants reported an average of 4.7 (SD=6.1) sex partners during the prior two months. The majority of participants reported at least one kind of partner who used MA, was HIV-positive or of unknown serostatus, and with whom they engaged in unprotected vaginal sex; marathon sex while high on MA was also commonly reported (64%). Compared to men, women were more likely to report the following: having a spouse or steady sex partner (OR=4.80, 95%CI=1.43, 16.01)

with whom they engaged in unprotected vaginal sex (OR=2.39, 95%CI=1.24, 4.63); receiving an STI diagnosis in the last 60 days (OR=2.63, 95%CI=1.63, 4.23) or having a spouse or steady sex partner with an STI (OR=2.86, 95%CI=1.02, 8.04); and being initiated to MA use by a sex partner (OR=2.05, 95%CI=1.31, 3.21). However, women were less likely to report engaging in marathon sex while high on MA (OR=0.43, 95%CI=0.28, 0.64).

Consequences of MA Use

The most commonly reported consequences of MA use were sleeplessness (70%), weight loss (63%), financial problems (62%), family problems (54%), and relationship loss (49%). Mean number of consequences reported overall by participants was 19.4 (SD=6.9, range=0-14); women reported a significantly greater number of consequences than did men (OR=1.10, 95%CI=1.05, 1.16). The mean BDI score for all participants was 15.3 (SD=10.2, range=0-51), but women had significantly higher scores than men (OR=1.07 per unit increase, 95%CI=1.05, 1.09).

Motivations for Initiating and Currently Using MA

Compared to men (Table 4-3), women were more likely to initiate MA use “to lose weight” (OR=5.27, 95%CI=3.24, 8.58) or “to escape” (OR=2.03, 95%CI=1.31, 3.14), and to currently use MA “to lose weight” or “to feel more attractive” (OR=6.43, 95%CI=3.49, 11.83) and “to escape” (OR=2.90, 95%CI=1.86, 4.53); women were less likely to report the desire “to enhance sexual pleasure” (OR=0.55, 95%CI=0.34, 0.91).

Factors Independently Associated with Female Gender

As shown in Table 4-4, the final multivariate model identified several factors independently associated with female gender ($p < 0.05$) including younger age, being married, having had a recent STI diagnosis, being introduced to MA by a sexual partner, having a higher BDI score, and initiating or currently using MA use due to a desire “to lose weight.” Engaging in sex marathons while high on MA and currently using MA “to meet sex partners” were associated with male gender ($p < 0.05$). The full model explained 27% of the total variance (pseudo $R^2 = 0.27$) (153).

E. Discussion

These findings show several significant differences between the male and female HIV-negative MA users in this sample. Certain drug use and sex behaviors of the female MA users in this study were influenced to a significantly greater degree by sex partners than were corresponding behaviors of males. These behaviors included initiation into MA use by a sex partner; unprotected vaginal sex with a spouse or steady; an STI or a spouse or steady with an STI; and sharing of needles or injection equipment with sex partners. Other studies have reported the greater likelihood of female MA users to be in steady relationships, especially with MA-using sex partners (44;72-75;147;150) and with whom they shared needles or equipment (70;72-75). Given the greater role of spouses and steady sex partners in HIV risk behavior among female MA users in this study, safer-sex interventions based on sex partnerships might be more effective than programs targeting the individual.

In keeping with earlier studies, we found that women were more likely to initiate and currently use MA “to lose weight” or “to feel more attractive” (36;154), or “to escape.” The current need “to escape” may result from our female sample’s higher number of consequences from MA use and higher depression scores; however, our study’s cross-sectional nature limits our ability to identify causal relationships. Female MA users’ motivations “to lose weight” or “to escape” may contribute to the greater number of days that they used MA per month relative to males. The more frequent use of MA might also be to mitigate negative consequences of MA use itself or to prevent the inevitable crash from a MA high. The motivation “to feel more attractive” suggests

an underlying lack of self-esteem. Interventions which address negative self-perceptions may empower female MA users to not only decrease their overall MA use but also to reduce their other drug use and risky sexual behaviors.

In contrast to females, male MA users were more likely to engage in marathon sex while high, a finding that was first observed in an earlier report of this study population (36). Male MA users were also more likely to report the desire “to enhance sexual pleasure” as a motivation to begin and currently use MA (57;66;139). Coupled with the finding that male MA users were also more likely to engage in sex marathons while high, the overlap between MA use and attitudes towards sex may be a potential target for STI risk reduction programs among males. In general, the gender differences we observed in motivations to initiate and to currently use MA may be useful in constructing gender-specific prevention and intervention messages and potentially in identifying higher-risk individuals before they initiate MA use.

Interpretation of these findings must take into account some limitations. First, this study intentionally recruited people with a higher sexual risk profile and who therefore may not be representative of the heterosexual, HIV-negative, MA using population as a whole. Further, the lack of a control group of people who use other drugs but not MA makes it impossible to identify which gender differences in sex behavior are correlated specifically to MA use and which correlate with drug use in general. Future studies could remedy this by including such a control group. Also, since we relied on self-reports of sensitive behaviors and STI diagnoses, under-reporting may have occurred, which in turn would lead to an underestimation of the

odds ratios for some high risk behaviors. However, the audio-CASI method of data collection has been shown to minimize under-reporting of sensitive data (155). Finally, the cross-sectional nature of this study creates difficulties in drawing causal inferences.

Despite these limitations, this study suggests that drug treatment strategies should take gender differences in MA-use motivations into account. Prevention programs should also address the possible negative self-perceptions of female MA users and the effects of these self-perceptions on treatment efficacy, retention, and completion.

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Table 4-1: Univariate associations of sociodemographic characteristics and drug use comparing female to male HIV-negative methamphetamine users in San Diego, CA, 2001–2005

Characteristic	All (N=452)		Women (N=146)		Men (N=306)		Reference = Men	
	%	(n)	%	(n)	%	(n)	OR	95%CI
	Mean Age in years (SD)*	36.6	(9.9)	35.4	(10.1)	37.1	(9.7)	0.98
Race: Caucasian (vs. other minority)	49.3	(223)	45.2	(66)	51.3	(157)	0.78	n.s.
Education: ≤ High school (vs. ≥ College)	58.0	(260)	59.3	(86)	57.4	(174)	0.92	n.s.
Marital Status							1.72	(1.35,2.19)
Married: Yes (vs. No)	8.4	(37)	10.4	(15)	7.4	(22)		
Divorced/Separated: Yes (vs. No)	35.9	(159)	45.8	(66)	31.1	(93)		
Never Married: Yes (vs. No)	55.8	(247)	43.8	(63)	61.5	(184)		
Mean Grams of MA Used Last 30 days (SD)*	9.4	(17.4)	10.3	(21.6)	9.0	(15.1)	1.00	n.s.
Mean # of Days of MA Use Last 30 days (SD)*	14.6	(9.1)	16.4	(9.0)	13.7	(9.0)	1.03	(1.01,1.06)
Injection Drug Use: Ever (vs. Never)	29.9	(136)	27.4	(40)	30.4	(93)	0.86	n.s.
Share needles: Ever (vs. Never)	49.2	(63)	61.5	(24)	43.8	(39)	1.61	(1.01,2.42)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; n.s. = not significant (95%CI includes 1.0); OR = odds ratio; CI = confidence interval

Table 4-2: Comparison of sexual behaviors of female vs. male HIV-negative methamphetamine users in San Diego, CA, 2001–2005

Characteristic	All (N=452)		Women (N=146)		Men (N=306)		Reference = Men	
	%	(n)	%	(n)	%	(n)	OR	95%CI
Types Sex Partners Last 60 days								
Spouse/Steady	93.2	(424)	98.0	(143)	90.9	(278)	4.80	(1.43,16.01)
Casual/Anonymous	89.0	(405)	85.6	(125)	90.5	(277)	0.62	n.s.
Mean # of Sex Partners in Last 60 days (SD)*	4.7	(6.1)	4.8	(7.6)	4.6	(5.3)	1.01	n.s.
Unprotected Vaginal Sex (last 60 days)								
Spouse/Steady: Always (vs. Sometimes)	85.4	(386)	91.8	(134)	82.4	(252)	2.39	(1.24,4.63)
Casual/Anonymous: Always (vs. Sometimes)	69.0	(312)	69.2	(101)	69.0	(211)	1.01	n.s.
Trade sex for MA: Ever (vs. Never)	29.0	(63)	33.7	(30)	25.8	(33)	1.46	n.s.
Sex Partner with HIV(+)/unknown status								
Spouse/Steady: Yes (vs. No)	55.1	(249)	55.5	(81)	54.9	(168)	1.02	n.s.
Casual/Anonymous: Yes (vs. No)	95.8	(433)	95.9	(140)	95.8	(293)	1.04	n.s.
Any STIs in last 60 days: Yes (vs. No)	20.0	(89)	31.0	(45)	14.6	(44)	2.63	(1.63,4.23)
Sex Partner had STI in last 60 days								
Spouse/Steady: Yes (vs. No)	14.1	(19)	20.6	(13)	8.3	(6)	2.86	(1.02,8.04)
Casual/Anonymous: Yes (vs. No)	5.8	(21)	8.1	(9)	4.8	(12)	1.76	n.s.
Marathon Sex while high on MA: Yes (vs. No)	64.8	(293)	51.4	(75)	71.2	(218)	0.43	(0.28,0.64)
Sex Partner MA-user								
Spouse/Steady: Yes (vs. No)	97.6	(441)	98.0	(143)	97.4	(298)	1.28	n.s.
Casual/Anonymous: Yes (vs. No)	97.6	(441)	96.6	(141)	98.0	(300)	0.56	
Consume MA with sexual partner: Yes (vs No)	86.3	(390)	84.9	(124)	86.9	(266)	0.85	n.s.

Table 4-2 (cont.): Comparison of sexual behaviors of female vs. male HIV-negative methamphetamine users in San Diego, CA, 2001–2005

Who initiated participant into MA use								
Friend: Yes (vs. No)	68.5	(309)	64.8	(94)	70.3	(215)	0.78	n.s.
Family: Yes (vs. No)	11.7	(53)	15.2	(22)	10.1	(31)	1.59	n.s.
Sex Partner: Yes (vs. No)	23.3	(105)	32.4	(47)	18.9	(58)	2.05	(1.31,3.21)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; n.s. = not significant (95%CI includes 1.0); OR = odds ratio; CI = confidence interval

Table 4-3: Univariate associations of consequences of current methamphetamine use and motivations for initiating and current use of MA comparing female to male HIV-negative MA users in San Diego, CA, 2001–2005

Characteristic	All (N=452)		Women (N=146)		Men (N=306)		Reference = Men	
	%	(n)	%	(n)	%	(n)	OR	95%CI
Mean # of Consequences of MA use (SD)*	6.2	(4.2)	7.4	(4.1)	5.7	(4.2)	1.10	(1.05,1.16)
Mean Beck Depression Inventory Score (SD)*	15.3	(10.2)	20.1	(10.5)	13.1	(9.3)	1.07	(1.05,1.09)
Motivations for Starting MA Use								
To escape	25.4	(115)	34.9	(51)	20.9	(64)	2.03	(1.31,3.14)
To enhance sexual pleasure	23.7	(107)	18.5	(27)	26.2	(80)	0.64	n.s.
To lose weight	20.4	(92)	39.7	(58)	11.1	(34)	5.27	(3.24,8.58)
Motivations for Continuing MA Use								
To escape	24.3	(110)	38.4	(56)	17.6	(54)	2.90	(1.86,4.53)
To enhance sexual pleasure	24.9	(34)	17.9	(26)	29.3	(86)	0.55	(0.34,0.91)
To lose weight/feel more attractive	12.7	(57)	27.6	(40)	5.6	(17)	6.43	(3.49,11.83)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; n.s. = not significant (95%CI includes 1.0); OR = odds ratio; CI = confidence interval

Table 4-4: Multivariate analysis of sociodemographic, drug use and sexual behavior characteristics, and consequences of and motivations for MA use comparing females to males among 452 MA users in San Diego, CA, 2001–2005

Characteristic	Adj. Odds Ratio	95% Confidence Interval
Age (years)	0.97	(0.94,0.99)
Ever Married	1.68	(1.25,2.24)
STI Diagnosis in last 60 days	2.49	(1.37,4.53)
Marathon Sex while High on MA	0.37	(0.22,0.62)
MA Initiation by a Sexual Partner	1.94	(1.09,3.43)
Beck Depression Inventory Score (1 unit increase)	1.07	(1.04,1.09)
Initiated MA Use to Lose Weight	2.61	(1.42,4.79)
Currently Use MA to Lose Weight	4.70	(2.14,10.33)
Currently Use MA to Meet Sex Partners	0.40	(0.21,0.77)

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V. MANUSCRIPT 3

Increased Drug Use and STI-risk with Injection Drug Use among HIV-Seronegative Heterosexual Methamphetamine Users

A. Abstract

Background: Methamphetamine (MA) use has been found to be associated with increased risk of HIV and sexually transmitted infections (STIs) among men having sex with men, but it is unknown whether injection of MA is associated with even greater risks, and data for heterosexual MA users are lacking. We investigated whether the HIV and STI risks of male and female, heterosexual MA users who inject MA differ from those of male and female, heterosexual MA users who do not inject MA.

Methods: Between 2001 and 2005, interviews were conducted with 452 HIV-negative men and women aged 18 and older in San Diego, CA, who in the previous 2 months had used MA at least twice and had engaged in unprotected sex at least once. Logistic regression was used to identify factors associated with use of MA by injection.

Results: Of 452 participants, mean age was 36.6 years; 68% were male; ethnicity was 49.4% Caucasian, 26.8% African-American, and 12.8% Hispanic; 55% had never married; and 58% never attended college. Compared to non-injection drug users (NIDU), IDU were more likely to be Caucasian, to be homeless, to have used

MA for a longer period and used more grams of MA in last 30 days, to have a history of felony conviction, and were more likely to report a recent STI.

Conclusions: MA injectors reported significantly more drug use and STI risk compared to NIDU MA users. HIV and STI prevention interventions that target MA users should be tailored according to the participants' method of MA use.

B. Introduction

A highly addictive and potent stimulant, methamphetamine (MA) was used by an estimated 529,000 individuals aged 12 and older in the US in 2007 (1). Although the drug has become common throughout the US, in many western US cities, use of MA by injection is on the rise (1-8).

Although MA use has been associated in the literature with risk behaviors for the acquisition of HIV and sexually transmitted infections (STI), few studies have examined injection use of MA among heterosexuals. Two studies, one conducted in San Bernardino, California, and the other in Yokohama City, Kanagawa, Japan, examined MA injection among heterosexual MA users entering treatment for MA abuse, and found that MA injection was associated with increased years of MA use, concurrent use of other drugs, and a history of felony convictions. The authors also reported multiple negative consequences of MA use, including depression, psychological manifestations (e.g., auditory hallucinations), and such physical effects as impaired sexual functioning, HIV infection, and loss of consciousness (9;10). Neither study examined HIV sex risk behaviors or motivations for MA use. A different study, which to our knowledge is the only one to have examined motivations for MA use, focused on a sample of men who have sex with men (MSM). That study reported injection of MA to be associated with being Caucasian, homeless, and unmarried, and with having lower educational attainment (11). Injection drug use in this population was also associated with greater number of years of MA use, greater amount and frequency of MA use, and greater consequences from MA use; in

addition, injection drug users (IDU) reported more HIV-seropositive partners, more incident STIs, and trading sex for money. Compared to non-injection drug users (NIDU), IDU were more likely to have initiated MA in order to get high, to escape, and to cope with mood. IDU were also more likely to report the desire “to cope with mood” and “to feel self-confident” as reasons for their current MA use.

Other studies comparing injection of MA to injection of other drugs report that MA use is associated with being Caucasian, homeless, bingeing on drugs, sharing of needles and other injection equipment, and HIV risk behaviors, including engaging in unprotected sex and having multiple sex partners (12-18). Studies of IDU have shown that compared to non-MA users, MA users were more likely to be HIV-infected and HCV-infected (19;20) and homeless (12;21); however, these studies could not state conclusively whether the mode of MA administration was associated with increased risk of negative outcomes, since they lacked a comparison group of non-injection drug users.

MA use is growing among some U.S. heterosexual populations, and HIV-seronegative individuals in these populations constitute an important target for HIV prevention efforts. Given the highly addicting nature of MA and the need for behavioral modification programs for cessation of use, an understanding the most common motivations for initiating and for continuing the use of MA may help researchers and clinicians to design more-effective interventions. In this study, we identify differences between injecting drug users (IDU) and non-injection drug users (NIDU). We hypothesized that in terms of sociodemographic characteristics, IDU

would be younger and more likely to be Caucasian or homeless. We further hypothesized that IDU would report greater drug use characteristics (e.g., years of use, amount, frequency), more STI-risk behaviors (e.g., more HIV-positive or serostatus-unknown partners, a greater number of recent STI diagnoses), and would experience more adverse consequences of MA use compared to NIDU. Finally, we examined whether IDU differ from NIDU in motivations for initiation and current use of MA, including the desires “to escape,” “to cope with mood,” “to feel more self-confident,” or “to meet more sex partners.”

C. Methods

Between June 2001 and August 2004, 452 HIV-negative, heterosexual, male and female MA users were enrolled in a sexual risk reduction intervention trial and completed a baseline risk assessment interview. The 90-minute Audio Computer-Assisted Self-Interview (ACASI) covered sociodemographic characteristics, alcohol and drug use, MA use patterns, sexual risk behaviors, social cognitive factors, social network factors, and physical and psychiatric health variables. Compensation of \$30 was provided for the baseline interview.

Setting and Sample

Recruitment and Screening of Participants

Recruitment methods for the parent intervention trial are described in detail elsewhere (22). In brief, recruitment involved street outreach in areas identified during formative research to have high concentrations of MA users. Potential participants were approached by community outreach workers and invited to take part in the study. Other recruitment methods included social marketing; referrals by friends, family and previously enrolled participants; and targeted advertising using posters in public areas and ads in newspapers and magazines. Participants were recruited irrespective of their injection drug use status, which was determined in the baseline survey by self-report.

Study Population

Participants in the study were: (1) self-identified heterosexual; (2) HIV-seronegative; and (3) aged 18 years or older. Since the intervention was designed to reduce high-risk sex behaviors among MA users, participants were also required to

have, in the 60 days prior to screening, used MA at least twice and engaged in unprotected vaginal, anal or oral sex with an opposite-sex partner at least once. Prior to enrollment, each prospective participant was tested using the OraSure[®] HIV-1 Oral Collection Specimen Device to confirm his or her HIV-seronegative status (23).

Measures

Demographics

We examined the following sociodemographic characteristics: age at baseline in years; gender (male vs. female); race or ethnicity (Caucasian, Asian American, African American, Native American, or Latino) educational attainment (no college vs. some college and beyond); and marital status (married, divorced, separated, or never married).

Sexual behavior

The following sexual behaviors in the last 60 days were examined: number of sex partners (continuous); number of unprotected vaginal sex acts (continuous); and self-reported diagnosis for any STI (yes vs. no). Sexual risk behavior data (i.e., number of non-protected sex acts) was also collected for lifetime history of HIV-positive or serostatus-unknown partners falling into two different categories: (1) spouse or steady sex partner, and (2) casual or anonymous sex partner. Participants were also asked whether they ever engaged in sex marathons, defined as “prolonged sexual activity with genital contact for hours and hours,” with five response categories ranging from “always” to “never.” These categories were collapsed for analysis into

“yes” (“some of the time,” “most of the time,” and “always”) and “no” (“never” or “rarely”).

Drug use

Participants were asked the amount of MA they had used (grams) in the last month and the number of days in the last month on which they had used MA. Self-reported binge use was assessed as “yes” or “no” depending on participant response to the question, “Are you a binge user? By binge user, I mean you keep using large quantities of meth for a period of time, until you run out or just can’t physically do it anymore.” Years of MA use was calculated as the difference between age at baseline interview and age at initiation of MA use. “Injection drug users” were defined as those who reported ever having injected MA or any other drug. Among IDU, the following additional variables were assessed with response categories ever vs. never: sharing of syringes; using injection paraphernalia (other than syringes) used by others; and using MA in a shooting gallery.

Psychosocial measures

We also examined both consequences of and motivations for MA use. A list of 14 different consequences (physical, psychological, and social or legal) associated with MA use was used to create a score by summing the number of consequences reported. In addition, a number of motivations for either initiating MA use or for continuing to use MA were examined. These motivations, which have been cited in the literature in association with injection drug use, were as follows: to get high, to escape, to cope with mood, to feel more confident, and to meet sex partners. Each of

these motivating factors was analyzed separately (yes vs. no). In addition, the Beck Depression Inventory (BDI) (24;25) was used to evaluate participants' level of depressive symptoms (range = 0–63).

Statistical Analysis

Variables were analyzed using means or medians for continuous measures and frequencies and percentages for categorical variables. Differences between IDU and NIDU groups were examined using chi-square tests for categorical variables and t-tests or Wilcoxon rank-sum tests for continuous variables, depending upon whether the data were normally distributed. Logistic regression was used to assess the bivariate and multivariate associations of factors with injection status. All variables found to be significant ($P < 0.05$) through bivariate analysis were considered for inclusion in multivariate analysis. Backward stepwise regression was performed manually to produce the most parsimonious model. Factors that were independently associated with being an IDU ($P < 0.05$) in multivariate analysis were retained in the final model, based on likelihood ratio tests comparing full to reduced models.

D. Results

Of the 452 participants, 133 (29.4%) were IDU and 319 (70.6%) were NIDU (Table 1). The participants were 36.6 years old (SD=9.9 years) on average, 67.7% male, 49.3% Caucasian, 26.8% African American, and 12.8% Hispanic; 15.3% reported being homeless. More than half had never attended college (58%) and had never been married (54.8%). IDU were significantly more likely to be older (mean age 40.4 vs. 35.0 years, $p<0.05$), Caucasian (68.4% vs. 41.4%, $p<0.05$), and homeless (24.1% vs. 11.6%, $p<0.05$) compared to NIDU.

Sexual Behavior

Overall, 20% of participants reported having had an STI in the prior 60 days, which was reported more often by IDU compared to NIDU (36.6% vs. 13%; $p<0.05$). No significant differences were observed between IDU and NIDU for number of sex partners in the last 60 days (mean=4.7, SD=6.1), number of unprotected vaginal sex acts in the last 60 days (mean=19.6, SD=24.7), or proportion engaging in marathon sex while high on MA (65%). The majority of participants also reported having had both steady (55.4%) and casual or anonymous (95.8%) sex partners whose HIV status was positive or unknown; no difference was noted by injection status for either of these variables.

Drug Behavior

As shown in Table 2, IDU were significantly more likely to be initiated into MA use by a family member (16.7% vs. 9.7%, $p<0.05$); IDU also reported more years of MA use (mean years 17.8 vs. 11.9 years, $p<0.05$), used more grams of MA (mean

amount 14.0 vs. 7.6 grams, $p<0.05$), used MA a greater number of days in the prior month (mean days 16.3 vs. 13.9, $p<0.05$), and were more likely to report binge MA use (51.9% vs. 35.8%, $p<0.05$) compared to NIDU. IDU also reported injection-related behaviors that could increase their risk for parenteral exposure to HIV and other blood-borne pathogens, including: syringe sharing (49.2%); sharing injection paraphernalia other than syringes (45.2%); and use of a shooting gallery (15.3%). IDU did not differ from NIDU by average age at MA initiation or in being initiated to MA by a friend (68.5%) or lover (23.3%).

Consequences of MA Use

IDU were more likely than NIDU to report having a felony conviction (59.1% vs. 32.7%, $p<0.05$). Overall, participants had a mean of 6.2 (SD=4.2) social, physical, or psychological consequences due to MA use, with a mean BDI score of 14.3 (SD=10.3); neither differed by injection drug use status.

Motivations for Initiating and Currently Using MA

As seen in Table 3, IDU were significantly more likely than NIDU to report the following motivations to initiate MA use: “to get high” (55.6% vs. 43.4%, $p<0.05$); “to cope with mood” (27.1% vs. 12.9%, $p<0.05$); “to escape” (25.6% vs. 12.9%, $p<0.05$); “to feel more confident” (21.1% vs. 11.0%, $p<0.05$); and “to meet sex partners” (16.5% vs. 8.5%, $p<0.05$).

For current MA use, IDU were more likely than NIDU to report the motivations “to get high” (61.4% vs. 45.7%, $p<0.05$) and “to escape” (24.2% vs. 13.6%, $p<0.05$). No other current motivations differed by injection drug use status,

including “to cope with mood” (17.6%), “to feel more confident” (9.1%), and “to meet sex partners” (7.6%).

Factors Independently Associated with Injection of MA

The final multivariate model identified several factors independently associated with injection drug use ($p < 0.05$), which included being Caucasian, being homeless, engaging in binge MA use, reporting more years of MA use and more grams of MA use in the last 30 days, having had an STI diagnosis in the last 60 days, and having a history of felony conviction (see Table 4). The full model explained 21.1% of the total variance (pseudo $R^2 = 0.211$) (26).

E. Discussion

These findings indicate that the population of MA users is heterogeneous according to injection drug use status. Overall, IDU differed from NIDU in sociodemographic characteristics, drug use behaviors, self-reported STI diagnosis, and history of felony conviction. Given the increased risk for blood-borne infections due to sharing of syringes and cookers among IDU, the findings from this study highlight important targets for prevention interventions.

In terms of sociodemographic characteristics, IDU were older and reported greater number of years of MA use compared to NIDU, suggesting that the risk of injecting rises with increasing years of MA use. Interventions for methamphetamine cessation should target younger and newly initiated MA users before they transition from smoking or snorting to injecting (10;27;28). Associations of injection drug use with MA initiation by family members suggest that MA use may be intergenerational or that increased availability at home may increase the risk of earlier MA initiation, a finding that has been observed among young heroin injectors (29). Prevention programs may wish to address the increased risk of injection drug use among younger household members of current IDU.

In addition, increased injection drug use among the homeless and ex-convicts suggests that these populations are vulnerable to the STI risk behaviors associated with injection drug use, and special interventions may be warranted. Homelessness has been closely associated in other studies with injection drug use and higher risk of HIV and STIs (12;21). Community-level risk-reduction programs may need to seek out

these populations and provide onsite safer sex counseling as well as access to sterile syringes through mobile needle exchange programs.

Although STI risk behaviors in this population were not significantly higher among IDU, IDU were more likely to report a recent STI. Other researchers have reported associations between MA injection and increased STI risk: Miller et al. (19) found elevated HIV infection rates among street-involved IDU youths in Vancouver, British Columbia, while Razak et al. (20) found higher HCV rates among IDU who were admitted to drug treatment programs in Thailand. In addition, a San Diego-based study of 194 men who have sex with men reported similar sociodemographic characteristics, drug use and sex behaviors, and consequences of MA use to those of this study, suggesting that correlates of MA use may be similar between heterosexual and MSM populations. Taken together with the high percentage of participants who shared needles and other injection equipment, the risk for HIV and other blood-borne infections is high among IDU in this population. Interventions that increase knowledge and skills regarding needle exchange, sanitization of equipment, and safer injection practices are clearly warranted for MA injectors.

IDUs in this study also reported greater frequency of MA use, more years of MA use, and binge use of MA. In the literature, increased use of MA is associated with more physical and psychological consequences, including irreversible neurological damage (9;11;30;31). Therefore, in addition to attempting to prevent transition to injection use of MA, intervention strategies should target reductions in the amounts and frequency of MA use.

This study, like many others, was limited in that both the IDU and NIDU groups included individuals who used MA exclusively and others who used multiple drugs; however the small number of polydrug users in the IDU group (n=35) limited our ability to conduct stratified analyses to identify differences. In a sub-analysis, we compared polydrug-injecting to MA-only injecting drug users and found that polydrug injectors were significantly more likely to engage in marathon sex compared to MA-only IDU, whereas MA-only IDU were significantly less likely to engage in marathon sex compared to NIDU (data not shown). Although the available data were insufficient to disentangle the association to explain differences in marathon sex behavior, the increased STI risk of engaging in marathon sex warrants further education on safer sex practices among IDU. IDU in this study were a heterogeneous population, and these differences may affect the efficacy of intervention and prevention messages. Further research into event-level behaviors for IDU when injecting versus when smoking or snorting MA may further elucidate the relationship between injection drug use and sex behaviors. Finally, future studies should also include a control group of non-MA drug users (IDU and NIDU).

A number of other limitations may affect the interpretation of these findings. The parent study excluded individuals who did not report sex with an opposite-sex partner in the prior 60 days; thus, the sample may not be representative of HIV-negative, heterosexual MA-users with lower sexual risk. However, our results are consistent with existing literature on MSM and other drug-using populations. Studies have reported associations of injection MA use with race (11;13;14;21), homelessness

(11;12;21), years of MA used (9;11;20), amount of MA used (11), STI diagnosis (19), and felony convictions (9;11;20). Another potential limitation is that the self-reported nature of our data may have introduced bias due to under-reporting of STI-risk behaviors. We guarded against this by using ACASI, which has been shown to decrease the likelihood of socially desirable responses during collection of personally sensitive data (32). The cross-sectional nature of the data also leads to difficulties in determining causal relationships between MA injection, risk behaviors, and psychosocial variables.

This study suggests that significant differences exist between MA users depending on route of drug administration and that interventions targeting MA users for prevention of HIV or STIs should consider these differences.

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G. Chapter Acknowledgements

This chapter has been submitted to the Journal of Psychoactive Drugs for consideration for publication. The author of this dissertation, Wei-Woon S. Cheng, will appear as the primary author on this manuscript in publication; Richard S. Garfein from the Department of Family and Preventive Medicine at the University of California, San Diego (UCSD), and Chair of this dissertation, will appear as second author; Shirley J. Semple from the Department of Family and Preventive Medicine at UCSD will appear as third author; Steffanie A. Strathdee from the Department of Family and Preventive Medicine at UCSD, Head of Division of Cross-Cultural Medicine, Harold Simon Chair, will appear as fourth author; James K. Zians from the Department of Family and Preventive Medicine at UCSD will appear as fifth author; and Thomas L. Patterson from the Department of Psychiatry at the University of California, San Diego will appear as the senior author.

Table 5-1: Bivariate associations of sociodemographic characteristics and sex behavior comparing 319 NIDU to 133 IDU among 452 HIV-negative MA users in San Diego, CA, 2001 – 2005

Characteristic	All (n=452)		NIDU (n=319)		IDU (n=133)		OR	95%CI
	%	(n)	%	(n)	%	(n)		
Mean Age in years (SD)*	36.6	(9.9)	35.0	(9.8)	40.4	(9.1)	1.06	(1.04,1.08)
Gender: female (vs. male)	32.3	(146)	33.2	(106)	30.1	(40)	0.86	(0.56,1.34)
Race							0.70	(0.61,0.81)
Caucasian	49.3	(223)	41.4	(132)	68.4	(91)		
Asian American	1.8	(8)	1.6	(5)	2.3	(3)		
African American	26.8	(121)	30.4	(97)	18.1	(24)		
Native American	2.2	(10)	2.5	(8)	1.5	(2)		
Latino/Hispanic	12.8	(58)	15.7	(50)	6.0	(8)		
Other	7.1	(32)	8.5	(27)	3.8	(5)		
Education: \geq College (vs. \leq High school)	42.0	(188)	44.3	(140)	36.4	(48)	0.72	(0.47,1.09)
Homelessness: Yes (vs. No)	15.3	(69)	11.6	(37)	24.1	(32)	2.41	(1.42,4.07)
Marital Status: Yes (vs. No)							0.96	(0.80,1.16)
Married	8.2	(37)	9.6	(31)	4.5	(6)		
Divorced/Separated	35.3	(159)	32.1	(102)	43.6	(58)		
Never Married	54.8	(257)	56.0	(178)	51.9	(69)		
Mean # of Sex Partners in Last 60 days (SD)*	4.7	(6.1)	4.6	(5.4)	4.9	(7.5)	1.01	(0.98,1.04)
Mean # of Unprotected Vaginal Sex Acts in Last 60 days (SD)*	19.6	(24.7)	19.3	(23.8)	20.4	(26.9)	1.00	(0.99,1.01)
Sex Partner with HIV(+)/unknown status: Yes (vs. No)								
Spouse/Steady	55.4	(252)	54.2	(173)	58.1	(79)	1.17	(0.78,1.75)
Casual/Anonymous	95.8	(436)	96.9	(309)	93.4	(127)	0.46	(0.18,1.15)
Any STIs in last 60 days: Yes (vs. No)	20.0	(89)	13.0	(41)	36.6	(48)	3.89	(2.39,6.27)
Marathon Sex while high on MA: Yes (vs. No)	65.1	(296)	66.8	(213)	61.0	(83)	0.78	(0.51,1.18)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; OR = odds ratio; CI = confidence interval; MA = methamphetamine; IDU = injection drug user ; NIDU = non-IDU

Table 5-2: Drug use characteristics associated with 319 NIDU to 133 IDU among 452 heterosexual, HIV-negative MA users in San Diego, CA, 2001 – 2005.

Characteristic	All (n=452)		NIDU (n=319)		IDU (n=133)		OR	95%CI
	%	(n)	%	(n)	%	(n)		
Mean Age of MA Initiation (SD)*	22.9	(9.2)	23.1	(9.0)	22.4	(9.7)	0.99	(0.97,1.01)
Initiated MA use by Friend: Yes (vs. No)	68.5	(309)	70.2	(224)	64.4	(85)	0.77	(0.50,1.18)
Initiated MA use by Family: Yes (vs. No)	11.8	(53)	9.7	(31)	16.7	(22)	1.86	(1.03,3.35)
Initiated MA use by Lover: Yes (vs. No)	23.3	(105)	22.9	(73)	24.2	(32)	1.08	(0.67,1.74)
Mean Years of MA Use (SD)*	13.6	(8.9)	11.9	(7.9)	17.8	(9.7)	1.08	(1.05,1.11)
Mean Grams of MA Used Last 30 days (SD)*	9.4	(17.4)	7.6	(13)	14.0	(24.8)	1.02	(1.01,1.03)
Mean # of Days of MA Use Last 30 days (SD)*	14.6	(9.1)	13.9	(9.1)	16.3	(8.8)	1.03	(1.01,1.05)
Binge Use: Ever (vs. Never)	40.6	(183)	35.8	(114)	51.9	(69)	1.93	(1.28,2.91)
Share needles: Ever (vs. Never)					49.2	(63)	n/a	
Use Works of Others: Ever (vs. Never)					45.2	(57)	n/a	
Use in Shooting Gallery: Ever (vs. Never)					15.3	(19)	n/a	

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; OR = odds ratio; CI = confidence interval, MA = methamphetamine; IDU = injection drug user ; NIDU = non-IDU

Table 5-3: Bivariate associations of consequences of current MA use and motivations for initiating and current use of MA comparing 319 NIDU to 133 IDU among 452 HIV-negative MA users in San Diego, CA, 2001 – 2005.

Characteristic	All (n=452)		NIDU (n=319)		IDU (n=133)		OR	95%CI
	%	(n)	%	(n)	%	(n)		
Mean # of Consequences of MA use (SD)*	6.2	(4.2)	6.4	(4.2)	5.8	(4.2)	0.97	(0.93,1.02)
Mean Beck Depression Inventory Score (SD)*	14.3	(10.3)	14.9	(10.1)	16.2	(10.6)	1.01	(0.99,1.03)
History of Felony: Yes (vs. No)	40.4	(182)	32.7	(104)	59.1	(78)	2.98	(1.96,4.52)
Motivations for Starting MA Use								
To get high	47.0	(212)	43.4	(138)	55.6	(74)	1.63	(1.01,2.46)
To escape	17.1	(77)	12.9	(41)	27.1	(36)	2.51	(1.51,4.15)
To cope with mood	18.8	(85)	16.0	(51)	25.6	(34)	1.80	(1.10,2.94)
To feel more confident	14.0	(63)	11.0	(35)	21.1	(28)	2.16	(1.25,3.72)
To meet sex partners	10.9	(49)	8.5	(27)	16.5	(22)	2.14	(1.17,3.91)
Motivations for Current MA Use								
To get high	50.3	(226)	45.7	(145)	61.4	(81)	1.88	(1.24,2.85)
To escape	16.7	(75)	13.6	(43)	24.2	(32)	2.04	(1.22,3.40)
To cope with mood	17.6	(79)	17.0	(54)	18.9	(25)	1.14	(0.67,1.92)
To feel more confident	9.1	(41)	8.83	(28)	9.9	(13)	1.13	(0.56,2.25)
To meet sex partners	7.6	(34)	7.3	(23)	8.3	(11)	1.16	(0.55,2.46)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; OR = odds ratio; CI = confidence interval; MA = methamphetamine; IDU = injection drug user ; NIDU = non-IDU

Table 5-4: Multivariate logistic regression analysis of sociodemographic, drug use and sexual behavior characteristics, and consequences of and motivations for MA use factors associated with injection drug use among 452 HIV-negative methamphetamine users in San Diego, CA, 2001 – 2005.

Characteristic	IDU vs. NIDU (ref)	
	AOR	95% CI
Race : Caucasian (vs. Non-Caucasian)	1.41	(1.19,1.67)
Homeless: Yes (vs. No)	2.76	(1.47,5.16)
Binge MA Use: Ever (vs. Never)	1.68	(1.02,2.75)
Mean Years of MA Use (unit = 1 year increase)	1.05	(1.03,1.09)
Mean Grams of MA Used Last 30 Days (unit = 1 gram)	1.02	(1.00,1.03)
STI Diagnosis in last 60 days: Yes (vs. No)	2.69	(1.24,3.93)
History of Felony Charge: Yes (vs. No)	2.56	(1.56,4.19)

Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; MA = methamphetamine; IDU = injection drug user; NIDU = non-IDU, STI = sexually transmitted infection

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VI. Discussion

The overall aim of the included studies was to identify unique characteristics among subgroups of heterosexual MA users that would inform researchers and policy makers and could improve identification of target populations to optimize the design and content of prevention and intervention programs for best efficacy of treatment. The studies in this dissertation also sought to compare findings among a heterosexual, HIV-seronegative population with the findings among MSM and HIV-seropositive populations and examine potential differences among these populations. The following chapter includes a summary of those findings, overall study strengths and limitations, and recommendations for future research.

A. Summary of Studies

Study 1 noted several differences between binge and non-binge users of MA. Binge user was associated with increased drug use behaviors (greater frequency of use, injection drug use) and greater STI-risk from engaging in sex marathons while high on MA. In addition, binge users were more likely to experience greater depressive symptoms (higher BDI score), initiate MA “to experiment,” and have a history of MA treatment. This suggests that binge use of MA corresponds to unique drug use and STI-risks that may affect the types and content of HIV-prevention and intervention messages.

Study 2 described gender-specific differences in sociodemographic, drug use and sex behaviors, and motivations for use. Men reported greater mental associations between MA use and sex, using MA “to enhance sexual pleasure” and engaging in sex marathons while high on MA. Although women were more likely to be married and to report MA initiation by a sex partner, women were also more likely to report a STI in the previous two months. In addition, women reported the desire “to lose weight” as a motivating factor more often than men and had greater depressive symptoms than their male counterpart. How men and women view the purpose of their MA use and the patterns of their MA differ in unique ways that may require prevention and intervention programs to be tailored to best identify and reduce HIV and STI-risks in these populations.

A post hoc analysis of population attributable risk (PAR) was performed on the characteristics and behaviors significantly associated with injection drug use.

Although less than half of the participants reported the following characteristics and behaviors, a quarter or more of the risk for injection drug use could be prevented by elimination of the following traits: STI (0.37), binge use (0.27), felony conviction (0.44), MA initiation “to get high” (0.23) or “to escape” (0.21), and current MA use “to get high” (0.31). Given the comorbidity of social, physical, and psychological consequences of injection drug use, it is significant to note the high PAR associated with the motivations “to get high” and the associated STI, binge use, and past felony convictions.

Study 3 examined differences in sociodemographics, behaviors, and motivations for MA use by injection drug use status. Injection drug use was associated with being Caucasian, homeless, and having a history of felony conviction. IDU were also more likely to report greater drug use (more years of use and greater amount of use) as well as a recent STI diagnosis. Given the increased risk of blood-borne infections by sharing of syringes among IDU, the recent STI diagnoses suggest that sex risks also exist in this HIV-seronegative population, and that prevention efforts should address both safer injection and safer sex messages.

These three studies expand and contribute to the small, but growing body of literature on heterosexual MA users. We observed that heterosexual methamphetamine users are a heterogeneous population. Although certain STI-risks exist for all study participants due to the inclusion criteria for this study (unprotected sex at least once in the last 60 days), there exists increased risks within subgroups of this population for individuals that use MA in binges and/or inject MA. In addition, gender-specific STI-

risk behaviors also exist with men reporting more sex marathons and women reporting more recent STI. Therefore, although overall safer-sex messaging may be useful among MA users in this population overall, specific messages that address the motivations and unique risks of the MA user subgroups may increase the efficacy of these interventions.

B. Study Strengths

There are several primary strengths of this study. First, the study population includes a large sample of heterosexual MA users, both men and women, and injection and non-injection drug users. Other studies on MA users have looked primarily at MSM or only at injection drug users, which precluded examination of gender- or administration-specific differences. The study population also includes only HIV-seronegative individuals who serve as a key target for HIV-prevention programs. A wide range of sociodemographic characteristics, drug use and HIV-risk sex behaviors, and consequences of MA use were included in this study, allowing for both a thorough examination of the characteristics and differences by subgroup, and the ability to evaluate potential confounders in the analyses. In addition, this study includes data on motivations of study both current and at initiation, which has been rarely studied in the literature. Finally, this study had sufficient power to identify clinically significant findings if they existed. Taken together, these three studies will have a significant impact on the known literature regarding MA use and abuse among heterosexual populations.

The primary significance of these studies was to provide a better understanding of the characteristics and patterns and risks of MA use in heterosexual populations. There has been a paucity of research on potential gender differences among MA using populations and specifically on female MA users. These three studies inform researchers of the associated characteristics and behaviors of heterosexual, HIV-seronegative MA users and to provide necessary findings to guide and generate future

studies among this population. The significant differences among binge users, injection drug users, and male and female MA users imply that treating MA use populations as homogenous groups may ignore intrinsic differences among these subgroups and specific findings need to be interpreted for unique groups. In addition, these studies help to elucidate some important characteristics that may be potential targets for prevention or intervention efforts.

C. Study Limitations

A limitation of this study may have been the generalizability of this study since participants were recruited from high risk populations and were volunteers for the study. The participants may not have been representative of the MA community and data may not be generalizable to other populations. However, many of the findings of these studies are similar to those reported in the literature on men who have sex with men or general drug-using populations. The self-reported nature of the collected data may also have contained certain biases such as recall bias, reporting bias, fatigue bias, and responder bias. However, the use of audio-CASI in collection of sensitive data has been validated in other studies, as was mentioned in discussion sections of the studies described above.

Misclassification of exposure and outcome variables could potentially introduce a bias in the findings of these studies. Underreporting of binge use or injection drug use due to social stigma, would potentially produce overly conservative associations leading to lower odds ratios than might be observed if this bias did not exist. Over reporting of non-injection MA use by participants to gain access to the study may have biased estimates higher than would be expected since these participants may generally report lower risk drug use and sex behavior if they are not current MA users. Additional information to confirm binge use and injection drug use status would be useful to ascertain validity of exposure classification. Binge use may be derived from additional data regarding the nature of a ‘typical month’s worth of MA use’ and injection drug use status may be confirmed with visual examination of

the participant for physical signs of injecting drug use. Validation of infrequent injection drug use and infrequent (or non recent) MA use would be more difficult to obtain.

Non differential recall and reporting bias of outcomes, such as underreporting of self-reported STIs and sex partners with STI, could produce misclassification and lower measures of associations where higher odds ratios would be expected. Underreporting or under diagnosis of STI is potentially likely among this population given the higher levels of homelessness and lower SES and subsequent lower access to health care. In general, men are also less likely to seek out medical diagnosis or treatment for a potential STI and misclassification of actual STI could differ by gender. Monthly MA use behaviors (frequency and amount) , unprotected vaginal sex and types of sex partners may have also been over reported by participants without recent MA use or unprotected sex who were eager to participate, since these were inclusion criteria for the study. However, there is no reason to believe that this misclassification would occur differentially between genders, IDU status, or bingeing (the dependent variables in my three analyses); therefore, the bias would tend to reduce the odds ratios observed toward the null hypothesis, making our findings conservative.

In addition, cross-sectional data could not allow for examination of trend changes over time, especially with regard to the effects of the intervention in the FASTLANE study. Longitudinal data would have been important in discerning the causality of some of the covariates to increased drug use and STI-risk sex behaviors.

Data on some variables of interest regarding initiation of MA use were not available in the current study including conversion from non-injection drug use to injection drug use, and event-level reporting of specific drug use and sex behaviors while high on MA versus sober or high on a different drug, or when injecting versus non-injecting MA use.

The small sample size of bisexual participants due to the inclusion criteria (unprotected sex with a member of the opposite gender within two months of baseline) also inhibited exploration of sexual orientation as a potential confounder or predictor of risk. Finally, the lack of a control group of non-MA drug users prevented the ability to distinguish the effects of MA on the covariates independent of the relationship between the covariates and the gender or injection drug use.

D. Recommendations and Future Directions

Although the included studies contribute to the existing literature on heterosexual MA-using populations, further studies are warranted in this population. Future studies may examine event-level MA use to distinguish the differences in drug use and sex behaviors and motivations for MA use depending on route of use (injection versus non-injection), binge versus non-binge use of MA, and drug-use company (sex partner versus known associate versus anonymous companion). As these studies show in the larger population, patterns of MA use may also be heterogeneous within the individual.

The overlap between the drug use and sex network of female MA users also suggest that partnership studies may be useful. Although some study participants may report a steady, monogamous relationship and engage in unprotected sex with their partner, it may be useful to also examine the STI-risk behaviors of their steady sex partners, who may report other STI-risk behaviors such as syringe sharing or unprotected sex with other partners.

Examining the characteristics and trends of the transition from non-injecting to injecting MA use would also be of interest. Studies involving other drugs (e.g. heroin) have commented on the acceleration of use between smoking or snorting a drug and then transitioning to injection drug use. Given the added HIV and blood-borne infection risk of sharing syringes and the increased number of physical and psychological consequences from injection MA use, a better understanding of the

motivations and behaviors that correlate with this transition to injecting may be helpful in adapting current intervention programs.

Although a major strength of this study is the large population of male and female MA users, lack of a control group of non-MA users prevents comparisons of MA-only behaviors with behaviors related to bingeing or injection drug use or by gender. Future studies may wish to compare the characteristics and behaviors of MA users to other drug users (e.g. cocaine, heroin) by gender, injection, and binge drug use.

A history of nonconsensual sex was reported by several participants in the study. Future studies should explore whether MA initiation or current MA use are correlated with a history of nonconsensual sex. Motivations for MA use may be ‘to escape’ or ‘to cope with mood’ subsequent to the trauma experienced by prior abuse, either in childhood or as an adult. Potential post traumatic stress disorder symptoms may lead to MA use as a means of coping with past or present emotional distress. In addition, the increase in depressive symptoms reported by women may be correlated with a history of nonconsensual sex or abuse. The desire ‘to lose weight’ may also suggest a potential coping mechanism to prior sex, as other eating disorders have been linked in the literature to prior trauma and abuse.

Future studies may also examine the potential differences in physiologic effects of MA use between men and women. Given the generally smaller stature of women compared to men, female MA users may experience the effects of MA more acutely, or just differently than their male counterparts. The findings of this study that

female MA users experience more depressive symptoms and more consequences of MA use and that the male MA users correlate MA use to enhancing sex, meeting sex partners, and engaging in sex marathons while high, suggest there may be differential physical and psychological effects of MA. Further studies into these potential differences are warranted.

Finally, future research in longitudinal behaviors in this population is also warranted. The FASTLANE study consists of a 4-session intervention program and it would be of great interest to examine the potential change in drug use and sex behaviors over the course of the study. In addition, it is difficult to draw conclusions of causality due to the cross-sectional nature of this study. For instance, although depressive symptoms were more likely to be reported among female MA users and binge users, it is difficult to discern whether the depressive symptoms led to MA initiation or if chronic MA use induced the depressive symptoms.

E. Conclusions

Overall, MA users are a heterogeneous group of individuals who report a spectrum of characteristics, behaviors, and motivations. MA users from both heterosexual and MSM populations report higher HIV and STI-risk drug use and sex behaviors, but differences are observed in subgroups. Sex risk reduction and safer syringe use practices would benefit most MA users, but specific messages for men and women and for injection and binge MA users would improve efficacy of current intervention and prevention programs. MA is a long-standing public health issue with a current epidemic in the US among both heterosexual and MSM populations, and further research is still warranted to better understand the subtleties of the behaviors and motivations of MA users domestically and abroad.

APPENDIX 1

Use of Receiver Operating Characteristic Analysis to Compare “Binge” versus “Intensity” of MA Use by

A. Abstract

Background: This study compared the correlated characteristics and behaviors of “binge use” and of “intensity” of use, and the degree to which intensity correlates with binge use among heterosexual, methamphetamine (MA) users.

Methods: The FASTLANE study included cross-sectional data from 451 MA users in San Diego collected June 2001 – August 2004 who had engaged in unprotected sex and MA use in the previous two months, and were HIV(-) at enrollment. Receiver operating characteristic analysis was performed to examine the correlation of self-classification of binge-use (a period of uninterrupted use of MA) status and calculated “intensity” (amount and frequency of MA use). Logistic (binge use) and linear (“intensity”) regression analyses were also performed.

Results: The study sample was 67.8% male, 49.4% Caucasian, 26.8% African-American, and 12.8% Hispanic, mean age 36.6 years; 183 (40.5%) reported binge MA use in the past 2 months. The final logistic regression model for binge MA use included greater number of consequences of MA use, the motivation “to experiment” when initiating MA use, and engaging in sex marathons while high on MA. In a final linear regression model, higher intensity of MA use was correlated with injection drug

use, number of consequences of MA use, and unprotected sex with spousal/steady partners. Intensity of MA use was not found to be an accurate diagnostic predictor of binge use status ($ROC_{Area}=0.65$).

Conclusions: Both binge and intensity of use was associated with a greater number of consequences of MA use and sexual risk behaviors. Since years of MA use was associated only with intensity of MA use, examining intensity may be less appropriate for studies on MA initiation or among new users of MA whereas binge use is independent of duration of use. Interventions should therefore distinguish between MA using subgroups to improve and adapt existing treatment and prevention programs.

B. Introduction

An established definition of “binge use” of methamphetamine (MA) is lacking in the existing literature. Binge use is often either self-classified or dichotomized as heavy vs. light. However, studies have not compared whether a quantifiable “intensity” of MA use variable yields similar patterns and correlates as a qualitative classification of “binge use” of MA, and there is sparse literature available regarding the factors associated with higher “intensity” of MA use. Binge users may be quite different than higher “intensity” (greater amount and frequency of MA use) users, or the correlates of binge use and higher intensity of use may be similar, affecting the potential development and adaptation of prevention and intervention efforts.

Therefore, it is important to examine and compare correlates of intensity of MA use along with binge use, and to statistically explore the degree to which the quantifiable measure of intensity might predict a participant’s binge use status compared to the reported binge use self-classification. For instance, available literature on alcohol use conveys the difficulty in definitions of “binge use.” Several studies have shown the lack of correlation between the “binge” drinking definition and actual blood alcohol concentration (BAC) levels, suggesting that participants classified as “binge drinkers” are not necessarily comprised exclusively of the heaviest drinkers and those most at risk of injury and health consequences (116;117). In addition, gender and physiological differences are often either unaccounted for in “binge” definitions or subgroup-specific thresholds are not universally observed (115;116).

This study thus proposes to examine the differences between self-classification as a “binge user” and calculated intensity of MA use.

C. Methods

Since binge use was subjective, an objective variable measuring “intensity” ($\log(\text{grams} \cdot \text{days}/\text{month})$) of MA use was calculated as the log of the product of the amount (in grams) and frequency (number of days used) of MA use in the last 30 days.

Potential differences between binge use and “intensity” of use were explored by a receiver operating characteristic (ROC) analysis for correlation (171-175). The area under the ROC curve is a measure of discrimination, the ability of an independent variable (intensity of MA use) to correctly classify a dependent variable (binge use), where values range from an inability to classify outcome status (area=0.50) to complete correlation/discrimination (area=1.0).

D. Results

Multivariate Logistic Regression for Binge Use

Multivariate logistic regression modeling was performed for variables in each of the following groups: demographics, drug use behavior, sex history and behavior, and motivations/consequences. The following variables that were significantly correlated with binge use in univariate analyses were entered into the full multivariate model: injection drug use, ever enrolling in a MA treatment program; unprotected vaginal intercourse with a casual or anonymous partner, involvement in sex marathons while high on MA; numbers of consequences of MA use, and BDI Score; initiating MA use in order “to experiment”, “to escape/avoidant coping”; and current MA associated with a desire to “enhance sex experiences/get sex partners”, or “to escape/avoidant coping.” The final, reduced multivariate model for binge-use included greater number of consequences from MA use, engaging in sex marathons while high on MA, and initiating MA use from the desire “to experiment” compared to non-binge MA use (Table A1-2).

Multivariate Linear Regression for “Intensity” of MA use

Similar to the regression modeling procedure described above for logistic regression, the following variables which were significantly correlated with higher intensity of MA use in univariate analyses were entered into the full, multivariate regression model: ever been an IDU and/or polydrug user, years of MA use; reported casual or anonymous partners, unprotected vaginal and anal sex with steady or

casual/anonymous partners, involvement in sex marathons while high on MA; reported greater number of consequences from MA use, higher BDI scores; and the motivation “to lose weight/feel more attractive,” “to stay awake/get more energy,” “to experiment,” and/or “to escape/avoidant coping,” when initiating MA use and the desire “to stay awake/get more energy,” and/or “to escape/avoidant coping” for current MA use. The final multivariate reduced model showed that injection drug use, greater number of consequences from MA use, and always engaging in unprotected vaginal sex with a spousal/steady sex partner were all significantly associated with increased intensity of MA use (Table A1-2).

Correlation between Binge and Higher Intensity of MA Use

Logistic regression analysis examining the association between binge use and intensity of MA use found that self-reported binge users were 1.3 (95%CI=1.17, 1.42) times more likely to be classified as higher intensity users (# days and amount of MA used in last month) compared to self-reported non-binge users (data not shown). And in Figure A1-1, the mean intensity of MA use was significantly higher for binge users (4.2) compared to non-binge users (3.1); in addition, binge use and higher intensity MA use were significantly associated with one another in univariate logistic and linear regression. However, the receiver operating characteristic (ROC) analysis showed low correlation between binge use and higher intensity of use, with the reported area under the ROC curve of 0.65 (95%CI=0.595,0.699) is closer to 0.50 (complete inability to distinguish between binge use status) than the upper range of 1.0 (Figure

A1-2). Although statistically significant, the quantitative measure of intensity of MA use may not serve as an accurate diagnostic of classifying binge use status.

E. Discussion

The purposes of this study were to identify and compare the correlates of binge-use and high intensity of MA use and to examine the correlation between binge-use and high intensity of MA use. The finding that average years of MA use correlated with higher intensity MA use but did not significantly differ by binge use, suggests that bingeing is not an escalated behavior due to longer term MA use unlike higher intensity of MA use. However, it is of particular concern that injection drug use was associated with both binge and intensity of MA use, given the associated risks with HIV and Hepatitis B/C infection. In addition, intensity of MA use was found to be significantly associated with polydrug use, thereby possibly bridging drug use networks between MA use and injection of other drugs used. The correlation between binge use and enrollment in previous treatment programs for MA use also suggest that binge users are willing and seeking treatment and that current treatment programs need to improve the methodologies for binge users to increase completion rates (only half finish the programs) and to cease binge use of MA.

Binge users were more likely to report engaging in sex marathons while high on MA, while an increase in “intensity” scores was correlated with always engaging in unprotected vaginal sex with spousal/steady partners. Both sex behaviors may be of special concern since the majority of participants always engaged in unprotected vaginal intercourse. Therefore, STI prevention measures may address binge use and

higher intensity of use as components of safer-sex education and intervention, while distinguishing between the STI-risk correlates of the two groups.

Similar to other studies that reported a correlation between MA use and social, physical, and psychological consequences (7;43;57;70;81;82;86;99;107;176;177), both binge use and intensity of MA use were correlated with a greater number of consequences from MA use, a finding which may help intervention programs address the overall well-being of enrollees in addition to HIV-risk reduction in sex and drug use behaviors. This is especially important since MA was used by a quarter of the participants as a means of escaping or avoidant coping, and intervention programs that do not address the subsequent consequences and lifestyle factors/environment of MA users may predispose participants to resume their cycle of MA use to escape their daily circumstances, leading to further consequences from their MA use.

The differences in motivations for starting vs. current MA use and between binge and intensity of MA use are also potentially helpful in improving existing prevention and intervention programs. As mentioned above, the desire to escape (or avoidant coping) figures significantly in both binge use and intensity of MA use, for initiating and continuing MA use. Therefore, intervention programs that address MA cessation must also focus on the circumstances surrounding the need for escape. Among binge users, the initial motivation for MA use, to experiment, is no longer significant for current use of MA whereas the desire to enhance sexual experiences or to meet sex partners becomes significant for current MA use, which is particularly concerning when combined with the increased odds of engaging in sex marathons

while high and the prevalence of unprotected sex in this study. For intensity of MA use, the desire to lose weight/feel more attractive and to experiment is also only significant for initiating MA use, and no longer significant for current MA use, suggesting a shift in motivation or priority setting for chronic use of MA. Effective treatment and cessation of MA use must therefore recognize and incorporate the initial and change in motivations for MA use.

Using a ROC analysis, this study found a poor correlation between binge MA use and “intensity” of MA use ($ROC_{area}=0.65$), and showed that a broad spectrum of MA use intensity exists for both binge and non-binge MA users. This suggests that either the self-reported binge use variable does not fully capture the most “intense” MA users in the study population, or that “binge-use” is a separate category than intensity of MA use and that the two variables might be measuring different types of MA use. Although self-reported binge-users have a significantly higher mean “intensity” MA level, there are non-binge-users that also report higher “intensity” of MA use levels. Therefore, it seems likely that the two variables might be measuring different types of MA use. MA binges where individuals “keep using large quantities of meth for a period of time, until [they] run out or just can’t physically do it anymore,” may differ from chronic MA users who do not “binge-use” in STI-risk drug and sex behaviors. Therefore, programs to reduce STI-risk among MA users must distinguish between binge-users vs. chronic “intense” users of MA to better develop and adapt interventions.

However, despite their differences, both measures were correlated with high HIV-risk behaviors (injection drug use, unprotected/marathon sex) and greater number of consequences of MA use, and should therefore be a target of prevention and intervention programs. Although intensity of MA use may not serve as a useful diagnostic for predicting binge use status, the similar correlated HIV-risk behaviors and consequences suggest that the qualitative “binge-use” classification captures HIV-risk behaviors as well as the quantitative intensity measure and that future studies may examine either measure as a drug use behavior correlated with physical, psychological, and social consequences. In addition, the results also suggest that intensity may increase with years of MA use, but that binge-use is independent of duration of use and may thus be more important for studies focusing on initiation or early use of MA whereas intensity of use may be more useful in studies of chronic or longer-term use. However, inclusion of both measures in a regression model may not be warranted and the addition of yet another drug use behavior may increase the risk of multiple comparisons.

Therefore, the contents of Chapter 2 on the binge use comparisons manuscript exclusively analyzes binge use of MA without intensity of MA. The data for intensity of MA was incorporated into the binge use regression models by the individual variables for amount of MA used in the last 30 days (in grams) and the number of days of MA used in the last 30 days. Future studies may wish to examine the intensity of MA use to determine unique characteristics and behaviors of the most “intense” MA users and to tailor reduction and cessation programs to this population.

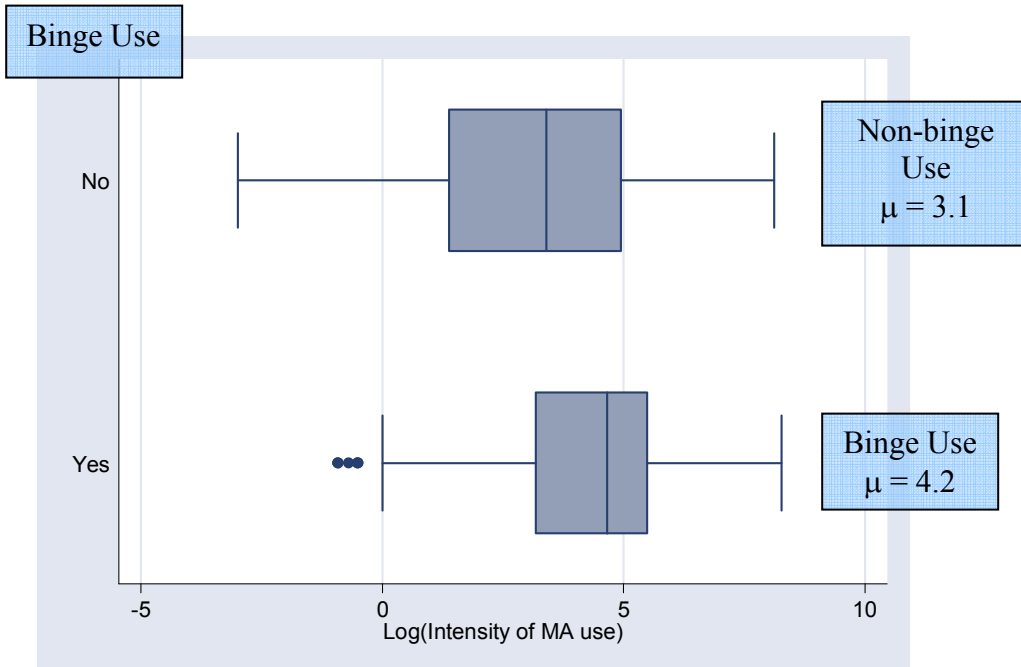


Figure A1-1: Intensity (amount*frequency) of MA Use Stratified by Binge Use Status

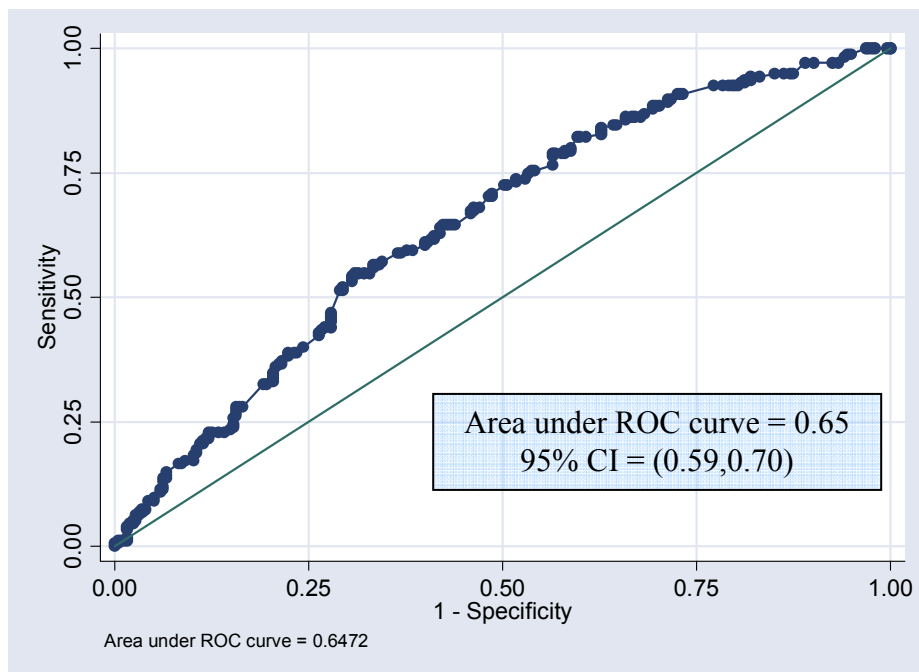


Figure A1-2: Receiver Operating Characteristic Analysis Graph of Binge Use and Intensity (amount*frequency) of MA Use for 451 Methamphetamine Users in San Diego, CA

Table A1-1: Descriptive statistics and univariate logistic regression for binge use (yes/no) and univariate linear regression for intensity of MA use (amount*frequency of MA use in last 30 days) with background characteristics, drug use and sex behavior among 451 methamphetamine users in San Diego, CA.

Characteristic	Descriptive	Logistic		Linear	
	Statistics	Regression: Binge Use (yes/no)		Regression: Intensity of MA Use (amt*freq)	
	% (n)	Odds Ratio	95% CI	e^{β}	95% CI
Gender: Female (vs. male)	32.2 (145)	0.85	n.s.	1.17	n.s.
Mean Age (Years) at Interview (SD)*	36.6 (9.9)	0.98	n.s.	0.98	n.s.
Ethnicity: Caucasian (vs. other minority)	49.4 (223)	1.1	n.s.	1.84	(1.21,2.79)
Education: ≤ High school (vs. ≥ College)	57.9 (259)	0.96	n.s.	1.45	n.s.
Binge Drug Use	40.6 (183)	n/a	n/a	3.16	(2.08,4.79)
Mean Intensity of MA use in last 30 days (SD)*:	3.6 (2.2)				
Log(Intensity=amount x freq)		1.29	(1.17,1.42)	n/a	n/a
Injection Drug Use: Ever (vs. Never)	29.5 (133)	1.93	(1.28,2.91)	2.40	(1.52,3.80)
Polydrug use: Yes (vs. No)	47.5 (213)	1.09	n.s.	1.22	(1.04,1.43)
Mean Years of MA use (SD)*	13.6 (8.9)	1.01	n.s.	1.03	(1.01,1.06)
Ever Treated for MA: Yes (vs. No)	34.7 (156)	2.32	(1.56,3.45)	1.51	n.s.
Completed Treatment: Yes (vs. No)	52.3 (68)	1.04	n.s.	1.12	n.s.
Types of Sex Partners in Last 60 days					
Spouse/Steady: Yes (vs. No)	93.1 (420)	1.09	n.s.	1.72	n.s.
Casual/Anonymous: Yes (vs. No)	88.9 (401)	1.68	n.s.	2.43	(1.24,4.75)
Mean # of Sex Partners Last 60 days (SD)*	3.7 (11.6)	1.01	n.s.	1.01	n.s.
Any STIs in last 60 days: Yes (vs. No)	20.0 (89)	1.39	n.s.	1.24	n.s.
Unprotected Vaginal Sex (last 60 days)					
Spouse/Steady: Always (vs. Sometimes)	85.4 (385) 69.0 (311)				
Casual/Anonymous: Always (vs. Sometimes)		1.69	n.s.	2.58	(1.43,4.64)
Marathon Sex while high: Yes (vs. No)	64.7 (292)	1.75	(1.16,2.62)	2.37	(1.51,3.72)
Mean # of Consequences of MA use (SD)*	34.9 (16.7)	1.04	(1.02,1.06)	1.04	(1.02,1.06)
Mean Beck Depression Inventory (SD)*	15.3 (10.2)	1.03	(1.01,1.05)	1.04	(1.02,1.06)
Motivations for Starting MA Use					
To lose weight	20.4 (92)	1.30	n.s.	2.31	(1.37,3.91)
To stay awake/get more energy	41.0 (185)	1.04	n.s.	1.65	(1.08,2.53)
To enhance sex/meet sex partners	30.8 (139)	1.22	n.s.	0.96	n.s.
To experiment	42.1 (190)	1.95	(1.33,2.87)	1.96	(1.29,3.00)
To escape/avoidant coping	25.5 (115)	1.56	(1.02,2.39)	2.03	(1.26,3.28)
Motivations for Continuing MA Use					
To lose weight/feel more attractive	12.7 (57)	1.18	n.s.	1.66	n.s.
To stay awake/get more energy	33.9 (153)	0.84	n.s.	1.97	(1.27,3.06)
To enhance sex/meet sex partners	30.6 (138)	1.60	(1.07,2.40)	1.30	n.s.
To experiment	4.0 (18)	0.73	n.s.	1.04	n.s.
To escape/avoidant coping	24.4 (110)	1.75	(1.13,2.70)	2.39	(1.45,3.87)

* Mean (SD); e^{β} = exponentiated beta coefficient showing “odds ratio” of one unit increase in log(intensity of MA use); n.s. = not significant (95%CI includes 1.0); n/a = not applicable

Table A1-2: Final multivariate models for logistic regression of binge use (yes/no) and linear regression of intensity of MA use (amount*frequency MA use in last 30 days) with correlated characteristics, and drug use and sex behaviors among 451 methamphetamine users in San Diego, CA.

Characteristic	Logistic Regression: Binge Use (yes/no)		Linear Regression: Intensity of MA Use (I = amount*freq)	
	Odds Ratio	95% CI	e^{β}	95% CI
Injection Drug Use: Ever (vs. Never)			2.35	(1.14,4.81)
Unprotected Vaginal Sex (last 60 days) Spouse/Steady: Always (vs. Sometimes)			3.38	(1.45,7.87)
Marathon Sex while high on MA: Yes (vs. No)	2.60	(1.34,4.87)		
Mean # of Consequences of MA use (SD)*	1.04	(1.03,1.07)	1.04	(1.02,1.05)
Starting MA Use Motivations: To experiment	2.14	(1.17,3.91)		

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APPENDIX 2

Polychotomous Logistic Regression Analysis of Polydrug versus MA-only Injectors

A. Abstract

Background: This study examined injection drug use differences in sociodemographic characteristics, drug use practices, sexual behaviors, and consequences and motivations for methamphetamine (MA) use among HIV-seronegative heterosexuals in San Diego, CA. Participants were classified into three groups: non injection drug users (NIDU), injection drug users injecting MA only (MA IDU), or injecting MA with other drugs (polydrug IDU).

Methods: Between 2001 and 2005, baseline interviews were conducted and provided cross-sectional data for 452 HIV-negative MA users aged 18 and older who had used MA and had engaged in unprotected sex in the previous two months. Polychotomous logistic regression was used to identify significant variables in the two multivariate final models with NIDU as the reference group.

Results: Participants were 68% male; 49.4% Caucasian, 26.8% African-American, and 12.8% Hispanic; 55% never married; 58% never attending college; and 36.6 years old on average. Compared to NIDU, MA IDU were less likely to be Caucasian or to have an STI in the last 60 days, but were more likely to engage in marathon sex while high on MA, have history of a felony charge, and have used more grams of MA in the last month and used MA for more years.

Similarly, polydrug IDU were also less likely to be Caucasian, more likely to engage in marathon sex and have a history of a felony, greater years of MA use and more grams of MA use per month; however, STI in the last 60 days was not significantly different between polydrug IDU and NIDU.

Conclusions: Injection drug users are a heterogeneous population with unique characteristics that vary by the drugs that they inject. Overall though, IDU report significant drug use and sex behavior differences compared to NIDU which may affect the effectiveness of prevention and intervention programs.

B. Introduction

The purpose of this sub-study was to explore the differences in sociodemographic and drug use characteristics, sexually transmitted infection (STI)-risk behaviors, and consequences of and motivations for MA use between MA users who reported injecting only MA, injecting MA with other drugs (polydrug), and non-injection drug users. We hypothesize that differences will exist between injection drug users (IDU) and non-injection drug users (NIDU) in background characteristics, drug use and sex behavior patterns, and consequences of MA use including past felony convictions. Furthermore, given the effects of MA on increasing libido (82;84;178-180), we hypothesize that differences in sex behaviors may arise between MA only and polydrug injecting drug users.

C. Methods

Statistical Analysis

Individual variables and groups of variables potentially associated with injection MA use were examined. Descriptive statistics were performed using chi-square and ANOVA. Polychotomous logistic regression analyses were performed to examine the odds associated with injection MA use. Both individual independent variables and groups of variables (demographic, drug use, sex behavior, consequences of MA use, and motivations for MA use) were performed were examined. Likelihood ratio tests comparing full to reduced models were used to evaluate independent variables in the polychotomous logistic regression models to produce a final multivariate model ($p < 0.05$). Variables specific to injection drug use (shooting galleries, sharing of needles, works, and cookers) were analyzed independently and logistic regression comparing polydrug to MA-only IDU were performed.

D. Results

There were 452 participants including 133 injection drug users, 98 who inject only MA and 35 who inject MA along with other drugs (e.g. cocaine, heroin), and 319 who never injected MA (Table A2-1). The participants were 36.6 years (SD9.9) on average, 67.7% male, 49.3% Caucasian, 26.8% African American, and 12.8% Hispanic; 15.3% reported being homeless. The majority had never attended college (58%), and had never been married (54.8%). Both MA and polydrug IDU were significantly more likely to be older at baseline, Caucasian, and homeless ($p < 0.05$) compared to NIDU (Table A2-4).

Sexual Behavior

As shown in Table A2-4, MA-only IDU were significantly more likely to report a STI in the last 60 days (OR=3.50, 95%CI=2.05,5.97), but less likely to engage in marathon sex (OR=0.61, 95%CI=0.39,0.97) compared to NIDU. Similarly, polydrug IDU were also more likely to report a STI in the last 60 days (OR=5.01, 95%CI=2.38,10.56) compared to NIDU.

Drug Behavior

Compared to NIDU, IDU were also significantly more likely to report binge drug use. MA-only injectors were 1.72 (95%CI=1.09,2.71) times more likely to binge use MA and polydrug injectors were 2.68 (95%CI=1.31,5.48) times more likely to binge use MA compared to NIDU (Table A2-4). Injection drug users, both MA only and polydrug, reported needle sharing (49%), using works of others (45%), and

sharing a cooker; use in a shooting gallery was less common (15%). Compared to MA-only injectors, polydrug injectors were significantly more likely to share a cooker (OR=1.77, 95%CI=1.16,2.68).

Consequences of MA Use

As shown in Table A2-4, felony convictions were significantly more likely among MA-only IDU (OR=3.34, 95%CI=2.08,5.35) and among polydrug IDU (OR=2.18, 95%CI=1.08,4.40) compared to NIDU. Mean number of consequences and BDI scores did not differ by injection drug use status. Both MA-only (OR=3.34, 95%CI=2.08,5.35) and polydrug (OR=2.18, 95%CI=1.08,4.40) IDU were significantly more likely to report a past felony conviction.

Motivations for Initiating and Currently Using MA

As seen in Table A2-4, MA-only IDU were more likely to initiate MA for the following reasons: “to get high” (OR=1.60, 95%CI=1.01,2.52), “to escape” (OR=2.57, 95%CI=1.48,4.46), “to cope with mood” (OR=2.20, 95%CI=1.30,3.73), or “to feel more confident” (OR=2.77, 95%CI=1.56,4.92) compared to NIDU. In contrast, polydrug IDU reported only one motivation, “to escape” (OR=2.34, 95%CI=1.02,5.34), more significantly than NIDU.

Compared to NIDU, MA-only IDU were more likely to currently use MA “to get high” (OR=1.72, 95%CI=1.09,2.72) or “to escape” (OR=1.95, 95%CI=1.11,3.45). Similarly, polydrug IDU were also more likely to report current MA use “to get high” (OR=2.48, 95%CI=1.17,5.26) or “to escape” (OR=2.29, 95%CI=1.05,5.24).

Factors Independently Associated with MA Injection and with Polydrug Injection

The final multivariate model identified several factors independently associated with MA injection ($p < 0.05$) including being Caucasian, homelessness, more years of MA use, greater MA used in the last 30 days, and a history of felony charge; MA injectors were less likely to report an STI in the last 60 days and engage in marathon sex while high on MA (Table A2-5). Polydrug injection was independently associated with being Caucasian, increase years of MA use, greater amount of MA used in the last 30 days, and reporting an STI in the last 60 days. The full model explained 18% of the total variance (pseudo $R^2 = 0.18$) (153). Of the final independently associated variables, only marathon sex was significantly associated with polydrug injection; polydrug IDU were significantly more likely to engage in marathon sex than MA-only IDU (OR=2.97, 95%CI=1.13,7.80).

E. Discussion

The findings of this study show that MA users are a heterogeneous population with characteristics that vary by both injection drug use status and by the type of drug injected. Although number of consequences and depression scores did not differ significantly by injection drug use status, MA-only IDU were more likely to initiate MA use “to escape,” “to cope with mood,” and “to feel more confident.” Identifying the underlying circumstances leading to these motivations and addressing the potential negative self-perceptions of these individuals may be an important topic for behavioral modification programs.

We also observed differences in characteristics by polydrug versus MA-only injection. Unlike MA-only IDU, polydrug IDU reported no significant differences in homelessness, marathon sex, or felony charges compared to NIDU. However, polydrug IDU were significantly more likely to engage in marathon sex compared to MA-only IDU, while MA-only IDU were significantly less likely to engage in marathon sex compared to NIDU. Injection drug users in this study are a heterogeneous population and these differences may affect the efficacy of intervention and prevention messages. Further research into event-level behaviors for IDU when injecting versus when smoking or snorting MA may further elucidate the relationship between injection drug use and sex behaviors.

This study reports novel differences in characteristics and behaviors of MA users by injection drug status and by type of drug injected. These findings suggest that intervention and prevention programs should highlight the increased risk of blood-

borne infections among IDU and address the potential circumstantial and motivational factors that underlie MA usage, and specifically MA injection.

Table A2-1: Univariate associations of sociodemographic characteristics and sex behavior comparing 319 NIDU to 98 MA-only and 35 polydrug IDU among 452 HIV-negative MA users in San Diego, CA, 2001 – 2005

Characteristic	All (n=452)		No IDU (n=319)		MA IDU (n=98)		Poly IDU (n=35)	
	%	(n)	%	(n)	%	(n)	%	(n)
Mean Age in years (SD)*	36.6	(9.9)	35.0	(9.8)	40.4	(8.9)	40.1	(9.9)
Gender: female (vs. male)	32.3	(146)	33.2	(106)	31.6	(31)	25.7	(9)
Race								
Caucasian	49.3	(223)	41.4	(132)	72.4	(71)	57.1	(20)
Asian American	1.8	(8)	1.6	(5)	1.0	(1)	5.7	(2)
African American	26.8	(121)	30.4	(97)	13.3	(13)	31.4	(11)
Native American	2.2	(10)	2.5	(8)	1.0	(1)	2.9	(1)
Latino/Hispanic	12.8	(58)	15.7	(50)	7.1	(7)	2.9	(1)
Other	7.1	(32)	8.5	(27)	5.1	(5)	0	(0)
Education: ≤ High school (vs. ≥ College)	58.0	(260)	55.7	(176)	60.8	(59)	71.4	(25)
Homelessness: Yes (vs. No)	15.3	(69)	11.6	(37)	27.6	(27)	14.3	(5)
Marital Status								
Married: Yes (vs. No)	8.2	(37)	9.6	(31)	6.1	(6)	0	(0)
Divorced/Separated: Yes (vs. No)	35.3	(159)	32.1	(102)	43.9	(43)	40.0	(14)
Never Married: Yes (vs. No)	54.8	(257)	56.0	(178)	50.0	(49)	57.1	(20)
Mean # of Sex Partners in Last 60 days (SD)*	3.7	(11.5)	3.1	(10.1)	5.1	(15.3)	4.6	(11.4)
Sex Partner with HIV(+)/unknown status	55.4	(252)	54.2	(173)	61.4	(62)	48.6	(17)
Spouse/Steady: Yes (vs. No)	95.8	(436)	96.9	(309)	94.1	(95)	91.4	(32)
Casual/Anonymous: Yes (vs. No)								
Any STIs in last 60 days: Yes (vs. No)	20.0	(89)	13.0	(41)	34.4	(33)	42.9	(15)
Marathon Sex while high on MA: Yes (vs. No)	65.1	(296)	66.8	(213)	56.4	(57)	74.3	(26)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; OR = odds ratio; CI = confidence interval; MA = methamphetamine; NIDU = non-injection drug user

Table A2-2: Drug use characteristics associated with 319 non-injection drug users to 98 MA-only and 35 polydrug-injecting drug users among 452 heterosexual, HIV-negative MA users in San Diego, CA, 2001 – 2005.

Characteristic	All (n=452)		No IDU (n=319)		MA IDU (n=98)		Poly IDU (n=35)	
	%	(n)	%	(n)	%	(n)	%	(n)
Mean Years of MA Use (SD)*	13.6	(8.9)	11.9	(7.9)	17.8	(9.3)	17.8	(10.9)
Mean Grams of MA Used Last 30 days (SD)*	9.4	(17.4)	7.6	(13)	13.7	(23.3)	14.6	(29.1)
Mean # of Days of MA Use Last 30 days (SD)*	14.6	(9.1)	13.9	(9.1)	16.1	(8.9)	16.8	(8.4)
Binge Use: Ever (vs. Never)	40.6	(183)	35.8	(114)	49	(48)	60	(21)
Share needles: Ever (vs. Never)	49.2	(63)			47.4	(45)	54.5	(18)
Use Works of Others: Ever (vs. Never)	45.2	(57)			43.0	(40)	51.5	(17)
Use in Shooting Gallery: Ever (vs. Never)	15.3	(19)			13.2	(12)	21.2	(7)
Share a Cooker: Ever (vs. Never)	39.5	(49)			28.2	(26)	69.7	(23)

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; OR = odds ratio; CI = confidence interval, MA = methamphetamine; NIDU = non-injection drug user

Table A2-3: Univariate associations of consequences of current MA use and motivations for initiating and current use of MA comparing 319 NIDU to 98 MA-only and 35 polydrug IDU among 452 HIV-negative MA users in San Diego, CA, 2001 – 2005.

Characteristic	All (n=452)		No IDU (n=319)		MA IDU (n=98)		Poly IDU (n=35)	
	%	(n)	%	(n)	%	(n)	%	(n)
Mean # of Consequences of MA use (SD)*	6.2	(4.2)	6.4	(4.2)	5.7	(4.1)	6.0	(4.4)
Mean Beck Depression Inventory Score (SD)*	14.3	(10.3)	14.9	(10.1)	16.2	(10.6)	16.2	(10.8)
History of Felony: Yes (vs. No)	40.4	(182)	32.7	(104)	61.9	(60)	51.4	(18)
Motivations for Starting MA Use								
To get high	47.0	(212)	43.4	(138)	55.1	(54)	57.1	(20)
To get more energy	31.5	(142)	31.8	(101)	34.7	(34)	20.0	(7)
To escape	17.1	(77)	12.9	(41)	27.5	(27)	25.7	(9)
To cope with mood	18.8	(85)	16.0	(51)	29.6	(29)	14.3	(5)
To feel more confident	14.0	(63)	11.0	(35)	25.5	(25)	8.6	(3)
Motivations for Continuing MA Use								
To get high		(226)	45.7	(145)	59.2	(58)	67.7	(23)
To get more energy	50.3	(127)	29.3	(93)	26.5	(26)	23.5	(8)
To escape	28.3	(75)	13.6	(43)	23.5	(23)	26.5	(9)
To cope with mood	16.7	(79)	17.0	(54)	18.4	(18)	20.6	(7)
To feel more confident	17.6	(41)	8.83	(28)	12.2	(12)	2.9	(1)
	9.1							

* Values for these characteristics are in the form of Mean (SD) instead of % (n). Abbreviations: SD = standard deviation; OR = odds ratio; CI = confidence interval; MA = methamphetamine; NIDU = non-injection drug user

Table A2-4: Bivariate logistic regression of MA-only and polydrug injecting drug use versus non-injecting drug use among 452 MA users in San Diego, CA, 2001 – 2005.

Characteristic	MA-only IDU (Ref=No IDU)	Polydrug IDU (Ref=No IDU)
	OR(95%CI)	OR(95%CI)
Mean Age in years (SD)*	1.06(1.04,1.09)	1.06(1.02,1.10)
Gender: female (vs. male)	0.93(0.57,1.51)	0.70(0.31,1.54)
Race (Non-Caucasian vs. Caucasian)	0.70(0.59,0.82)	0.71(0.55,0.91)
Education: \leq High school (vs. \geq College)	0.81(0.51,1.29)	0.50(0.86,1.08)
Homelessness: Yes (vs. No)	2.89(1.65,5.06)	1.27(0.46,3.46)
Marital Status (Not Married vs. Married)	0.92(0.75,1.12)	1.11(0.80,1.54)
Mean # of Sex Partners in Last 60 days (SD)*	1.01(1.00,1.03)	1.01(0.99,1.04)
Sex Partner with HIV(+)/unknown status		
Spouse/Steady: Yes (vs. No)	1.28(0.81,2.02)	0.80(0.40,1.60)
Casual/Anonymous: Yes (vs. No)	0.50(0.18,1.40)	0.35(0.79,1.32)
Any STIs in last 60 days: Yes (vs. No)	3.50(2.05,5.97)	5.01(2.38,10.56)
Marathon Sex while high on MA: Yes (vs. No)	0.61(0.39,0.97)	1.44(0.65,3.18)
Mean Years of MA Use (SD)*	1.08(1.05,1.11)	1.08(1.04,1.12)
Mean Grams of MA Used Last 30 days (SD)*	1.02(1.01,1.03)	1.02(1.00,1.04)
Mean # of Days of MA Use Last 30 days (SD)*	1.03(1.00,1.05)	1.04(1.00,1.08)
Binge Use: Ever (vs. Never)	1.72(1.09,2.71)	2.68(1.31,5.48)
Share needles: Ever (vs. Never)	1.06(0.69,1.64)	
Use Works of Others: Ever (vs. Never)	0.92(0.57,1.48)	
Use in Shooting Gallery: Ever (vs. Never)	1.06(0.56,2.01)	
Share a Cooker: Ever (vs. Never)	1.77(1.16,2.68)	

Table A2-4 (cont.): Bivariate logistic regression of MA-only and polydrug injecting drug use versus non-injecting drug use among 452 MA users in San Diego, CA, 2001 – 2005.

Characteristic	MA-only IDU (Ref=No IDU)	Polydrug IDU (Ref=No IDU)
	OR(95%CI)	OR(95%CI)
Mean # of Consequences of MA use (SD)*	0.96(0.91,1.02)	0.98(0.90,1.06)
Mean Beck Depression Inventory Score (SD)*	1.01(0.99,1.03)	1.01(0.98,1.05)
History of Felony: Yes (vs. No)	3.34(2.08,5.35)	2.18(1.08,4.40)
Motivations for Starting MA Use		
To get high	1.60(1.01,2.52)	1.74(0.86,1.13)
To get more energy	1.14(0.71,1.84)	0.54(0.23,1.26)
To escape	2.57(1.48,4.46)	2.34(1.02,5.34)
To cope with mood	2.20(1.30,3.73)	0.87(0.32,2.36)
To feel more confident	2.77(1.56,4.92)	0.76(0.22,2.60)
Motivations for Continuing MA Use		
To get high	1.72(1.09,2.72)	2.48(1.17,5.26)
To get more energy	0.87(0.52,1.45)	0.74(0.32,1.70)
To escape	1.95(1.11,3.45)	2.29(1.0,5.24)
To cope with mood	1.10(0.61,1.98)	1.26(0.52,3.05)
To feel more confident	1.44(0.70,2.95)	0.31(0.04,2.37)

Table A2-5: Polychotomous logistic regression analysis of sociodemographic, drug use and sexual behavior characteristics, and consequences of and motivations for MA use comparing 319 NIDU to 98 MA-only and 35 polydrug IDU, and comparing MA-only to polydrug IDU among 452 MA users in San Diego, CA, 2001 – 2005.

Characteristic	MA only vs. NIDU		Polydrug IDU vs. NIDU		Polydrug IDU vs. MA-only IDU	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Race : Caucasian (vs. non-Caucasian)	1.46	(1.20,1.77)	1.33	(1.02,1.74)	0.91	(0.67,1.24)
Homeless: Yes (vs. No)	3.24	(1.65,6.36)	1.43	(0.49,4.20)	0.44	(0.15,1.30)
Years of MA Use (1 year increase)	1.06	(1.03,1.10)	1.05	(1.01,1.10)	0.99	(0.95,1.04)
Amount of MA Used in Last 30 Days (1 gram increase)	1.02	(1.00,1.04)	1.02	(1.00,1.04)	1.00	(0.98,1.02)
Marathon Sex while High on MA: Yes (vs. No)	0.51	(0.29,0.89)	1.51	(0.61,3.75)	2.97	(1.13,7.80)
STI Diagnosis in last 60 days: Yes (vs. No)	2.04	(1.08,3.85)	2.94	(1.29,6.69)	1.44	(0.60,3.45)
History of Felony Charge: Yes (vs. No)	2.72	(1.57,4.71)	2.04	(0.94,4.42)	0.75	(0.32,1.74)

Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; MA = methamphetamine; NIDU = non-injection drug user (IDU)

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