Published in final edited form as:
Addict Behav. 2007 December ; 32(12): 2727–2736. doi:10.1016/j.addbeh.2007.04.006.

Discrepancies Between Self-Report and Objective Measures for Stimulant Drug Use in HIV: Cognitive, Medication Adherence and Psychological Correlates

M. J. Reinhard, **C. H. Hinkin**, **T. R. Barclay**, **A. J. Levine**, **S. Marion**, **S. A. Castellon**, **D. Longshore**, **T. Newton**, **R. S. Durvasula**, **M. N. Lam**, and **H. Myers**

Abstract

While it has long been recognized that self-reported drug use may be at variance with objectively obtained evidence such as urine toxicology assays, few studies have explored the behavioral correlates of such discrepancies. Here we compared self-reported and objective measures of stimulant drug use for 162 HIV infected individuals and identified a sub-group with discrepancies between data obtained via the two methods. Results showed poorer neurocognitive performance (attention, learning/memory) and lower medication adherence rates for the discrepant group as compared to those who either acknowledged their drug use or accurately denied recent stimulant use. Using the Millon Clinical Multiaxial Inventory –III, it was also found that those in the discrepant group were more hesitant to reveal psychopathology. Comparisons of self-reported and objectively measured medication adherence data are also discussed.

Whether in a clinical or research setting, it is often unclear whether individuals' self-reported drug use accurately corresponds with their actual drug use behavior. The research in this area is equivocal. A number of recent studies using objectively measured data, such as urinalysis, along with self-report measures of recent stimulant drug-use, found poor concordance between these measures (Chermack et al., 2000; Ehrman et al., 1997; Fendrich et al., 2004; Kilpatrick, Howlett, Sedgwick, & Ghodse, 2000; Lu, Taylor, Bruce, & Riley, 200; Tassiopoulos et al., 2004). However, others have reported a reasonable degree of concordance between self reported and objectively measured stimulant drug use (Darke, 1998; Yacoubian, & Urbach, 2002), especially when subjects are not seeking actual drug use/abuse treatment (Elman et al., 2000). Despite inconclusive research in this area, it is reasonable to assume that many clinicians and researchers suspect that a portion of drug using individuals will under-report the actual frequency and quantity of their drug use. Such misrepresentation is troublesome for clinicians whose treatment plans are contingent upon patients' drug-use behaviors, as well as for researchers who are seeking accurate information necessary for statistical control. This concern is especially germane in HIV, where there is a high comorbidity with drug-use. Indeed, there is now strong evidence that stimulant drug use in combination with HIV infection has an untoward synergistic effect and results in increased rates of neuropsychological impairment and disease progression (Chang et al., 2005; Levine et al., in press; Rippeth, 2004). Further, recent findings suggest that current drug use as well as neurocognitive dysfunction is associated with poor medication adherence among HIV infected adults (Hinkin et al., 2004).

While it is important to identify HIV+ individuals who are also active drug users, it is possible that identification of drug use status alone does not identify those who are most at risk for poor health. It may be that HIV+ individuals who are currently using illicit substances, but who deny their drug-use, are at greatest risk for poor health outcomes such as impaired cognition and medication compliance. Denial or inaccurate representation of actual drug use likely results in not receiving necessary primary services, such as substance use/abuse treatment, which can have serious consequences in those with HIV. Unfortunately, at present individuals with discrepancies between their self-reported and actual drug use are rarely identified. One hurdle in identifying such individuals is that there are no known indicators that would suggest under-reporting of drug use. For example, it may be that discrepant reporting is due in part to neuropsychological difficulties, as has been found in the case of self-reporting of medication adherence (Levine et al., 2006).

Strict adherence to antiretroviral medication is another important variable in the treatment of HIV. In an analogous fashion to the above discussed discrepancies between self-reported vs. objectively determined drug use, evidence suggests that a portion of HIV infected individuals may inaccurately estimate or misrepresent their adherence to HAART medication (Bangsberg et al., 2000; Levine et al., 2006; Liu et al., 2001). Thus, it may be that those who are discrepant in reporting drug use may also be discrepant in reporting medication adherence.

In the present study we sought to: 1) identify a sub-group of individuals who do not report recent stimulant drug use, but who test positive on an objective measure of stimulant drug use ("Discrepant Group"), and 2) to characterize this sub-group in comparison to non-discrepant reporters for stimulant drug use in terms of their neuropsychological functioning, medication adherence rates, as well as their approach to self-report measures. In addition to objectively assessing adherence rates for the groups that are identified, we also sought to 3) compare the concordance of self-report and objective measures of medication adherence for these groups. This would allow us to assess whether a similar pattern of discrepant self-reporting exists such that individuals who are discrepant in their reporting of stimulant drug use (i.e. deny stimulant use but have positive urine screens) also report a higher rate of medication adherence than is actually recorded via an electronic measuring device.

We hypothesize that the group identified as having discrepant self-report and urinalysis for stimulant drug use will show evidence of poorer health outcomes as measured by neurocognitive performance versus those individuals who evidence concordance in their self-report and urinalysis. Further, the discrepant group's psychological approach to self-report measures will be more guarded as compared to the other concordant groups. We also hypothesize that the discrepant group will show the poorest rates of medication adherence as well as a similar pattern of discrepancy between self reported and objectively measured medication adherence.

Methods

Participants

Participants were 166 ethnically diverse, community dwelling, HIV-seropositive adults who were recruited as part of a study of antiretroviral medication adherence. Participants were recruited using fliers posted in infectious disease clinics at two university affiliated medical centers and from community agencies in the Los Angeles area. Demographic data are presented in Table 1. At the time of entry to the study all participants were on antiretrovial therapy.

Measurements of drug use

To ascertain self-reported drug use we utilized the UCLA Brief Drug History Questionnaire (UCLA-BDH) (Longshore, 2000) which provides information on recent stimulant drugs such as cocaine (crack/freebase and powder separately), and methamphetamines, as well as non-stimulants such as inhalants, marijuana/hashish, hallucinogens, barbiturates, opiates, tranquilizers, phencyclidine (PCP), methylenedioxymethamphetamine (ecstacy) and other club drugs. Reliability and validity of data collected on the UCLA-BDH have been established (Anglin, Longshore, & Turner, 1999; Hser, Anglin, & Chou, 1992; Longshore, 2000). Urine toxicology screening was used as the objective measure of recent drug use. Urine was analyzed using EMIT and confirmed with GS-MS by Quest Diagnostics Inc., Van Nuys, CA.

Neuropsychological measures

Participants completed a battery of commonly used, standardized neuropsychological tests (see Table 2). Test scores were converted to demographically corrected T scores with a mean of 50 and a standard deviation of 10 using published normative data. Neuropsychological tests were grouped into 7 cognitive domains (attention, information processing, learning and memory, verbal fluency, motor speed, executive functioning, and global functioning) and individual test T scores were then averaged to establish domain T scores. A global neuropsychological estimate (Global NP) was established by averaging all of the individual T scores. In addition to neuropsychological measures, participants completed the Millon Clinical Multiaxial Inventory- III (MCMI-III) (Millon, 1994).

Measurements of adherence

The Medication Event Monitoring System (MEMS) (Aprex, Union City, CA), was used as the objective measure of HAART adherence. MEMS caps record the date, time, and duration of a bottle opening via a pressure-activated microprocessor in the cap of the bottle. MEMS cap data were later retrieved using a specifically designed communication module connected to a PC serial port. Participants were instructed to take their MEMS medication as directed by their physician, not to remove the cap from the bottle for any reason other than taking a dose of medication, and not to “pocket-dose” (i.e., remove several pills at one opening intended for later use). For self-reported adherence we used a modified form of an adherence questionnaire developed by the adult AIDS Clinical Trials Group (ACTG) (Chesney et al., 2000a). This measure asked participants to report or estimate the number of doses of the medication being counted by MEMS that they missed over the past four days.

Procedures and statistical analyses

To establish the relationship between self-report and objective data we first identified those participants who self-reported recent stimulant drug use (cocaine, methamphetamine), and those who did not report recent stimulant drug use. Recent stimulant drug use was defined as use within the last three days. This cut-off was utilized as urinalysis for stimulants can only give a use/no-use indication for at most the last three days (Schwartz, 1998). We then matched the urinalysis results (positive or negative) for stimulant drugs with the participants’ self-report. After matching the self-report and objective data we identified three groups: 29 subjects who did not report recent stimulant drug use but tested positive for stimulants (“Discrepants”), 29 reported recent stimulant drug use and tested positive for a stimulant drug (“True Positives”), and 104 subjects did not self report stimulant use and tested negative for any stimulants (“True Negatives”). There was an additional small group (1% of sample) who self-reported stimulant drug use but did not test positive via urinalysis that were excluded from further analyses. The present study separated groups based on stimulant drug use variables as opposed to other non-stimulant drug categories due to previous research suggesting the neuropsychological consequences of stimulant use (Strickland, Ismael, Villanueva, & Miller, 1993), and the

particular synergistic effect that may exist in a population with concomitant HIV+ status (Rippeth, 2004).

To investigate potential neurocognitive differences between the three groups, one-way ANOVA's for each of the 7 cognitive domain scores along with post-hoc *t*-tests were conducted. The Jonckheere-Terpstra test for ordered alternatives was performed to assess for a potential group trend of cognitive impairment. The Jonckheere-Terpstra test is a between groups trend test (Joncheere, 1954; Terpstra, 1952) and to reject the null hypothesis that cognitive functioning does not differ between groups, the median level of cognitive impairment would have to increase in an orderly fashion. In this analysis, cognitive performance was expected to be the worst among the discrepant group, followed by the true positive group, followed by the true negative group, who accurately did not report drug use. Response style towards self-report measures was assessed via one-way ANOVA's with post-hoc *t*-tests for three MCMI-III validity scales (Disclosure, Desirability, and Debasement). The Jonckheere-Terpstra test was then performed to test for the presence of any ordered group trends for the MCMI-III validity scales.

Next we took the three groups (Discrepants, True Positives, and True negatives) and analyzed their medication adherence behavior. We conducted a one-way ANOVA with post-hoc *t*-tests to assess each group's objectively verified medication adherence (MEMS) for the past 30 days. The Jonckheere-Terpstra test for ordered alternatives was conducted to assess for a group trend of MEMS adherence. In addition to obtaining an overall objective measure of medication adherence for the three groups we wanted to see if a similar pattern of self-reported and objectively measured concordance exists for medication adherence data. We derived a self-reported adherence percentage for each participant by dividing the number of doses subjects reported having missed in the last 4 days (ACTG questionnaire) by the number of doses prescribed. An objective adherence percentage for MEMS data over the same time period was similarly obtained. By subtracting the objective adherence rate from the self-report rate we derived an absolute discrepancy score such that smaller numbers were equivalent to greater self-report/MEMS concordance. We then conducted a one-way ANOVA with post-hoc *t*-tests to assess the influence that group membership (i.e., Discrepant, True Positive, and True Negative) has on self-report/MEMS adherence concordance. The Jonckheere-Terpstra test for ordered alternatives was conducted to assess for a group trend of adherence concordance such that the discordant group was expected to have the poorest adherence concordance, followed by the true positive group, then followed by the true negative group who were expected to have the best self-report/MEMS concordance.

Results

The first series of analyses focused on neurocognitive performance among the three stimulant drug use groups (Discrepants, True Positives, True Negatives). Results of ANOVA revealed main effects for both Learning (F (2,159) = 4.7, p=.01, partial $\acute{\eta}^2$=.056) and Attention (F (2,159) = 3.5, p=.03, partial $\acute{\eta}^2$=.043) domains (see Table 3). Follow-up Bonferroni post-hoc comparisons reveal that the discrepant group performed significantly poorer than the true negatives within the Learning domain (p=.02) and significantly poorer than the true positives within the Attention domain (p=.03). The true negative and true positive groups did not significantly differ on any cognitive domain. The Jonckheere-Terpstra test was significant for the Learning domain (J-T statistic=2.8, p=.005) and Global NP functioning (J-T statistic=2.0, p=.04), indicating the presence of a monotonic trend among the three groups, such that the discrepant group who misrepresented their stimulant drug use showed the poorest performance, followed by stimulant drug users who acknowledged their use, with the non stimulant drug users performing best among the groups.

The next analysis looked at the groups' approach towards self-report measures by comparing performance on the MCMI-III validity scales. Results of ANOVA revealed a main effect for the MCMI-III Disclosure scale (F (2,159)=3.5, p=.03, partial $\acute{\eta}^2$=.043) (see Table 4). Post-hoc analyses revealed that the discrepant group scored significantly lower than the true negatives (p= .03). The Jonckheere-Terpstra test was significant for the Disclosure scale (J-T statistic=2.2, p=.02) indicating a monotonic trend such that the discrepant group scored lowest, followed by the true positive and true negative groups. This suggests that the discrepant group was more defensive than the other groups when responding to a self-report measure.

The next series of analyses examined medication adherence rates for the three groups. Results of ANOVA revealed a main effect for MEMS adherence (F (2,159)=12.7, p=<.001, partial $\acute{\eta}^2$= .165) (see Table 5). Post-hoc comparisons revealed that the discrepant group were least adherent (54%) and had a significantly lower (p=<.001) adherence rate than the true negative group who were most adherent (81%). The true positive group also showed a significantly lower (p=<.004) adherence rate (63%) as compared to the true negative group. The discrepant and true positive groups did not significantly differ on MEMS adherence. The Jonckheere-Terpstra test was significant (J-T statistic=4.0, p<.001) and indicated a group trend with the Discrepants being least adherent followed by the True Positives, and then by the True Negatives who were most adherent.

ANOVA, performed to determine whether the three groups differed on their self-report/MEMS adherence discrepancy score, revealed significant group differences (F (2, 128)=6.5, p=.002, partial $\acute{\eta}^2$= .093) (see Table 6). Post-hoc comparisons indicated that the true positive group had a significantly larger self-report/MEMS discrepancy score than did the true negative group (p= .003). The Jonckheere-Terpstra test, which compares median scores between groups (rather than mean scores), was significant (J-T statistic= -2.4, p=.012), and showed that the discrepant and true positive groups had similar median adherence discrepancy scores, while the true negative group showed better concordance between their self-report and MEMS adherence rates.

Discussion

The present study identified a sub-group of HIV-infected individuals with discrepant self-report/urinalysis for stimulant drug use. As hypothesized, this group was at greater risk for poor health outcomes compared to groups that either accurately acknowledged or accurately denied recent stimulant drug-use. Results indicated a trend for the discrepant group showing poorer global neuropsychological (GNP) functioning. A closer look at ANOVA results suggest it is likely the relatively poorer learning and memory, and perhaps attention functioning that is driving the relatively reduced GNP. A trend was also noted in the discrepant group showing the poorest percentage of medication adherence (54%). The discrepant group's poor medication adherence and relatively poorer performance in aspects of cognitive functioning is consistent with existing research that has shown drug-use and neurocognitive dysfunction to be associated with poor medication adherence (Hinkin et al., 2004). This complex relationship among drug use, cognition, and medication adherences continue to be a critical area of investigation.

While it is not necessarily surprising that drug using individuals perform poorer on neuropsychological measures and are less adherent to their medication than non-drug users, the fact that the discrepant group (who are drug users) showed poorer outcomes (i.e Attention, poorer percentage of adherence to HAART) relative to the true positive group (also drug users) suggests that a variable exists other than current drug-use to account for these differences. It is possible that the discrepant group's relatively poorer cognitive functioning plays a central role in their reduced ability to accurately recall their frequency of drug-use and may also affect

their medication adherence behavior. Our findings of the discrepant groups' reduced attention abilities compared to the true positive group supports that line of reasoning.

With respect to their approach to self-report measures, comparison of the MCMI-III validity scales suggested that the discrepant group had a greater tendency to underreport psychopathology and responded to questions in a more defensive manner. It is possible that in addition to poorer recall or estimation of actual drug-use behavior, the discordant group was also not as open and forthcoming in their approach toward reporting drug-use and emotional symptomatology.

Agreement between self-reported and objectively measured medication adherence rates was similar for the drug using groups (Discrepants and True Positives). Yet, both drug using group's self-report/MEMS discrepancy scores were significantly higher than that of the non-drug using group. Drug-use itself and relatively poorer neuropsychological functioning likely play a role in the drug-using group's poorer self-report/MEMS concordance. Considering that both the discordant and the true positive groups are identified via urinalysis as having used stimulant drugs within the last three days, residual stimulant-related neurocognitive dysfunction may decrease the accuracy of self-reported medication adherence. A previous study comparing self-reported and electronically monitored adherence to HIV antiretrovirals found that cognitive functioning (and not drug-use) was the only variable marginally associated with self-report accuracy (Kimerling, Wagner, & Ghosh-Dastidar, 2003). The larger sample size of the present study may be uncovering the trends suggested by this earlier study. A recent study by Levine et al (2006)) found that neuropsychological impairment and health locus of control predicted greater discrepancy between self-report and the MEMS.

A social desirability response bias is thought to influence the under-reporting of stimulant drug-use (Harrison, 1995; Hingson, & Strunin, 1993; Sloan, Bodapati, & Tucker, 2004; Welte, & Russell, 1993). The discrepant group may have been hesitant to reveal their frequency of stimulant drug-use and more willing to reveal the frequency of medication they missed. This would explain why the discrepant group, despite their under reporting of stimulant drug-use, showed a similar level of accuracy in their self reported medication adherence as the true positive group.

Beyond identifying HIV infected individuals who erroneously denied recent stimulant drug-use, the present study included data to further characterize this at-risk group and suggested factors that may underlie self-report discrepancies. The present study also underscores the need to verify patient self-report, particularly with regards to sensitive areas of inquiry, as inaccurate reporters may be at particular risk for poor health outcomes such as aspects of cognitive functioning and HAART adherence. By detecting discrepancies between patient self-report and objectively obtained data, clinicians and researchers working with HIV-infected drug users may be better positioned to intervene in a timely and appropriate manner.

Acknowledgements

This study was supported by a grant from NIDA (RO1 DA13799). Drs. Reinhard, Barclay and Levine are supported by an NIMH training grant (T32 MH19535).

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Table 1

Demographic characteristics of participants (N=166)

Demographics	**Mean**	**SD**
Age	41.3	6.6
Education	12.9	2.3
CD4 count[a]	448	295
	% participants	
Male	83	
Female	17	
Ethnicity		
African American	63	
White	16	
Hispanic	12	
Asian/Pacific Islander	4	
Multiracial	4	
American Indian	1	

[a] CD4 cell counts were obtained on 159 participants

Table 2

Neuropsychological tests by domain and normative data utilized.

Domain/test	Normative data
Speed of Information Processing	
Digit Symbol Test (Wechsler Memory Scale-III)	Manual
Trail Making Test part A	Heaton et al. (1991)
Learning and Memory	
CVLT[1] trial 1-5	Delis et al. (2000)
CVLT short-delay free recall	Delis et al. (2000)
CVLT long delay free recall	Delis et al. (2000)
Verbal Fluency	
Controlled Oral Word Association Test	Miller (2003)
Attention and Working Memory	
Paced Auditory Serial Addition Test	Stuss et al. (1988)
Executive functioning	
Trail Making Test Part B	Heaton et al. (1991)
Stroop Color Word Interference Test	Golden (2002)
Motor functioning	
Grooved pegboard dominant hand	Heaton et al. (1991)
Grooved pegboard non-dominant hand	Heaton et al. (1991)

[1]CVLT, California Verbal Learning Test

Table 3

ANOVA and Jonckheere-Terpstra (J-T) results for cognitive domain and global NP T scores between groups

***N*=162**	**Discrepant N=29**	**True Positive N=29**	**True Negative N=104**		
Cognitive Domain	***M(SD)***	***M(SD)***	***M(SD)***	***p* value**	**J-T *p*-value**
Attention	40.9 (7)	46.3 (7.6)	44.5 (8.2)	.03	.26
Information Processing	43.8(8.2)	44.9 (7.7)	44.1 (6.7)	.80	.83
Learning and Memory	38.2 (8)	39.8 (9.9)	44.1 (11)	.01	.005
Verbal Functioning	43.4 (10.3)	47.4 (8.5)	45.6 (11.2)	.35	.58
Motor Functioning	39.1 (7.3)	38.6 (10.8)	39.2 (8.8)	.95	.40
Executive Functioning	41.8 (6.4)	41.6 (7.60	42.1 (7.2)	.93	.80
Global Functioning	40.9 (5)	42.7 (6.2)	43.3 (6)	.15	.04

Note: Cognitive domain scores are T-scores. Lower T-scores denote greater impairment.

Table 4

ANOVA and Jonckheere-Terpstra (J-T) results for MCMI Validity Scales

***N*=162**	**Discrepant N=29**	**True Positive N=29**	**True Negative N=104**		
MCMI-III Scale	***M(SD)***	***M(SD)***	***M(SD)***	***p* value**	**J-T *p*-value**
Disclosure Index	54 (20)	60.1 (19.7)	64.5 (18.6)	.03	.02
Desirability Index	71.3 (15.8)	69.1 (18)	64.2 (18.8)	.12	.08
Debasement Index	47.2 (23.1)	52.8 (21.6)	55.5 (23)	.21	.06

Note: MCMI-III scale scores are BR scores. Higher BR scores denote greater dysfunction.

Table 5

ANOVA and Jonckheere-Terpstra(J-T) Results of MEMS Adherence Percentage for The Past 30 Days.

***N*=135**[1]	**Discrepant N=22**	**True Positive N=25**	**True Negative N=88**		
	M(SD)	***M(SD)***	***M(SD)***	***p* value**	**J-T *p* value**
MEMS adherence%	54% (33)	63% (29)	81% (18)	<.001	<.001

[1] 27 participants either were lost to attrition, did not bring back their MEMS cap for return visit or it was broken and unable to be read

Table 6

ANOVA and Jonckheere-Terpstra(J-T) Results for the Self-Report and MEMS Adherence Discrepancy Score Between Groups.

***N*=135**[1]	**Discrepant N=22**	**True Positive N=25**	**True Negative N=88**		
	M(SD)	***M(SD)***	***M(SD)***	***p* value**	**J-T *p* value**
Self report/MEMS Discrepancy score[2]	29% (26%)	34% (32%)	19% (21%)	.002	.01

[1] 27 participants either were lost to attrition, did not bring back their MEMS cap for return visit or it was broken and unable to be read

[2] Note: Larger percentiles denote greater discrepancy