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Assessing illicit drug use among adults with schizophrenia

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Abstract

Accurate drug use assessment is vital to understanding the prevalence, course, treatment needs, and outcomes among individuals with schizophrenia because they are thought to remain at long-term risk for negative drug use outcomes, even in the absence of drug use disorder. This study evaluated self-report and biological measures for assessing illicit drug use in the Clinical Antipsychotic Trials of Intervention Effectiveness study (N=1460). Performance was good across assessment methods, but differed as a function of drug type, measure, and race. With the Structured Clinical Interview for DSM-III-R as the criterion, self-report evidenced greater concordance, accuracy and agreement overall, and for marijuana, cocaine, and stimulants specifically, than did urinalysis and hair assays, whereas biological measures outperformed self-report for detection of opiates. Performance of the biological measures was better when self-report was the criterion, but poorer for black compared white participants. Overall, findings suggest that self-report is able to garner accurate information regarding illicit drug use among adults with schizophrenia. Further work is needed to understand the differential performance of assessment approaches by drug type, overall and as a function of race, in this population.

Keywords

assessment; drug use; self-report; biological; schizophrenia; race

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1. Introduction

Over one-quarter of adults with schizophrenia evince *lifetime* drug use disorders (Brady and Sinha, 2005; Meister et al., 2010; Regier et al., 1990; Vincenti et al., 2010), a rate higher than in other groups of adults with serious mental illnesses (SMI) or in the general population. Rates of *current* drug use disorders are similarly high (Fowler et al., 1998) and rates of use are even higher (Swartz et al., 2006a). Adults with schizophrenia who use illicit drugs are at greater risk of adverse sequelae (Drake and Mueser, 2001; Mueser et al., 1998; Schiffer et al., 2010; Swartz et al., 2006b). Therefore, accurate assessment is vital to understanding the prevalence, course, treatment needs, and outcomes in this population.

1.1. Assessment approaches

Studies rely, in the main, on self-report, despite perceived problems related to non-disclosure (Carey and Correia, 1998; Carey et al., 2003; Kilpatrick et al., 2000) and that there has been little evaluation of the accuracy of reported substance use in adults with schizophrenia or other SMI (Møller & Linaker, 2010). Researchers have begun including laboratory tests, such as urinalysis and hair assays, as part of a comprehensive assessment strategy, to overcome this potential bias. Urinalysis, though reliable and valid, has a narrow window of detection, usually from 24 hours to seven or more days (Bellack et al., 2006; Wolff et al., 1999). Radioimmunoassay (RIA) of hair can detect drugs from 2 to 3 days after the most recent use to an indefinite period. RIA of hair is thought to be less intrusive than urinalysis and less vulnerable to countermeasures (Swartz et al., 2003). Acceptable levels of sensitivity and specificity have been found for both biological measures (DuPont & Baumgartner, 1995).

Although inclusion of biological measures is thought to improve detection of substance use over self-report (Allgood et al., 1991; Baumgartner et al., 1989; Bessa et al., 2010; de Beaurepaire et al., 2007; DuPont and Baumgartner, 1995; Kelly and Rogers, 1996; Magura and Kang, 1996; Mieczkowski, 2010), research findings remain equivocal (Haddock et al., 2009; Ledgerwood et al., 2008; Lee et al., 2009; Vitale et al., 2006; Welp et al., 2003; Williams and Nowatzki, 2005; Wolford et al., 1999). In a recent study of adults with schizophrenia, for example, combining self-report, with results of urine testing and RIA of hair increased detection rates from 16% (self-report alone) to 38% (Swartz, et al., 2003). In contrast, self-report outperformed results of urine and blood tests in detecting alcohol and drug use disorders in another study of adults with SMI (Wolford, et al., 1999).

Many factors may affect assessment accuracy, including drug type, recency of use, and race/ethnicity. For instance, compared to self-report, hair assays proved useful in detecting cocaine and heroin in the general population but less useful for detecting marijuana (Fendrich et al., 2004). Under-reporting appears to increase with recency of use, particularly among black respondents (Fendrich, et al., 2004). Similar race effects have been found regarding concordance between self-reported drug use and hair assays (Ledgerwood, et al., 2008; Vignali et al., 2012). Such racial disparities may be attributable to over-detecting drug metabolites in African Americans' hair (Borges et al., 2003; Cone and Joseph, 1996; Fendrich, et al., 2004; Han et al., 2011; Henderson et al., 1998; Kidwell et al., 2000; Kintz et al., 2000; Ledgerwood, et al., 2008; Welp, et al., 2003); however, findings are mixed (Hoffman, 1999; Kelly et al., 2000; Mieczkowski, 2011; Mieczkowski et al., 2002; Mieczkowski and Newel, 2000), and no data have been presented for adults with schizophrenia.

1.2. Present study

Given the preliminary evidence from, but also the limitations of prior studies, research is needed on whether biological measures, as a part of a comprehensive assessment strategy, increase accuracy over self-report. In addition to the limited research focus on adults with schizophrenia, there also has been limited use of the Structured Clinical Interview for DSM-III-R (SCID) (First et al., 1996), a recognized 'gold standard', as the criterion against which accuracy is measured. Instead, self-report is used sometimes as the criterion (Ledgerwood et al., 2008). No research has examined how drug test performance may differ as a function of these criterion measures. Finally, there has been scant examination of whether measures of *use* contribute to false positives and overidentification of *drug use disorders*.

We examined (1) concordance between self-report, urinalysis, hair assays and the SCID; (2) accuracy of self-report, urinalysis, and hair assays with the *SCID as criterion*; (3) accuracy of urinalysis and hair assays with *self-report as criterion*; (4) incremental validity of urinalysis and hair assays over self-report; and (5) correlates of disagreement. All outcomes were evaluated overall and as a function of race; the latter focus being exploratory, and drawing on general population research that has identified racial effects in drug testing.

2. Methods

2.1. Study design and sample

Data were collected as part of the NIMH Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) study, a randomized clinical trial investigating the cost-effectiveness of atypical and conventional antipsychotic medications. The CATIE study was conducted at over 50 U.S. sites, including academic medical centers and representative community providers. Only 7% of screened patients were excluded, and the study sample resembled a usual-care, noninterventional study sample in its demographic and clinical characteristics (Swanson et al., 2006). Study design and entry criteria details are presented elsewhere (Stroup et al., 2003). We report findings from baseline assessments (i.e., before randomization and initiation of treatments) of 1460 participants. The CATIE protocol was approved by local IRBs, and participants gave written informed consent prior to enrollment; the University of South Florida IRB approved the current study's protocol.

2.2. Measures & Procedures

2.2.1. Illicit drug use—The SCID (First et al., 1996) was used to assess past month drug abuse or dependence. Assessments were completed by SCID-trained and qualified master's level clinicians.

Subjects also self-reported any use of marijuana, cocaine, opiates, PCP, amphetamines, or other illicit drugs over the past 90 days in a separate research interview. Subjects were coded as positive for self-reported use if they responded in the affirmative to any one of the six self-report questions.

Hair specimens were collected by sites and shipped to PsycheMedics Corporation for RIA. This technique assays drugs and their metabolites transferred from capillary circulation through the hair follicle to the internal hair structure (Baumgartner et al., 1989). A tuft of hair about the diameter of pencil lead and 1.5 inches long was cut from the scalp on the back of the head, a specimen that affords assessment of drug use in the preceding three months. A larger volume was removed from participants with short hair. Hair was taken from the chest, arm, or leg if none was present on the head. A positive test was defined as a result more than three standard deviations from the mean of a comparison sample of drug-free individuals. Initial positives were confirmed using gas chromatography/mass spectrometry. The length

and amount of hair removed and assessed from each participant was intended to provide a surveillance window of up to 90 days. However, because of the slow growth rate of hair out of the follicle, detection of very recent use (i.e., between 1 and 7 days) is limited (DuPont and Baumgartner, 1995).

Drug urinalysis was performed with a commercially available rapid multiple immunoassay urine drug test, Triage by Biosite. Urine samples have a shorter surveillance window than do RIA of hair samples. Broadly, urine samples show evidence of drug use between 1 and 4 days (DuPont and Baumgartner, 1995; Verstraete, 2004). This timeframe can vary by chronicity of use and type of drug, with extremely chronic cocaine and marijuana use being detected up the 3 weeks after the most recent use (Verstraete, 2004).

All tests assessed for marijuana, cocaine, opiate, and stimulant use. A composite 'all tested drugs' variable was defined as a positive test for at least one type of drug. We additionally created an 'any laboratory test' variable. A positive test was defined as a positive hair or urine test. Participants who tested positive for a prescribed medication detected in hair or urine were considered not to be using.

2.2.2. Other variables—We included other variables in our regression analyses assessing disagreement (described below): *age* (measured continuously), *sex* (male, female), *race* (white, African American/black), *marital status* (married/living together as married, single/living alone), *education* (high school graduate or higher, non-high school graduate), total PANSS score (measured continuously), and other drug use (yes, no), all of which were obtained during the research interview.

2.3. Data Analysis

2.3.1. Prevalence and concordance—Differences in prevalence were calculated using chi-square tests. We also calculated detection ratios. McNemar's tests were used to determine if the ratios detected by two different measures were significantly different. Bonferonni corrections were made, based on five comparisons per test per drug (α=0.01).

2.3.2. Performance—With the *SCID as the criterion*, we calculated sensitivity, specificity, and conditional probabilities for self-report, hair and urine, as well 'any laboratory test'. We also calculated the Areas Under the Curve (AUCs) of Receiver Operating Characteristics curves and Cohen's kappas. We calculated the same measures for hair and urine with *self-report as the criterion*.

2.3.3. Incremental validity—Hierarchical logistic regression analyses tested the incremental validity of urine and hair over self-report. Significant chi-square change values reflected model improvement and significant odds ratios indicated contributions of individual factors.

2.3.4. Correlates of disagreement—Multivariable logistic regressions were used to examine the relative effects of correlates on disagreement between assessment methods for cocaine and marijuana, the two most frequently endorsed drugs. It is important to note that disagreement regression models were restricted to white and black subjects given our primary interest in potential race-based differences between these two groups, as well as the relatively small number of participants representing other racial/ethnic categories.

All incremental validity and disagreement models controlled for study site as a random effect (Fleiss et al., 1986; Hosmer and Lemeshow, 2000).

3. Results

Over 70% of participants were male (n=1079). Nearly 60% were white (n=874), 35% black (*n*=513) and 5% 'other' (*n*=101). Average age was 40.6 years (SD=11.1; median=42). One-quarter (*n*=374) did not complete high school, 35.1% (*n*=512) graduated from high school, and the remaining (39.3%, *n*=573) had some level of education beyond high school. Four out of five (*n*=1181) were not married nor cohabitating.

3.1. Prevalence

Table 1 presents prevalence by assessment method, overall and by race. Table 1 also lists the valid *N* for each assessment method. Black participants evidenced higher rates of cocaine use than white participants. They additionally had higher rates of any drug use across methods, except the SCID. White subjects had higher rates of stimulant use according to three of seven methods.

3.2. Concordance and performance

Table 2 presents performance measures for self-report and the laboratory tests compared to the SCID as criterion. Detection ratios ranged from 0.50 for stimulants (urine) to 6.60 for opiates (any laboratory test). Assessment for 'any drug' classifications, regardless of method, resulted in rates higher than obtained from the SCID. Hair showed the greatest overdetection compared to the SCID. Opiates showed the highest detection ratios across methods.

All AUCs, except self-reported opiate use, ranged between 0.71 and 0.88, indicating good accuracy compared with the SCID (Swets, 1988). The highest AUC for marijuana was found for self-report; 'any laboratory test' had the highest AUCs for both cocaine and opiates; hair had the highest AUC for stimulants. Sensitivity was highest for self-report (0.85) and lowest for urine (0.55) detecting any drug. All approaches were more specific than they were sensitive. Correct classification ranged from 77.0% for 'all tested drugs' (hair) to 99.3% for stimulants (urine). Kappas generally indicated moderate agreement (i.e., κ=0.41–0.60); others, however, only demonstrated fair (i.e., κ=0.21–0.40) or slight agreement (i.e., κ=0.00–0.20) (Landis and Koch, 1977). Assessments of opiate use demonstrated the lowest and assessments of stimulant use, the highest kappas, respectively.

Table 3 presents performance measures, with self-report as the criterion. Detection ratios were generally lower than found with the SCID as criterion. Urine detection was significantly less than self-report (detection ratios < 1), except for opiate use, which was not significantly different than self-report. Hair detected higher rates of use than self-report for cocaine and 'all tested drugs'; 'any laboratory test' detected higher rates for cocaine, opiates and 'all tested drugs'.

The highest AUCs for marijuana and opiate use were found for 'any laboratory test'; hair alone had the highest AUC for both cocaine and stimulant use. Sensitivity was low for most biological tests. Hair for cocaine had the highest sensitivity, whereas urine for opiates and stimulants had the lowest sensitivity. Again, biological measures were more specific than they were sensitive. Correct classification ranged from 79.5% for 'all tested drugs' (hair) to 98.5% for stimulants (any laboratory test). All kappas demonstrated moderate to fair agreement. As before, assessments of opiate use consistently demonstrated the lowest kappas, whereas assessments of stimulant use demonstrated the highest kappas (except urine).

We also stratified analyses by race. With the SCID as criterion, hair produced the highest sensitivity (92.0%) for black participants; however, specificity was poor (66.7%) and only

68.9% were classified correctly. The AUC for hair detecting cocaine use among blacks was 0.79 and κ=0.20. Self-report for black participants appeared more valid for cocaine: sensitivity=84.4%, specificity=91.0%, classified correctly=90.5%, AUC=0.88, and κ=0.56. (Full results not shown, but are available.) Regardless of criterion measure, black participants evinced lower rates of cases classified correctly for biological tests.

3.3. Incremental validity

First we examined whether the biological measures added to the capacity of self-report to detect marijuana use, overall and by race. Self-report was added in Step 1 of each of three models with SCID as the criterion for all, white, and black participants, respectively. All three models were significant (Table 4). In Step 2, laboratory tests were added in one block. Accuracy improved significantly, although there were small increases in R^2. Across participants, urine and hair demonstrated incremental validity; for white participants, only urine contributed to the model; for black participants, neither urine nor hair were significant factors.

We repeated these analyses for cocaine use (Table 5). All Step 1 models were significant. Adding the laboratory tests significantly improved the models for the entire sample and white, but not black participants. Hair was associated with unique contributions overall and for white, but not black participants. Urine was not a significant factor.

3.4. Correlates of disagreement

We explored disagreement with the SCID and self-report in separate models. Two cocaine models were run: (1) SCID, no; self-report, yes; any laboratory test, yes; and (2) SCID, no; self-report, no; any laboratory test, yes. Three marijuana models were run: (1) SCID, no; self-report, yes; any laboratory test, yes; (2) SCID, no; self-report, no; any laboratory test, yes; and (3) SCID, no; self-report, yes; any laboratory test, no. (Other combinations were endorsed too infrequently.)

Table 6 (first column) shows that older age, male sex and other drug use (i.e., besides cocaine) increased the likelihood of a positive self-report and any positive laboratory test, in the absence of a positive SCID. This model also found negative effects for white compared to black participants and for those who completed at least high school compared to those who did not. The second column shows correlates of disagreement between any positive laboratory test, but a negative SCID and self-report. There were stronger effects for both race and sex in this model, compared to the prior model; however, the age effect was not significant.

Table 7 shows the results for marijuana. The only significant race effect was found for participants who were positive for any laboratory test, but negative for the SCID and self-report: white participants were significantly less likely to be in this classification than black participants.

We repeated these analyses focusing on disagreement between self-report and the laboratory tests (Table 8). There was a significant race effect for both cocaine and marijuana for individuals who did not self-report use, but were positive for urine or hair.

4. Discussion

This study evaluated self-report and biological measures for assessing illicit drug use among adults with schizophrenia. Though results differed somewhat by drug, overall performance was good across assessment methods. Assessments were more specific than they were

sensitive. Results also highlighted differences in performance as a function of assessment method and participant race. We explore these findings in more detail below.

Can adults with SMI accurately self-report substance use (Drake et al., 1990; Goldfinger et al., 1996; Shaner et al., 1993)? Our findings support the validity of self-report data among adults with schizophrenia and provide evidence for their utility over laboratory tests. Self-report demonstrated greater concordance, accuracy and agreement with the SCID overall, and for marijuana, cocaine, and stimulants specifically, than did urinalysis and hair assays. Though biological measures outperformed self-report for detection of opiates, this finding should be interpreted with caution due to low rates of opiate use. Prior investigations (Wolford, et al., 1999) have documented laboratory tests' limited utility in identifying alcohol use disorders among individuals with SMI; the current study extends those results to assessment of illicit drug use among adults with schizophrenia when self-report data are available.

This study is the first to statistically test the utility of biological measures above and beyond self-reported information. Though they contributed statistically to the models, the practical gains were small. Instead, self-report appears sufficient to garner accurate information regarding illicit drug use among adults with schizophrenia. That being said, we are unable to determine how subjects' knowledge of the laboratory tests affected the accuracy of their self-reported use. Indeed, the value of such tests may not be in their contribution of unique information, but rather in their contribution to increased disclosure rates.

Some prior studies have identified racial disparities in assessment accuracy, although none have examined this issue among adults with schizophrenia. Our findings highlighted three effects. First, across assessment methods, higher rates of drug use were detected among black compared to white participants. Second, regardless of whether the SCID or self-report was the criterion, performance of biological measures was better for white than black participants. Third, whereas laboratory results added to the prediction of disordered use among white participants, these tests were not useful for that purpose among black participants.

A unique feature of this study was our use of both the SCID and self-report as criterion measures. As anticipated, measures of use (self-report, laboratory tests) overdetected disordered use *compared to the SCID*. In contrast, urinalysis underdetected marijuana, cocaine, and stimulant use while hair assays typically overdetected use *compared to self-report*. These findings would seem to indicate that the presence of *drug use* in adults with schizophrenia is a poor proxy for *disordered drug use* (Carey, 2002; Carey and Correia, 1998).

Limitations of present study include our inability to look at incremental validity, race effects, and correlates of disagreement for opiates, stimulants and amphetamines due to low base rates. We also were unable to determine rates of inter-rater reliability on the SCID data. There also were 323 cases (22%) who were missing hair data at baseline, a rate higher than any other assessment method. In addition, there were no self-report data regarding intensity or recency of use in the CATIE study. Next, we limited our racial analyses to white and black participants. Future research could expand upon this dichotomy and examine potential differences in other racial and ethnic groups. This might help clarify whether or not potential racial differences are attributable to social, economic, and cultural factors, which are distributed differentially across racial and ethnic groups. Also, it is important to note that willful nondisclosure may vary as a function of social norms or legal status regarding acceptability of drug use, which may affect drug use self-report accuracy and limit generalizability of findings from one setting to another. Future research on the assessment of

illicit drug use among adults with schizophrenia may find utility in a more nuanced focus on other illness-specific factors, as well. Whereas we controlled for total PANSS score, education level and concurrent evidence of any other drug use, other characteristics of the participants (e.g., cognitive deficit, persecutory ideation, antipsychotic medications, etc.), their environment, and the assessors themselves might affect the accuracy of drug tests. Finally, we only can speculate on reasons for the lower accuracy of biological measures.

Because of the implications for research and practice, further work is needed to understand the differential performance of assessment approaches among individuals with schizophrenia. For instance, case reports and other small studies suggest that antipsychotic medications may affect the reliability and validity of biological measures; this potential relationship should be more closely examined with an eye towards refining drug testing in this population. A related issue regarding differential performance of assessment approaches has to do with the concept of a “gold standard”. While prior research has identified the SCID as a gold standard assessment approach, and thus, we treated the SCID as that referent measure, it is not without its own limitations (e.g., susceptibility to willful non-disclosure), particularly in research studies where less is known about a participant. Finally, given that a number of people evinced non-disordered drug use, research should seek to provide more nuance regarding differences in course, treatment needs, and outcomes among these non-disordered users compared to those with disordered drug use.

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Table 1

Prevalence of illicit drug use by mode of assessment and race for adults with schizophrenia

Measure	n (%)	White	Black	χ^2 value
SCID Drug Abuse (N=1459)				
Marijuana	76 (5.2%)	38 (4.4%)	33 (6.4%)	2.88
Cocaine	42 (2.9%)	12 (1.4%)	27 (5.3%)	17.87†
Opiate	2 (0.1%)	2 (0.2%)	0 (0.0%)	1.18
Stimulant	13 (0.9%)	13 (1.5%)	0 (0.0%)	7.71†
All tested drugs	113 (7.8%)	57 (6.5%)	50 (9.8%)	4.67
SCID Drug Dependence (N=1459)				
Marijuana	43 (3.0%)	21 (2.4%)	21 (4.1%)	3.13
Cocaine	37 (2.5%)	6 (0.7%)	28 (5.5%)	30.73†
Opiate	7 (0.5%)	4 (0.5%)	3 (0.6%)	0.10
Stimulant	7 (0.5%)	5 (0.6%)	2 (0.4%)	0.22
All tested drugs	80 (5.5%)	34 (3.9%)	42 (8.2%)	11.49†
Combined SCID Drug Abuse and Dependence (N=1459)				
Marijuana	108 (7.4%)	53 (6.1%)	49 (9.6%)	5.74
Cocaine	69 (4.7%)	18 (2.1%)	46 (9.0%)	34.98†
Opiate	7 (0.5%)	4 (0.5%)	3 (0.6%)	0.10
Stimulant	18 (1.2%)	16 (1.8%)	2 (0.4%)	5.25
All tested drugs	169 (11.6%)	80 (9.2%)	80 (15.6%)	13.09†
Self-report (N=1448)				
Marijuana	247 (17.1%)	141 (16.2%)	95 (18.9%)	1.66
Cocaine	123 (8.5%)	39 (4.5%)	79 (15.7%)	51.31†
Opiate	20 (1.4%)	15 (1.7%)	3 (0.6%)	3.12
Stimulant	29 (2.0%)	22 (2.5%)	5 (1.0%)	3.87
All tested drugs	322 (22.2%)	171 (19.6%)	134 (26.6%)	9.13†
Urine (N=1457)				
Marijuana	130 (8.9%)	67 (7.7%)	57 (11.1%)	4.71
Cocaine	91 (6.3%)	21 (2.4%)	64 (12.5%)	56.99†
Opiate	27 (1.9%)	19 (2.2%)	3 (0.6%)	5.23
Stimulant	9 (0.6%)	7 (0.8%)	1 (0.2%)	2.07
All tested drugs	227 (15.6%)	100 (11.5%)	111 (21.7%)	26.03†
Hair				
Marijuana (N=990)	147 (14.9%)	81 (12.1%)	61 (22.1%)	15.43†
Cocaine (N=1133)	201 (17.7%)	62 (8.4%)	130 (37.6%)	137.80†
Opiate (N=1136)	30 (2.6%)	16 (2.2%)	13 (3.7%)	2.26
Stimulant (N=1134)	29 (2.6%)	24 (3.3%)	2 (0.6%)	7.30†
All tested drugs (N=1137)	327 (28.8%)	151 (20.4%)	165 (47.3%)	83.14†
Any laboratory test (N=1458)				

Measure	n (%)	White	Black	χ^2 value
Marijuana	216 (14.8%)	108 (12.4%)	100 (19.5%)	12.96†
Cocaine	228 (15.6%)	69 (7.9%)	148 (28.9%)	107.74†
Opiate	48 (3.3%)	29 (3.3%)	14 (2.7%)	0.37
Stimulant	30 (2.1%)	25 (2.9%)	2 (0.4%)	10.34†
All tested drugs	404 (27.7%)	184 (21.1%)	201 (39.3%)	53.15†

†=Bonferonni adjusted p-value ($p<0.01$)

Table 2

Measurement performance of drug use assessments for adults with schizophrenia: SCID as criterion

	SCID 1 Month Drug Abuse or Dependence						
Measure	**Detection ratio**	**AUC (SE)**	**AUC 95%CI**	**Sensitivity**	**Specificity**	**Percent Classified Correctly**	**Cohen's Kappa**
Self-report							
Marijuana	2.31†	.87 (.02)	.83–.91†	86.0%	88.4%	88.2%	0.46
Cocaine	1.80†	.87 (.03)	.82–.93†	79.4%	95.0%	94.2%	0.54
Opiate	2.80†	.67 (.13)	.39–.88	28.6%	98.8%	95.2%	0.14
Stimulant	1.66	.88 (.06)	.77–.99†	77.8%	99.0%	96.8%	0.59
All tested drugs	1.91†	.86 (.02)	.82–.89†	85.1%	86.0%	85.9%	0.51
Urine							
Marijuana	1.20	.74 (.03)	.68–.80†	53.7%	94.7%	91.4%	0.44
Cocaine	1.34	.73 (.04)	.65–.81†	50.0%	95.9%	93.6%	0.40
Opiate	3.80†	.74 (.13)	.49–.99	50.0%	98.3%	98.1%	0.17
Stimulant	0.50	.71 (.08)	.55–.86†	41.2%	99.9%	99.3%	0.53
All tested drugs	1.34†	.73 (.02)	.68–.77†	55.4%	89.6%	85.5%	0.39
Hair							
Marijuana	2.01†	.73 (.04)	.66–.80†	58.3%	88.5%	86.1%	0.32
Cocaine	3.31†	.85 (.03)	.78–.91†	84.1%	84.9%	84.9%	0.25
Opiate	5.20†	.74 (.16)	.42–1.00	50.0%	97.5%	97.3%	0.11
Stimulant	2.17†	.87 (.07)	.74–.99†	75.0%	98.5%	98.2%	0.52
All tested drugs	2.48†	.75 (.02)	.70–.79†	75.4%	77.2%	77.0%	0.32
Any laboratory test							
Marijuana	2.00†	.78 (.03)	.72–.83†	65.7%	89.3%	87.4%	0.38
Cocaine	3.32†	.78 (.03)	.72–.85†	69.6%	87.0%	86.2%	0.27
Opiate	6.60†	.77 (.12)	.54–.99	57.1%	97.0%	96.8%	0.14
Stimulant	1.75†	.88 (.06)	.76–.99†	76.5%	98.8%	98.6%	0.55
All tested drugs	2.39†	.78 (.02)	.74–.81†	76.3%	78.6%	78.4%	0.34

†=Bonferonni adjusted p-value (p<0.01)

Table 3

Measurement performance of drug use assessments for adults with schizophrenia: Self-report as criterion

	Self-report						
Measure	**Detection ratio**	**AUC (SE)**	**AUC 95%CI**	**Sensitivity**	**Specificity**	**Percent Classified Correctly**	**Cohen's Kappa**
Urine							
Marijuana	0.52†	.70 (.02)	.66–.74†	41.9%	97.8%	88.3%	0.49
Cocaine	0.74†	.72 (.03)	.67–.78†	47.2%	97.6%	93.0%	0.51
Opiate	1.36	.67 (.07)	.47–.76†	25.0%	98.5%	97.7%	0.20
Stimulant	0.30†	.62 (.06)	.50–.75	25.0%	99.9%	98.4%	0.37
All tested drugs	0.70†	.72 (.02)	.68–.76†	49.5%	94.1%	84.3%	0.49
Hair							
Marijuana	0.87	.70 (.03)	.65–.75†	48.8%	91.9%	84.6%	0.43
Cocaine	2.08†	.86 (.02)	.81–.90†	83.7%	87.7%	87.3%	0.44
Opiate	1.86	.64 (.08)	.48–.79	29.4%	97.8%	97.1%	0.20
Stimulant	1.30	.84 (.06)	.72–.95†	68.0%	98.9%	98.3%	0.62
All tested drugs	1.30†	.76 (.02)	.72–.79†	68.8%	82.5%	79.5%	0.46
Any laboratory test							
Marijuana	0.87	.75 (.02)	.71–.79†	56.3%	93.7%	87.3%	0.53
Cocaine	1.84†	.81 (.02)	.76–.85†	71.5%	89.5%	87.9%	0.44
Opiate	2.36†	.74 (.07)	.60–.88†	50.0%	97.3%	96.9%	0.28
Stimulant	1.05	.82 (.06)	.71–.93†	64.3%	99.2%	98.5%	0.61
All tested drugs	1.25†	.77 (.02)	.74–.80†	69.9%	84.3%	81.1%	0.50

†=Bonferonni adjusted p-value (p<0.01)

Table 4

Logistic Regression Analyses Testing Incremental Validity for Assessment of Marijuana Use

	All Participants (n = 983)				White Participants (n=669)				Black Participants (n=271)			
Step 1	Model fit $\chi^2(2) = 176.98^{***}$, $R^2 = 0.41$				Model fit $\chi^2(2) = 143.77^{***}$, $R^2 = 0.50$				Model fit $\chi^2(2) = 31.68^{***}$, $R^2 = 0.26$			
	β	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*
Self-Report	3.73^{***}	0.35	41.69	21.19–82.02	4.73^{***}	0.61	113.74	34.22–378.03	2.65^{***}	0.50	14.12	5.32–37.50
Step 2	Model fit $\chi^2(4) = 203.47^{***}$, $R^2 = 0.46$ $\Delta\ \chi^2(2) = 26.49^{***}$				Model fit $\chi^2(4) = 158.16^{***}$, $R^2 = 0.55$ $\Delta\ \chi^2(2) = 14.39^{***}$				Model fit $\chi^2(4) = 36.92^{***}$, $R^2 = 0.30$ $\Delta\ \chi^2(2) = 5.23$			
	β	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*
Self-Report	3.02^{***}	0.38	20.43	9.76–42.79	3.97^{***}	0.65	52.72	14.69–189.18	2.29^{***}	0.53	9.90	3.52–27.83
Urine	1.29^{***}	0.35	3.63	1.82–7.23	1.06^{*}	0.44	2.89	1.22–6.83	1.15	0.63	3.16	0.92–10.90
Hair	0.68^{*}	0.34	1.97	1.01–3.85	0.81	0.44	2.25	0.95–5.31	0.36	0.57	1.44	0.47–4.37

Notes.

$^{*}P < .05$.

$^{**}P < .01$.

$^{***}P < .001$.

R^2 values are Nagelkerke.

Table 5

Logistic Regression Analyses Testing Incremental Validity for Assessment of Cocaine Use

	All Participants (n=1125)				White Participants (n=736)				Black Participants (n=341)			
Step 1	Model fit χ^2 (2) = 159.25***, R^2 = 0.48				Model fit χ^2 (2) = 53.82***, R^2 = 0.43				Model fit χ^2 (2) = 71.26***, R^2 = 0.47			
	β	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*
Self-Report	4.56***	0.44	95.69	40.34–226.97	4.75***	0.70	115.13	29.23–453.47	4.17***	0.65	64.68	17.98–232.67
Step 2	Model fit χ^2 (4) = 169.92***, R^2 = 0.51 Δ χ^2 (2) = 10.66**				Model fit χ^2 (4) = 63.96***, R^2 = 0.51 Δ; χ^2 (2) = 10.14**				Model fit χ^2 (4) = 76.35***, R^2 = 0.50 Δ χ^2 (2) = 5.09			
	β	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*	*β*	*S.E.*	*Odds Ratio*	*Odds Ratio 95% CI*
Self-Report	3.40***	0.55	30.02	10.24–88.03	4.04***	0.83	56.56	11.11–288.03	3.31***	0.80	27.48	5.76–131.10
Urine	0.62	0.45	1.85	0.76–4.49	−1.48	0.92	0.23	0.04–1.39	1.12	0.60	3.05	0.95–9.80
Hair	1.43*	0.60	4.16	1.29–13.47	2.63**	0.85	13.86	2.62–73.37	0.63	0.99	1.87	0.27–12.95

Notes.

$^{*}P < .05$.

$^{**}P < .01$.

$^{***}P < .001$.

R^2 values are Nagelkerke.

Table 6

Cross-site multivariable models: Correlates of cocaine disagreement between modes of assessment for adults with schizophrenia who did not meet SCID criteria

	Cocaine	
	Self-report, yes; any laboratory test, yes	**Self-report, no; any laboratory test, yes**
	OR (95% CI)	**OR (95% CI)**
Age	1.01 (1.00 – 1.02) **	1.00 (0.99 – 1.01)
Male	1.27 (1.01 – 1.59) *	1.73 (1.28 – 2.36) ***
White	0.55 (0.45 – 0.68) ***	0.31 (0.23 – 0.41) ***
Cohabitation	1.13 (0.89 – 1.44)	1.13 (0.82 – 1.57)
High school or higher	0.77 (0.62 – 0.95) *	0.67 (0.50 – 0.88) **
PANSS total score	1.00 (0.99 – 1.00)	1.00 (1.00 – 1.01)
Evidence of any other drug use	2.41 (1.95 – 2.97) ***	1.80 (1.37 – 2.37) ***

* p<0.05;

** p<0.01

*** p<0.001

Table 7

Cross-site multivariable models: Correlates of marijuana disagreement between modes of assessment for adults with schizophrenia who did not meet SCID criteria

	Marijuana		
	Self-report, yes; any laboratory test, yes	**Self-report, no; any laboratory test, yes**	**Self-report, yes; any laboratory test, no**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**
Age	0.99 (0.98 – 1.00) *	1.00 (0.99 – 1.01)	0.97 (0.95 –0.98) ***
Male	1.18 (0.88 – 1.57)	0.98 (0.73 – 1.30)	0.96 (0.72 –1.29)
White	1.09 (0.83 – 1.42)	0.59 (0.45 – 0.77) ***	1.22 (0.92 –1.60)
Cohabitation	1.01 (0.74 – 1.39)	1.25 (0.92 – 1.70)	0.86 (0.62 –1.18)
High school or higher	1.15 (0.87 – 1.53)	0.73 (0.55 – 0.96) *	1.12 (0.85 –1.48)
PANSS total score	0.99 (0.99 – 1.00)	1.00 (0.99 – 1.00)	1.00 (0.99 –1.01)
Evidence of any other drug use	2.87 (2.18 – 3.79) ***	1.33 (0.99 – 1.78)	1.75 (1.32 –2.33) ***

* p<0.05;

** p<0.01

*** p<0.001

Table 8

Cross-site multivariable models: Correlates of disagreement between self-report and combined labs for adults with schizophrenia

	Cocaine		Marijuana	
	Self-report, yes; any laboratory test, no	**Self-report, no; any laboratory test, yes**	**Self-report, yes; any laboratory test, no**	**Self-report, no; any laboratory test, yes**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Age	1.00 (0.99–1.01)	1.00 (0.99–1.01)	0.96 (0.95–0.98) ***	1.00 (0.99–1.01)
Male	1.07 (0.85–1.34)	1.64 (1.20–2.23) **	1.11 (0.82–1.51)	1.04 (0.78–1.40)
White	0.82 (0.66–1.00)	0.32 (0.24–0.42) ***	1.05 (0.79–1.40)	0.52 (0.40–0.68) ***
Cohabitation	0.72 (0.56–0.93) *	1.12 (0.81–1.55)	0.79 (0.56–1.11)	1.30 (0.95–1.78)
High school or higher	1.02 (0.82–1.27)	0.68 (0.51–0.90) **	1.12 (0.84–1.51)	0.63 (0.48–0.83) ***
PANSS total score	1.00 (1.00–1.01)	1.00 (1.00–1.01)	1.00 (1.00–1.01)	1.00 (0.99–1.01)
Evidence of any other drug use	2.16 (1.75–2.66) ***	1.93 (1.46–2.54) ***	2.57 (1.92–3.43) ***	1.21 (0.90–1.63)

* p<0.05;

** p<0.01

*** p<0.001