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The Impact of Age, HIV Serostatus and Seroconversion on Methamphetamine Use

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Abstract

Background—Characterizing methamphetamine use in relation to age, HIV serostatus and seroconversion is pertinent given the increasingly older age of the population with HIV and the intertwined epidemics of methamphetamine use and HIV.

Objectives—Study aims were to investigate whether 1) methamphetamine use differs by age and HIV serostatus and 2) receiving an HIV diagnosis impacts methamphetamine use among younger and older persons with HIV.

Methods—This study examined methamphetamine use characteristics among 217 individuals with a lifetime methamphetamine dependence diagnosis who completed an in-person study assessment.

Results—Multivariable regressions revealed that HIV serostatus uniquely attenuates methamphetamine use, such that persons with HIV report a smaller cumulative quantity ($\beta = -.16$, $p = .01$) and a fewer number of days ($\beta = -.18$, $p = .004$) of methamphetamine use than persons without HIV. Among the HIV+ sample, all participants persisted in methamphetamine use after receiving an HIV diagnosis, with about 20% initiating use after seroconversion. Repeated measures analysis of variance indicated that density of methamphetamine use (i.e., grams per day used) was greater among the younger, relative to the older, HIV+ group ($p = .02$), and increased for both age groups following seroconversion ($p < .001$).

Conclusion—These analyses indicate that although HIV serostatus may attenuate methamphetamine use behaviors, many people with HIV initiate, or persist in, methamphetamine use after receiving an HIV diagnosis. These findings raise the question of whether tailoring of

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prevention and intervention strategies might reduce the impact of methamphetamine and HIV across the age continuum.

Keywords

methamphetamine; stimulant; HIV/AIDS; age; HIV risk behavior

Introduction

Methamphetamine is a highly addictive stimulant that is a major risk factor for acquisition and transmission of human immunodeficiency virus (HIV) (1). Methamphetamine use increases risk of HIV acquisition and transmission directly through injection drug use and indirectly by increasing engagement in high-risk sexual behaviors (1-5). Among people with HIV, methamphetamine is among the most commonly abused substances (6). Use of methamphetamine confers risk for poor HIV health outcomes directly through increased viral replication (7) and indirectly via poor adherence to antiretroviral therapy (ART) (8). The relationship between HIV and methamphetamine use across the lifetime warrants investigation given the health consequences of methamphetamine among people at risk for, and with, HIV. The impact of age on the relationship between HIV and methamphetamine should also be considered, given that persons with HIV are living longer lives (9) and incident HIV infection among those above 50 years old is no longer uncommon (10).

Risk behaviors for HIV transmission may modestly decrease for a proportion of individuals as a result of receiving an HIV diagnosis (11, 12), although a rebound in transmission risk behaviors may occur after about one year (13-15). Age-related differences (i.e., younger versus older) in the engagement in transmission risk behaviors have been inconsistently detected [e.g., (16, 17)]; therefore, the effect of age on the rebound of risk behaviors remains unclear. A majority of studies focused exclusively on changes in sexual risk following an HIV diagnosis, leaving a gap in our knowledge regarding changes in substance use. Although rates of substance use disorder decline with increasing age in the general population, preliminary evidence indicates that this decline is not observed among older persons with HIV (18). Patterns of substance use, in particular methamphetamine use, should be examined in relation to both HIV seroconversion and age given that older individuals who do not attenuate their methamphetamine use following seroconversion may be at increased risk for various negative health consequences. For example, among persons with HIV, older persons are particularly vulnerable to methamphetamine-associated neurotoxicity and neurocognitive impairment than younger counterparts (19).

The aim of this paper was two-fold: 1) to determine if patterns of methamphetamine use differ by age and HIV serostatus and 2) to investigate whether receiving an HIV diagnosis impacts methamphetamine use among younger (20s and 30s) and older (40s and 50s) age groups. We hypothesized that age and HIV serostatus would impact methamphetamine use behaviors, such that older age and being an adult without HIV would additively contribute to greater lifetime methamphetamine use. Furthermore, methamphetamine use was hypothesized to persist after receiving an HIV diagnosis for both older and younger persons with HIV. A more detailed description of the relationships between methamphetamine use,

age, and HIV serostatus and seroconversion may better inform public health efforts of when, and to whom, to direct prevention and treatment efforts for addressing the intertwined methamphetamine and HIV epidemics.

Methods

Participants

Participants included 217 English-speaking individuals enrolled in the University of California, San Diego (UCSD) HIV Neurobehavioral Research Center (HNRC) and UCSD Translational Methamphetamine AIDS Research Center (TMARC) from July 2005 to December 2011. Study protocols were approved by the UCSD Institutional Review Board. Participants were recruited generally from the San Diego community, including HIV clinics and substance abuse treatment programs. After providing written, informed consent, each participant underwent an extensive substance use interview, as well as a neuropsychological (NP), medical, and psychiatric evaluation. General exclusion criteria were prior histories of neurological (e.g., seizure disorders, closed head injuries, and cerebrovascular accidents) or severe psychiatric (e.g., schizophrenia and mental retardation) conditions.

Substance-related inclusion criteria—Individuals who met Diagnostic and Statistical Manual of Mental Disorders 4th edition (*DSM-IV*) (20) criteria for lifetime methamphetamine dependence and for methamphetamine abuse or dependence within 18 months of enrolling in the study based on the Composite International Diagnostic Interview (CIDI) version 2.1 (21) were included. Due to the high prevalence of cannabis and alcohol use reported among methamphetamine users, persons who had previously met diagnostic criteria for alcohol or cannabis abuse or dependence were included, provided that criteria for cannabis or alcohol dependence had not been met within the past 12 months. Individuals meeting lifetime criteria for abuse of other substances (e.g., cocaine, opioids, hallucinogens, and sedatives) were included in the sample only if their abuse was more than 12 months prior to study enrollment. Individuals with histories of non-methamphetamine substance dependence were included only if they met criteria for dependence more than five years prior to enrollment.

Procedure

Psychiatric Assessment—Each participant underwent a comprehensive semi-structured timeline follow-back interview in order to obtain a detailed history of substance use (22). The variables derived from this substance use history interview included age of first use, recency of use (i.e., days since last use), cumulative quantity (i.e., amount in grams of substance used in lifetime), cumulative days of substance use, span of use (i.e., total number of days that elapsed between first use and last use), average density of use (i.e., average grams per day used, which was calculated by dividing cumulative quantity by cumulative duration), binge use (yes/no), any injection use (yes/no), and primary route of administration for methamphetamine and other recreational substances. Additionally, for substance use data collected among the sample of participants with HIV (HIV+ sample), the variables of quantity, duration, span, and density were split into two epochs: pre- and post-diagnosis of HIV according to the self-reported age of testing positive for HIV for the first time.

Cronbach's α was .78 for the frequency variables (i.e., cumulative quantity, cumulative days, and span of substance use) derived from the substance use history interview in the current sample ($n = 217$).

Diagnoses for lifetime and current (i.e., within the last 30 days) Major Depressive Disorder (MDD), a psychiatric disorder common in methamphetamine-using populations, were established using the CIDI. DSM-IV diagnoses of childhood and current Antisocial Personality Disorder (ASPD) and Attention Deficit/Hyperactivity Disorder (ADHD) was assessed using modules of the Diagnostic Interview Schedule (DIS) (23). We assessed for these conditions given that they may affect methamphetamine-using behaviors (24-26).

Each participant was administered the Beck Depression Inventory-II (BDI-II) (27) in order to assess current depressive symptoms (Cronbach's $\alpha = .94$ in the current sample). The BDI-II is a 21-item instrument assessing depressive symptoms in the past two weeks, with higher BDI-II scores indicating greater affective distress.

Neuromedical Assessment—Each individual received a medical evaluation including a blood draw and an assessment of medical conditions common among people with HIV, including hepatitis C virus (HCV). HIV disease was established by either an enzyme-linked immunosorbent assay (ELISA) and a Western Blot confirmatory test, or MedMira Multiplo rapid test (MedMira Inc., Nova Scotia, Canada). Additional data was collected on the HIV+ sample, including age of first HIV positive test, duration of HIV disease, route of HIV transmission, and self-reported nadir CD4+ T-cell count.

Neuropsychological (NP) Assessment—Each participant was administered a comprehensive NP test battery to determine the comparability of groups on NP performance given that methamphetamine use increases risk of NP impairment (22). For each participant, estimated pre-morbid verbal IQ [i.e., reading subtest of the Wide Range Achievement Test (WRAT) (28)] and a summary index of overall NP functioning [i.e., global deficit score (GDS)] were derived based on published, demographically-adjusted normative standards (29). A standard cutoff score of 0.5 was applied to the GDS to classify individuals as NP impaired; thus an individual who demonstrated a GDS greater than 0.5 would be classified as NP impaired (29).

Data analyses

Given that the distributions of the methamphetamine use variables were highly skewed (Shapiro-Wilk test $p's < .001$), the distributions of residuals were visually inspected when performing statistical tests to determine whether transforming these variables was appropriate in order to meet the statistical assumptions of parametric tests. For all statistical analyses, the methamphetamine use variables were transformed (i.e., either square root or log transformation based on which transformation achieved normality of the residuals); non-transformed values are reported in the tables to ease interpretability. Demographic variables and methamphetamine use behaviors were compared between the HIV serostatus groups [i.e., groups consisting of study participants with HIV (HIV+) and without HIV (HIV-)] using *t*-tests for continuous variables and using Pearson chi square tests or Fisher's Exact Test (for small cell frequencies, i.e., $n \leq 20$) for dichotomous or nominal variables.

Multivariable regressions were performed for the methamphetamine use variables, with HIV serostatus, age (continuous), and the interaction between HIV serostatus and age included in the model. Further, demographic variables on which the HIV serostatus groups statistically differed using a critical alpha level of .10 (i.e., education, gender or sexual orientation, lifetime MDD, ASPD diagnosis, lifetime opioid use diagnosis, and estimated pre-morbid verbal IQ) were considered as covariates. Given the singularity between gender and sexual orientation, two multivariable regressions were evaluated for each methamphetamine use variable—one including gender, and the other including sexual orientation. For parsimony, only statistically significant variables using a critical alpha level of .10 were retained in the final multivariable regression models.

Among the HIV+ sample ($n = 117$), repeated measures analyses of variance (ANOVA) tests were conducted to examine the effects of age and receiving an HIV diagnosis on methamphetamine use behaviors, with age as the between-subjects factor and time (i.e., pre-versus post-diagnosis of HIV) as the within-subjects factor. To ease interpretability of results and to be consistent with prior research [e.g., (17)] age was dichotomized (i.e., younger versus older groups) based on age decades for the repeated measures ANOVA tests. The younger HIV+ group was defined as those participants in their 20's and 30's ($n = 46$) and the older HIV+ group consisted of participants in their 40's and 50's ($n = 71$). Additionally, identified demographic, HIV, and psychiatric variables on which the younger and older HIV + groups statistically differed using a critical alpha level of .10 (i.e., nadir CD4 count, estimated pre-morbid verbal IQ, lifetime cannabis use diagnosis, lifetime cocaine use diagnosis, and BDI-II score) were considered as covariates. Follow-up independent- and paired-samples t tests were conducted on any significant omnibus effects in order to further examine between- and within-group differences, respectively. Hedge's g statistic was used to generate effect sizes for group comparisons.

Results

The sample consisted of 217 participants who were mostly well-educated Caucasian men with relatively well-controlled HIV disease. Demographic, psychiatric, substance-related, neuropsychological, and neuromedical characteristics of the sample are presented in Table 1. In general, HIV serostatus groups were comparable (i.e., p values for group differences $> .10$) across many of the characteristics, including ethnicity, current depressive symptoms (i.e., BDI-II total score and current MDD diagnoses), NP functioning (e.g., proportion NP impaired), and proportion with HCV. The HIV+ group had significantly more years of education, a higher proportion of gay/bisexual males, higher scores on a measure of premorbid verbal IQ, and a higher proportion of males and diagnoses of lifetime MDD than the HIV– group. The HIV+ group had a lower proportion with diagnoses of lifetime ASPD and lifetime opioid use disorder than the HIV– group (p 's $< .10$). The broad comparability of the groups allowed us to keep the number of covariates to a minimum, as only these latter variables were included in each of the multivariable regression models as covariates.

Methamphetamine use characteristics by age and HIV serostatus

On average, the 217 participants initiated methamphetamine use in their early 20s, reported their last use about two months prior to the study visit, consumed about one kilogram of methamphetamine in their lifetime, and consumed an average of three quarters of a gram of methamphetamine per day used (see Table 2).

To test the effects of age, HIV serostatus, and their interaction on methamphetamine use characteristics, a series of multivariable regressions were performed (see Table 3). The models were significant (p 's < .05), with the exception of the model for density of methamphetamine use (p .05). The main effect of age was statistically significant (p 's < .05) for the models of span, cumulative days, age of first use, and cumulative quantity of methamphetamine use. Specifically, as age increases, reported values for span, cumulative days, and cumulative quantity of methamphetamine use also increases. The main effect of HIV serostatus was statistically significant (p 's < .05) for the models of cumulative days and quantity of methamphetamine use, such that persons with HIV reported fewer days and smaller cumulative quantities of methamphetamine use. The interaction of age and HIV serostatus was not a significant variable in any of the models (p 's > .05), and, therefore, the interaction term was not retained in any of the final models. The number of completed years of formal education was a significant covariate in the final models for span, cumulative days, age of first use, and cumulative quantity of methamphetamine use (p 's < .05), such that less education was associated with greater methamphetamine use. A lifetime diagnosis of ASPD was a significant covariate for the models of cumulative days and recency of methamphetamine use, and gay/bisexual orientation was a significant covariate in the models for span and age of first methamphetamine use (p 's < .05). Lastly, a lifetime opioid use diagnosis was a significant covariate in the model for recency of methamphetamine use (p < .05). Gender was not a significant covariate (p > .05), and therefore not included, in any of the models.

Methamphetamine use characteristics before and after receiving an HIV diagnosis among the HIV+ sample

On average, the younger ($M = 28.4$, $SD = 4.7$) HIV+ group received an HIV diagnosis at an earlier age than the older ($M = 36.2$, $SD = 8.4$) HIV+ group [$t(115) = 5.7$, $p < .001$]. A greater proportion of the younger HIV+ group (33%) received an HIV diagnosis within a year of the study visit ($\chi^2 = 9.5$, $p = .002$), relative to the older HIV+ group (10%). Descriptively, all participants with HIV reported at least some methamphetamine use after receiving an HIV diagnosis (i.e., none of the participants with HIV discontinued methamphetamine use after receiving an HIV diagnosis). After receiving an HIV diagnosis, 22% initiated methamphetamine use and 28% met criteria for a methamphetamine dependence diagnosis for the first time in the younger HIV+ group. Among the older HIV+ group, 20% initiated methamphetamine use and 32% met criteria for a methamphetamine dependence diagnosis for the first time after receiving an HIV diagnosis.

Table 4 summarizes methamphetamine use characteristics for the HIV+ sample by age group during the pre- and post-diagnosis of HIV epochs. Table 4 also summarizes the results of the final repeated measures ANOVA models. Results of the repeated measures ANOVAs found

that for span of methamphetamine use, there was a significant effect of group (i.e., younger versus older), $F(1, 105) = 10.71, p = .001$, but neither a significant effect of time (i.e., pre-versus post-diagnosis of HIV), $F(1, 105) = 0.00, p = .95$, nor a significant effect of a group by time interaction, $F(1, 105) = .24, p = .62$. Planned independent-samples t -test analysis revealed that the older group had a greater span of methamphetamine use than the younger group $t(115) = -4.3, p < .001$, Hedge's $g = -.81$. For density of methamphetamine use, the repeated measure ANOVA demonstrated a significant effect of time, $F(1, 115) = 19.32, p < .001$ and a significant effect of group, $F(1, 115) = 5.28, p = .02$, but no group by time interaction, $F(1, 115) = .41, p = .52$. Planned independent-samples t -test analysis revealed that the younger group had a higher methamphetamine use density than the older group, $t(115) = -2.4, p = .02$, Hedge's $g = -.41$. Planned paired-samples t tests indicated that density of methamphetamine use was higher during the post- compared to the pre-diagnosis of HIV epoch period $t(116) = 6.2, p < .001$, Hedge's $g = -.53$. There was no statistically significant effect of time, group, or group by time interaction for the repeated measures ANOVA models for cumulative quantity or cumulative days of methamphetamine use (p 's $> .05$).

Discussion

Our findings indicate that HIV serostatus attenuates the patterns of methamphetamine use for a well-characterized sample of individuals carrying a lifetime diagnosis of methamphetamine dependence. Persons with HIV reported less methamphetamine use than persons without HIV. Regardless of HIV serostatus, an age effect emerged such that younger persons reported initiating methamphetamine use at an earlier age than older counterparts. Among the sample of persons with HIV, all participants reported some methamphetamine use during the period after receiving an HIV diagnosis, with about 20% reporting an initiation of methamphetamine use after seroconversion. Cumulative quantity and number of days of methamphetamine use did not differ between the periods before and after an HIV diagnosis, indicating persistence of methamphetamine use. Of note, density of methamphetamine use (i.e., grams per day used) was greater among the younger, relative to the older, HIV+ group, and, on average, increased for both age groups during the period after receiving an HIV diagnosis. These results offer a gross examination of methamphetamine use behaviors as they relate to age and HIV serostatus and seroconversion.

Broadly, persons without HIV appear to use methamphetamine to a greater degree than persons with HIV. Older persons accumulated greater levels of methamphetamine use, which is likely an artifact of having a longer time to accrue a substantial methamphetamine-use history. Given the established association between methamphetamine use and risk for HIV transmission (1-5), the high levels of methamphetamine use among older persons without HIV may place them at high risk for HIV seroconversion. In addition to the effects of age and HIV serostatus on methamphetamine use behaviors, those with lower educational attainment achieved a more chronic methamphetamine use history, which is consistent with previous findings among older and younger persons (30, 31).

Methamphetamine use persisted after receiving an HIV diagnosis for both younger and older adults. Density of use, which was higher among the younger HIV+ group, increased during the epoch period after receiving an HIV diagnosis for both age groups. Persistence and increased density of methamphetamine use are concerning findings given that methamphetamine use is associated with risky sexual behavior among persons recently diagnosed with HIV (32). Results of a recent study involving men recently diagnosed with HIV indicated a rebound in unprotected sex with serodiscordant or unknown HIV-serostatus partners at one year post-diagnosis of HIV (14). The rebound appears to be more pronounced since the introduction of combination ART (33). The observation that risk reduction in transmission behaviors is not sustained beyond one year following diagnosis of HIV (14) indicates a need for targeted intervention aimed at promoting sustained risk-reduction behaviors among persons with HIV (34, 35). Persons who increase or decrease stimulant drug use over time report congruent changes in sexual risk taking (36), demonstrating the parallel levels of sexual risk and stimulant drug use. Thus, interventions for this population must consider stimulant use in conjunction with sexual risk reduction.

In our study sample, a larger proportion of the younger HIV+ group had more recently received an HIV diagnosis compared to the older HIV+ group. Specifically, 33% of the younger HIV+ group had received an HIV diagnosis within a year of the study visit compared to 10% of the older HIV+ group. Methamphetamine use behaviors during the acute and early HIV infection (AEH) period warrants consideration given that this period is characterized by high levels of HIV replication and compartmentalization (37), which is associated with an increased risk of HIV transmission (38). In a previous report, up to 85% of individuals with AEH demonstrated an increased prevalence of methamphetamine use, such that 40% of persons with a recent HIV diagnosis reported ever using methamphetamine compared to 21% of persons without HIV (1). Methamphetamine use, in the context of HIV disease, may confer risk for viral replication (39), HIV-associated neurocognitive disorders (22), nonadherence to ART (8, 40, 41), and engagement in various health risk behaviors (e.g., having unprotected sexual intercourse and sharing unclean needles) (42-46). Thus, it is critical to better characterize and understand the role of substance use behaviors among persons with HIV in the AEH period, as substance use may play a significant role in treatment planning (e.g., ability to maintain ART adherence) and in the assessment of HIV transmission risk (47).

Beyond the AEH period, a significant proportion of older adults with HIV report engaging in risky sexual behaviors (48). In addition, older adults with HIV are less likely to receive behavioral health care for substance use disorders (49). The persistence of methamphetamine use and lower likelihood of engagement in behavioral health care may confer additive risk for poorer health outcomes among older persons with HIV. For example, methamphetamine dependence is known to confer risk for neurocognitive impairment (22), and among older persons with HIV, neurocognitive impairment is a risk factor for poorer ART adherence (50). In the current study, neurocognitive impairment status was not a statistically significant covariate for methamphetamine use. In the comparison of methamphetamine use during the periods before and after receiving an HIV diagnosis, however, pre-morbid verbal IQ was a statistically significant covariate, such that higher pre-morbid verbal IQ was associated with fewer days and span of methamphetamine use for

both the younger and older HIV+ groups. Although the directionality of the association between higher pre-morbid verbal IQ and methamphetamine use cannot be inferred from the cross-sectional design of the current study, the study findings suggests a relationship between neurocognitive functioning and methamphetamine use among persons with HIV.

Limitations

Several limitations of this study should be noted. This study examined the effects of age using a cross-sectional study design, preventing the investigators from ruling out the possibility that the study's findings may reflect cohort, rather than age, effects. Additionally, the cross-sectional study design does not allow the investigators to disentangle the directionality of the observed associations. This sample of convenience also consisted of mostly well-educated Caucasian men with relatively well-controlled HIV disease (e.g., median current CD4 cell count was 469.5). As such, these findings may not generalize to more demographically diverse populations, as well as populations with HIV who have lower degrees of current virologic suppression. Lastly, the assessment of substance use behaviors relied on self-report and was administered via a face-to-face interview, which may introduce bias. Despite potential measurement error, the substance use variables may minimally reflect the participants' perception of how their substance use has changed across their lifetime.

Conclusions

Methamphetamine use disorders are chronic and active throughout the life span. Age, HIV serostatus, and HIV seroconversion impact methamphetamine use parameters. Given that the number of adults aged 50 or older with substance use disorder is expected to increase significantly (30), health care providers need to address both issues of substance use and other behaviors that confer risk for HIV transmission in older individuals. By building knowledge about substance use characteristics across the age continuum, tailored substance abuse treatment and prevention strategies may be improved in order to reach and engage persons at risk for HIV transmission or seroconversion.

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Table 1

Demographics by HIV serostatus among the methamphetamine-dependent sample

Variable	HIV- (n=100)	HIV+ (n=117)	Overall sample (n=217)	p-value
Descriptive demographics				
Age, mean (SD)	40.4 (8.5)	41.0 (7.2)	40.7 (7.8)	
Education, mean (SD)	11.9 (2.0)	13.1 (2.0)	12.5 (2.1)	<.001
Male, n (%)	88 (88.0%)	111 (94.9%)	199 (91.7%)	FET .08
Caucasian, n (%)	61 (61.0%)	81 (69.2%)	142 (65.4%)	ns
Sexual orientation ^b				<.001
Gay/bisexual male, n (%)	19 (19.4%)	90 (78.3%)	109 (51.2%)	
Heterosexual male, n (%)	67 (68.4%)	19 (16.5%)	86 (40.4%)	
Lesbian/Bisexual/Heterosexual female, n (%)	12 (12.2%)	6 (5.2%)	18 (8.5%)	
Psychiatric diagnoses				
Current MDD, n (%)	14 (14.0%)	21 (17.9%)	35 (16.1%)	ns
LT MDD, n (%)	42 (42.0%)	67 (57.3%)	109 (50.2%)	.03
LT ADHD, n (%)	16 (16.5%) ^c	19 (16.7%) ^d	35 (16.6%) ^e	ns
LT ASPD, n (%)	30 (30.9%) ^c	21 (18.4%) ^d	51 (24.2%) ^e	.03
BDI-II total, median [IQR]	14.0 [6.3, 21.8]	14.0 [5.5, 21.0]	14.0 [6.0, 21.0]	ns
LT substance dependence or abuse diagnosis				
Alcohol, n (%)	73 (73.0%)	80 (68.4%)	153 (70.5%)	ns
Cocaine, n (%)	35 (35.0%)	46 (39.3%)	81 (37.3%)	ns
Cannabis, n (%)	54 (54.0%)	55 (47.0%)	109 (50.2%)	ns
Opioid, n (%)	14 (14.0%)	6 (5.1%)	20 (9.2%)	FET .02
Neuropsychological (NP) functioning				
Global deficit score, median [IQR]	.30 [1.1, .56]	.26 [.08, .54]	.28 [1.1, .56]	ns
NP impaired, n (%)	30 (30.0%)	31 (26.5%)	61 (28.1%)	ns
Pre-morbid Verbal IQ ^a , mean (SD)	95.8 (11.3) ^f	98.7 (12.0) ^g	97.3 (11.7) ^h	.08
HCV, n (%)	25 (26.0%) ⁱ	30 (27.0%) ^j	55 (26.6%) ^k	ns
HIV disease characteristics				
On ART, n (%)	-	79 (71.2%) ^j	-	-

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Variable	HIV- (n=100)	HIV+ (n=117)	Overall sample (n=217)	p-value
Current CD4, median [IQR]	-	469.5 [328.5, 636.0] ^f	-	-
Nadir CD4, median [IQR]	-	219.0 [68.5, 384.0] ^g	-	-
HIV plasma viral load detectable, n (%)	-	62 (57.9%) ^m	-	-
AIDS, n (%)	-	55 (47.8%) ⁿ	-	-
Age of first positive HIV test, mean (SD)	-	33.1 (8.1)	-	-
Estimated years living with HIV, mean (SD)	-	7.9 (7.0)	-	-
Self-reported route of HIV acquisition				
Male-to-male sexual contact, n (%)	-	78 (66.7%)	-	-
Injection drug use, n (%)	-	16 (13.7%)	-	-
Heterosexual contact, n (%)	-	15 (12.8%)	-	-
Other/unknown, n (%)	-	8 (6.8%)	-	-

Note: LT=lifetime; MDD=major depressive disorder; ADHD=attention deficit hyperactive disorder; ASPD=antisocial personality disorder; BDI-II=Beck Depression Inventory II; HCV=hepatitis C virus; HIV=human immunodeficiency virus; ART=antiretroviral treatment; CD4=cluster of differentiation 4; AIDS=acquired immunodeficiency syndrome; ns=statistically non-significant at alpha level=.10

^aBased on the reading subtest of the Wide Range Achievement Test (WRAT)

^b=213
^c=97
^d=114
^e=211
^f=95
^g=109
^h=204
ⁱ=96
^j=111
^k=207
^l=112
^m=107

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Table 2

Methamphetamine use characteristics by HIV serostatus among the methamphetamine-dependent sample

Variable	HIV- (n=100)	HIV+ (n=117)	Overall sample (n=217)	p-value
Age of first use, median [IQR]	20 [16, 26] ^a	25 [19, 32] ^b	22 [18, 30] ^c	<.001
Recency of use (days), median [IQR]	91 [21, 274] ^a	61 [30, 152] ^d	61 [21, 213] ^e	ns
Cumulative quantity (grams), median [IQR]	2159 [603, 6354]	980 [280, 2531]	1232 [411, 3440]	.001
Cumulative days of use, median [IQR]	2832 [1150, 5583]	1413 [588, 3473]	2144 [724, 4299]	.001
Span of use (years), median [IQR]	20 [13, 25]	16 [9, 22]	18 [9, 23]	.01
Average density per use, median [IQR]	.89 [.36, 1.67]	.63 [.26, 1.22]	.75 [.29, 1.39]	.06
Binge use endorsed, n (%)	80 (82.0%) ^f	87 (78%) ^g	167 (80%) ^h	ns
IV use endorsed, n (%)	47 (47.0%)	70 (59.8%) ^b	117 (53.9%)	.05
Primary route of administration				ns
Smoking, n (%)	55 (55.0%)	61 (52.1%)	116 (53.5%)	
Intranasal, n (%)	24 (24.0%)	27 (23.1%)	51 (23.5%)	
Injection, n (%)	20 (20.0%)	27 (23.1%)	47 (21.7%)	
Other, n (%) [*]	1 (1.0%)	2 (1.7%)	3 (1.4%)	

Note: Span of use is defined as the difference between age of last use and age of first use; Density is defined as the average grams consumed per day of reported use; IV=intravenous; "Other" category includes rectal and ingesting; ns=statistically non-significant at alpha level=.10

^a =99^b =116^c =215^d =115^e =214^f =97^g =112^h =209

Table 3

Multivariable regressions testing the association between age, HIV serostatus, and methamphetamine use characteristics

	Adj R ²	F	β	p-value
Span of Use	.37	31.57		<.001
Age			.50	<.001
Education			-.18	.004
Sexual orientation				
Heterosexual male [ref]				
Gay/bisexual male			-.27	.003
Lesbian/bisexual/heterosexual female			.07	.38
Cumulative Days of Use	.27	20.08		<.001
Age			.38	<.001
HIV serostatus [ref: HIV-]			-.18	.004
Education			-.32	<.001
ASPD diagnosis [ref: no]			.14	.03
Age of First Use	.26	19.75		<.001
Age			.37	<.001
Education			.21	.001
Sexual orientation				
Heterosexual male [ref]				
Gay/bisexual male			.35	<.001
Lesbian/bisexual/heterosexual female			-.13	.13
Cumulative Quantity	.13	11.89		<.001
Age			.23	<.001
HIV serostatus [ref: HIV-]			-.16	.01
Education			-.22	.001
Recency of Use	.03	4.29		.01
ASPD diagnosis [ref: no]			.13	.06
Lifetime opioid use diagnosis [ref: no]			-.17	.02
Density of Use	.01	3.56		.06
HIV serostatus [ref: HIV-]			-.13	.06

Note: ASPD = antisocial personality disorder

Table 4

Comparison of methamphetamine use characteristics during the pre- and post-diagnosis of HIV epochs for the HIV+ sample

Variable	Younger HIV+ (n=46)	Older HIV+ (n=71)	Time (p)	Group (p)	Time × Group (p)	Lifetime Cocaine Diagnosis (p)	Pre-morbid Verbal IQ ^a (p)
Quantity (grams)			.08	.89	.97	.04	-
Pre	98 [1, 841]	209 [3, 1317]					
Post	195 [51, 1353]	293 [81, 1161]					
Days of use			.42	.08	.72	-	.01
Pre	220 [9, 1232]	368 [12, 2557]					
Post	238 [71, 1142]	491 [136, 1527]					
Span of use (years)			.95	.001	.62	-	.03
Pre	6 [1, 10]	6 [2, 16]					
Post	4 [1, 8]	6 [4, 12]					
Average density per use			<.001	.02	.52	-	-
Pre	.25 [.05, 1.16]	.36 [.08, .70]					
Post	.83 [.29, 1.75]	.50 [.25, 1.20]					

Note: Groups: younger (ages 20 to 39 years) and older (ages 40 to 58 years) age

^aBased on the reading subtest of the Wide Range Achievement Test (WRAT)