



Research report

Negative mood and sexual behavior among non-monogamous men who have sex with men in the context of methamphetamine and HIV

C.A. Bousman^{a,b}, M. Cherner^a, C. Ake^a, S. Letendre^a, J.H. Atkinson^a, T.L. Patterson^a,
I. Grant^a, I.P. Everall^{a,*}
and The HNRC Group

^a University of California San Diego, HIV Neurobehavioral Research Center, Department of Psychiatry, La Jolla, California, USA

^b San Diego State/University of California, San Diego Joint Doctoral Program in Public Health (Health Behavior), USA

ARTICLE INFO

Article history:

Received 4 November 2008

Received in revised form 18 March 2009

Accepted 7 April 2009

Available online 5 May 2009

Keywords:

Mood

Sexual behavior

Methamphetamine

HIV

MSM

ABSTRACT

Background: Research comparing the independent and combined contextual effects of methamphetamine dependence (METH) and HIV-infection (HIV) on mood and sexual behavior among men who have sex with men (MSM) has been sparse and inconsistent. This study examined the contextual influence of METH, HIV-infection and their combination on mood states and sexual behavior.

Methods: 175 non-monogamous MSM concordant or discordant for METH and HIV were included. Multivariate analysis was conducted to examine mood and sexual behavior differences between groups, as well as to elucidate the relationship between mood and sexual risk behavior and explore the potential moderator (i.e. contextual) effects of METH and/or HIV on this relationship.

Results: METH+/HIV+ participants reported condom use less than 25% of the time whereas METH-/HIV+ participants reported condom use 51–75% of the time. METH+ and HIV+ status were associated with higher depression and confusion scores. Univariate regressions revealed negative relationships between mood states (depression, tension, anger, fatigue and confusion) and condom use. Neither METH nor HIV status moderated the relationships between negative mood and condom use.

Limitations: Results are derived from cross-sectional data, sample sizes for each of the four groups were relatively small, and condom use could not be linked to specific sexual practices and/or partner types.

Conclusion: METH dependence, HIV seropositivity, and negative moods are associated with reduced condom use among non-monogamous MSM. Independent effects of METH dependence and negative mood on condom use suggest that sexual risk reduction interventions for MSM should incorporate multi-faceted approaches, including substance abuse and mental health treatment.

© 2009 Elsevier B.V. All rights reserved.

1. Introduction

Despite numerous studies investigating the link between negative mood and sexual behavior among men who have sex

with men (MSM) within the context of methamphetamine (meth) and human immunodeficiency virus-infection (HIV) (Bancroft et al., 2003a,b; Semple et al., 2005a,b, 2006b,c; Shoptaw et al., 2003), little research compares the independent and combined contextual (i.e. moderating) effects of METH and HIV on negative mood and sexual behavior among MSM. This is unfortunate, since understanding mood states and sexual practices of MSM within these independent and

* Corresponding author. Department of Psychiatry, University of California San Diego, 140 W. Arbor Dr., 2nd floor, San Diego, CA 92103, USA.

E-mail address: ieverall@ucsd.edu (I.P. Everall).

combined contexts, and estimating the effect of these contexts, have important implications for HIV prevention and public health.

It has been well established that MSM who use meth engage in sexual practices at an increased rate, duration, and risk compared to when meth is not used (Halkitis et al., 2005a,b; Semple et al., 2005a; Shoptaw, 2006). Likewise, it has been reported that a substantial proportion of HIV-positive individuals continue to engage in sexual risk behavior for at least a year after diagnosis (Gorbach et al., 2006; Kalichman et al., 1997) and that the frequency of sexual risk behavior among those HIV-positive is greater than HIV-negative MSM (Halkitis et al., 2005c).

Negative mood states, particularly depression have also been demonstrated to be highly prevalent among users of methamphetamine (Peck et al., 2005) and HIV-infected individuals (Dew et al., 1997). However, research examining the link between negative mood and sexual behavior has revealed inconsistent findings. A meta-analysis by Crepaz and Marks (2001) reported a “null relationship” after review of 25 studies in which the relationship between negative mood and sexual risk behavior was assessed. This finding may be a result of differential effects of negative mood on sexual behavior in which, for some, negative mood will reduce, and for others will increase sexual risk behavior (Bancroft et al., 2003b). Furthermore, it is believed that among MSM the link between mood and sexual behavior is more complex than it is for heterosexual men (Bancroft et al., 2003a). Contributing to this complexity are increases in the rates of HIV-infection (CDC, 2003, 2005) and meth use (CDC, 2007) among MSM. Thus, it is apparent that when examining the relationship between negative mood and sexual risk behavior it is imperative to also examine the contextual effects of METH and HIV status on this relationship. Contextual effects can be viewed as a third variable and are often denoted as a moderating variable (i.e., METH, HIV). Moderating variables can strengthen or weaken the effect observed between two factors (i.e. negative mood, sexual behavior). Examination of potential moderators is important in that, if identified, they suggest the possibility that different causal mechanisms are in operation in distinct subpopulations (Kraemer et al., 2001).

Unfortunately, research to date has primarily examined the METH/HIV context relevant to mood and sexual behavior without inclusion of comparison or control groups. In addition, a majority of the research has focused on comorbid METH and HIV but has not explored the moderating effect of METH or HIV. Thus, the purpose of this study was to address these limitations in the current literature by examining both mood states and sexual behavior among non-monogamous MSM concordant and discordant for HIV-infection and meth dependence and exploring the moderating effects of meth dependence and HIV status on the relationship between mood and sexual risk behavior. We hypothesized that participants in the METH+/HIV+ group would report greater frequency of negative mood states and sexual risk behavior (i.e. lower condom use) compared to comparison participants (i.e. METH–/HIV–). We also hypothesized that a significant negative association between negative mood and sexual risk behavior would be detected, and that this association would be moderated by METH and/or HIV status.

2. Methods

2.1. Participants

Participants were volunteers evaluated at the HIV Neuro-behavioral Research Center (HNRC) at the University of California in San Diego as part of a cohort study focused on central nervous system effects of HIV and methamphetamine. The current study comprised 175 sexually active non-monogamous men who have sex with men (MSM). In this study, men were classified as non-monogamous if they stated they had “no current partner” at time of assessment. Monogamous MSM were excluded because unsafe sexual behavior within a monogamous relationship can be considered less risky than in non-monogamous relationships (McKusick et al., 1990). Participants were further classified into one of the following four groups: methamphetamine dependent/HIV seropositive (METH+/HIV+; $n = 71$); methamphetamine dependent/HIV seronegative (METH+/HIV–; $n = 20$); methamphetamine non-users/ HIV seropositive (METH–/HIV+; $n = 64$); and methamphetamine non-users/ HIV seronegative (HIV–/METH–; $n = 20$).

HIV serological status was determined by enzyme linked immunosorbent assays (ELISA) plus a confirmatory test. METH+ participants met dependence criteria in their lifetime and abuse criteria within the previous 18 months, as determined by the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders Version IV (SCID). However, participants were not actively using other substances, with the exception of cannabis and alcohol. Potential participants were excluded if they met lifetime dependence criteria for other drugs, unless the dependence was judged to be remote (greater than 5 years ago) and episodic in nature by a doctoral level clinician. Alcohol dependence within the last year was also an exclusion criterion. Participants with a history of methamphetamine dependence were primarily recruited from residential drug treatment programs in the San Diego area, while those participants without a history of methamphetamine abuse were recruited from the larger San Diego community through the use of flyers and appearances at community events. All participants gave written consent prior to enrollment and all procedures were approved by the Human Research Protection Program of the University of California, San Diego and San Diego State University.

2.2. Measures

2.2.1. Background characteristics

Data were collected on the participants' age, ethnicity, education and partner preference. Age and education were coded in years. Ethnicity was coded as 0 (*ethnic minority*) or 1 (*Caucasian*) and partner preference was coded as 0 (*males only*) or 1 (*both males and females*). In addition, lifetime occurrence of mood (i.e. Major Depression, Bipolar) and substance abuse (i.e. cannabis, alcohol, cocaine, etc.) disorders was ascertained utilizing the SCID-IV. Further information was gathered regarding age at first use and years of cumulative use of methamphetamine, as well as HIV RNA plasma copies among HIV seropositive groups.

2.2.2. Sexual behavior questionnaire

Sexual behavior was assessed through an HNRC-developed self-report measure covering the preceding year. Information was gathered with regard to age at first intercourse, number of different sex partners and number of injection drug user (IDU) sex partners. Age at time of first intercourse was coded in years for both male and female partners. However, when two different ages were given for first intercourse, the younger of the two ages was used. In addition, participants were asked to indicate the percentage of time that they used a condom as well as engaged in mutual masturbation, oral, vaginal, anal (receptive and insertive) and/or intoxicated sex. Responses were recorded on a 6-item, Likert-type scale with a value of 0 = 0%, 1 = 1–5%, 2 = 6–25%, 3 = 26–50%, 4 = 51–75% and 5 = 76–100%.

2.2.3. Mood questionnaires

Current mood was assessed utilizing the Beck Depression Inventory–I (BDI-I) (Beck, 1972) and the Profile of Moods States (POMS) (McNair et al., 1971) questionnaires. The BDI-I is a twenty-one question multiple choice self-report inventory asking participants how they have felt on average in the last week. It is composed of items relating to depression symptoms such as hopelessness and irritability, cognitions such as guilt or feelings of being punished, as well as physical symptoms such as fatigue, weight loss, and lack of interest in sex. Scores for the BDI-I range from 0 to 63 with greater scores indicative of more severe depression.

The POMS is a self-report questionnaire measuring mood states over the past 7 days. The measure consists of 65 adjectives (such as 'hopeless', 'annoyed', 'sluggish') or short phrases ('sorry for things done', 'ready to fight'), which the participant rates on a five-point Likert-type scale (0 = not at all, 1 = a little, 2 = moderately, 3 = quite a bit, 4 = extremely). Utilizing scoring guidelines (McNair et al., 1971), 6 subscales were calculated that included depression–dejection, anger–hostility, tension–anxiety, fatigue–inertia, vigor–activity and confusion–bewilderment. Each subscale was interpreted utilizing each participant's raw score. Raw scores for depression–dejection, anger–hostility, tension–anxiety, fatigue–inertia, vigor–activity and confusion–bewilderment subscales ranged from 0 to 60, 0 to 48, 0 to 36, 0 to 28, 0 to 32 and 0 to 28, respectively. A Total Mood Disturbance (TMD) score was calculated by adding the raw scores from depression–dejection, anger–hostility, tension–anxiety, fatigue–inertia and confusion–bewilderment and then subtracting the vigor–activity score, which resulted in a value between –32 and 200, with higher scores indicative of people with less stable mood profiles.

2.3. Statistical analysis

All statistical tests and procedures were conducted using SPSS 10.0 (SPSS, 2000). Analysis of variance (ANOVA) was conducted to determine mean differences in mood states and sexual behavior between participants concordant and discordant for METH and HIV. In addition, pairwise comparisons utilizing a Tukey adjustment for multiple tests were conducted to examine *post hoc* differences between specific groups. Effect sizes were also calculated utilizing the Hedges' g bias-corrected method (Hedges and Olkin, 1985) to examine

potential clinically significant differences between each group and controls while taking into account differences in sample sizes. We also conducted Pearson's correlations between lifetime Major Depression and Bipolar Disorder diagnosis and each of the sexual behaviors to examine the influence of stable states of mood rather than recent states measured using the BDI and POMS. Finally, to assess the contextual effects of METH and HIV on the association between negative mood and condom use, a moderator analysis using a hierarchical multiple linear regression was run for METH and HIV status according to Barron and Kenny's approach (Baron and Kenny, 1986) for establishing moderation. Prior to running each analysis, all predictors (i.e., mood scales) were centered and the moderator variables (METH or HIV) contrast

Table 1
Participant characteristics.

Characteristic	METH+		METH–		
	HIV+ (n = 71)	HIV– (n = 20)	HIV+ (n = 64)	HIV– (n = 20)	
	1	2	3	4	
Age (years) M (sd)	37 (7)	40 (8)	40 (8)	40 (13)	
Ethnicity (% ethnic minority)	30	30	33	25	
Education (years) M (sd)	13 (3)	14 (2)	14 (2)	13 (2)	
Partner preference (% males only)	90	80	97	95	
MDD (% lifetime)	52	26	45	30	
Bipolar (% lifetime)	9	5	3	5	
Sedative (% lifetime)					
Abuse	10	5	0	5	
Dependence	0	0	0	0	
Cannabis (% lifetime)					
Abuse	34	33	8	5	1,2>3,4**
Dependence	17	16	3	0	1,2>3,4*
Stimulant (% lifetime)					
Abuse	–	–	–	–	
Dependence	100	100	0	0	1,2>3,4**
Opioid (% lifetime)					
Abuse	10	5	0	0	1,2>3,4*
Dependence	0	0	0	5	
Cocaine (% lifetime)					
Abuse	19	11	5	5	
Dependence	17	5	0	0	1,2>3,4**
Hallucinogen (% lifetime)					
Abuse	14	5	3	5	
Dependence	1	0	0	0	
Alcohol (% lifetime)					
Abuse	44	61	31	6	
Dependence	30	42	3	5	
Age first METH use (mean yrs) M (sd)	26 (7)	24 (10)	–	–	
Total METH use (mean yrs) M (sd)	5 (5)	11 (6)	–	–	2>1**
Last use of METH (mean days) M (sd)	93 (121)	81 (83)	–	–	
HIV RNA, plasma (log copies/ml) M (sd)	3.6 (1.1)	–	3.6 (1.1)	–	

* = $p < 0.05$; ** = $p < 0.005$.

coded to reduce problems resulting from multicollinearity (Kraemer and Blasey, 2004). In addition, interaction terms were created by multiplying METH or HIV status by the centered mood scales. The centered scale and METH or HIV status as well as the new interaction term were entered as independent variables into a hierarchical multiple regression equation. Moderation was considered present if the interaction term was found to be statistically significant ($p < 0.05$).

3. Results

3.1. Participant characteristics

Participant characteristics are summarized in Table 1. All four groups were similar in regard to age, ethnicity, education and partner preference. Groups also had similar frequencies of lifetime Major Depression (MDD) and Bipolar (both I and II) Disorder. Methamphetamine dependent groups (METH+) were significantly more likely to have had lifetime cannabis or opioid abuse diagnosis, as well as a lifetime cannabis dependence and remote episodic cocaine dependence. Among METH+ participants, those seronegative (HIV−) reported significantly more cumulative years of methamphetamine use than seropositive (HIV+) participants.

3.2. Sexual behavior

Sexual behavior data for the four participant groups are listed in Table 2. Analysis for condom use [$F(3,171) = 4.02$; $p < 0.01$], intoxicated sex [$F(3,171) = 43.84$; $p < 0.005$] and number of IDU partners [$F(3,171) = 6.38$; $p < 0.005$] showed significant differences between groups. *Post hoc* Tukey tests indicated that METH+/HIV+ participants reported greater engagement in intoxicated sex and reported a greater number of IDU partners compared to both METH−/HIV+ and METH−/HIV− participants. Among HIV+ participants, METH+ status was significantly associated with decreased condom use (95% CI 2.3 ± 0.5 vs. 3.5 ± 0.4 ; $p < 0.005$).

However, this was not the case among HIV− participants (95% CI 2.7 ± 1.0 vs. 2.6 ± 1.0 ; $p = 0.737$) (Fig. 1).

Table 2 also provides effect size estimates utilizing the Hedges' (\hat{g}) bias-corrected method (with the METH−/HIV− group as the reference group). The METH+/HIV+ ($\hat{g} = 0.71$) and METH+/HIV− ($\hat{g} = 0.80$) groups reported younger sexual debuts compared to the METH−/HIV− group. Furthermore, receptive anal sex was reported more frequently by the METH+/HIV+ ($\hat{g} = 0.63$), METH+/HIV− ($\hat{g} = 0.55$) and METH−/HIV+ ($\hat{g} = 0.51$) groups compared to METH−/HIV−. In addition, the METH+/HIV+ group reported greater total number of sexual partners ($\hat{g} = 0.42$) compared to the METH−/HIV− group.

3.3. Mood

A significant difference between groups was found for BDI depressed mood [$F(3,171) = 4.51$; $p < 0.005$] as well as the POMS confusion–bewilderment [$F(3,171) = 3.12$; $p < 0.05$] (Table 3). *Post hoc* Tukey tests indicated that the METH+/HIV+ group reported significantly higher depression and confusion–bewilderment scores than those in the METH−/HIV− group. Group differences related to other mood states measured by the POMS did not reach statistical significance. However, examination of the effect size estimates indicated moderate differences between the METH+/HIV+ group ($\hat{g} = 0.62$) and the METH−/HIV− group with regard to reported tension–anxiety. In addition, METH+/HIV+ ($\hat{g} = 0.55$) and METH−/HIV+ ($\hat{g} = 0.52$) groups reported greater fatigue–inertia than the METH−/HIV− group. Furthermore, METH+/HIV+ ($\hat{g} = 0.63$) and METH+/HIV− ($\hat{g} = 0.56$) groups had greater TMD scores than the METH−/HIV− group.

3.4. Major Depression, Bipolar Disorder, and sexual behavior

Correlations examining the association between lifetime Major Depression and Bipolar Disorders for each of the sexual behaviors within each group revealed significant associations

Table 2

Sexual behavior differences among MSM concordant and discordant for methamphetamine and HIV.

N = 175	METH+						METH−						post hoc ^c
	HIV+ (n = 71) 1			HIV− (n = 20) 2			HIV+ (n = 64) 3			HIV− (control) (n = 20) 4			
	Median ^a	M (sd) ^a	\hat{g}^b	Median	M (sd)	\hat{g}^b	Median	M (sd)	\hat{g}^b	Median	M (sd)		
Sexual behaviors													
Condom use*	2.0	2.3 (1.8)	0.16	4.0	2.7 (2.3)	0.04	4.0	3.5 (1.8)	0.64	3.0	2.6 (2.3)	1<3	
Intoxicated sex**	4.0	3.4 (1.6)	1.75	4.0	3.2 (2.1)	1.37	0.0	0.8 (1.3)	0.08	0.0	0.7 (1.2)	3,4<1	
Oral sex	5.0	4.1 (1.2)	0.33	5.0	4.0 (1.8)	0.19	4.0	3.6 (1.3)	0.08	4.0	3.7 (1.2)		
Receptive anal	2.0	2.6 (1.8)	0.63	3.5	2.7 (2.3)	0.55	2.0	2.3 (1.6)	0.51	0.5	1.5 (1.8)		
Insertive anal	2.0	2.3 (1.6)	0.24	1.5	2.2 (1.9)	0.15	2.0	2.5 (1.8)	0.35	1.0	1.9 (2.0)		
Mutual masturbation	4.0	3.8 (1.8)	0.06	5.0	4.7 (1.7)	0.47	4.5	4.1 (1.8)	0.12	4.0	3.9 (1.5)		
Vaginal sex	0.0	0.4 (1.2)	0.23	0.0	0.6 (1.4)	0.07	0.0	0.1 (0.6)	0.61	0.0	0.7 (1.7)		
Other sexual variables													
Total partners	10.0	21.6 (34.9)	0.42	4.0	9.0 (15.4)	0.07	3.0	11.0 (23.2)	0.14	2.0	7.9 (16.8)		
Total IDU partners**	1.0	2.8 (4.9)	0.62	2.0	2.8 (4.5)	0.81	1.0	0.4 (1.7)	0.23	1.0	0.05 (0.24)	3,4<1	
Age at 1st intercourse	15.0	15.1 (4.4)	0.71	15.0	14.5 (4.0)	0.80	16.0	15.9 (5.3)	0.41	17.5	18.0 (4.2)		

* = $p < 0.05$; ** = $p < 0.005$.

^a Medians and means are of frequencies of the behavior in the current year; 0 = 0%, 1 = 1–5%, 2 = 6–25%, 3 = 26–50%, 4 = 51–75%, 5 = 76–100%.

^b Hedges' $\hat{g} = (\text{mean}_1 - \text{mean}_2) / \text{sd}_{\text{pooled}} \times (1 - [3/4(n_1 + n_2) - 9])$.

^c Multiple pairwise comparisons using a Tukey adjustment.

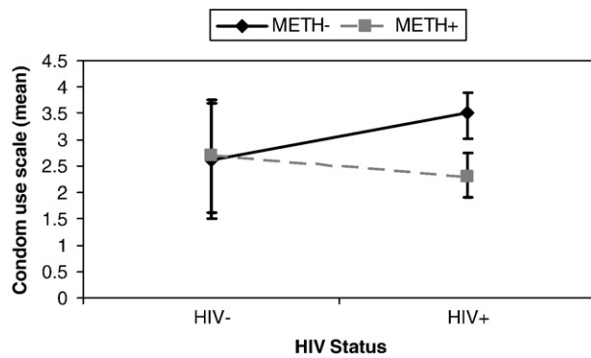


Fig. 1. Condom use for METH+ and METH– participants in the context of HIV-infection. *Note:* METH groups differed for HIV+ ($p=0.005$) but not HIV– ($p=0.737$).

within the HIV+ groups but not the METH+/HIV– or METH–/HIV– groups. Specifically, within the METH+/HIV+ group a significant association between lifetime Major Depression and number of sexual partners ($r=0.28$, $p=0.02$) was observed as well as associations between vaginal sex and Major Depression ($r=-0.32$, $p=0.01$) and Bipolar Disorder ($r=0.27$, $p=0.03$). Among the METH–/HIV+ group, lifetime Major Depression was associated with oral sex ($r=0.26$, $p=0.04$). However, applying a corrected significance cut-off ($p<0.005$) for multiple testing resulted in no significant associations.

3.5. Negative mood and condom use

Table 4 provides results of the univariate regression analysis between all mood scales and condom use as well as a moderator analysis for all mood scales with METH or HIV as the potential moderator. Significant unadjusted relationships were found between all mood scales and condom use. When adjusting each model for METH or HIV status, significant independent main effects for mood on condom use were found for tension–anxiety

Table 4

METH and HIV as moderators of the relationship between mood and condom use using hierarchical multiple linear regression, $N=175$.

	Standardized regression coefficients ¹			
Predictor		Step 1 (Main effects)		Step 2 (Interaction)
Moderator	Univariate model	<i>a</i>	<i>b</i>	<i>c</i>
Depression ²	−0.16*			
METH		−0.12	−0.19*	−0.110
HIV		−0.17*	0.08	0.090
Tension–anxiety	−0.23*			
METH		−0.19*	−0.18*	−0.040
HIV		−0.23*	0.07	0.040
Vigor–activity	0.22*			
METH		0.20*	−0.20*	0.100
HIV		0.23*	0.07	−0.110
Anger–hostility	−0.05*			
METH		−0.09	−0.20*	−0.002
HIV		−0.12	0.05	−0.150
Fatigue–inertia	−0.19*			
METH		−0.18*	−0.20*	−0.010
HIV		−0.20*	0.07	0.020
Confusion– bewilderment	−0.16*			
METH		−0.13	−0.19*	−0.090
HIV		−0.17*	0.07	−0.030
Total mood disturbance	−0.22*			
METH		−0.19*	−0.19*	−0.080
HIV		−0.22*	0.07	−0.020

¹ = regression coefficients based on a 0–5 condom use scale; 0 = 0%, 1 = 1–5%, 2 = 6–25%, 3 = 26–50%, 4 = 51–75%, 5 = 76–100%; ² = Beck Depression Inventory.

a = impact of predictor (mood).

b = impact of moderator (METH or HIV).

c = impact of interaction (mood × METH or mood × HIV).

* = $p<0.05$.

(METH: $t=-2.67$, $df=172$, $p=0.008$; HIV: $t=-3.15$, $df=172$, $p=0.002$), vigor–activity (METH: $t=2.80$, $df=172$, $p=0.006$; HIV: $t=3.03$, $df=172$, $p=0.003$), fatigue–inertia (METH: $t=-2.38$, $df=172$, $p=0.019$; HIV: $t=-2.62$,

Table 3

Depression and other mood state differences among MSM concordant and discordant for methamphetamine and HIV.

	METH+						METH−						<i>post hoc</i> ^b
	HIV+			HIV−			HIV+			HIV− (control)			
	(n = 71)			(n = 20)			(n = 64)			(n = 20)			
	1			2			3			4			
N = 175	Median	M (sd)	\hat{g} ^a	Median	M (sd)	\hat{g} ^a	Median	M (sd)	\hat{g} ^a	Median	M (sd)		
Depression scales													
BDI**	15.0	15.1 (9.1)	0.98	12.0	13.0 (10.9)	0.69	11.0	12.9 (9.3)	0.71	7.0	6.7 (5.5)	4<1,3	
Other mood states													
Depression–dejection	12.0	15.5 (13.1)	0.48	11.0	16.1 (15.2)	0.51	8.0	12.4 (13.0)	0.24	4.0	9.3 (12.0)		
Tension–anxiety	11.0	12.5 (7.3)	0.62	10.0	11.5 (7.1)	0.47	8.0	10.3 (8.2)	0.27	5.5	8.2 (6.1)		
Vigor–activity	15.0	14.8 (7.3)	0.47	16.0	15.8 (6.3)	0.40	15.0	15.4 (7.4)	0.41	18.5	18.3 (5.3)		
Anger–hostility	7.0	9.7 (9.1)	0.37	6.0	9.3 (9.4)	0.34	5.0	7.7 (8.7)	0.14	3.0	6.4 (6.8)		
Fatigue–inertia	8.0	10.1 (6.7)	0.55	9.0	9.7 (7.8)	0.45	8.0	9.9 (6.9)	0.52	5.0	6.4 (5.5)		
Confusion–bewilderment*	10.0	9.7 (6.3)	0.77	7.0	8.8 (6.9)	0.60	10.0	8.3 (6.2)	0.57	3.0	4.9 (5.2)	4<1	
Total mood disturbance	36.0	42.7 (41.5)	0.63	29.5	39.5 (45.9)	0.56	36.0	33.3 (43.0)	0.39	7.0	16.9 (34.2)		
TMD score>42 ^c		42%			45%			39%			20%		

* = $p<0.05$; ** = $p<0.005$.

^a Hedges' $\hat{g} = (\text{mean}_1 - \text{mean}_2) / \text{sd}_{\text{pooled}} \times (1 - [3/4(n_1 + n_2) - 9])$.

^b Multiple pairwise comparisons using a Tukey adjustment.

^c Total mood disturbance score > 42 indicative of significant psychological stress.

$df=172$, $p=0.010$) and TMD (METH: $t=-2.56$, $df=172$, $p=0.011$; HIV: $t=-3.01$, $df=172$, $p=0.003$), whereas BDI depression ($t=-2.22$, $df=172$, $p=0.028$) and confusion–bewilderment ($t=-2.30$, $df=172$, $p=0.023$) main effects remained significant only in the context of HIV. In addition, METH status but not HIV status had significant main effects on condom use regardless of which mood scale was in the model. However, interaction effects between METH and mood or HIV and mood were not observed for condom use; thus, neither METH nor HIV was found to moderate the relationship between negative mood and condom use (Table 4; Step 2, c).

4. Discussion

To our knowledge, this is the first study to present both mood and sexual behavior profiles of individuals with and without METH dependence and/or HIV-infection as well as, explore how the contexts of METH and HIV interact with mood to affect sexual behavior. Although our results suggest many differences in mood and sexual behavior across the four groups examined, we will focus our discussion on statistically significant findings in which we found the independent and combined contexts of METH and HIV play an influential role in negative mood states as well as sexual behavior patterns among non-monogamous MSM. We also found a significant negative association between negative mood states and condom use. However, neither the METH nor the HIV context was found to have a moderating effect on the association between negative mood and condom use.

In terms of sexual behavior, participants in the METH+/HIV+ group reported that 6–25% of their sexual encounters included receptive anal and/or insertive anal sex and 51–75% of encounters included oral sex. Compared to recent reports of METH+/HIV+ MSM sexual practices (Halkitis et al., 2005c; Semple et al., 2006c), these rates of sexual behavior are not uncharacteristically high. However, upon examination of condom use frequencies among METH+/HIV+ participants, it is clear that these rates of sexual behavior could be of substantial concern in relation to the spread of HIV and other sexual transmitted infections.

Approximately 75% or more of sex among METH+/HIV+ participants was unprotected. Interestingly, the METH–/HIV+ group reported significantly greater use of condoms. Thus, it appears that among those in HIV+ groups, METH use is a critical factor in the frequency of condom use: among METH+ individuals, frequency of condom use is 6–25% and among METH– individuals it is at 51–75%. However, recent work (Semple et al., 2006c) found that although unprotected sex among METH+/HIV+ individuals was widespread, fewer unprotected sex acts were performed with HIV– and unknown partners compared to HIV+ partners. This said, the current study examined non-monogamous MSM only, and thus, although we did not capture this information specifically, the potential for sex with HIV– and unknown partners may be greater. However, even if all of the HIV+ participants in this study had sex with seroconcordant partners, this still may contribute to an increased risk of reinfection or superinfection with HIV variants as well as transmission of other sexually transmitted infections (STIs). Thus, interventions to address condom use and potentially other protective behaviors among HIV-infected MSM METH users are warranted.

The METH+/HIV+ group not only had a greater likelihood of unprotected sex but also reported more than twice the number of partners in the previous year than the other groups. Previous studies (Halkitis et al., 2005c; Semple et al., 2006c) have attributed greater number of partners to METH use, which is known to increase sexual arousal and thus sexual partner seeking. However, in this study, although participants in both METH+ groups reported much higher rates of sex while intoxicated than did the METH– groups, only the METH+/HIV+ group reported a significantly greater number of partners than the METH– groups. In fact, the METH–/HIV+ group reported a higher, albeit not significant, number of partners than the METH+/HIV– group.

In addition to unprotected sex and number of partners, injection drug use and sexual encounters with IDUs can increase risk for reinfection and transmission of HIV and other STIs. In this study, the METH+/HIV+ group, and to a lesser extent the METH+/HIV– group, reported greater number of IDU partners in the past year than the METH– groups. Although this finding is not surprising given the likely close proximity of IDU behavior to METH use behavior, it supports a further need for prevention efforts among IDUs and their partners.

In terms of mood, specifically depressed mood, many studies have reported higher rates among METH+ (Peck et al., 2005; Semple et al., 2005b) and HIV+ (Dew et al., 1997; Evans et al., 1999) individuals. In this study, levels of depression based on established criteria for the BDI (American Psychiatric Association. Task Force for the Handbook of Psychiatric Measures and Rush, 2000), across all groups fell within the range of mild symptomatology, except among the METH–/HIV– group, which was classified as minimal. Yet, we observed that participants in the METH+/HIV+ group reported depression scores that were greater than those in either of the single-risk groups. The METH+ only and HIV+ only groups had similarly elevated depression scores, suggesting an additive effect of the combined risk factors on mood disturbance.

In addition to depression, we also found that the METH+/HIV+ group reported significantly more confusion–bewilderment than the control group. Confusion–bewilderment may be indicative of cognitive difficulties as a result of METH dependence and/or the known central nervous system consequences of HIV-infection. This is supported by recent work (Rippeth et al., 2004) with a similar sample of MSM concordant and discordant for METH and HIV that identified a monotonic relationship between number of risk factors and cognitive impairment as determined by detailed neuropsychological assessment.

A relationship between mood and sexual risk behavior, although inconsistent in the literature, was found in this study between all measured mood scales and condom use. After adjusting for METH or HIV status, significant main effects of tension–activity, vigor–activity, fatigue–inertia and TMD were found for condom use within the context of both METH and HIV, whereas main effects of depression and confusion–bewilderment were only significant within the context of HIV. This supports the notion that a relationship does exist between mood and sexual risk behavior and that this relationship is potentially context dependent. However, results from the moderator analysis do not suggest a moderating effect of either METH or HIV on the relationship between mood and condom

use. This finding is perhaps related to our relatively small sample and homogeneity on the mood scales in which detection of a moderating effect is weakened as a result of not having a full range of values for the independent variables (i.e. mood scales) (Bennett, 2000; Aguinis, 2004). Thus, larger and more heterogeneous samples are required to address the moderating effects of these contexts further.

There are several limitations that must be considered. First, the study is cross-sectional and thus temporal order of the relationships examined cannot be established. For example, it is possible that a subset of the METH using population who has a propensity for risk behaviors through some mechanism not measured in this study is the subset that ends up contracting HIV, and therefore their risky sex profiles obtained in this study reflect longstanding characteristics. Certainly, METH and HIV status were determined prior to the current mood assessment; thus, the temporal order of the variables is not completely unknown. Nevertheless, mood that was assessed, although prefaced in the “past 7 days”, may actually represent a longstanding mood state pre-dating the participants’ current METH and/or HIV status. Second, sample size for each of the four groups was relatively small and therefore the study may lack sufficient power to detect effects that otherwise are present, thus having a greater probability of Type II errors. In addition, the measure utilized to capture sexual behavior asked respondents to select an answer within a range of frequencies and thus the estimates of the frequencies of sexual behavior are imprecise and introduce statistical “noise”. Finally, we were unable to link condom use to specific sexual practices and/or to specific partner types. Thus, it is unknown to what extent unprotected sex within this study occurred within a specific sexual practice and with whom this sexual practice was performed. Therefore, these results are preliminary and require replication in prospective investigations.

In summary, the present findings suggest that mood and sexual behavior of non-monogamous MSM differ depending on the context in which they are examined. As hypothesized, participants in the METH+/HIV+ group reported significantly greater negative mood and sexual risk behavior when compared to controls. Further, this study suggests a complex relationship between negative mood and condom use in the context of HIV and METH. Although a consistent relationship between negative mood and condom use was found, of potentially greater importance is that METH and to a lesser extent HIV status, potentially modifies these negative mood effects on condom use. Thus, our data support the development of new and refinement of existing sexual risk reduction interventions among non-monogamous MSM that incorporate multi-faceted approaches, including both substance abuse and mental health treatment.

Role of funding source

Funding for this study was provided by NIH Grants P01-DA12065 and P30-MH62512; the NIH had no further role in the study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Conflict of interest

The authors declare that, except for income received from their primary employer, no financial support or compensation has been received from any individual or corporate entity over the past three years for research or professional service and there are no personal financial holdings that could

be perceived as constituting a potential conflict of interest for Mariana Cherner, Chad Bousman, Daniel Barron, Florin Vaida, Robert Heaton, Ian Everall, and Igor Grant. The authors declare that over the past three years, J. Hampton Atkinson has received compensation from Eli Lilly Pharmaceuticals; Scott Letendre is an advisor for Abbott Labs, GlaxoSmithKline, and Schering-Plough, has given CME accredited talks funded by Abbott Labs and GlaxoSmithKline, and has received research funding from GlaxoSmithKline, Schering-Plough, Merk, Tibotec, and Gilead Sciences.

Acknowledgements

The authors wish to acknowledge support from the United States National Institutes of Health (grant numbers P01-DA12065 and P30-MH62512) and the contributions of study participants and staff at the HIV Neurobehavioral Research Center (HNRC), San Diego, CA, USA.

The HNRC Group is affiliated with the University of California, San Diego, the Naval Hospital, San Diego, and the Veterans Affairs San Diego Healthcare System, and includes: Director: Igor Grant, M.D.; Co-Directors: J. Hampton Atkinson, M.D., Ronald J. Ellis, M.D., Ph.D., and J. Allen McCutchan, M.D.; Center Manager: Thomas D. Marcotte, Ph.D.; Business Manager: Melanie Sherman; Naval Hospital San Diego: Braden R. Hale, M.D., M.P.H. (P.I.); Neuromedical Component: Ronald J. Ellis, M.D., Ph.D. (P.I.), J. Allen McCutchan, M.D., Scott Letendre, M.D., Edmund Capparelli, Pharm.D., Rachel Schrier, Ph.D.; Jennifer Marquie-Beck; Terry Alexander, R.N.; Neurobehavioral Component: Robert K. Heaton, Ph.D. (P.I.), Mariana Cherner, Ph.D., Steven Paul Woods, Psy.D., David J. Moore, Ph.D.; Matthew Dawson, Donald Franklin; Neuroimaging Component: Terry Jernigan, Ph.D. (P.I.), Christine Fennema-Notestine, Ph.D., Sarah L. Archibald, M.A., John Hesselink, M.D., Jacopo Annese, Ph.D., and Michael J. Taylor, Ph.D., Neurobiology Component: Eliezer Masliah, M.D. (P.I.), Ian Everall, FRCPsych., FRCPATH., Ph.D., and Cristian Achim, M.D., Ph.D.; Neurovirology Component: Douglas Richman, M.D., (P.I.), and David M. Smith, M.D.; International Component: J. Allen McCutchan, M.D., (P.I.); Developmental Component: Ian Everall, FRCPsych., FRCPATH., Ph.D. (P.I.), and Stuart Lipton, M.D., Ph.D.; Clinical Trials Component: J. Allen McCutchan, M.D., J. Hampton Atkinson, M.D., Ronald J. Ellis, M.D., Ph.D., and Scott Letendre, M.D.; Participant Accrual and Retention Unit: J. Hampton Atkinson, M.D. (P.I.), and Rodney von Jaeger, M.P.H.; Data Management Unit: Anthony C. Gamst, Ph.D. (P.I.), Clint Cushman (Data Systems Manager), and Daniel R. Masys, M.D. (Senior Consultant); Statistics Unit: Ian Abramson, Ph.D. (P.I.), Florin Vaida, Ph.D., and Christopher Ake, Ph.D.

The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, nor the United States Government.

References

- Aguinis, H., 2004. Regression Analysis for Categorical Moderators. Guilford Press, New York.
- American Psychiatric Association. Task Force for the Handbook of Psychiatric Measures, Rush, A.J., 2000. Handbook of Psychiatric Measures, (1st ed.). American Psychiatric Association, Washington, DC.
- Bancroft, J., Janssen, E., Strong, D., Carnes, L., Vukadinovic, Z., Long, J.S., 2003a. Sexual risk-taking in gay men: the relevance of sexual arousability, mood, and sensation seeking. Arch. Sex. Behav. 32, 555–572.
- Bancroft, J., Janssen, E., Strong, D., Vukadinovic, Z., 2003b. The relation between mood and sexuality in gay men. Arch. Sex. Behav. 32, 231–242.

- Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J. Pers. Soc. Psychol.* 51, 1173–1182.
- Beck, A.T., 1972. *Depression: Causes and Treatment*. University of Pennsylvania Press, Philadelphia.
- Bennett, J.A., 2000. Mediator and moderator variables in nursing research: conceptual and statistical differences. *Res. Nurs. Health* 23, 415–420.
- Center for Disease Control, 2003. Increases in HIV Diagnoses—29 States, 1999–2002. *MMWR*, vol. 52, pp. 1145–1148.
- Center for Disease Control, 2005. *HIV/AIDS Surveillance Report*, 17. Rev ed. Atlanta: US Department of Health and Human Services, CDC: 2007:1–46. Accessed Aug 11, 2007.
- Center for Disease Control, 2007. *Methamphetamine and HIV Risk among Men Who have Sex with Men [Fact Sheet]*. Available at <http://www.effectiveinterventions.org>. Accessed Aug 15, 2007.
- Crepaz, N., Marks, G., 2001. Are negative affective states associated with HIV sexual risk behaviors? A meta-analytic review. *Health Psychol.* 20, 291–299.
- Dew, M.A., Becker, J.T., Sanchez, J., Caldararo, R., Lopez, O.L., Wess, J., Dorst, S.K., Banks, G., 1997. Prevalence and predictors of depressive, anxiety and substance use disorders in HIV-infected and uninfected men: a longitudinal evaluation. *Psychol. Med.* 27, 395–409.
- Evans, D.L., Staab, J.P., Petitto, J.M., Morrison, M.F., Szuba, M.P., Ward, H.E., Wingate, B., Luber, M.P., O'Reardon, J.P., 1999. Depression in the medical setting: biopsychological interactions and treatment considerations. *J. Clin. Psychiatry* 60 (Suppl 4), 40–55 discussion 56.
- Gorbach, P.M., Drumright, L.N., Daar, E.S., Little, S.J., 2006. Transmission behaviors of recently HIV-infected men who have sex with men. *J. Acquir. Immune Defic. Syndr.* 42, 80–85.
- Halkitis, P.N., Fischgrund, B.N., Parsons, J.T., 2005a. Explanations for methamphetamine use among gay and bisexual men in New York City. *Subst. Use Misuse* 40 (9–10), 1331–1345.
- Halkitis, P.N., Green, K.A., Mourgues, P., 2005b. Longitudinal investigation of methamphetamine use among gay and bisexual men in New York City: findings from project BUMPS. *J. Urban Health* 82, 118–125.
- Halkitis, P.N., Shrem, M.T., Martin, F.W., 2005c. Sexual behavior patterns of methamphetamine-using gay and bisexual men. *Subst. Use Misuse* 40, 703–719.
- Hedges, L.V., Olkin, I., 1985. *Statistical Methods for Meta-analysis*. Academic Press, Orlando.
- Kalichman, S.C., Kelly, J.A., Rompa, D., 1997. Continued high-risk sex among HIV seropositive gay and bisexual men seeking HIV prevention services. *Health Psychol.* 16, 369–373.
- Kraemer, H.C., Blasey, C.M., 2004. Centring in regression analyses: a strategy to prevent errors in statistical inference. *Int. J. Methods Psychiatr. Res.* 13 (3), 141–151.
- Kraemer, H.C., Strice, E., Kazdin, A., Offord, D., Kupfer, D., 2001. How do risk factors work together? Mediators, moderators, and independent, overlapping, and proxy risk factors. *Am. J. Psychiatry* 158 (6), 848–856.
- McKusick, L., Coates, T.J., Morin, S.F., Pollack, L., Hoff, C., 1990. Longitudinal predictors of reductions in unprotected anal intercourse among gay men in San Francisco: the AIDS behavioral research project. *Am. J. Publ. Health* 80, 978–983.
- McNair, P.M., Lorr, M., Drappelman, L., 1971. *POMS Manual*. Education and Industrial Testing Services, San Diego, CA.
- Peck, J.A., Reback, C.J., Yang, X., Rotheram-Fuller, E., Shoptaw, S., 2005. Sustained reductions in drug use and depression symptoms from treatment for drug abuse in methamphetamine-dependent gay and bisexual men. *J. Urban Health* 82, i100–i108.
- Rippeth, J.D., Heaton, R.K., Carey, C.L., Marcotte, T.D., Moore, D.J., Gonzalez, R., et al., 2004. Methamphetamine dependence increases risk of neuropsychological impairment in HIV infected persons. *J. Int. Neuropsychol. Soc.* 10, 1–14.
- Seiple, S.J., Zians, J., Grant, I., Patterson, T.L., 2005a. Impulsivity and methamphetamine use. *J. Subst. Abuse Treat.* 29, 85–93.
- Seiple, S.J., Patterson, T.L., Rant, I., 2005b. Methamphetamine use and depressive symptoms among heterosexual men and women. *J. Subst. Use* 10 (1), 31–47.
- Seiple, S.J., Zians, J., Grant, I., Patterson, T.L., 2006b. Sexual compulsivity in a sample of HIV-positive methamphetamine-using gay and bisexual men. *AIDS Behav.* 10, 587–598.
- Seiple, S.J., Zians, J., Grant, I., Patterson, T.L., 2006c. Sexual risk behavior of HIV-positive methamphetamine-using men who have sex with men: the role of partner serostatus and partner type. *Arch. Sex. Behav.* 35, 461–471.
- Shoptaw, S., 2006. Methamphetamine use in urban gay and bisexual populations. *Top. HIV Med.* 14, 84–87.
- Shoptaw, S., Peck, J., Reback, C.J., Rotheram-Fuller, E., 2003. Psychiatric and substance dependence comorbidities, sexually transmitted diseases, and risk behaviors among methamphetamine-dependent gay and bisexual men seeking outpatient drug abuse treatment. *J. Psychoact. Drugs* 35 (Suppl 1), 161–168.
- SPSS, 2000. *Statistical Package for the Social Sciences*, Version 10. SPSS, Chicago.