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Journal
Journal of Substance Use, 20(6)

ISSN
1465-9891

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Publication Date
2015-11-02

DOI
10.3109/14659891.2014.942397

Peer reviewed

HHS Public Access

Author manuscript

J Subst Use. Author manuscript; available in PMC 2016 February 03.

Published in final edited form as:

J Subst Use. 2015 ; 20(6): 407–416. doi:10.3109/14659891.2014.942397.

Predictors of Attrition in a Cohort Study of HIV Infection and Methamphetamine Dependence

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Abstract

Longitudinal cohort studies of HIV and substance use disorders play an important role in understanding these conditions, but high rates of attrition can threaten their integrity and generalizability. This study aimed to identify factors associated with attrition in a 5-year observational cohort study of 469 individuals with and without HIV infection and methamphetamine (MA) dependence. Rates of attrition in our four study groups were approximately 24% in HIV-MA-, 15% in HIV+MA-, 56% in HIV-MA+, and 47% in HIV+MA+ individuals. Predictors of attrition in the overall cohort included history of MA, alcohol, and other substance dependence, learning impairment, reduced cognitive reserve, and independence in activities of daily living (all *p*s < .05), but varied somewhat by clinical group. Of particular note, enrollment in a neuroimaging substudy was associated with significantly boosted rates of retention in the MA groups. Results from this investigation highlight the complexity of the clinical factors that influence retention in cohort studies of HIV-infected MA users and might guide the development and implementation of targeted retention efforts.

Keywords

longitudinal research; study attrition; study retention; methamphetamine dependence

Introduction

Longitudinal cohort studies of HIV infection and substance use disorders greatly enhance our understanding of these dynamic clinical conditions by allowing for the investigation of the natural history, trajectory, and biopsychosocial predictors of disease-related outcomes over time. This approach is particularly informative in the areas of comorbid HIV (Brown et al., 2007) and substance use (Claus, Kindleberger, & Dugan, 2002; Scott, 2004) in which

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Competing Interests

All authors declare that they have no conflicts of interest.

immunovirological disease progression, changes in the therapeutic armamentarium, additional comorbidities (e.g., mood disorders), and an inherent relapsing-remitting temporal course create challenges for clinical researchers (Claus, Kindleberger, & Dugan, 2002). However, attrition is inherent to almost all cohort studies, particularly those in complex and underserved clinical populations such as illicit substance users. Attrition in cohort studies may threaten both their internal and external validity, potentially producing biased results and limiting generalizability of the findings (Hansen et al., 1985). Therefore, identifying the characteristics of participants at risk for drop-out in cohort studies of HIV and substance use disorder is a key step toward strategically allocating resources to minimize attrition and bolster the representativeness of cohorts and the integrity and impact of study results.

Background/Literature

Several studies have examined demographic and clinical characteristics that might impact attrition in longitudinal studies more generally. Sociodemographic factors, such as male gender (Eaton et al., 1992; Radler et al., 2010), lower education (deGraaf, 2000; Gustavson et al. 2012; Radler et al., 2010; Young et al., 2006), unemployment (Psaty et al., 1994), minority ethnicity (Eaton et al., 1992; Radler et al., 2010) and being single (Eaton et al., 1992; Psaty et al., 1994; Radler et al., 2010) are commonly identified as risk factors for study attrition. While neurocognitive impairment and difficulties in activities of daily living (ADL) are less frequently studied in the general population, they are predictive of study attrition in certain subpopulations, such as among older adults (Chatfield et al., 2005; Matthews et al., 2004). Individuals with alcohol and substance use are also at greater risk for attrition in population-based community cohort studies, even after adjusting for sociodemographic characteristics (deGraaf et al., 2000; Psaty et al., 1994).

Although substance use consistently increases risk for attrition, the specific rates of attrition reported in cohort studies focused on substance users vary widely, ranging from nearly 30% (Des Jarlais et al., 2000; Ruan et al., 2005) to less than 5% (Cottler et al., 1996, Claus et al., 2002; Messiah et al., 2003; Cottler et al., 1996). Similar to studies in other populations, being male, unemployed, unmarried, not owning a residence, and having less than a high school education are related to higher rates of attrition specifically among substance users (Claus et al 2002). Although severity of alcohol or illicit substance use, and comorbid psychiatric disorder are typically related to reduced retention in treatment studies (Mancino et al., 2010; Curran et al., 2007; Stark et al., 1992), they are often not reliably associated with increased attrition in cohort studies of substance users when adjusting for potential confounds (Claus et al., 2002; Ruan et al., 2005; Messiah et al., 2003).

The literature is sparse with regard to predictors of cohort study attrition among HIV-infected persons. In contrast to studies in substance users, being infected with HIV is associated with *reduced* attrition in observational studies (Smith et al., 1997), with rates of retention among HIV+ persons without substance use disorders hovering around 11.5% (Dudley et al., 1995). The precise reasons for this paradoxical retention effect in this at-risk population remain to be determined, but research to date suggests that motivation for research participation in HIV points to diverse financial and disease-related factors (Stanford et al., 2003). One study of HIV seropositive women showed that unstable housing, White

ethnicity, having no past experience in studies of HIV/AIDS, and not currently taking antiretroviral therapy were significantly associated with increased attrition (Hessol et al., 2001). Further, participation in substance abuse treatment programs (specifically, methadone treatment) has been associated with reduced longitudinal study attrition in HIV-infected cohorts (Rabkin et al., 1997).

Despite the "protective" effect that being HIV+ might have on attrition, prevalent substance use comorbidities may disrupt participation in longitudinal research. Some estimates suggest that nearly one-third of HIV+ injection drug users drop out of longitudinal studies (Rabkin et al., 1997), which is well above the thresholds considered to be acceptable in cohort studies based on the general population (Hansen et al., 1985). The role of methamphetamine (MA) is particularly understudied in this regard, despite its frequent co-occurrence with HIV. The high incidence of this comorbidity (Colfax & Shoptaw, 2005) is due in large part to risky drug (e.g., injection use; Semple et al., 2004) and sexual behaviors (Gonzalez, et al., 2005) that are thought to exacerbate the HIV epidemic, particularly in the western US (Mansergh et al., 2006). The comorbid presentation of HIV and MA dependence can lead to higher rates of neurocognitive impairment (Rippeth et al., 2004; Carey et al., 2006) and disruption of real world functioning (Blackstone et al., in press; Reback, Larkins, & Shoptaw, 2010), both of which are associated with increased attrition (e.g., Chatfield et al., 2005; Matthews et al., 2004). At present, however, very little is known about the impact of comorbid HIV and MA use on cohort study attrition or its clinical predictors. This gap in the literature is especially important because MA is the mostly widely abused substance worldwide, apart from cannabis (United Nations Office for Drugs and Crime, 2009), and might well play a greater role in North America and Europe, and in the emerging HIV epidemics in Southeast Asia and China.

The primary aim of this study was to identify subject-level variables (i.e., demographics, psychiatric, substance use, and medical characteristics) that may be associated with elevated risk of attrition in a large, well-characterized, longitudinal sample of individuals with and without HIV and histories of MA use. We also aimed to identify process-level variables (i.e., interim adjunct study participation) that may assist in mitigating the likelihood of attrition in high-risk groups.

Method

Participants

The present study utilized data that was collected as part of a 5-year longitudinal, observational NIDA-funded cohort on the effects of HIV and MA on the central nervous system (CNS). This program was conducted through the University of California San Diego's (UCSD) HIV Neurobehavioral Research Program (HNRP), and the parent study was approved by the UCSD Human Subjects Protection Program. All participants provided written consent prior to study enrollment. More details regarding study methodology are described elsewhere (e.g., Rippeth et al., 2004).

The sample was comprised of 469 participants across four groups stratified by HIV serostatus (+/-) and MA status, which was defined by history of an MA use disorder (+/-).

As such, the final sample consisted of HIV+/MA+ (*n*=107), HIV-/MA+ (*n*=144), HIV +/MA- (*n*=90), and HIV-/MA- (*n*=95) individuals. HIV serostatus was determined by enzyme-linked immunosorbent assay (ELISA) and confirmatory Western blot. Participants who met criteria for MA dependence in their lifetime as well as MA abuse or dependence within the last 18 months (with a minimum abstinence period of 10 days) received a classification of MA+, whereas the MA- participants have never met these criteria. Lifetime and recent MA abuse and dependence diagnoses were assigned using a structured assessment designed to diagnose psychiatric disorders based on Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM–IV–TR; American Psychiatric Association, 2000) criteria; i.e. the Structured Clinical Interview for DSM IV (SCID; First et al., 1996). A semi-structured timeline follow-back interview was also administered to determine participants' patterns of MA and other substance use (e.g., quantity, frequency, and duration of use) during all relevant epochs in their lifetime.

Participants from any study group were excluded if they met DSM–IV criteria for alcohol or other substance dependence (except cannabis) within 1 year of the evaluation. Participants were also excluded if they reported histories of head injury with a loss of consciousness of greater than thirty minutes, or any other neurological or psychiatric illness known to adversely affect cognitive functioning (e.g., seizure disorders; schizophrenia or other disorders including psychotic features). Prior to assessment, all participants completed a urine toxicology screen and Breathalyzer test to exclude active users.

Attrition

Participants in the current analysis were recruited in years 1 through 4 of the 5-year cohort study with rolling enrollment. Participants were scheduled to be assessed at annual follow-up visits. To operationalize longitudinal attrition, we split eligible participants into two groups: 1) those who completed at least one scheduled annual follow-up visit (i.e., retained), and 2) those who completed a baseline assessment but no visits thereafter (i.e., lost to follow-up). Table 1 displays the sociodemographic and clinical characteristics of the overall sample (*n*=429), those who were retained in the study (*n*=264), and those who were lost to follow-up (*n*=165).

Materials and Procedures

Medical and Psychiatric Assessment—All participants completed a comprehensive neuromedical evaluation including a physical examination, blood draw, and a review of medication and medical history. Hepatitis C virus (HCV) infection was determined by ELISA. In addition to mood and substance use disorders determined using the SCID, we assessed for Attention-Deficit/Hyperactivity Disorder (ADHD) and Antisocial Personality Disorder (ASPD) using the Diagnostic Interview Schedule-IV (DIS-IV, Robins et al., 1995). The Beck Depression Inventory (BDI-II; Beck et al., 1961) was administered to assess current mood.

Neuropsychological Assessment—All participants were administered a comprehensive neuropsychological battery assessing 7 domains demonstrated to be sensitive to the central nervous system effects of HIV and MA. Measures of executive functions,

working memory, motor skills, speeded information processing, episodic learning and memory, and verbal fluency were administered by certified psychometrists using standardized clinical measures and procedures (for full details see Rippeth et al. 2004). In order to summarize overall and domain-specific neuropsychological performance for each participant, we calculated a Global Deficit Score (GDS) and seven Domain Deficit Scores (DDS) that were based on published, demographically-adjusted normative standards (see Carey et al., 2004). The Wide Range Achievement Test Version 3 (WRAT-3) Reading subtest, a commonly utilized estimate of premorbid cognitive functioning, was also administered to each participant.

Assessment of Everyday Functioning—Participants completed a modified version of the Lawton and Brody (1996) Instrumental Activities of Daily Living Scale (IADL; Heaton et al., 2004; Woods et al., 2006), a measure designed to assess functional dependence based on one's current ability to perform various tasks of everyday living (e.g., financial management). Participants rated each item on a 4-point scale, with higher scores indicating greater dependence, and were classified as IADL dependent if they reported decline (relative to their best level of functioning) in their ability to independently perform two or more tasks (see Heaton et al., 2004). Additionally participants completed the Patient's Assessment of Own Functioning Inventory (PAOFI; Chelune, Heaton & Lehman, 1986). The PAOFI is a self-report instrument in which individuals rate their perception of their current level of difficulties in daily functioning across multiple domains: (1) language and communication, (2) memory, (3) higher cognitive functioning, and (4) sensory-perceptual and motor skills, and (5) recreation. An item from the PAOFI was also used to determine participants' employment status using a dichotomous response option (employed versus unemployed). If a participant endorsed current employment, additional information (e.g., full-time or part time employment) was obtained.

Cognitive Reserve—Cognitive Reserve is a construct that summarizes resilience against neuropathological damage, and is often estimated using metrics such as years of education and vocabulary knowledge (Stern, 2002). To assess cognitive reserve, we computed sample-based *z*-scores for the number of years of formal education completed, and performance on the WRAT-3 Reading subtest for each participant. These *z*-scores were averaged for each participant to represent cognitive reserve.

Data Analysis Approach—Due to the dearth of studies in the HIV/MA comorbidity to inform *a priori* hypotheses, we employed a data-driven approach to model building in order to identify the baseline predictors of attrition. The primary outcome of interest was a dichotomous variable denoting whether participants enrolled at baseline completed at least one scheduled longitudinal follow-up visit. Predictors were selected based on their clinical relevance to HIV and MA and the limited prior literature, and included: 1) demographic characteristics; 2) global and domain-level neurocognitive impairment; 3) psychiatric comorbidity; 4) alcohol and substance use diagnoses; and 5) self-reported everyday functioning. The association between attrition and each predictor was tested at the univariable level in order to identify candidates for entry into the model. Variables that reached a critical alpha $p<.20$ were entered into a stepwise regression model predicting

attrition (dichotomous) along with terms for HIV, MA and their interaction, using a backward selection method and minimum Akaike's Information Criterion (AIC) stopping rule. We report the results of the optimized logistic regression model (including those variables selected through stepwise regression) in order to illustrate the independence of effects of each predictor. We used a comparable approach to the one outlined above to identify baseline predictors of attrition within each of the clinical groups (HIV+MA-, HIV-MA+, and HIV+MA+), with the exception that disease-specific variables were also considered for inclusion in the models. When relevant, HIV disease and treatment parameters (e.g., current and nadir CD4 counts, plasma HIV RNA, current ARV status) and MA use parameters (e.g., onset, recency) were included.

In order to examine the effect of interim study participation on attrition, we first conducted a logistic regression model predicting attrition, with predictors including participation in 1) a parallel study at the research center, and 2) a concurrent, nested neuroimaging substudy for which most participants were recruited at baseline. We then examined the association between attrition and parallel and nested enrollment within each clinical group.

Results

Rates and Predictors of Attrition in Overall Sample

As shown in Figure 1, rates of attrition in our four study groups were 23.91% in HIV-MA-, 15.12% in HIV+MA-, 55.56% in HIV-MA+, and 46.73% in HIV+MA+ individuals.

Figure 2 illustrates variables selected for inclusion in optimized regression models for the overall sample and each of the clinical groups. Table 2 shows results from regression models on attrition. The overall final model was significant (χ^2=92.46, p<.001) indicating that MA dependence, lifetime alcohol dependence, lifetime other substance dependence (non-alcohol, non-MA), and learning impairment were associated with increased attrition, while greater cognitive reserve and dependence in instrumental activities of daily living (IADL) were associated with decreased attrition. Although HIV status was significantly associated with reduced attrition in univariable analyses (see Table 1), it was only marginally associated with decreased attrition in the multivariable model. Of note, the MA × HIV interaction was not selected by the stepwise regression model.

In order to investigate whether the effect of these subject-level variables on attrition may differ by HIV and MA status, we conducted follow-up analyses including two separate stepwise regression models using a backward selection method and minimum AIC stopping rule. The first of these models included all variables that were significantly associated with attrition in multivariable models (see Table 2), and terms for the interaction between each of these subject-level variables and MA. None of the interaction terms survived this process. The second model, including interactions with HIV status instead of MA, selected the interactions of HIV with cognitive reserve and lifetime alcohol dependence for inclusion in the optimized model. Results from this final logistic regression model indicated that the interaction between HIV and cognitive reserve was significant (p=.01), while the interaction with lifetime alcohol dependence was not significant (p=.18). As shown in Figure 3, greater

cognitive reserve was associated with decreased attrition in the HIV- groups (p<.01, *OR*=0.54, *CI*=0.36-0.79), but not in the HIV+ groups (p=.68).

Predictors of Attrition in the Individual Clinical Groups

In HIV+MA- individuals (n=86), the overall logistic regression model predicting attrition was significant (χ^2=10.8; p<.05,). In this model, having a lifetime history of substance dependence (non-MA/non-alcohol; χ^2= 6.4, p<.02, OR=9.7) was the only significant independent predictor of increased attrition. The other selected variables from the stepwise regression (lifetime history of alcohol dependence, lifetime Major Depression Disorder, and current CD4) did not reach statistical significance (ps>.10). Further subgroup analyses were precluded by small sample size.

In HIV-MA+ individuals (n=144), the overall logistic regression model predicting attrition was significant (χ^2=18.7, p<.01). In this model, having a lifetime history of any (non-MA, non-alcohol) substance dependence (χ^2 =4.5, p<.05, OR = 2.1,), total cognitive reserve (χ^2 =7.9, p<.01, OR = 0.51), and, at the trend level (p<.08) independence in instrumental aspects of daily living (χ^2= 3.7, OR = 2.1) predicted increased attrition. Impaired learning did not significantly predict attrition in this group (p>.10). None of the MA use parameters tested (e.g., recency, cumulative quantity or duration) made it past step 1. With regard to non-MA substance-specific effects that may be driving the 'any lifetime substance dependence' finding, only having a lifetime history of cocaine dependence was significantly associated with attrition (p<.05, OR=0.40).

In the HIV+MA+ group (n=107), the overall logistic regression model predicting attrition was significant (χ^2= 28.6, p<.01). In this model, lifetime alcohol dependence (χ^2= 10.3, p<. 01, OR = 4.5,), executive impairment (χ^2= 9.1, p<.01, OR=4.1), and current independence in instrumental aspects of daily living (p < .05, OR = 3.6, χ^2= 6.2) significantly predicted attrition. PAOFI total score and lifetime non-alcohol/non-MA substance dependence were not significant predictors of attrition in the final model (ps > .10). None of the HIV disease characteristics or MA use parameters were retained past step 1 (see Fig. 1).

Impact of Interim Study Visit in Clinical Groups

With regard to process-level characteristics (specifically, study-related factors that may be associated with attrition), we included an exploratory analysis of the relationship between coenrollment in other center projects and attrition rates, both overall and by study group. In the overall sample, coenrollment in any other center project was significantly associated with reduced rates of attrition (21.8% vs. 78.2%) relative to those who with no interim contact (p<.0001). However, this effect varied by visit type and study group. Participating in a substudy of the parent project was associated with significantly lower rates of attrition (odds ratio=4.8, p<.0001) overall, whereas enrollment in a parallel study was unrelated to attrition (p> .10). By group, coenrollment in any study was associated with lower attrition in HIV-MA+ and HIV+MA+ individuals (all Likelihood ratios < .01) but not HIV+MA- individuals (p>.05).

Discussion

HIV infection and MA use disorders may be best understood through longitudinal study designs due to the dynamic and progressive nature of both disorders. Therefore, understanding attrition in longitudinal studies is an important step in identifying which subpopulations may be most vulnerable in order to target retention efforts accordingly. Consistent with prior studies indicating associations between substance use and increased attrition (deGraaf et al., 2000; Psaty et al., 1994), we observed that MA dependent participants were 2.6 times more likely to drop out of this longitudinal cohort relative to non-MA dependent individuals, even when adjusting for other important subject-level characteristics. Similarly, participants with a history of alcohol and other substance dependence (e.g., cocaine) were approximately twice as likely to be lost to follow-up than those who did not. That learning impairment was associated with increased attrition is not surprising given consistent associations between cognitive impairment and attrition in elderly populations (Chatfield et al., 2005). In addition, robust links have been established between more specific impairments in prospective memory (remembering to carry out a future intention) and other important aspects of everyday functioning (e.g., medication adherence; Woods et al., 2009). However, this represents a novel finding in our study population, and highlights the importance of dedicating specific efforts to assist individuals with cognitive difficulties in remaining in longitudinal studies of HIV and MA, particularly given the prevalence of cognitive impairment in these groups (Heaton et al. 2011, Rippeth et al., 2004). IADL impairment is a risk factor for attrition in some populations (e.g., older adults; Matthews et al., 2004), but it was unexpectedly predictive of reduced attrition in our high-risk clinical cohort. This might be explained by stronger connections with the healthcare system in participants with lower levels of functioning in our study population, due to their need for more frequent or aggressive follow-up by their treating clinician. They may also have increased structural support in performing daily activities, such as remembering appointments or arranging transportation, which would in turn enhance their likelihood of continued participation. Alternatively, it might be that those with higher functioning are more active in their everyday lives and have competing obligations, which might hamper their continued participation in research.

The association between HIV status and decreased attrition in univariable analyses is in line with prior findings showing that HIV infection might be “protective” against attrition (Smith et al., 1997). However, in adjusted models this association was only marginally significant, indicating that at least part of the association between HIV status and attrition might be accounted for by other co-existing characteristics. Perhaps more interestingly, HIV status modified the association between cognitive reserve and attrition. Among HIV-uninfected individuals, higher cognitive reserve protected against attrition, which is consistent with prior studies (deGraaf, 2000; Gustavson et al., 2012; Radler et al., 2010; Young et al., 2006). However, cognitive reserve did not significantly influence attrition in HIV-infected participants, in contrast to prior studies in HIV, which indicate that cognitive reserve is protective against syndromic HIV-associated neurocognitive disorder (Morgan et al., 2012). This contrast may relate to some of the often-cited reasons for participation in HIV-studies by those infected, including altruism, access to quality medical care, and health

opportunities (Stanford et al., 2003), which might dampen cognitive reserve's effects on attrition.

Our dual-risk group had an attrition rate of 46.7% at annual follow-up, which is well above the threshold considered to be acceptable in longitudinal studies, and represents significant risks for systematic bias and diminished statistical power (Scott, 2004). In this cohort, we observed that executive dysfunction, having a history of alcohol dependence, and independence in everyday living were associated with higher rates of attrition. While there may be a number of potential explanations for these effects, we hypothesize that impaired executive functions may pose specific risks relevant to study participation and appointment-keeping, in that cognitive flexibility and novel problem solving skills may be required in order to respond to initial longitudinal contact (within an appropriate time window), schedule study appointments, arrange appropriate transportation, etc. Individuals with impaired executive performance were over four times more likely to fail to complete their longitudinal follow-up, consistent with other studies that have noted associations between cognitive (and specifically executive) performance, missed clinic visits, and adherence (Hinkin et al., 2002). We also observed an approximately four-fold increase in attrition associated with lifetime history of alcohol dependence, even though these individuals were not current users, which is consistent with a number of studies indicating that alcoholism increases risk for psychiatric comorbidity and adversely affects quality of life in samples with HIV (e.g., Rosenbloom et al., 2007), as well as confers additional risk for brain dysmorphology (Pfefferbaum et al., 2006) and cognitive dysfunction (Green, Saveanu, & Bornstein, 2004). Finally, independence in instrumental aspects of everyday living was associated with a tripled risk of attrition. Unlike MA-dependent individuals who are not also infected with HIV, HIV+MA+ individuals who are experiencing everyday functioning problems may qualify for disability income or services related to their health status, potentially increasing availability for research participation as well as potential for utilizing these and other services.

Relative to the other study groups, the HIV-MA+ group demonstrated the highest rate of attrition overall: a striking 56% of the baseline sample was lost to longitudinal follow-up. This suggests that even relative to dual-risk individuals, who possess recent histories of MA dependence *and* HIV-related health risks, longstanding MA use in isolation poses a notable risk to longitudinal retention. One possible explanation for this result may be the transient and chaotic lifestyle that often accompanies MA addiction (e.g., Tucker et al., 2004), in the absence of the potential mitigating effects of clinical follow-up and motivation to successfully treat HIV disease. One recent study indicated that MA use has tripled in homeless and marginally housed individuals, contributing to risk for morbidity and mortality (Das-Douglas et al., 2008). However, relative to their HIV+MA+ counterparts, HIV-MA+ individuals may be less likely to qualify for, and therefore maintain, regular clinical follow-up with medical providers. They may also lack the impetus for behavior change following seroconversion that has been associated with reduced levels of risk behaviors (e.g., Cleary et al., 1991), and may be less likely to reduce MA use in favor of health behaviors geared toward the management of HIV disease. Interestingly, having lower cognitive reserve also contributed to higher rates of attrition in this group. As this variable was calculated using the

number of completed years of education, this may reflect the observed tendency of MA use to interfere with both quality and quantity of education (Dean et al., 2012), as well as premorbid differences in cognitive ability and specific traits (e.g., cognitive control) that may predispose individuals to stimulant drug use (Smith, Jones, Bullmore, Robbins, & Ersche, 2013). Also in this group, a history of non-MA, non-alcohol substance dependence doubled risk of attrition (a finding that was driven by history of cocaine addiction, reported by nearly 1/3 of this sample), suggesting a stimulant-specific use profile rather than a polydrug picture. This is consistent with other studies which have suggested that adverse everyday functioning impacts (e.g., nonadherence) in stimulant users may stem from disruptions in sleep and eating patterns, in addition to increased levels of environmental instability (Reback, Larkins, & Shoptaw, 2003).

Importantly, we noted that adjunct study participation resulted in reduced attrition in our overall sample, and that this effect was driven by significant associations in both MA-using groups. This effect was amplified in an imaging substudy (vs. parallel neurocognitive study enrollment) which is notable given that the largest difference between these visit types tends to be the shorter scheduling latency after baseline visit. While the former can typically be scheduled on the same day as the original visit, the latter generally requires an inter-testing interval that would allow for appropriate follow-up neurocognitive testing. This dissociation suggests that prompt as well as frequent contact might be an important determinant of successfully retaining individuals, especially in these high-risk groups. Of course, it might also be the case that participants recruited into other studies are the ones who are more likely to provide any relevant changes to contact information at interim visits, thereby reducing the likelihood of loss to follow-up. While comprehensive and planned recruitment approaches can be highly successful in retaining substance users and other “at-risk” populations in longitudinal studies (Cottler et al., 1996; Lankenau et al., 2009; Scott et al., 2004), many of these approaches require a great deal of resources, which might not be available to all research enterprises. Thus, it is encouraging that co-enrollment in other studies might not only facilitate initial recruitment and sharing of resources and data across studies, but might also increase retention in those studies that require serial exposures. Caution is warranted, however, to assure that excess participant burden does not occur.

While these findings are pertinent to researchers and clinicians, several limitations to this study warrant further discussion. Due to the retrospective nature of this study, several factors relevant to attrition (e.g., housing and transportation access) were unavailable. These variables are not only important due to their immediate consequences (for example, diminished transportation access may decrease feasibility of attendance), but are relevant in that secondary effects (e.g., increased need for monetary stability may increase a patient’s motivation to attend) may also impact retention. Additionally, while predictors of attrition were identified across groups, causal interpretations are limited to findings in the existing literature, as no information on the reason for participation or related factors were obtained. Finally, while intermittent contact emerged as a protective factor for retention in our high-risk groups, more comprehensive information could have aided in determining the differential impact of interim contact techniques (e.g., number of attempted patient contacts and number of attempts at rescheduling). Future studies may therefore benefit from

collecting data specific to motivation as well as barriers to participation (e.g., transportation issues, loss to follow up).

Conclusions

Overall, results of this investigation suggest that rates of attrition vary substantially and not necessarily intuitively in cohorts with HIV, MA use disorders, and their comorbidity. In addition, other factors (e.g., premorbid characteristics, additional alcohol or other substance use disorders, cognitive impairments, and functional status) may differentially aid in the identification of individuals at highest risk for attrition in each of these clinical groups. By more sensitively and effectively identifying individuals at high risk for attrition, future longitudinal studies might target these individuals to augment participation, particularly in the case of long-term (e.g., annual) follow-up. Our results suggest that interim contacts and ongoing participation in research studies may mitigate attrition, so by facilitating participation in related studies, investigators may increase frequency of contact with participants and beneficially affect their ability to collect representative and meaningful longitudinal data in high-risk MA-using populations.

Acknowledgments

The Translational Methamphetamine AIDS Research Center (TMARC) group is affiliated with the University of California, San Diego (UCSD) and the Sanford-Burnham Medical Research Institute. The TMARC is comprised of: Director: Igor Grant, M.D.; Co-Directors: Ronald J. Ellis, M.D., Ph.D., Cristian Achim, M.D., Ph.D., and Scott Letendre, M.D.; Center Manager: Steven Paul Woods, Psy.D.; Aaron Carr (Assistant Center Manager); Clinical Assessment and Laboratory Core: Scott Letendre, M.D. (P.I.), Ronald J. Ellis, M.D., Ph.D., Rachel Schrier, Ph.D.; Neuropsychiatric Core: Robert K. Heaton, Ph.D. (P.I.), J. Hampton Atkinson, M.D., Mariana Cherner, Ph.D., Thomas Marcotte, Ph.D., Erin E. Morgan, Ph.D.; Neuroimaging Core: Gregory Brown, Ph.D. (P.I.), Terry Jernigan, Ph.D., Anders Dale, Ph.D., Thomas Liu, Ph.D., Miriam Scadeng, Ph.D., Christine Fennema-Notestine, Ph.D., Sarah L. Archibald, M.A.; Neurosciences and Animal Models Core: Cristian Achim, M.D., Ph.D., Eliezer Masliah, M.D., Stuart Lipton, M.D., Ph.D.; Participant Unit: J. Hampton Atkinson, M.D., Jenn Marquie, M.P.H. (Unit Manager); Data Management and Information Systems Unit: Anthony C. Gamst, Ph.D., Clint Cushman (Unit Manager); Statistics Unit: Ian Abramson, Ph.D. (P.I.), Florin Vaida, Ph.D., Reena Deutsch, Ph.D., Anya Umlauf, M.S.; Project 1: Arpi Minassian, Ph.D. (P.I.), William Perry, Ph.D., Mark Geyer, Ph.D., Brook Henry, Ph.D.; Project 2: Amanda B. Grethe, Ph.D. (P.I.), Martin Paulus, M.D., Ronald J. Ellis, M.D., Ph.D.; Project 3: Sheldon Morris, M.D., M.P.H. (P.I.), David M. Smith, M.D., M.A.S., Igor Grant, M.D.; Project 4: Svetlana Semenova, Ph.D. (P.I.), Athina Markou, Ph.D.; Project 5: Marcus Kaul, Ph.D. (P.I.). This research was supported by National Institutes of Health grants T32-DA31098, P01-DA12065, P50-DA026306, L30-DA032120, and P30-MH62512. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, nor the United States Government.

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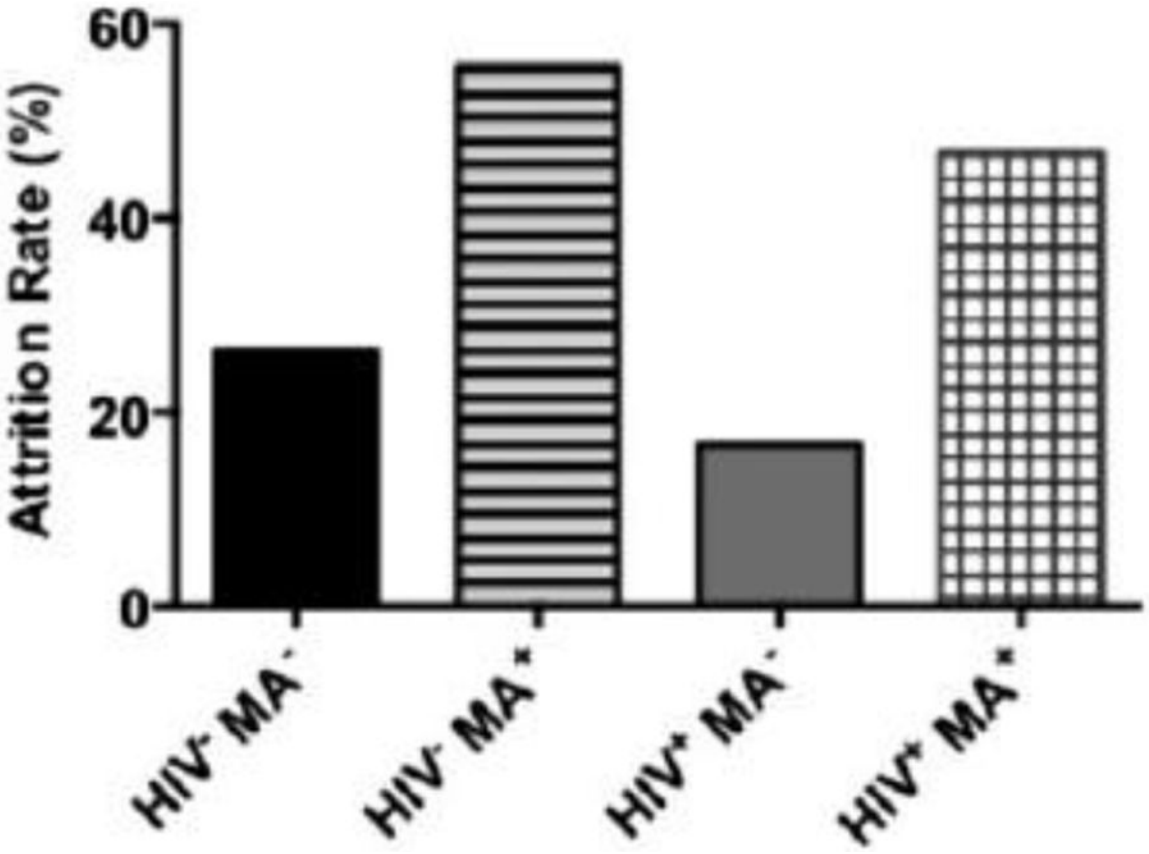

Figure 1.
Rates of attrition by HIV/MA group (*N*= 429).

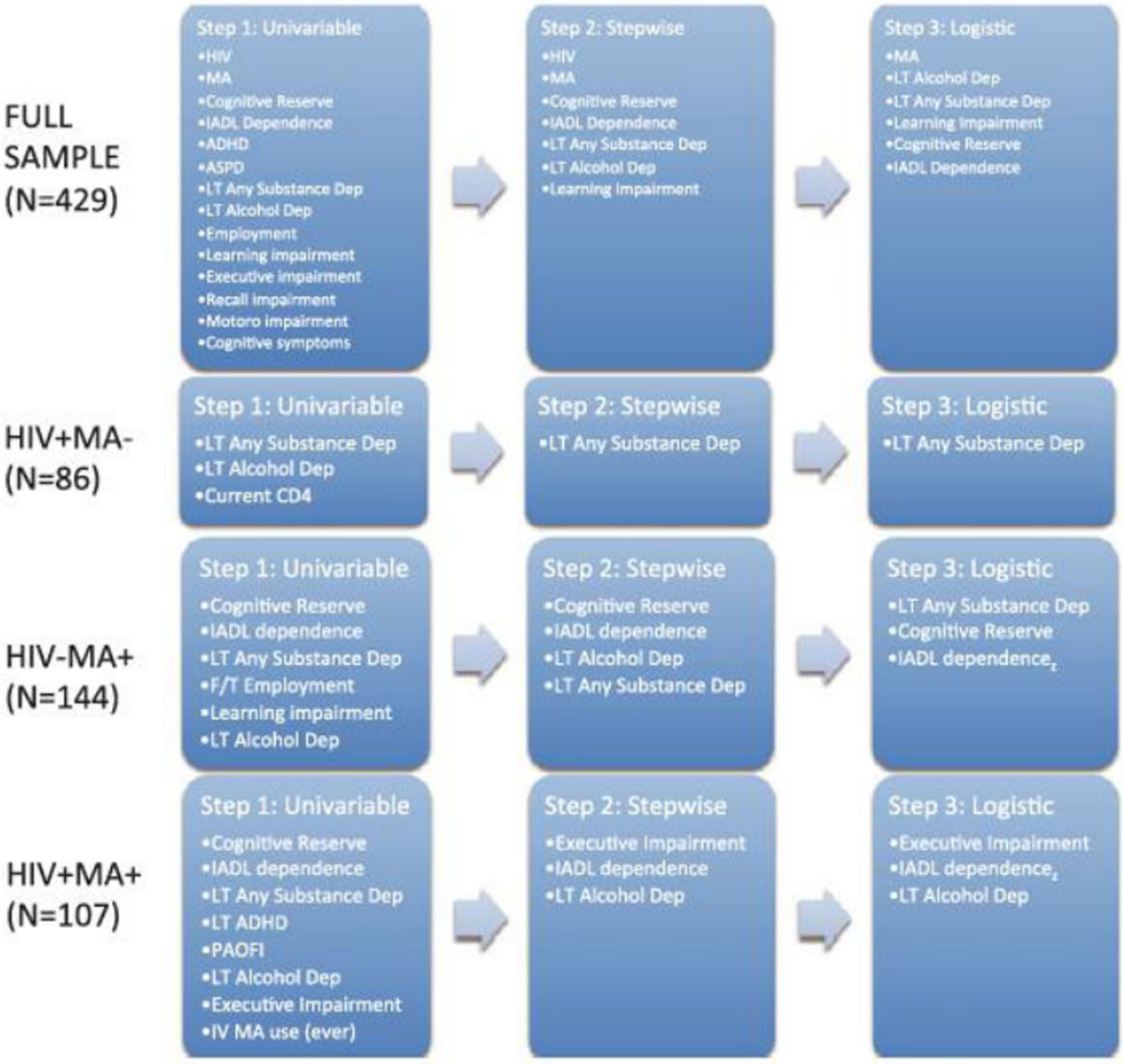

Figure 2.

Selection of predictors for inclusion in optimized regression models. Predictors which were significantly associated with retention at the univariable level (meeting a threshold of $p < 0.20$; Step 1) were included in stepwise regressions (Step 2).

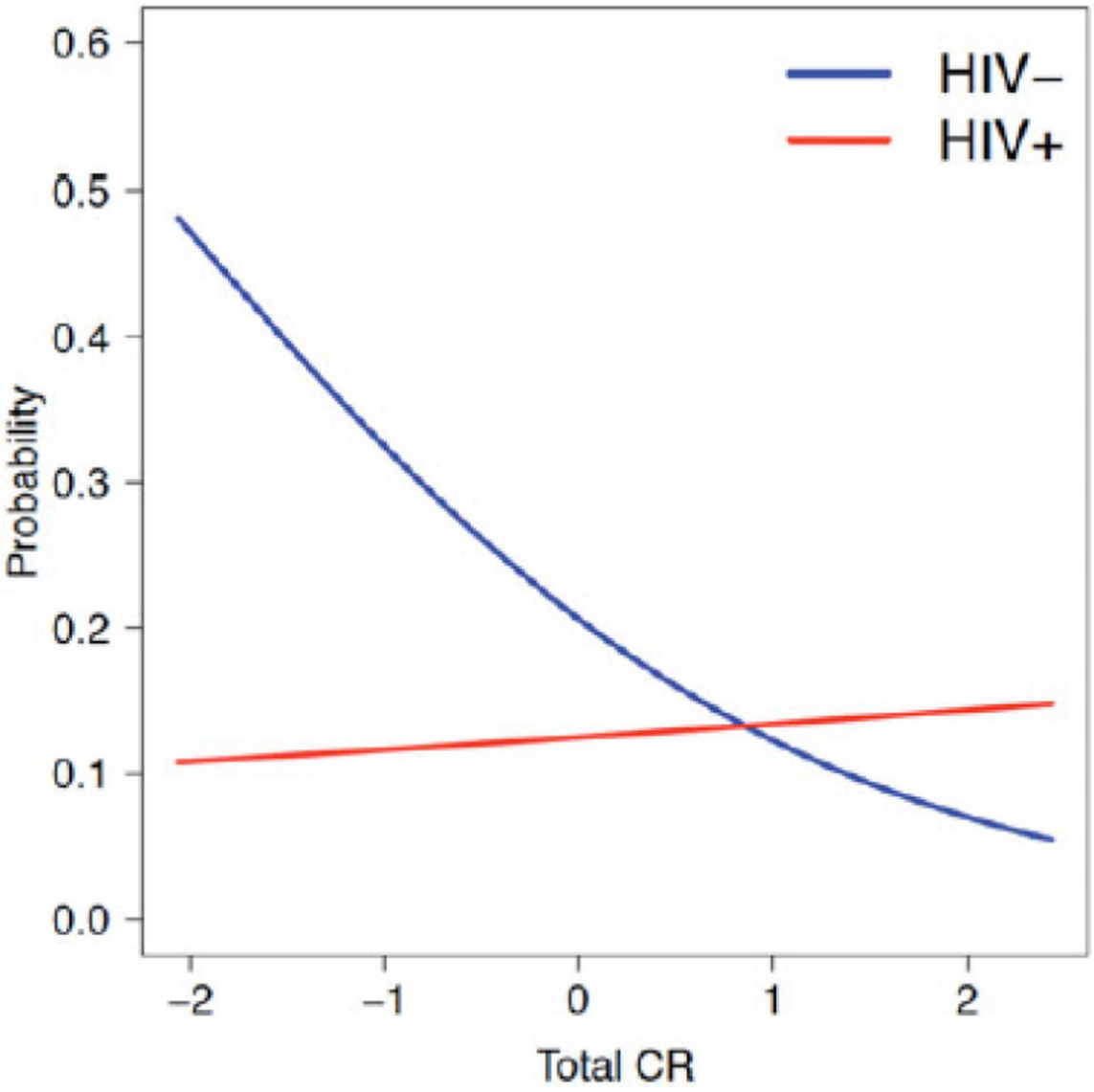

Figure 3.
Effect of cognitive reserve (CR) on probability of attrition by HIV status.

Table 1

Characteristics of Participants by Attrition Status

Variable	Overall (*N*=429)	Retained (*n*=264)	Dropped (*n*=165)	*p*[a]
Demographic Characteristics				
Age (years)	37.48 (9.08)	37.59 (9.52)	37.31 (8.37)	.75
Education (years)	12.47 (2.40)	12.75 (2.35)	12.03 (2.41)	<.01
Sex (male)	80.42%	79.92%	81.21%	.74
Ethnicity (non-Hispanic White)	70.63%	69.70%	72.12%	.59
WRAT-3 Reading (SS)	98.84 (10.76)	100.17 (10.73)	96.72 (10.49)	<.01
Cognitive reserve[b]	0.02 (0.85)	0.14 (0.86)	-0.18 (0.79)	<.001
HIV Infection (% seropositive)	44.99%	49.24%	38.18%	.02
Methamphetamine dependence	58.51%	45.83%	78.79%	<.001
HCV (% seropositive)	18.88%	17.79%	22.09%	.38
Psychiatric Characteristics				
Current mood symptoms[c]	32.48%	31.44%	34.15%	.56
Major Depressive Disorder				
Current	11.71%	10.27%	14.02%	.24
Lifetime	36.92%	38.64%	34.15%	.35
Lifetime Bipolar I or II Disorder	5.36%	5.68%	4.84%	.71
ADHD	14.69%	10.99%	20.61%	<.01
ASPD	16.36%	12.88%	21.95%	.01
Lifetime Alcohol Dependence	31.00%	20.83%	47.27%	<.001
Lifetime Other Substance Dependence[d]	29.84%	19.70%	46.06%	<.001
Marijuana	14.45%	10.99%	20.00%	.01
Cocaine	17.72%	8.71%	32.12%	<.001
Opioids	3.50%	1.14%	7.27%	<.01
Neurocognitive Impairment				
Global	33.33%	31.44%	36.36%	.29
Verbal Fluency	17.48%	16.29%	19.39%	.41
Attention/Working Memory	25.36%	24.71%	26.38%	.70
Speed of Information Processing	13.75%	12.12%	16.36%	.22
Executive Function	26.81%	24.24%	30.91%	.13
Learning	26.57%	23.11%	32.12%	.04
Recall	6.81%	23.49%	32.12%	.05
Motor Skills	21.31%	19.01%	25%	.14
Everyday Functioning				
IADL dependence	20.14%	23.11%	15.34%	.05
Cognitive Symptoms[e]	5.80 (6.63)	5.54 (6.59)	6.23 (6.69)	.10
Employed	35.21%	39.16%	28.83%	.03

Note.

[a] comparisons between participants who did and did not complete follow-up.

[b] average *z* scores based on WRAT-3 Reading scores and education

[c] elevated mood symptoms on the Beck Depression Inventory

[d] excludes MA and alcohol.

[e] total scores on the Patient Assessment of Own Funcitoning

WRAT = Wide Range Achievement Test 3; SS = Standard Score; HCV = Hepatitis C Infection; HIV = human immunodeficiency virus; ADHD = Attention-Deficit/Hyperactivity Disorder; ASPD = antisocial personality disorder; IADL = Instrumental activities of daily living; PAOFI = Patient's Assessment of Own Functioning Inventory.

Table 2

Predictors of attrition in the overall sample (N=429)

Variables included in Stepwise Regression[a]	**Results from Logistic Regression**[b]		
	χ^2	*p*	*OR (CI)*
MA dependence	12.30	<.001	2.60 (1.52-4.48)
HIV infection	3.07	.08	0.67 (0.43-1.05)
MA × HIV	---		
Cognitive Reserve	4.20	.04	0.76 (0.58-0.99)
ADHD	---		
ASPD	---		
Lifetime Alcohol Dependence	10.78	<.01	2.32 (1.40-3.87)
Lifetime Other Substance Dependence[c]	9.39	<.01	2.15 (1.32-3.54)
Executive Function Impairment	---		
Learning Impairment	4.15	.04	1.67 (1.02-2.74)
Recall Impairment	---		
Motor Impairment	---		
IADL Dependence	10.94	<.001	0.38 (0.21-0.68)
Employment status	---		
Cognitive symptoms	---		

Note.

[a] Variables included in a backward stepwise regression model on attrition (i.e. MA, HIV, MA × HIV and other subject-level characteristics that were associated with attrition in univariable analyses at $p<.20$).

[b] Cells with no values represent variables that were not selected through stepwise regression and thus were not included in the final logistic regression model.

[c] excludes MA and alcohol