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Neurocognitive Impact of Substance Use in HIV Infection

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Running head: Substance use, HIV and neurocognition

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ABSTRACT

BACKGROUND: To determine how serious a confound substance use (SU) might be in studies on HIV-associated neurocognitive disorder (HAND) we examined the relationship of SU history to neurocognitive impairment (NCI) in participants enrolled in the CNS HIV Antiretroviral Therapy Effects Research (CHARTER) study. METHODS: After excluding cases with behavioral evidence of acute intoxication and histories of factors that independently could account for NCI (e.g., stroke), baseline demographic, medical, SU, and neurocognitive data were analyzed from 399 participants. Potential SU risk for NCI was determined by the following criteria: lifetime SU DSM-IV diagnosis, self-report of marked lifetime SU, or positive urine toxicology (UTOX). Participants were divided into three groups: no SU (N = 134), Non-syndromic SU (N = 131), syndromic SU (N = 134) and matched on literacy level, nadir CD4, and depressive symptoms. RESULTS: While approximately 50% of the participants were diagnosed with HAND, a MANCOVA of neurocogntive summary scores, covarying for UTOX, revealed no significant effect of SU status. Correlational analyses indicated weak associations between lifetime heroin dosage and poor recall and working memory, as well as between cannabis and cocaine use and better verbal fluency. CONCLUSIONS: These data indicate that HIV neurocognitive effects are seen at about the same frequency in those with and without historic substance abuse, in cases that are equated on other factors that might contribute to NCI. Therefore, studies on neuroAIDS and its treatment need not exclude such cases. However, the effects of acute SU and current SU disorders on HAND require further study.

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Keywords: Substance use, HIV-associated neurocognitive disorder, cognition

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Introduction

HIV infection and abuse of alcohol and illicit substances are independently associated with neurologic, neurocognitive, and neuropathologic complications (1-6). When concurrent, drugs of abuse can exacerbate the neuropathogenesis of HIV by suppressing immunity and increasing viral replication in the central nervous system (7-9). Some research has confirmed synergistic deleterious effects of substance use (SU) on neurocognitive functioning and the progression of HIV-related neurocognitive disorders (10-15). Given these findings, some investigators have questioned the appropriateness of including substance abusers in neurocognitive HIV studies. Importantly, the number of HIV-infected persons with significant substance use histories has been increasing since the 1980's (16). To exclude these individuals from participation in neuroAIDS research would limit understanding of the neurological manifestations of HIV in SU patients and decrease generalizability of findings.

Despite concerns regarding the synergy of HIV infection and substance use, studies have produced conflicting results (17-26). Primary contributing factors to these conflicting results are methodologic and include heterogeneity of study designs, variable comparison groups (e.g., normative data sets, matched seronegatives), methods of SU history ascertainment (e.g., self-report versus objective measurement; syndromic diagnoses versus report of misuse), small sample sizes, and importantly, lack of control for other impactful co-factors (e.g., literacy level, depression, and other comorbid conditions with potential CNS effects; 27). Further, most studies of mono-drug abuse and HIV-related cognitive functioning fail to control for past or present use of other substances, even though published data confirm that substance users typically use

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multiple substances over their lifetimes and even simultaneously (28, 29). Even neurocognitive studies in which polysubstance users with and without HIV were well matched demographically have yielded mixed results (30, 31). Thus, the appropriateness of including substance abusing participants in cognitive research remains uncertain.

To date, no study of a large, multi-site, diverse HIV-infected cohort has examined the impact of substance use histories on neurocognitive functioning while simultaneously considering other relevant demographic and medical factors. To address this limitation, the present study selected cases from the CHARTER study that differed in substance use status, but were relatively free of other comorbidities (e.g., head injuries) that might confound interpretation of the contribution of substance use to NC function. The aim of the current study was to determine whether persons with histories of illicit substance use deserve special inclusion consideration in cognitive neuroAIDS research. We hypothesized that: 1) HIV-infected participants with histories of prior SU disorders and/or recent use of illicit substances would be more neurocognitively (NC) impaired than HIV-infected patients without such histories, and 2) cumulative lifetime dose of substances would be negatively correlated with NC functioning.

Methods

Participants

The 1284 HIV+ participants evaluated for this study were derived from the CHARTER cohort and had complete data in the fields described below which served to create three matched groups. The design and methods of CHARTER have been reported previously (33). In brief, the aim of the parent CHARTER study was to determine the prevalence,

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characteristics, and correlates of HAND in the context of current combination antiretroviral therapy (CART).

Procedure and Measures

The following assessments were completed at baseline evaluation: neuromedical examination, including blood samples for laboratory and virologic determinations; neurocognitive (NC) testing; and a diagnostic neuropsychiatric interview, including detailed substance use history, a measure of depressive symptoms, urine toxicology screen, and self-report assessments of cognitive symptoms and activities of daily living. Participants demonstrating behavioral evidence of intoxication or acute withdrawal were not administered the NC battery at the time of presentation and were rescheduled. Additionally, 239 participants were excluded who had conditions other than HIV ("confounds") that would be expected to compromise NC test performance (e.g., traumatic brain injury, stroke, seizure history, special education; 32, 33). This was completed by a senior neuropsychologist (R.K.H.). The classification of these conditions was made by independent review of cases by two senior investigators with extensive experience in HIV neurocognitive research: a neuropsychologist (R.K.H.) and a neurologist (D.B.C.) following the guidelines for the classification of comorbid conditions set forth in the Frascati Criteria for the diagnosis of HIV Associated Neurocognitive Disorder (HAND; 32). Rates of agreement were calculated and disagreement was adjudicated.

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Neuromedical Examination

The neuromedical examination included a detailed medical history, a structured neurological and medical evaluation, antiretroviral medication history, and adherence assessments. Collected blood samples were tested for hepatitis C, CD4+ counts and HIV viral load. Nadir CD4 was provided by participant self-report.

Neurocognitive Test Battery

A comprehensive battery of NC tests, listed in Appendix 2 with normative references, was used to assess learning, memory, speed of information processing, fine motor speed, executive functioning, verbal fluency, working memory and literacy (34-38). Raw scores from all tests were converted to demographically adjusted T-scores that adjusted performance for effects of age, education, sex and ethnicity. T-scores for each test were averaged to yield domain T-scores for each cognitive domain, as detailed in the Appendix, which were averaged to compute the Global NC T-score.

Neurocognitive Disorder Classifications

HAND was diagnosed using a computerized algorithm that established presence of the criteria specified by the recently published international nomenclature (Frascati criteria; 32, 33). In general, criteria for HIV-associated dementia (HAD) and mild neurocognitive disorder (MND) requires evidence of impairment in at least two cognitive domains and functional impairment. Asymptomatic neurocognitive impairment (ANI) was diagnosed when cognitive impairment was observed without functional impairment.

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Depressive Symptoms

The Beck Depression Inventory, 2nd edition (BDI-II), is a self-report measure of depressive symptoms comprising 21 items, each with four possible responses that are assigned a score ranging from zero to three, with a higher total score indicating depression severity (39).

Functional Status/Cognitive Complaints

A modified version of the Lawton and Brody Activities of Daily Living Questionnaire (40) assessed self-report of ability to independently complete daily tasks: (e.g., managing finances, housekeeping, etc.). Functional dependence was determined by significant difficulty with at least two of 13 specified daily tasks (41).

Cognitive symptoms were measured with the Patient's Assessment of Own Functioning Inventory (PAOFI; 42), a self-report measure in which participants indicate how frequently they experience difficulties with their memory, language and communication, sensory perceptual and motor skills, and higher level cognitive functions (e.g., calculations, navigation, and problem solving).

Substance Use

The computerized World Health Organization Composite International Diagnostic Interview-Substance Abuse Module (CIDI-SAM 2.1) was used to ascertain lifetime and current (within the last 30 days) DSM-IV diagnoses of substance abuse and dependence (43). Queried substances included alcohol, amphetamines and other stimulants, cannabis, cocaine, phencyclidine (PCP) and other hallucinogens, inhalants,

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opiates, barbiturates and other sedatives. If a participant reported frequent use of a substance (five or more times), the CIDI examiner determined if criteria for abuse or dependence were met. Separately, total lifetime quantity and duration of use was evaluated with a structured questionnaire. Using standardized units for each substance (e.g., 1 unit = 1 drink or 1 line of cocaine), lifetime dosage was estimated by multiplying the number of units/grams used per day by the number of days in each epoch of use (time periods where use was consistent), and adding the units for each epoch, yielding a cumulative number of units/grams used across a participant's lifetime.

All participants were screened for recent use of alcohol or illicit substances by breathalyzer (Alcohol Countermeasure Systems ALERT J5x, Toronto) and urine toxicology conducted immediately before neuropsychological assessment. Urine toxicology was completed with on-site dipstick testing using Rapid Response Urinalysis Strips (Labstix, Coral Springs) and screened for non-prescription opiates (determined by review of prescribed medications), cocaine, methamphetamine, cannabinoids, benzodiazepines and PCP metabolites.

SU Group Classification

SU status was determined by three methods in order to capture the full range of substance exposure and, in particular, to avoid inclusion of drug users in the no-SU group simply because they denied significant functional impacts of their substance use: 1) meeting DSM-IV diagnostic criteria for at least one SU disorder (abuse or dependence) in the past, 2) positive urine toxicology for illicit substances and 3) self-report of lifetime use of illicit substances. All 1284 participants were grouped into one of

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three SU categories through a series of steps. First, a control “no SU” group was formed by selecting participants who were negative for all three above mentioned criteria (n = 134). Notably, the no SU group was a small minority of the total sample. Second, all participants who met diagnostic criteria for a lifetime substance disorder were classified as “Syndromic SU” (n = 942). Finally, the remaining participants who did not meet DSM-IV criteria but who had either positive urine toxicology or admitted using an illicit substance at least five times were grouped into the “Non-syndromic SU” group (n = 208; 19, 26).

Participants in each of the two SU groups were separately matched to persons in the non-SU group. We equalized the group sizes by individually matching the non-SU group, to the closest degree possible, on selected demographic and medical factors, to persons from the Syndromic and Non-syndromic SU groups. The factors considered for matching were drawn from studies which identified variables relevant to NC test performance in HIV-infected samples (44-46). The priority with which variables were assigned in the process was determined by their relative weight in a bivariate correlation with Global NC functioning. This order was: WRAT-3 reading score, nadir CD4 count, and BDI total score. Other variables considered, but not selected, included: education, gender, age, ethnicity, hepatitis C co-infection, plasma viral load and CSF viral load (see Appendix 1). Finally, because persons with current diagnoses comprised only 8% of the total syndromic group, they were excluded from the matching process to avoid potential mixed signals resulting from variable degrees of abstinence (i.e., current vs past diagnoses) within this group.

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Statistical Analyses

Demographic and medical characteristics were compared using ANOVA or Pearson's chi-square tests, as appropriate. For hypothesis 1, comparing neuropsychological functions between the SU groups, MANCOVA was used for domain scores because of the moderate interdependence of these scores; the covariate in this analysis was positive urine toxicology. For hypothesis 2, regarding the expected association between lifetime dosage of substances used and cognition, bivariate Pearson's correlations were computed. Indices of lifetime quantity of SU were $\log_{10}$ transformed prior to analyses to correct for the extreme positive skew in the distribution of these data due to a few persons who endorsed very high quantities of use. Kruskal Wallis tests were used to compare group median values of CD4 counts and median number of lifetime alcoholic beverages consumed. Level of significance was set at .01.

Results:

Demographic and medical characteristics

Demographics from the matched SU groups are presented in Table 1. As planned, the no SU, Syndromic SU and Non-syndromic SU groups were similar on most relevant demographic and medical variables, including duration of HIV infection, CART status and adherence levels (all p values >.01); the exceptions were proportion with hepatitis C infection (9.8%, 30.8%, and 16.4%, respectively, p<.001) and years of education (13.5, 12.5, and 13.3, respectively, p<.01). Of note, these variables had minimal effect on the overall demographically adjusted test scores (see Appendix 1) and thus were not covaried in analyses.

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Insert Table 1 about here

Because the matching process eliminated many subjects from the overall Syndromic SU group, the Syndromic SU subset (n = 134) that was selected for analysis was compared to the larger unselected Syndromic SU group (n = 808). The selected subset was similar to the larger group on age, education, WRAT-3 scores, nadir CD4, BDI scores, urine toxicology, Hepatitis C, and average number of SU diagnoses (all p values >.01). However, the selected Syndromic SU group had a smaller proportion of Hispanics (6.3% vs. 16.4%, respectively, p <.001). Analyses comparing NC test performance of these two groups revealed no statistically significant differences in global or domain T-scores (all p values >.01).

When the Non-syndromic SU group was compared to the Syndromic SU group on substance use characteristics, more persons in the Syndromic group had history of intravenous drug use (36 % vs 10%, p <.001) but equal proportions had positive urine toxicology for illicit substances at the time of testing (16% vs 23%, p > .01). The Syndromic SU group reported using significantly greater dosages of all substances, with the exception of heroin, over the lifetime than the Non-syndromic SU group (p values <.01; see Appendix 3).

Finally, to confirm that the inclusion of social drinkers in the no SU group did not inadvertently select high use drinkers, we contrasted the median reported number of lifetime drinks in this group (930; range = 3 to 32,433) to that of the Syndromic SU group (12,800; range = 3 to 145,061). This large difference (p < 0.001) supports the notion that undiagnosed Syndromic levels of drinking were unlikely in the no SU group.

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General substance use characteristics

In the Syndromic SU group, the three most frequent diagnoses were for alcohol, cocaine and cannabis. The frequency of past diagnoses for this group is presented in Table 2. Nearly half (47%) of the group had 3 or more lifetime diagnoses (maximum number = 8). The most frequent combinations of multi-substance use disorders were for alcohol and cocaine (43.0%), cocaine and cannabis (29%), and alcohol, cocaine and cannabis (23.8%). All diagnoses were for past syndromic use with average time since any use of an illicit substance ranging from 2.5 to 10 years for each substance though 29% of this group reported use of illicit substances within the last year.

Insert Table 2 about here

Neurocognition in Substance Use Groups

Group performance scores on the neurocognitive battery are presented in Table 3. Average global and all seven cognitive domain T-scores, controlling for positive urine toxicology by MANCOVA, were similar among the groups ($F(16, 776) = 1.46$; $p>.01$), even when the two substance use groups were combined and compared to the no-SU group ($F(8, 388) = 2.33$, $p>.01$). No significant differences were detected in the diagnosis of HIV-associated neurocognitive disorders between the SU groups (Table 4; $p>.01$).

Insert Table 3 about here

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Functional Status

Substance use status had no effect on the proportion of participants with functional dependence (χ^2 (4)=1.14, p>.01) or the mean number of functional complaints (F (2, 395)= .14, p>.01). Neither did it impact the total number of subjective cognitive symptoms on the PAOFI (See Table 4; F (2, 396) = .22, p>.01).

Insert Table 4 about here

Quantity of use and NC functions

We next examined if lifetime "dosage" of alcohol and illicit substances was related to NC function. Bivariate correlational analyses of quantified lifetime SU exposure with NC domain T-scores were performed on participants from the overall sample of 1284 to increase power (Table 5). Increased lifetime use of heroin was weakly associated with worse recall and working memory (both p values <.01). On the other hand, increased use of cocaine and cannabis was weakly associated with improved verbal fluency (p<.01). No other associations reached statistical significance. A similar analysis of duration of substance use (the number of days of reported use) and Global T-score did not reach statistical significance (p>.01). Finally, we explored potential relationships between duration and quantity of lifetime tobacco use and NC. These correlations did not approach statistical significance (p>.01).

Insert Table 5 about here

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DISCUSSION

On the basis of comprehensive neurocognitive testing HIV+ participants with either DSM-IV based SU disorders or self-reported histories of Non-syndromic, illicit substance use performed no differently, on average, than a carefully matched group of HIV+ participants without any indication of significant lifetime substance use. Similarly, participants with SU histories demonstrated neither a higher rate of HAND diagnoses nor more functional difficulties in everyday life.

This finding was unexpected, given the multiple studies that have linked abuse of specific substances, particularly alcohol (47) and methamphetamine (48) as well as polydrug use (49) to NC impairment; and the indications both from preclinical and clinical research suggesting that alcohol and other drugs may augment the neurotoxicity of HIV (25, 50, 51) The divergent findings may reflect the differences between the design of our study and most other studies which have examined HIV effects in the context of substance use. We compared NC function in HIV-infected groups with three levels of SU rather than comparing HIV-positive to HIV-negative persons with similar drug histories (30, 52). Two prior studies with similar design to ours reported more cognitive impairment among HIV-infected stimulant users relative to HIV-infected non-drug users (25, 53). However, participants in both studies had acute or recent use (within 24 months) and one study applied a less traditional cognitive NC task as the outcome measure (53). Thus, the discrepant findings between these two studies and ours may reflect differences in abstinence periods and NC measures.

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The similarity in NC performance between the SU groups in the current study could be due to several factors. First, most of our participants with lifetime substance use disorders were not *currently* syndromic and reported their use as occurring years prior to the time of assessment. Thus, the prolonged period of abstinence may have allowed for reversal of substance use effects, although our cross-sectional study design does not allow for a definitive test of this hypothesis. The literature on cognitive recovery following abstinence from drugs other than alcohol is limited and has produced of mixed findings. Investigations involving acute/short term withdrawal have reported deficits across multiple cognitive domains (54, 55). In contrast, normalization of NC functioning has been demonstrated to occur in the months and years after achieving stable abstinence in alcoholics (56, 57), and users of cannabis (58) and methamphetamine (59). Few studies have examined cognitive recovery from SU in the context HIV (59), but the process varies greatly in degree and course among people without HIV and for specific substances of abuse (60- 62). In fact, recency of alcohol and drug use is reported as a stronger predictor of NC functioning than chronicity of prior use (47, 63).

Our negative findings might also reflect type and severity of substance abuse in CHARTER as compared to some other studies. As one example, heavy methamphetamine exposure has been linked to greater likelihood of NC impairment, and neuroimaging indicators of brain dysfunction in HIV+ persons (25, 68, 69). However, in our study only about 12 % of subjects met lifetime methamphetamine dependence criteria. The selection of study populations may also account for why our findings differ from earlier literature, as prior investigations reporting differences between SU groups may not have adjusted for group differences on NC-relevant co-

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factors such as literacy level or other sources of neurological injury (e.g., traumatic brain injury, stroke). Thus, some prior studies might have found greater NC deficits in HIV+ drug abusers partly because of difficulty in adjusting for comorbidities that often track with drug abuse.

Another potential explanation for apparent lack of drug effect on neurocognitive performance in the present study could be lack of sensitivity of our neurocognitive battery to substance associated brain injury. We consider this to be unlikely, given that a similar battery of tests identified both separate and additive neurocognitive effects of methamphetamine and HIV in a prior study (25), and also detected improvement in methamphetamine users who became stably abstinent (59). Nevertheless, we cannot rule out the possibility that a different test battery might yield different results.

Lifetime dosages of most substances did not predict NC performance in this study. This observation is consistent with lack of success in relating lifetime drinking estimates to neurocognition in many studies of alcoholism (e.g., see review by Rourke & Grant, 2009 (47) and similar findings in Cherner et al. (69) who also were not able to relate lifetime estimates of methamphetamine use to NC impairment. The exceptions in the current study were associations between heroin use and worse recall and working memory scores and cocaine and cannabis use and improved verbal fluency. While statistically significant, the correlation coefficients reflecting the strengths of these associations were weak and therefore may reflect true, mild substance specific effects.

This study has several significant and unique strengths. First, multiple methods were used to characterize illicit substance use, allowing for a rigorous approach to classifying such SU and its absence. Studies utilizing non-drug using comparison

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groups (“controls”) often identify these through the absence of syndromic SU diagnoses. This method may misclassify persons who use substances heavily, but underreport their use or its functional impact. For example, among persons without a current diagnosis in our sample, 23% had positive urine toxicology for illicit substances, highlighting the value of toxicology screening. The multiple detection methods employed here provides increased confidence in identification of our “no substance” control group. The importance of avoiding misclassification of “controls” is underscored by reports that HIV-infected persons with positive urine toxicology yet denial of recent substance use were impaired in attention and learning/memory relative to HIV-infected persons who accurately reported recent drug use (70). This difference suggests that substance use non-disclosure and acute drug effects may be associated with cognitive dysfunction. A final strength is that our groups were screened for exclusion of severe neurologic confounds and matched to minimize the influence of factors that might influence NC test performance, namely, literacy level, depression, nadir CD4 count, and CART adherence level.

Given the complex histories of polysubstance use in our participants, we lacked statistical power to investigate individual effects of specific substances. The average number of syndromic SU diagnoses in our sample was 3 with a maximum of 8. Instead, we grouped users across classes of substances. This method is relevant to our primary aim: to determine if neuroAIDS cognitive research is confounded by historic substance use (broadly defined) as all assessed substances have demonstrated negative effects, at least acutely, on neurocognition (71-72).

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This study raises important questions. What are the best methods for summarizing complex polysubstance use in neuroAIDS research? What aspects of substance use are most relevant to functional impact: type(s), age of onset, duration, recency, etc.? How does the order and overlap of exposure to substances and HIV infection influence neuropathogenesis? What biomarkers are relevant in the study of HIV and SU? Finally, does illicit SU lead to more rapid neurocognitive decline or to a unique pattern or course of NC functioning over time?

In conclusion, while methodological challenges remain in cognitive neuroAIDS research with substance users, our study provides assurance that the impact of remote SU disorders and Non-syndromic use may be subtle, at least in the absence of acute or recent use/abuse. While this finding does not suggest neurocognitive safety of past substance use, it does indicate that substance use history, even when complex, does not necessarily merit exclusion of patients in short-term analyses of cognition in neuroAIDS research.

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Table 1

Demographic and medical characteristics of SU groups

	No SU (n = 134) Mean (SD) or %	Syndromic SU (n = 134) Mean (SD) or %	Non-syndromic SU (n = 131) Mean (SD) or %
Age, years	42.0 (11.2)	43.5 (8.0)	44.4 (8.4)
Gender (%Male)	67%	78%	80%
Ethnicity (% Black)	49%	49%	50%
Education, years*	13.5 (2.6)	12.5 (3.2)	13.3 (2.3)
WRAT-3 Reading (SS)	93.6 (16.1)	92.9 (15.8)	94.1 (15.4)
BDI total score	11.4 (10.0)	12.1 (9.4)	12.0 (10.1)
Median Nadir CD4	181	186	172
Median Current CD4	456	438	400
Duration of HIV infection (months)	104.4 (75.8)	122.8 (71.8)	114.9 (72.7)
% w/ Hepatitis C*	10%	30%	16%
On CART	74%	76%	74%
CART Adherence (>95%)	65%	69%	63%
% Undetectable viral load	49%	38%	37%

*p < .01

WRAT = Wide Range Achievement Test

BDI = Beck Depression Inventory

CART = combined antiretroviral therapy

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Table 2

Frequency of single current and lifetime SU diagnoses and time since last use in Syndromic SU *group (n=134)*

	Lifetime Abuse Dx N (%)	Lifetime Dependence Dx N (%)	Days since last use Mean (SD) [Range]
Alcohol	46 (34%)	62 (46%)	960 (2182) [1-10,950]
Cocaine	15 (11%)	62 (46%)	1,850 (2083) [1 – 8030]
Cannabis	45 (34%)	10 (8%)	2,489 (3,303) [0 – 10,585]
Opiate	7 (5%)	24 (18%)	3,753 (3,282) [0 – 11,680]
Methamphetamine	10 (8%)	20 (15%)	2,337 (3,308) [2-12,775]
Hallucinogen/PCP	10 (8%)	2 (2%)	n/a
Sedative	10 (8%)	7 (5%)	n/a
Inhalant	2 (2%)	3 (2%)	n/a
Other drug	1 (0.7%)	1 (0.7%)	n/a

n/a = Not available

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Table 3

Neurocognitive test performance* by drug group

	No SU (n = 134)	**Syndromic SU (n = 134)**	**Non-syndromic SU (n = 130)**	**p value**
	T-score M (SD)	**T-score M (SD)**	**T-score M (SD)**	
Global	45.9 (6.7)	46.6 (6.7)	46.0 (6.4)	.69
Motor	46.6 (11.9)	46.7 (9.3)	45.7 (9.5)	.73
Speed of Info Processing	48.0 (10.4)	49.0 (8.7)	48.9 (8.4)	.72
Working Memory	45.3 (8.8)	47.0 (9.8)	45.6 (8.7)	.35
Learning	43.2 (8.3)	41.9 (9.7)	41.4 (9.1)	.34
Memory	46.6 (8.4)	45.1 (8.7)	44.8 (9.6)	.28
Verbal	46.3 (8.9)	49.6 (9.2)	48.0 (8.2)	.01
Executive Functioning	44.7 (8.8)	46.3 (8.8)	46.0 (9.4)	.41

* age, education, and gender adjusted T-scores

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Table 4

Prevalence Rates of HIV-associated neurocognitive disorders and Functional status indicators by SU Group

	No SU (n = 134)	Syndromic SU (n = 134)	Non-syndromic SU (n = 131)
Cognitive Disorder			
Normal	50%	51%	47%
ANI	40%	40%	40%
MND	8%	8%	12%
HAD	3%	2%	2%
Functional Status			
% ADL Dependent	16%	15%	16%
Mean # ADL complaints	1.26 (1.71)	1.34 (1.76)	1.31 (1.71)
PAOFI Total	5.16 (6.86)	5.37 (6.91)	5.63 (6.91)

ANI = Asymptomatic neurocognitive impairment
HAD = HIV-associated dementia
MND = mild neurocognitive disorder
ADL = Activities of Daily Living
PAOFI = Patient's Assessment of Own Functioning

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Table 5
Correlations between quantity of lifetime substance use and NC function

	Alcohol (n = 1214)	Cannabis (n = 924)	Cocaine (n = 809)	Heroin (n = 261)	Methamphetamine (n = 308)
Global	.03	.04	.04	-.11	.01
Motor	-.02	.04	.06	-.03	-.02
Speed of Info Processing	.002	.03	.06	-.09	-.02
Learning	.04	.02	-.04	-.07	-.09
Memory/Recall	.07	-.01	-.05	**-.20****	.04
Working Memory	.03	.03	-.01	**-.14****	.04
Verbal Fluency	.04	**.11****	**.15****	.08	.04
Executive Functioning	.007	-.03	.04	-.10	.04

**p<.01

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