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## Illicit drug use and HIV treatment outcomes in a US cohort

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### Abstract

**Objective**—To determine the prevalence of illicit drug use and the impact on HIV treatment.

**Design**—Multivariable regression of cross-sectional data from 1163 HIV-infected and 294 controls from the Study of Fat Redistribution and Metabolic Change in HIV Infection (FRAM).

**Methods**—An analysis of (1) prevalence of specific illicit drug use (ever, current), (2) being on HAART among those with an indication and (3) current HIV RNA and CD4 cell count among HAART users.

**Results**—Median age was 42 years, approximately 50% were non-Caucasian and 33% were women. Eighty-six percent of HIV-infected and 67% of controls reported ever using illicit drugs ( $P < 0.0001$ ); 28% of HIV-infected and 16% of controls reported current use ( $P = 0.0001$ ). In adjusted models, current cocaine use and past heroin use were associated with not currently being on HAART. Among HAART users, those reporting past heroin use were as likely to have an undetectable HIV viral load as those who had never used heroin. Current and past cocaine use and current heroin use was associated with lower odds of undetectable HIV RNA. Past amphetamine use was associated with having an undetectable HIV. Similar results were seen for CD4 lymphocyte counts.

**Conclusion**—Illicit drug use in the US is common, although far fewer report current use than past use. Among HIV-infected patients, understanding of the type of illicit drugs used and whether drug use was in the past or ongoing is important, because of their differential effects on HIV treatment outcomes.

### Keywords

amphetamines; cocaine; heroin; HIV; street drugs; viral load

## Introduction

HIV infection is epidemic in the US and illicit drug use, a major risk factor for HIV acquisition, is highly prevalent [1]. Once infected, the continued use of illicit drugs contributes to the ongoing transmission of HIV infection [2]. Some data in HIV-infected patients suggest that current use of illicit drugs is predictive of a poorer HIV outcome. A longitudinal study of HIV-infected participants in Baltimore, Maryland found that the risk of developing new opportunistic infections was two-fold higher for both intermittent drug users during periods of active use and for persistent drug users. During periods of illicit drug abstinence, however, the risk of opportunistic infection was similar to that for those who never used drugs [3].

Furthermore, not all illicit drugs appear to carry the same risk of nonadherence to HAART. Tucker and colleagues, using data from the HIV Cost and Services Utilization Study, found that use of cocaine, marijuana, amphetamines, or sedatives in the previous month was associated with approximately two-fold odds of nonadherence [4]. In another small study of 85 HIV-infected current and former drug users, the strongest predictor of nonadherence to HAART was active cocaine use. In that study active cocaine users were less likely to maintain viral suppression than nonusers during the six-month study period [5].

Using self-reported, anonymous data from a large, nationally representative multicenter cohort of HIV-infected individuals and controls, we report the prevalence of specific illicit drug use, including ever having used, current use, and the amount of illicit drugs participants reported using over their lifetime (lifetime use). In addition, we report on the association between use of specific illicit drugs and being on HAART, and among those on HAART, the association between specific illicit drug use and both HIV viral load and CD4 lymphocyte count.

## Methods

### Outcome measurements

The study of Fat Redistribution and Metabolic Change in HIV Infection (FRAM) enrolled 1183 HIV-infected persons and 297 controls from June 2000 to September 2002. HIV-infected participants were recruited from sixteen participating HIV, infectious disease clinics, or cohorts. Participating HIV sites were selected based upon geographic diversity and the ability to perform the protocol. The 16 HIV clinical sites included in FRAM were affiliated to academic medical centers, and most were highly experienced in conducting HIV clinical trials. The FRAM population is representative of patients with HIV infection in the US [6]. Control participants were recruited from two centers (Birmingham, Alabama and Oakland, California) of the Coronary Artery Risk Development in Young Adults (CARDIA) study that followed participants longitudinally enrolled in the Visceral Fat and Metabolic Rate in Young Adults (VIM) ancillary study of CARDIA. CARDIA participants were originally recruited as a population-based sample of healthy 18 to 33-year-old Caucasian and African American men and women from four cities in 1986 for a longitudinal study of cardiovascular risk factors. The VIM ancillary study recruited participants from two of the four CARDIA Centers in 1995–96. VIM enrolled approximately 100 CARDIA participants from each of the race-gender groups with BMI distributed similarly above and below race-gender specific medians of the population-based CARDIA study. The CARDIA methodology has also been previously reported [7,8]. Eighty-three percent of CARDIA participants approached agreed to participate in FRAM at the year 15 CARDIA study visit. The FRAM protocol was approved by institutional review boards at all sites.

## Measurements

Illicit drug use was assessed by a standardized self-administered questionnaire developed for the CARDIA study that included questions regarding use of crack, cocaine, heroin, amphetamines, and marijuana [8,9]. The questionnaire was covered by an NIH Certificate of Confidentiality. For prevalence of illicit drug use, use was categorized as current (within the last 30 days), ever or never. Adherence was based on the AIDS Clinical Trials Group measure of 3 days prior to the study visit. For analysis of illicit drug and the association with receipt of HAART, HIV RNA levels and CD4 lymphocyte count, drug use was categorized as current, past but not current, or never. Based on the CARDIA questionnaire, amount of current use was further divided into <10 days per month versus  $\leq 10$  days per month. Lifetime drug use was divided into  $\geq 10$  times versus greater than 10 times; lifetime marijuana was divided into  $\leq 100$  times versus greater than 100 times. Age, gender, ethnicity, medical history, and risk factors for HIV were determined by self-report. Income was stratified into tertiles: <US\$12 000, US\$12 000–35 000, and >US\$35 000 per annum.

In HIV-infected participants, CD4 lymphocyte count and HIV RNA quantification were measured centrally, and research associates performed a detailed chart abstraction of all antiretroviral medications as well as medical history. Participants were considered to have AIDS if they had a CD4 lymphocyte count less than 200 cells/ $\mu$ l or a history of an AIDS-defining illness.

Data from the FRAM sites were categorized geographically into four regions: (1) south-east: Atlanta VA Center, Atlanta, Georgia; University of Alabama, Birmingham, Alabama; Johns Hopkins University School of Medicine, Baltimore, Maryland; University of North Carolina, Chapel Hill, North Carolina and the Washington DC VA Center, Washington, DC; (2) north-east: New York Harbor VA Center, New York, New York; Tufts University, Boston, Massachusetts and St. Lukes-Roosevelt Hospital Center, New York, New York; (3) central: Indiana University, Indianapolis, Indiana; University Hospitals of Cleveland, Cleveland, Ohio; University of Colorado HSC, Denver Colorado and Washington University, St Louis, Missouri; and (4) west coast: Stanford University: Palo Alto, California; University of California, San Diego Owen Clinic, San Diego, California; University of California, San Francisco, California and the University of California, Los Angeles, California.

## Statistical analysis

Analyses were restricted to 1163 HIV-infected and 294 control men and women, after exclusion of those with missing illicit drug use questionnaires ( $n = 12$  HIV-infected and  $n = 3$  controls). Analyses that compared HIV-infected persons with controls were restricted to those between the ages of 33 and 45 ( $n = 620$  HIV-infected), since the control population did not include participants outside this age range. Characteristics of the HIV-infected participants and controls were compared and tested for statistical significance using the Mann–Whitney U test for continuous variables, and Fisher’s exact test for categorical variables.

Among HIV-infected patients in the full cohort ( $n = 1163$ ), multivariable logistic and linear regression models were used to examine the association of illicit drug use with being on HAART, HIV viral suppression (defined as HIV RNA <400 copies/ml), and current CD4 lymphocyte count. The analysis of the association between illicit drug use and current HAART was restricted to patients with AIDS by CD4 cell count or prior AIDS-defining illness, because at the time of our study, national guidelines recommended the initiation of HAART when the CD4 cell count either fell below 200 cells/ $\mu$ l or there was a history of

AIDS. The associations of illicit drug use with HIV viral load and CD4 cell count were analyzed in current HAART users.

These regression models were built using stepwise regression with  $P = 0.05$  for entry and retention. Gender, age, and ethnicity were included in every model. Models were built in a sequence of steps, where each step built on the prior ones, controlling for (1) demographic factors only; (2) illicit drugs and socio-economic factors; (3) hepatitis C virus (HCV) status (by HCV RNA level); and (4) antiretroviral adherence (for HIV viral load and CD4 outcomes). At each stage, a factor was dropped from the model if it did not reach statistical significance or if it worsened model fit as assessed by standard statistical measures [e.g., adjusted  $R^2$ , Akaike information criteria (AIC), area under the receiver operating characteristic curve (AROC), etc.]. We separately analyzed the use of speed, heroin and cocaine/crack, as there was incomplete overlap among the use of these categories of drugs; however, we pooled crack and cocaine because they are chemically similar and had overlap of use. We tested for a dose–response relationship of illicit drugs used, both for current amount of drug used and, separately, for the amount of lifetime use.

Interactions between gender, ethnicity, and other factors in the model were assessed; no statistically significant interactions were identified. The linearity assumption for continuous predictors was also tested. Candidate variables considered for inclusion in the multivariable models included illicit drug use (marijuana, amphetamines, heroin, crack, cocaine, and the combination of crack or cocaine use), socio-economic factors (income, education, homeless status, and adequate food intake), HCV status, HAART use, and antiretroviral adherence (for the 3 days prior to the study visit). In model step (2), illicit drug use was categorized as current, past, or never.

Due to its skewed distribution, current CD4 lymphocyte count was log-transformed in all linear regression analyses; the results were back-transformed to produce estimated percentage effects. Confidence intervals in linear regression analyses were determined using the bias-corrected accelerated bootstrap method [10], with  $P$ -values defined as one minus the highest confidence level that still excluded zero; this was necessary because the error residuals appeared to be non-Gaussian. Logistic regression models were assessed at each stage using the Hosmer–Lemeshow goodness of fit test [11]. All analyses were conducted using the SAS system, version 9.1 (SAS Institute, Inc., Cary, North Carolina, USA).

## Results

### Participant demographics

TABLE 1 displays the demographic information for the patients included in this analysis. The characteristics of the twelve HIV-infected patients excluded because they did not fill out the drug use questionnaires were similar to those included, other than excluded patients having a higher rate of AIDS-defining illness in comparison with those included (17 versus 2%,  $P = 0.036$ ); however, the 17% represents only two out of the 12 patients. Nearly half of the FRAM participants' risk for HIV infection was men who have sex with men (MSM); CARDIA participants were not queried about HIV-related risk factors.

### Prevalence of self-reported drug use

Figure 1 displays self-reported use of illicit drugs of study participants. The majority reported a history of illicit drug use. More HIV-infected patients reported ever using any illicit drug than controls (86 versus 67%,  $P < 0.0001$ ), but the majority was marijuana. Although report of marijuana use was more common in HIV-infected patients in comparison with controls (83 versus 66%,  $P < 0.0001$ ), fewer HIV-infected patients reported using nothing other than marijuana (19 versus 26%,  $P < 0.0001$ ). Among those who reported ever

use of marijuana, 22% of HIV-infected patients and 1.6% of controls reported they used marijuana for medical reasons. History of use of other illicit drugs (amphetamines, heroin, crack or cocaine) was more common in HIV-infected patients in comparison with controls (67 versus 41%,  $P < 0.0001$ ).

The trends for current drug use were similar to those for ever having used drugs, although current drug use was much less prevalent than ever drug use. More HIV-infected patients reported current use of illicit drugs (28 versus 16%,  $P = 0.0001$ ) and current use of illicit drugs other than marijuana (10 versus 2%,  $P < 0.0001$ ).

For those who report only marijuana use, current marijuana only use was 39% among HIV-infected patients and 20% among control individuals. Among those who reported any current use of marijuana, 29% of HIV-infected and 4% of controls reported using marijuana for medical reasons.

Figure 2 displays the self-reported use of illicit drugs, categorized by the number of times used over the lifetime. Categories were based on the previously validated CARDIA instrument. Again, reported lifetime use of each drug was greater in those with HIV infection.

### Gender and ethnic differences

Prevalence of illicit drug use was also examined by gender and race. Among the HIV-infected patients, women and African Americans reported more lifetime crack and heroin use, whereas men and Caucasians reported more lifetime marijuana and amphetamine use. Among controls, it was found that men reported more lifetime use of cocaine, crack, and amphetamines. African Americans reported more crack use but less use of other drugs in comparison with Caucasians. Patterns of ever and current use showed similar results. When separated by gender and race, use of most drugs was higher in HIV-infected patients than in the respective controls.

### Illicit drug use and HAART

**Association of drug use with receipt of HAART in those with AIDS**—We then evaluated whether illicit drug use was associated with currently being on HAART in those with an AIDS diagnosis, for whom treatment is clearly warranted. Table 2 displays the factors associated with current use of HAART in a multivariable logistic regression analysis. Women and current users of crack or cocaine were less likely to be on HAART, as were past users of heroin. Current heroin users were also less likely to be on HAART, but prevalence of current heroin use was low and the association did not reach statistical significance.

Use of HAART in those with AIDS appeared similar by age and race. Associations between amount of each drug used in the past 30 days, or in a lifetime and being on HAART did not reach statistical significance in any models; there appeared to be no dose–response relationship.

**Association of drug use with viral suppression and CD4 lymphocyte count among those on HAART**—The factors associated with achievement of viral suppression (undetectable HIV RNA quantification) for patients currently on HAART were assessed (Table 3). Seventy-six percent of the HIV-infected FRAM participants were on HAART. Multivariable analysis demonstrated that African Americans were less likely than Caucasians to have an undetectable HIV RNA, as were current users of heroin and crack or cocaine in comparison with those who had never used each drug. Past crack/cocaine use was associated with lower odds of being suppressed, but not past heroin use.

Age and gender showed little or no association with viral suppression. In contrast, the data demonstrated that past use of amphetamines was associated with higher odds of having an undetectable HIV RNA. Not surprisingly, adherence was also associated with having an undetectable HIV RNA. Marijuana use did not appear to be associated with HIV treatment outcomes in any of the models (data not shown).

We also evaluated the factors associated with current CD4 lymphocyte counts (Table 4). African Americans had 24% lower CD4 lymphocyte counts than Caucasians, similar to the lack of suppression of viral replication. Women had 21% higher CD4 lymphocyte counts, similar to the slight but not statistically significant trend toward higher viral suppression in women. Lower income was associated with lower CD4 cell count; level of education did not appear to have an independent association with CD4 cell count. Current heroin use was associated with 53% lower CD4 lymphocyte counts. Similar to the analysis of viral suppression, past heroin use did not appear to be associated with a substantially lower CD4 lymphocyte count; nor did current or past cocaine use. In contrast, both current amphetamine use and past amphetamine use were associated with higher CD4 lymphocyte counts in comparison with those who had never used amphetamines. Adherence was associated with 15% higher CD4 lymphocyte counts, but did not reach statistical significance ( $P = 0.075$ ). After multivariable adjustment, geographic region showed essentially no association with receipt of HAART, viral suppression, or CD4 lymphocyte counts.

## Discussion

In this large, nationally representative multicenter study of HIV-infected and control individuals, we found a high prevalence of past illicit drug use, but the majority was marijuana. Few other cohorts have been as large and systematically recruited as FRAM. Nearly all of the HIV-infected patients and two-thirds of control participants reported a history of illicit drugs, mainly marijuana, but only 28% of HIV-infected and 16% of control individuals reported current use of any illicit drug. History of crack, cocaine, and heroin use was more common in HIV-infected patients, consistent with data that suggests that use of these drugs is associated with HIV acquisition [12]. We also observed that specific illicit drugs had different associations with being on HAART, and among those on HAART, achieving viral suppression.

Even though significantly fewer FRAM patients report current use of illicit drugs in comparison with the number who reported ever using, the prevalence of current illicit drug use in both HIV-infected and control individuals in our study remained substantially higher than the approximate 8% prevalence reported in the 2005 National Survey on Drug Use and Health in patients of similar age [13]. The higher rates of illicit drug use in the FRAM study at our control sites may be explained in part by the fact that our study sites were mainly focused around US urban centers. Although there were small geographic regional differences in illicit drug use (data not shown), they were smaller than the differences between HIV patients and control individuals. The majority of HIV-infected men in our study were men who have sex with men. Another study limited to men who have sex with men (regardless of HIV status) using an Internet survey conducted over a 6-month period found a 30% prevalence of marijuana use and 7% prevalence of cocaine use in the past 6 months [14]. Finally, our finding of less reported current illicit drug use in comparison with past use only is consistent with national trends suggesting that people generally stop using illicit drugs over time or as they age [13,15]. The reason for the decreased use of current illicit drugs is not clear, however. Whereas one factor could be aging in both HIV-infected and control individuals, other factors such as concern about health and HIV treatment may



play a role. These data suggest that future research into the reasons for stopping use should be considered.

As illicit drug use is a major risk factor for HIV acquisition, it is critical to understand the impact of use of specific drugs on HIV treatment outcomes. Several studies have found that active heroin use is associated with poorer HIV outcomes, whether due to poorer treatment adherence [16,17] and/or inadequacy of the social support network [18]. Cocaine use has also been associated with less adherence coupled with worse virologic and clinical outcomes [5,19,20]. Consistent with these studies, we report that current heroin and crack/cocaine users who were on HAART were less likely to achieve viral suppression. We have, however, observed that past heroin users who were on HAART were as likely as nonheroin users to achieve viral suppression. In FRAM, past heroin users were less likely to be on HAART, suggesting a possible bias against heroin users in receiving HAART. Some studies show that those in remission from substance abuse have higher rates of receipt of HAART [21]. Treatment of narcotic addiction with methadone maintenance therapy or buprenorphine/naloxon improves adherence and/or suppression of HIV viral load [22–24]. It will be important for future studies to evaluate the impact of drug treatment in HIV care centers.

There are somewhat limited and conflicting data on the impact of specific stimulant use on HIV treatment outcomes. In a longitudinal study of 150 HIV-infected individuals, of whom 102 tested positive for recent illegal drugs, those using stimulants, especially cocaine with methamphetamines, had a four-fold greater risk of nonadherence, particularly among those who had used within the past 3 days [25]. One study reported that methamphetamine use, in particular, was associated with increased risk-taking behavior, poorer adherence and worse clinical outcomes [26]. In contrast, another study did not find an association between methamphetamine use alone and adherence [27]. Using actual HIV RNA levels and CD4 cell count to assess treatment efficacy, past amphetamine users in FRAM were more likely to have an undetectable viral load and increased CD4 cell count, and current amphetamine users were more likely to have an increased CD4 cell count. The prevalence of current amphetamine use was low, with large confidence intervals. Given the limitations, we are hesitant to speculate on possible biological reasons. One small study did find that HIV-infected men who used methamphetamines had a lower prevalence of HIV-related diarrhea [28]. We report our results and look forward to additional studies to either confirm or refute these findings. Men who have sex with men (MSM) were just as likely to ever use amphetamines as all other HIV-positive men (39% of all HIV-positive versus 37% of MSM), suggesting an independent amphetamine effect. Our study, however, did not distinguish methamphetamines from other types of amphetamines. Finally, marijuana use showed no association with any HIV treatment outcome. Among HIV-infected patients, nearly one-third reported that they used marijuana for medical reasons. Our data confirm the importance of clinicians determining a patient's specific drug-use history and especially current use rather than assuming that all drug users are the same.

Our study has certain limitations. The data are self-reported and therefore subject to recall and reporting bias. As the control individuals were population-based, they differ in demographic factors from the HIV-infected patients in our study. Our adherence evaluation was based upon a single point in time, limiting our ability to fully explore this parameter. The strikingly lower current use of drugs in the last 30 days compared to 'ever' use is of importance in understanding the effects of past and present drug use. A caveat is, however, that we may not be able to adjust for all factors that might confound current drug use. Furthermore, we did not ask about amyl nitrate, recreational use of prescription drugs, or other drugs often considered to be 'party drugs'. The contribution of illicit drug use to current CD4 cell count levels is difficult to define in our study as many variables impact

current CD4 cell counts (including nadir CD4, time on antiretroviral therapy, and when HAART was initiated) that may not be fully accounted for in the multivariable model. Finally, it should also be noted that women had a lower odds of receiving HAART, although women who did receive HAART were slightly more likely than men to have a suppressed viral load. Future study into potential gender bias is needed.

Our study suggests that illicit drug use is common in the US, although far fewer people report current use compared to ever having used drugs. Among HIV-infected patients, an understanding of the type of illicit drugs used and whether drug use was in the past or is ongoing is important, because of their differential effects on HIV treatment outcomes. Past use of some illicit drugs, especially heroin and amphetamines, and current use of marijuana, may not be a barrier to achieving a therapeutic benefit from antiretroviral therapy. Our study contributes to the growing literature suggesting that HIV treatment programs need to incorporate treatment of current heroin and cocaine addiction.

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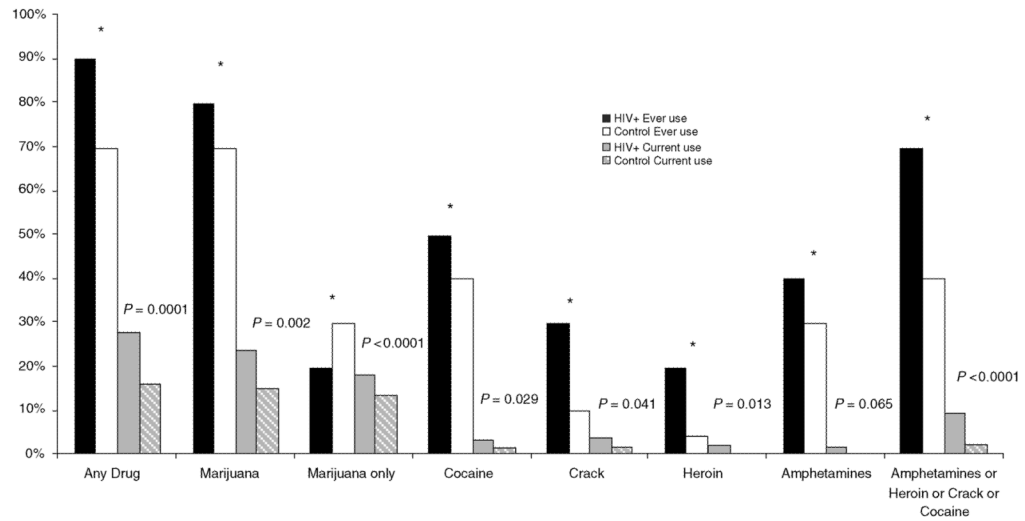
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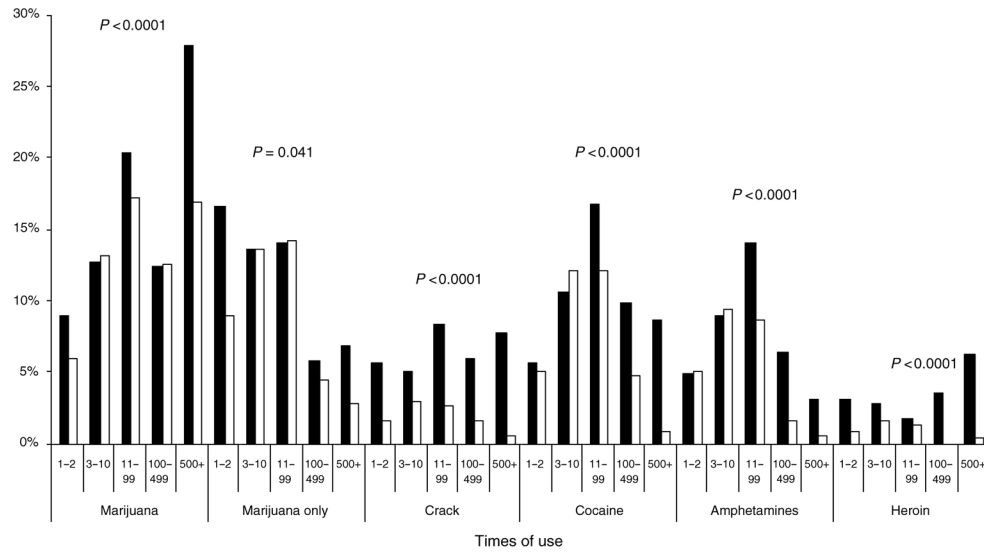
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**Fig. 1. Prevalence of self-reported illicit drugs (age restricted)**

\* $P < 0.001$  for all comparisons of ever use in HIV versus Control.  $P$ -values provided for comparison of current use in HIV-infected patients versus control individuals.



**Fig. 2.** Self-reported lifetime use of illicit drugs (age restricted).

TABLE 1

Demographic and clinical characteristics of HIV-infected and control individuals.

	HIV+(AR <sup>a</sup> )	Control	P-value	HIV+(not AR <sup>a</sup> )
<i>n</i>	620	294		1163
Age (years)				
Median	40.0	41.0	0.014	42.0
IQR	36.5–43.0	37.0–43.0		37.0–48.0
Gender				
Female	30%	48%	<0.0001	29%
Male	70%	52%		71%
Ethnicity				
Caucasian	49%	51%	<0.0001	48%
African American	38%	49%		39%
Hispanic	11%	0		10%
Other	1%	0		3%
Ever homeless	9%		NA	8%
Income				
<US\$12 000	38%	7%	<0.0001	39%
US\$12 000–35 000	35%	25%		34%
>US\$35 000	27%	69%		27%
Education				
Elementary	3%	0	<0.0001	3%
High School	42%	20%		40%
College	48%	63%		46%
Graduate school	8%	17%		10%
Current smoker	46%	17%	<0.0001	42%
HCV RNA+	19%	2%	<0.0001	22%
Current methadone	3%	0	0.0005	4%
Current CD4 cell count (cells/μl)				
Median	364	NA		350
IQR	214–531			214–539
CD4 cell count <200 cells/μl	24%	NA		23%
HIV RNA (1000 copies/ml)				
Median	0.4	NA		0.4
IQR	0.4–15.2			0.4–12.5
Detectable HIV RNA	51%	NA		49%
HAART status				
Current	78.5%	NA		76.4%
Past	11.5%			12.7%
Never	10.0%			11.0%
Antiretroviral adherence <sup>b</sup>	71.8%	NA		75.7%
Duration HIV (years)				

	HIV+(AR <sup>a</sup> )	Control	<i>P</i> -value	HIV+(not AR <sup>a</sup> )
Median	8.2	NA		8
IQR	5.4–11.8			5.2–11.7
HIV risk factors				
MSM	48%	NA		46%
IDU	19%			21%
Other	8%			9%
Heterosexual	25%			24%
Recent OI	3%	NA		2%
AIDS by CD4 cell count <200 cells/μl or OI	74%	NA		73%

HCV, hepatitis C virus; IDU, injection drug user; IQR, interquartile range; MSM, men who have sex with men; NA, not applicable; OI, opportunistic infection.

<sup>a</sup> AR, age restricted;

<sup>b</sup> Antiretroviral adherence was based on the 3 days prior to the study visit.



**Table 2**

Multivariable logistic regression analysis of demographic and illicit drug factors associated with being on HAART in HIV-infected patients with AIDS (not age restricted).

	Current HAART		
	OR	95% CI	P-value
Demographics			
Female versus male	0.57	(0.38, 0.85)	0.006
African American versus Caucasian	0.85	(0.56, 1.29)	0.44
Hispanic versus Caucasian	0.95	(0.49, 1.84)	0.88
Other versus Caucasian	0.40	(0.15, 1.08)	0.071
Age (per decade)	1.24	(0.98, 1.58)	0.077
Significant candidates			
Heroin: current versus never	0.42	(0.14, 1.24)	0.12
Heroin: past versus never	0.43	(0.27, 0.69)	0.001
Crack/cocaine: current versus never	0.40	(0.19, 0.85)	0.017
Crack/cocaine: past versus never	0.84	(0.54, 1.30)	0.43

CI, confidence interval; OR, odds ratio; Number of HIV-infected patients with AIDS: 834, with 82% receiving HAART.

**Table 3**

Multivariable logistic regression analysis of demographic and illicit drug factors associated with HIV RNA suppression in current HAART recipients (not age restricted).

	<b>Undetectable HIV RNA</b>		
	<b>OR</b>	<b>95% CI</b>	<b>P-value</b>
Demographics			
Female versus male	1.22	(0.85, 1.74)	0.27
African American versus Caucasian	0.60	(0.43, 0.85)	0.004
Hispanic versus Caucasian	0.87	(0.52, 1.47)	0.61
Other versus Caucasian	0.73	(0.29, 1.87)	0.51
Age (per decade)	1.09	(0.92, 1.30)	0.31
Significant candidates			
Adherent versus nonadherent	1.70	(1.19, 2.42)	0.003
Heroin: current versus never	0.19	(0.05, 0.74)	0.017
Heroin: past versus never	1.12	(0.71, 1.78)	0.63
Crack/cocaine: current versus never	0.43	(0.20, 0.91)	0.027
Crack/cocaine: past versus ever	0.65	(0.45, 0.94)	0.021
Amphetamines: current versus ever	1.23	(0.32, 4.78)	0.77
Amphetamines: past versus ever	1.86	(1.28, 2.69)	0.001

CI, confidence interval; OR, odds ratio; Number of current HAART recipients: 885: 60% with undetectable HIV RNA.

Table 4

Multivariable logistic regression analysis of demographic and illicit drug factors associated with current CD4 lymphocyte count in HIV-infected patients on current HAART (not age restricted).

	Current CD4 lymphocyte count			Median CD4 lymphocyte count
	% Effect	95% CI	P-value	
<b>Demographics</b>				
<b>Gender</b>				
Female versus male	20.9	(2.3, 41.1)	0.029	Male 338 Female 376
<b>Ethnicity</b>				
African American versus Caucasian	-23.6	(-34.2, -10.9)	<0.0001	African American 291
Hispanic versus Caucasian	-18.0	(-36.2, 2.6)	0.084	Hispanic 301
Other versus Caucasian	1.0	(-30.8, 43.3)	0.95	Other ethnicity 343
Age (per decade)	4.0	(-3.4, 12.2)	0.34	Caucasian 406
<b>Significant candidates</b>				
<b>Heroin</b>				
Current versus never	-53.0	(-85.1, -18.7)	0.003	Heroin: never use 359
Past versus never	-6.6	(-24.0, 13.5)	0.51	Heroin: current use 261
<b>Amphetamines</b>				
Current versus never	101.4	(41.8, 198.4)	<0.0001	Heroin: past use 335
Past versus never	15.5	(0.3, 32.0)	0.044	Amphetamines: never use 332
<b>Income</b>				
<US\$12 000 versus >US\$35 000	-28.5	(-38.3, -15.5)	<0.0001	Amphetamines: current use 466
US\$12 000-35 000 versus >US\$35 000	-15.1	(-27.7, -1.5)	0.032	Amphetamines: past use 376
				Income: >US\$35 000 424
				Income: <US\$12 000 286
				Income: US\$12 000-35 000 336

CI, confidence interval. Outcome is log-transformed CD4 lymphocyte count; results are back-transformed. Number of current HAART recipients: 885.