

ORIGINAL ARTICLE

## Methamphetamine use and depressive symptoms among heterosexual men and women

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### Abstract

This study investigated the relationship between intensity of methamphetamine use and depressive symptoms in a sample of 182 heterosexually identified methamphetamine users. Perceived stigma and social and health problems were hypothesized as potential mediators of the relationship between methamphetamine use and depressive symptoms. Forty per cent of the sample met criteria for moderate to severe depression. As hypothesized, the greater the intensity of methamphetamine use, the higher the levels of depressive symptoms. Results of the mediation analyses failed to identify mediating effects for stigma, social problems or health problems. However, perceived stigma had a significant positive direct effect on depressive symptoms. Gender, age and marital status also predicted higher levels of depression. This research suggests the need for drug treatment programmes to: (1) identify and treat depressive symptoms among methamphetamine users; and (2) address social and psychological issues, such as perceived stigma, in an effort to decrease depressive symptomatology and ultimately enhance programme effectiveness.

**Keywords:** *Methamphetamine, depression, heterosexual, stigma, mediation model.*

Throughout the 1990s, there was a notable shift in methamphetamine use from California and other western states to the heartland of America (National Institute of Justice 1999). The health and social consequences of methamphetamine use have been well documented in the drug-use literature. The short-term effects of the drug on the central nervous system and the cardiovascular system result in feelings of euphoria, increased alertness, increased energy, shakes, tremors, increased pulse, increased blood pressure, stomach cramps, cardiac arrhythmia and stroke, reduced inhibition and impaired judgement (Molitor, Truax, Ruiz, & Sun, 1998). Long-term effects of methamphetamine use include insomnia, irritability, aggressiveness, stomach disorders, weight loss, paranoid psychosis, compulsive scratching (“crank bugs”) and both auditory and visual hallucinations (San Diego Association of Governments, 1997). High-intensity users are also characterized by body odour, sweating, bad teeth and poor skin tone, as well as scars and open lesions on the face

and other areas of exposed skin (San Diego Association of Governments, 1997). Social problems include aggressive acts, legal problems, drug dealing, high levels of unprotected sex and work, family and relationship problems.

In addition, several studies have reported an association between methamphetamine use and increased levels of depression. In a three-city study, Morgan (1994) found that 67% of male users reported depressive symptoms associated with their use of methamphetamine. In another study of youth living in Los Angeles, Rotheram-Borus, Mann, and Chabon (1999) reported that methamphetamine users had more lifetime symptoms of emotional distress compared with their non-using counterparts. Gorman, Gunderson, Mariatt, and Donovan (1996) described emotional distress as a correlate of methamphetamine use. Siever (1998) suggested that emotional depression among methamphetamine users may be the result of going for days without eating, drinking or sleeping.

This study investigated the relationship between methamphetamine use and mental health in a sample of HIV-negative, heterosexually identified methamphetamine users. Two primary questions were addressed: (1) Is methamphetamine use associated with increased depressive symptoms? (2) If methamphetamine use is associated with more depressive symptoms, is the distress due to perceived social stigma associated with being a methamphetamine user or is it due to the negative social and health consequences of being a methamphetamine user?

#### *Negative appraisal of others and perceived social stigma*

Cooley's (1964) theory of the looking-glass self would suggest that being a methamphetamine user is distressing because our society views drug use in a negative light; and, because we view ourselves through the eyes of others, negative evaluations and appraisals of others are internalized and ultimately lead to perceptions of social stigma. Perceived stigma may in turn become internalized and result in high levels of depression. Partial support for this position comes from our previous work with methamphetamine-using men who have sex with men (Semple, Patterson, & Grant, 2002). In-depth qualitative interviews revealed that methamphetamine users felt stigmatized by others and viewed themselves negatively. The reflected self-appraisal-of-others perspective would thus predict that methamphetamine use leads to higher levels of perceived stigma, which in turn leads to increased depressive symptomatology. Two hypotheses that reflect the negative self-appraisal and perceived stigma perspective will be tested: (1) methamphetamine use is positively associated with perceived social stigma; and (2) the relationship between methamphetamine use and depression is explained by perceived stigma, such that adjusting for stigma will attenuate the relationship between methamphetamine use and depression.

#### *Health and social problems*

The negative social and health consequences of methamphetamine use may be more distressing than the negative view of others and perceived stigma. As previously stated, methamphetamine use is associated with a variety of health problems (e.g. high blood pressure, cardiac arrhythmia) and social difficulties (e.g. family and legal problems). Aneshensel, Frerichs, and Huba (1984) found that physical health problems were associated with increased levels of depression, even after controlling for past levels of depression. Thus, methamphetamine use may be depressing because it makes the individual feel physically sick. Social problems have also been found to increase levels of

depression (e.g. Hammen, 2003; Mazure, Bruce, Maciejewski, & Jacobs, 2000). It may be that social problems or negative life events lead to increased levels of perceived stress, which in turn raise levels of depression. Two hypotheses that reflect the health and social problems perspective will be tested: (1) methamphetamine use is positively associated with perceived health and social problems; and (2) the positive effect of methamphetamine use on depression is explained by health and social problems, so that adjusting for these factors will eliminate the direct effect of methamphetamine use on depression.

## **Methods**

### *Sample selection*

This research used baseline data from a sample of 182 HIV-negative, heterosexually identified, methamphetamine-using men and women (>18 years) who were enrolled in a sexual risk reduction intervention at the University of California, San Diego. The FASTLANE research project is an eight-session, theory-based, one-on-one counselling programme designed to reduce the sexual risk practices of the target population. To be eligible for this research, participants had to self-identify as heterosexual and report having unprotected vaginal, anal or oral sex with at least one opposite-sex partner during the past 2 months. Eligible participants also had to report using methamphetamine at least twice in the past 2 months. HIV-negative serostatus was assessed at baseline using the OraSure HIV-1 Oral Collection Specimen Device, which has a reported reliability of 99.9% (George, Fitchen, Goldstein, & Hindahl, 1997). Oral specimens were analysed at the Long Beach Health Laboratory in Long Beach, California.

### *Recruitment*

FASTLANE participants were recruited through multiple community outreach strategies. One strategy involved direct contact between potential participants and outreach workers. Several geographic areas in San Diego County were targeted for recruitment. These areas were identified as having high concentrations of methamphetamine users and young adults. Outreach workers distributed cards containing eligibility criteria and condom packets. Interested persons were instructed to contact our project offices for a screening interview. A second recruitment strategy involved a large-scale poster campaign. With the consent of business owners, posters were placed in a variety of locations (e.g., bars, after-hour clubs, adult bookstores). A variety of posters were developed to appeal to different ethnic groups and communities. A third recruitment strategy involved a small-scale media campaign. Weekly advertisements were run in local magazines and newspapers. A fourth recruitment strategy involved obtaining referrals from case managers and program staff at local agencies such as North County Health Centers and Family Health Centers of San Diego. Participants were also referred through family, friends, and enrolled participants. Among individuals who were screened for eligibility, refusal rates were very low (<2%). In the present sample, 51% of participants were recruited through the poster and media campaign and 49% were referrals from local agencies, enrolled participants, family members and friends.

### *Procedures*

Participation in this longitudinal cohort study required an 18-month commitment. Eligible participants completed a baseline assessment, four 90-min weekly counselling sessions,

four 90-min booster sessions, and follow-up assessments at 6, 12 and 18 months. The counselling sessions and booster sessions involved motivational interviewing (Miller & Rollnick 1991) and skill-building exercises (Bandura, 1986). The content of intervention counselling sessions included: the context of methamphetamine use and unsafe sex, condom use, negotiation of safer sex practices and enhancement of social supports. The intervention was not designed to reduce or abate drug use behaviours. Baseline and follow-up data were gathered through computer-assisted interview technology (audio-CASI; Turner et al., 1998). The audio-CASI interview covered a range of topics, including socio-demographic characteristics, patterns of methamphetamine use, sexual risk behaviour, social cognitive factors, social support and social network factors. Participants were paid US\$30 for their baseline assessment and first 90-min counselling session. Data for the present analyses were gathered between June 2001 and April 2003.

### *Measures*

Depression was measured with the Beck Depression Inventory (BDI; Beck, 1967, 1976). The BDI consists of 21 items, each having four graded statements pertaining to how the participant has been feeling during the past week. The statements within a question are ordered (0 to 3) to show increasing depressive symptoms. Summary scores ranged from 0 to 63. The items of the BDI are clinically derived and have undergone extensive reliability and validation studies. Internal consistency reliability is reported as  $>0.9$  (Beck, 1967, 1976). The alpha reliability for the BDI in the present sample was 88.

*Substance use classification system.* The Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA) was used to classify the severity of participants' use of methamphetamine and other substances. The SSAGA is described as a "comprehensive psychiatric interview to assess physical, psychological, social, and psychiatric manifestations of alcohol abuse and dependence and related psychiatric disorders in adults" (Bucholz et al., 1994, p. 149). SSAGA diagnoses are based on DSM-III-R and at least one other classification system. Many of the interview questions derive from other psychiatric research instruments, including the Composite International Diagnostics Interview (CIDI; Robins et al., 1989) and the Structured Clinical Interview for DSM-III-R (SCID; Spitzer, Williams, Gibbon, & First, 1992). New sections were also written by the SSAGA's developers. The SSAGA covers a range of psychiatric diagnoses, including psychoactive substance dependence and abuse. Reliability of the SSAGA has been found to be good for substance dependence diagnoses (Bucholz et al. 1994, 1995). In the present study, the SSAGA-II Section G (DSM/ICD Drug Diagnosis) was used to determine dependence and abuse in relation to participant's use of methamphetamine.

*Socio-demographic characteristics.* Sex was coded as a dummy variable, where 0=male, 1=female. Age was coded in number of years. Education was coded 0=high school or less and 1=some college or more. Marital status was coded 0=unmarried and 1=married. Ethnicity was coded 0=ethnic minority and 1=non-Hispanic white.

*Intensity of methamphetamine use.* Intensity of methamphetamine use was measured using a summary variable that multiplied number of days used by number of times used per day (duration  $\times$  frequency). Duration of methamphetamine use was measured by the following question: During the past 30 days, on how many days did you do methamphetamine?

Frequency of methamphetamine use was measured by the following question: On a typical day, how many times did you do methamphetamine? The distribution of the summary variable was normalized by performing a log 10 transformation. The transformed summary variable was used in all analyses.

*Social problems.* Participants were presented with a list of common social problems associated with methamphetamine use. All items were developed by researchers at the San Diego Association of Governments (1997). The list of social problems included family problems, work problems, financial difficulties, violent behaviour, legal problems and the loss of important personal relationships. Participants were asked how often during the previous 2 months methamphetamine use had resulted in any of these problems. A dichotomously scored response category was used for each item. "Social problems" was measured with a summary variable that represented the total number of social problems experienced in the past 2 months. The reliability alpha for this scale in the present sample was 0.73.

*Health problems.* A list of nine health problems commonly associated with methamphetamine use was developed by researchers at the San Diego Association of Governments (1997). Participants reported how often during the past 2 months their methamphetamine use had resulted in any of the following health problems: weight loss, sleeplessness, dental problems, high blood pressure, skin problems, diarrhoea, dehydration, paranoia and hallucinations. Response categories were coded 1=Yes and 0=No. A summary variable was calculated to represent the total number of methamphetamine-related health problems experienced during the past 2 months. The reliability alpha for this scale in the present sample was 0.66.

*Perceived stigma.* Our measure of perceived stigma was developed for use in this research. Participants were presented with 12 statements that captured the extent to which the individual believed his/her methamphetamine use was associated with discrimination, ostracism and direct mistreatment by others. Sample items include: "Most people are prejudiced against people who use methamphetamine"; "Methamphetamine users are rejected by society"; and "I have lost friends because they found out about my methamphetamine use." All items were measured on a four-point scale ranging from (1) Strongly Disagree to (4) Strongly Agree. A mean score was used in these analyses. The internal consistency reliability alpha for this measure in the present sample was 0.86. Table I contains a list of the items included in this scale.

#### *Data analysis*

Two statistical methods were used in this study. Correlations among variables were examined using Pearson correlation coefficients. Multiple regression analyses were used to examine the relationship between the independent variables or hypothesized mediator variables (social problems, health problems, stigma) and the dependent variable (depression scores). Multiple regression permits an assessment of the direct effects of independent variables on the dependent variable while controlling for variables such as age, gender and ethnicity. Regression coefficients (e.g. betas) reveal the strength of the association between the independent variables and the dependent variable. Regression coefficients are tested for statistical significance. The unique proportion of variance accounted for by each independent variable is expressed as  $sr^2$ . This indicator helps to

Table I. Items in the perceived social stigma scale.

No.	Item
1	Most people are prejudiced against people who use methamphetamine.
2	People will treat me differently if they find out that I use methamphetamine.
3	Most people hold negative stereotypes about people who use methamphetamine.
4	Methamphetamine users are rejected by society.
5	People who are associated with methamphetamine users get treated badly.
6	Most people don't want their children to be around someone who is a methamphetamine user.
7	Most people think that people who use methamphetamine are "bad" people.
8	I have been mistreated by others because I use methamphetamine.
9	Some family members act differently toward me because I use methamphetamine.
10	I have lost friends because they found out about my methamphetamine use.
11	People in my neighbourhood mistreat me because of my methamphetamine use.
12	People who are associated with me are discriminated against because of my methamphetamine use.

determine the overall importance of each independent variable to the regression model. The  $R^2$  reveals the proportion of variance in the dependent variable explained by the overall regression model. Moreover, the relationship between an independent variable and the dependent variable can also vary as a function of some other factor. This is called a conditional relationship and it can be tested in regression analyses by creating interaction terms. A significant interaction term indicates that the relationship between the independent and dependent variable depends upon the level of the conditional factor. For example, the relationship between methamphetamine use and depression may vary by gender, such that the association between the two variables holds true for men but not women. This would be known as a conditional relationship or an interaction. A variety of conditional relationships were tested in the present analyses. For more detail on the use of multiple regression methods in the behavioural sciences, see Cohen and Cohen (1983).

## Results

### *Sample characteristics*

The present sample consisted of 182 participants who met the following eligibility criteria: (1) self-identified as heterosexual; (2) had unprotected vaginal, oral or anal sex with an opposite sex partner in the past 2 months; and (3) used methamphetamine at least twice in the past 2 months and once in the past 30 days. Approximately 75% of participants were male; 25% were female. Participants ranged in age from 18 to 59 years (mean=37.8, SD=9.7). The majority of participants were non-Hispanic white (50.5%). Other ethnic groups included: African American (29.1%), Latino/a (11.0%), Native American (2.7%), Asian or Pacific Islander (1.1%), and Other (5.5%). The majority of participants were either never married (50.8%) or divorced (28.7%). The remainder of the sample were separated (10.5%), married (7.2%), or widowed (2.8%). Fifty-four per cent of the sample had at least a high-school diploma or graduate equivalency diploma (GED). Thirty-eight per cent had some college or a 2-year degree. Only 8% had a 4-year degree or more. Seventy-two per cent of the sample were unemployed. Among those who were employed, 49% worked only part-time. The median income category for all participants was US\$10,000–19,999 per year. On average, participants reported using methamphetamine for 14.5 years (SD=9.3, range=<1–42 years). The average age of first use was 23.6 years (SD=9.3, range=8–49 years). Using the SSAGA, 94% of the sample met criteria for

methamphetamine dependence, and 6% met criteria for methamphetamine abuse. Approximately 42% of the sample reported having a felony conviction. Among those with a felony conviction ( $n=75$ ), the three most frequently occurring charges were (in rank order): possession of an illegal substance (54.7%); break, enter and robbery (21.3%); and assault (17.3%). Scores on the BDI ranged from 0 to 45. The mean score was 15.7 with a standard deviation of 9.8. The median BDI score was 13.5. Published guidelines for interpreting the severity of Beck depression scores indicate that 37.6% of our sample met criteria for moderate to severe depression. The remainder of the sample may be characterized as having minimal to mild depressive symptoms (Yonkers & Samson, 2000).

#### *Correlations among key variables*

The correlations among methamphetamine use, social problems, health problems, stigma and depressive symptoms are shown in Table II. Intensity of methamphetamine use (IV) was significantly positively correlated with social problems, health problems, social stigma (potential mediators) and depressive symptoms (DV). Significant positive associations between Beck depression scores and the three potential mediators were also observed. Higher scores on the BDI were significantly associated with more social and health problems and more social stigma.

#### *Methamphetamine use and social stigma*

The first step in the test of mediation involved three regressions. Each hypothesized mediator was regressed onto our measure of intensity of methamphetamine use. Table III displays the results from the regression of social stigma on methamphetamine use with socio-demographic variables included in the equation. As shown, higher-intensity methamphetamine users report significantly more social stigma compared with lower-intensity users, even after controlling for socio-demographic characteristics. In terms of the socio-demographic correlates of stigma, only age was statistically significant. Older individuals reported significantly lower levels of social stigma. Interactions of methamphetamine use with socio-demographic characteristics in relation to stigma were insignificant, indicating that older methamphetamine users experienced fewer stigma, regardless of the intensity of their methamphetamine use.

Table II. Mean, standard deviation (SD) and correlation among the variables ( $n=182$ ).

	Beck Depression	Metham- phetamine use	Social problems	Stigma	Gender	Age	Education	Ethnicity	Marital status
Methamphetamine use	0.38***								
Social problems	0.21**	0.30***							
Health problems	0.21**	0.26***	0.62***						
Social stigma	0.21**	0.17*	0.20**	0.28***					
Gender	0.27**	0.13	0.03	0.07	-0.06				
Age	0.08	0.02	-0.09	-0.19**	-0.21**	-0.13			
Education	0.11	0.15*	0.26***	0.18**	0.15*	0.01	0.03		
Ethnicity	0.03	0.10	0.23**	0.17*	0.12	-0.06	-0.02	0.12	
Marital status	-0.04	0.07	0.07	-0.04	-0.06	-0.02	0.44***	0.13	-0.05
Mean	15.7	1.7	1.7	2.1	3.4	n/a	37.8	n/a	n/a
SD	9.8	0.53	1.7	1.7	0.53	n/a	9.7	n/a	n/a

\* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ .

Table III. Social stigma regressed on methamphetamine use and socio-demographic characteristics ( $n=182$ ).

	$\beta$	$sr^2$
Methamphetamine use	0.18*	0.03
Gender	-0.12	0.02
Age	-0.27***	0.06
Ethnicity	0.08	0.01
Marital status	0.03	0.00
Education	0.12	0.02
Constant	3.7***	
Multiple $R$	0.36	
$R^2$	0.13	
Adjusted $R^2$	0.10	
$F(6, 170)$	4.2***	

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ , two-tailed tests.

#### *Methamphetamine use and social problems*

In a second regression equation, social problems were regressed on methamphetamine use, controlling for socio-demographic characteristics. Table IV shows the relationship between methamphetamine use and social problems. As expected, higher-intensity methamphetamine users reported significantly more social problems compared with lower-intensity users. Two socio-demographic variables—education and ethnicity—also yielded positive associations with social problems. Participants who had a higher level of education (some college or more) reported significantly more social problems than those with lower levels of education (high school or less). Moreover, non-Hispanic whites reported more social problems compared with ethnic minority participants. An examination of the interaction terms revealed no sub-group differences in the strength of the relationship between methamphetamine use and social problems. Thus, non-Hispanic whites and more educated participants reported more social problems than their counterparts at all levels of methamphetamine use.

#### *Methamphetamine use and health problems*

In a third regression equation, health problems were regressed on methamphetamine use. As shown in Table V, the positive beta for methamphetamine use indicates that

Table IV. Social problems regressed on methamphetamine use and socio-demographic characteristics ( $n=182$ ).

	$\beta$	$sr^2$
Methamphetamine use	0.25***	0.06
Gender	-0.02	0.00
Age	-0.14	0.02
Ethnicity	0.17*	0.03
Marital status	0.10	0.01
Education	0.19***	0.04
Constant	0.71	
Multiple $R$	0.42	
$R^2$	0.17	
Adjusted $R^2$	0.15	
$F(6, 169)$	6.0***	

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ , two-tailed tests.

Table V. Health problems regressed on methamphetamine use and socio-demographic characteristics ( $n=182$ ).

	$\beta$	$sr^2$
Methamphetamine use	0.21***	0.05
Gender	0.02	0.00
Age	-0.21	0.04
Ethnicity	0.11	0.01
Marital status	0.02	0.00
Education	0.14	0.02
Constant	1.8*	
Multiple $R$	0.37	
$R^2$	0.14	
Adjusted $R^2$	0.11	
$F(6, 169)$	4.5***	

\* $p < 0.05$ , \*\* $p < .01$ , \*\*\* $p < .001$ , two-tailed tests.

higher-intensity methamphetamine users reported significantly more health problems compared with lower-intensity users, after controlling for socio-demographic variables. The regression analysis revealed only one socio-demographic correlate of health problems. Age was inversely related to health problems such that older methamphetamine users reported fewer health problems compared with their younger counterparts. The interactions of methamphetamine use and socio-demographic variables were insignificant, indicating that the effect of age on health problems is independent of the intensity of the individual's methamphetamine use.

#### *Methamphetamine use and depressive symptoms*

The second step in the test of mediation is to determine whether the relationship between the independent variable (methamphetamine use) and the dependent variable (depressive symptoms) is attenuated when the hypothesized mediators are added to the regression equation. The first step in these analyses was to examine the relationship between methamphetamine use and depressive symptoms by regressing the latter onto the former. Equation 1 in Table VI shows that participants with higher-intensity methamphetamine use have significantly more depressive symptoms, even after controlling for socio-demographic characteristics. In addition, this analysis revealed that women compared with men, older participants compared with younger ones, and unmarried compared with married participants had higher levels of depressive symptoms. Education and ethnicity were not associated with depressive symptoms. Regression analyses to test for the interactions of methamphetamine use with social characteristics yielded insignificant results; thus, the strength of the relationship between methamphetamine use and depressive symptoms does not vary by gender, age, education, marital status or ethnicity. Three additional regression analyses were performed in order to examine whether social stigma, social problems and health problems mediate the relationship between methamphetamine use and depressive symptoms. In equation 2 (Table VI), social stigma was added to the regression equation. As shown, the association between methamphetamine use and depressive symptoms remained constant, even after adjusting for perceived stigma. Significant main effects were found for gender, age and marital status in relation to depressive symptoms. Perceived social stigma also had a significant direct effect on depressive symptoms. The positive beta indicates that participants with higher levels of perceived stigma reported more depressive symptoms. In

Table VI. Depressive symptoms regressed on methamphetamine use, controlling for socio-demographic characteristics (equation 1), social stigma (equation 2), social problems (equation 3) and health problems (equation 4).<sup>a</sup>

	Equation 1		Equation 2		Equation 3		Equation 4	
	$\beta$	$sr^2$	$\beta$	$sr^2$	$\beta$	$sr^2$	$\beta$	$sr^2$
Methamphetamine use	0.37***	0.15	0.34***	0.13	0.32***	0.11	0.31***	0.11
Gender	0.23***	0.06	0.25***	0.08	0.25***	0.08	0.25***	0.07
Age	0.15*	0.02	0.19**	0.04	0.21**	0.04	0.21**	0.04
Ethnicity	0.01	0.00	0.01	0.00	0.02	0.00	0.02	0.00
Marital status	-0.14	0.02	-0.15*	0.02	-0.16*	0.03	-0.16*	0.03
Education	0.08	0.01	0.05	0.00	0.03	0.00	0.03	0.00
Perceived stigma	-	-	0.16*	0.03	0.14*	0.03	0.13*	0.02
Social problems	-	-	-	-	0.12	0.02	0.07	0.00
Health problems	-	-	-	-	-	-	0.08	0.01
Constant	-7.4		-18.1		-17.7		-17.6	
$R^2$	0.24		0.26		0.27		0.28	
Multiple $R$	0.49		0.51		0.52		0.53	
Adjusted $R$	0.22		0.23		0.24		0.24	
$R^2$ change	0.13***		0.02*		0.01		0.01	
$F$ (6, 169)	8.9***							
$F$ (7, 168)			8.5***					
$F$ (8, 167)					7.9***			
$F$ (9, 166)							7.1***	

$\beta$ =standardized regression coefficient; <sup>a</sup>four cases excluded owing to missing data; \* $p$ <0.05, \*\* $p$ <0.01, \*\*\* $p$ <0.001, two-tailed tests.

equation 3 (Table VI), social problems were added to the regression equation. Social problems did not yield any significant association with depressive symptoms. The effects of methamphetamine use on depressive symptoms were essentially unchanged, indicating that social problems do not mediate the relationship between methamphetamine use and depressive symptoms. With social problems added to the equation, the main effects for gender, age, marital status and perceived stigma also remained significant and substantively the same. When health problems were added in equation 4 (Table VI), the regression results were only slightly changed. The betas for methamphetamine use, gender, age, marital status and social stigma were similar to those reported in equation 3. Health problems did not have either a direct or mediating effect on depressive symptoms.

Overall, these results do not provide support for our hypotheses regarding the mediating effects of social stigma or social or health problems on the relationship between methamphetamine use and depressive symptoms. Rather, there is a significant direct effect of methamphetamine use on depressive symptoms, controlling for socio-demographic characteristics, perceived stigma, social problems and health problems.

## Discussion

This study is one of the first to report the prevalence of depressive symptoms in a sample of community-dwelling, active methamphetamine users. To date, estimates of the prevalence of depressive disorders among methamphetamine users are not well established. One study of methamphetamine-dependent men who were assessed at entry into outpatient drug treatment in Los Angeles found that 52.9% met criteria for lifetime depressive disorders

(primarily major depressive disorders) and 28.4% met criteria for major depression (Shoptaw, Peck, Reback, & Rotheram-Fuller, 2003). Prevalence estimates obtained through in-treatment samples may not accurately represent rates of depression among active methamphetamine users who are not in treatment. In the present study, depressive symptomatology was identified in 67% of our active methamphetamine-using sample, and 40% met BDI criteria for moderate to severe depression. These results suggest that depression among active methamphetamine users may be quite common. One implication of this finding is that all individuals who enter drug treatment for methamphetamine use should be screened in order to identify those who may need specific therapy for a concurrent mental health disorder (Weiss, Griffin, & Mirin, 1989). The BDI, which was used in this study, is considered a useful screening tool because it is brief, self-administered, easily scored and has good specificity and sensitivity (Weiss et al., 1989).

A primary objective of this study was to test three social and contextual variables—social and health problems and perceived stigma—as possible mediators of the relationship between methamphetamine use and depressive symptoms. All three potential mediators passed the first test of mediation by demonstrating significant relationships with methamphetamine use and depressive symptoms. Having satisfied these conditions of mediation, the three variables were included in a subsequent test of mediation involving the regression of depressive symptoms on methamphetamine use with each potential mediator included in the regression equation. Results from the second test of mediation indicated that none of these factors accounted for the relationship between methamphetamine use and depression, and therefore none can be considered mediating variables. In other words, the relationship between intensity of methamphetamine use and depressive symptoms was not explained by perceived stigma, social problems or health problems. The failure of all three variables to pass the second test of mediation indicates the need for further research to identify additional unmeasured variables and pathways that may account for the association between methamphetamine use and depression. The search for intervening variables remains an important research objective because the identification of such factors may help to inform drug treatment strategies and improve the effectiveness of drug treatment programmes for methamphetamine users.

Overall, this study provides evidence that the greater the intensity of methamphetamine use, the higher the levels of depressive symptoms. In multivariate analyses, methamphetamine use uniquely accounted for 11% of the explained variance in depressive symptoms. The significant association between methamphetamine use and depressive symptoms is consistent with data from other studies of stimulant users. For example, the literature on cocaine and depressive disorders suggests that higher frequency of problematic cocaine use is associated with higher levels of depressive symptoms (Falck, Wang, Carlson, Eddy, & Siegal, 2002; Grant, 1995; Kilbey, Breslau, & Andreski, 1992). The mechanisms through which methamphetamine use leads to depressive symptoms remain unclear. As noted in studies of other stimulant drugs, depressive symptoms among methamphetamine users could be associated with methamphetamine withdrawal, chronic intoxication with the drug, or reactions to adverse life events (Weiss et al., 1989). More research is needed to identify underlying neurophysiological (e.g. dopamine depletion) or psychological pathways that may explain the link between methamphetamine use and depressive symptoms.

In general, research that informs our understanding of the relationship between methamphetamine use and depression is important because it has the potential to enhance our ability to deliver more effective treatment services for methamphetamine users. The significant direct effect of methamphetamine use on depressive symptoms, even after

controlling for socio-demographic characteristics, perceived stigma and social and health problems, suggests that the best approach to improving the mental health of methamphetamine users would be to reduce or eliminate the use of this drug through effective drug treatment programmes. Additionally, this research suggests that treatment programmes may need to address social and psychological issues, such as perceived stigma, which may contribute to depressive symptoms in this population. The ability to identify and treat depressive symptoms in treatment-seeking patients may result in fewer dropouts and longer-term beneficial treatment effects. Studies conducted with cocaine users suggest that depressive symptoms may interfere with the effectiveness of drug treatment programmes (Falck et al., 2002).

As previously stated, the results of this study suggest that factors other than the intensity of methamphetamine use should be considered when attempting to understand and ultimately treat depressive symptoms in methamphetamine-using populations. The present data provide evidence that depressive symptoms increase as perceived stigma increases. Perceived stigma uniquely explained a significant 2% of the variance in depressive symptoms, above and beyond that accounted for by methamphetamine use. Previous research on stigma associated with drug use and mental illness indicates that stigma can serve as a barrier to treatment and the use of other clinical and non-clinical services (Falck et al., 2002). The degree of stigmatization of methamphetamine users among health care professionals has not been studied; however, if negative attitudes prevail (e.g. providers believe that drug use is self-inflicted or not curable), it could result in the under-referral of methamphetamine users to appropriate drug treatment and mental health care services by physicians and other care providers (Bolton, 2003).

Three demographic variables also significantly predicted higher levels of depressive symptoms. They included gender, age and marital status. The finding that women are more likely to experience depressive symptoms is consistent with epidemiological studies of depression in the general population (Robins & Regier, 1991). Similarly, a positive relationship between age and depression has been found in general population studies. Data from the Epidemiological Catchment Area (ECA) Study indicate that older individuals have higher rates of depressive symptoms compared with their younger counterparts (Fiske, Kasl-Godley, & Gatz, 1998; Newmann, 1989). ECA data also support the finding that unmarried individuals experience higher levels of depressive symptoms compared with those who are married (Robins & Regier, 1991).

### *Limitations*

This study contributes to a growing body of literature that shows an association between the intensity of methamphetamine use and depressive symptoms. The results suggest moderate rates of depression among methamphetamine users and identify social and contextual factors that impact levels of depressive symptoms in this population. Despite these strengths, this study has a number of limitations that warrant discussion. The data for these analyses were derived from a convenience sample of active methamphetamine users. Participants were also volunteers in a sexual risk reduction intervention programme. Although the intervention did not attempt to reduce or abate methamphetamine use, individuals who volunteered for this study may not be representative of the general population of community-residing methamphetamine users. It is possible that volunteers were biased toward behavioural change and this may be reflected in higher levels of methamphetamine use and depressive symptoms at baseline assessment. The sample,

however, did contain a good mix of ethnic groups and a range of methamphetamine-use patterns among the volunteers. The level of educational attainment among participants may also have implications for the representativeness of our sample. Overall, the present sample was quite well educated; 92% had a high school diploma or some college. Other studies of methamphetamine users in California have reported lower levels of educational attainment, ranging from a low of 36.2% with a high-school diploma among methamphetamine-using inmates in state prison to a high of 80% with a high-school education among methamphetamine users enrolled in state-funded drug treatment programmes (Farabee, Prendergast, & Cartier, 2002; Gibson, Leamon, & Flynn, 2002). Two other studies of methamphetamine users who were enrolled in drug treatment programs reported the average level of education as the completion of high school (Reiber, Galloway, Cohen, Hsu, & Lord 2000; Simon et al., 2002). It is possible that the higher level of educational attainment in our sample is explained to some extent by the fact that our participants were community-residing, active methamphetamine users compared with incarcerated or in-treatment users. More studies of community-residing, active methamphetamine users are needed to enhance our understanding of the educational profile of the average user.

The eligibility criteria for this study may also have biased the sample. The longitudinal nature of the study design precluded the inclusion of those individuals who lacked adequate contact information for follow-up purposes. As such, some of the most dysfunctional methamphetamine users may have been screened out of the study, resulting in an underestimate of the prevalence of depression and methamphetamine use.

Moreover, owing to time constraints and concerns regarding participant burden, we were unable to gather historical data on a number of social and behavioural factors that may have had an impact on participants' current drug use and depressive symptoms. For example, we were unable to gather data on participants' employment history. Other researchers have reported patterns of chronic unemployment, employment instability and part-time employment among methamphetamine users. For example, Reiber et al. (2000) reported that only 26.8% of methamphetamine users were usually employed full-time. Other researchers have also reported that methamphetamine users tend to be periodically employed and that use of this drug, particularly binge use, often interferes with the performance of work responsibilities, which can lead to job loss (Gibson et al., 2002; Morgan & Beck, 1997, pp.135–162). Future studies of community-residing, active methamphetamine users should gather detailed data on employment history in an effort to enhance our understanding of how this drug may affect occupational functioning.

Adverse childhood experiences represent another factor that may contribute to our understanding of methamphetamine use and depression among adult users. This factor was not examined in this research; however, studies of drug- and alcohol-dependent adults have found a relationship between substance use and early experience of parental absence (Rahav & Link 1995), childhood exposure to parental drug use (Dube et al., 2003) and adverse childhood experiences, including sexual, physical and emotional abuse and neglect (Turner & Lloyd 2003; Wilsnack, Vogeltanz, Klassen, & Harris, 1997). Future studies should examine the role of these factors in the lives of adult methamphetamine users so that those who have been affected can receive appropriate treatment and intervention. Also, identifying and understanding the potential relationship between childhood adversity and methamphetamine use could have important implications for prevention.

Participants' early history of depression is another factor that was not measured in this study but could have potentially improved the interpretability of our data. For example, if

depression occurred prior to the initiation of drug use, this information could be important in terms of early detection as well as the development of treatment programmes for methamphetamine users. Currently, there exists a body of literature that supports the relationship between psychiatric disorders and the onset of drug and alcohol dependence (Compton, Cottler, Phelps, Abdallah, & Spitznagel, 2000; Gilman & Abraham, 2001). Other research has shown an association between early drug use and the development of psychiatric disorders (e.g. Brook, Brook, Zhang, Cohen, & Whiteman, 2002). Prospective data are needed to disentangle the casual relationships between psychiatric disorders and the onset of substance abuse. It is recommended that future studies of methamphetamine users examine the role of lifetime depression in relation to the onset of drug use and current psychiatric status.

Our data also yielded modest correlations between the dependent variable, depression and key independent variables. For example, the correlation between perceived stigma and depressive symptoms was only 0.21 ( $p < 0.01$ ). However, this correlation is approximately the same magnitude as those reported in other studies of stigma and mental health outcomes in substance-using populations. For example, Link, Struening, Rahav, Phelan, and Nuttbrock (1997) reported significant correlations, ranging from 0.24 to 0.43, between depressive symptoms and stigma variables at baseline assessment and 1-year follow-up.

Similarly, the correlation between intensity of methamphetamine use and BDI scores was a modest 0.38 ( $p < 0.001$ ). Although this is a modest association, correlations of similar magnitude have been reported in the drug and alcohol literature. For example, Mehrabian (2001) reported a correlation of 0.41 ( $p < 0.05$ ) between depression/anxiety and substance use in a large sample of participants drawn from the general population. In the present study, the correlation between intensity of methamphetamine use and depressive symptoms may also have been attenuated because our sample was community-residing as opposed to in-treatment patients, who often exhibit higher depression scores. Future research should be directed at examining the association between methamphetamine use and depressive symptoms in larger samples of community-residing users.

Another limitation of this study stems from the limited amount of psychiatric data that were gathered from study participants. Without a comprehensive assessment of lifetime history of psychiatric disorders and in-depth, psychiatric evaluations of current status, we were unable to determine if participants' depressive symptoms were consistent with primary or secondary psychiatric disorders, whether symptoms were methamphetamine induced or manifestations of methamphetamine withdrawal.

Another study limitation stems from the use of participant self-report, and the subsequent potential for socially desirable responses in relation to drug-use behaviours. To minimize the risk of self-report bias, the FASTLANE project used computer-assisted interview technology (audio-CASI) to gather data. In a methodological study that compared face-to-face interviews with audio-CASI technology, Des Jarlais et al. (1999) found the audio-CASI to be more effective in reducing the under-reporting of sensitive behaviours in a drug-using population.

Lastly, the cross-sectional data that were used in this study do not allow us to make causal statements about the relationship between methamphetamine use and depression. Longitudinal data will be necessary to establish whether methamphetamine use leads to increased depressive symptoms or whether depressive symptoms lead to methamphetamine use (i.e. the self-medication hypothesis). A similar issue arises in relation to the causal nature of the relationship between perceived stigma and depressive symptoms. Is perceived stigma a cause of depression or do the psychiatric symptoms associated with depression affect

perceived levels of stigma? Future research should seek to disentangle this relationship through longitudinal data analyses.

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