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Utility of Hair, Urine, and Self-Report to Monitor Drug Use in Research Studies including People with Schizophrenia

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Previous studies demonstrated the superiority of hair samples over self report in identifying substance use among groups as diverse as homeless women (4), known drug users (6), and persons with schizophrenia (5,8). In two reports, analysis of hair samples also identified more substance users than urine analyses (6,8). Despite this and other advantages (longer surveillance window, ability to re-test the sample, and difficulty of providing a substitute sample (2)), little is known about the willingness of study participants to provide hair samples. In one study, 16% (38 of 241) of individuals with schizophrenia declined to participate in a study including an interview, urine screen, and hair sample for drug use, and more than half (n=20, 53%) declined because they were not willing to provide a hair sample while about one-quarter (n=10, 26%) were not willing to provide a urine sample (8).

The purpose of the present report is to describe the utility of hair samples versus urine samples to monitor drug use in research studies by examining the number of urine and hair samples provided among individuals with schizophrenia and schizoaffective disorder who were participating in a randomized trial examining the effectiveness of switching antipsychotic medications. Further, the present report compares rates of drug use identified from hair, urine, and self-report.

Methods

This report includes data from the first 40 individuals who agreed to participate in an ongoing randomized trial examining the effectiveness of switching antipsychotic medications. Specific inclusion criteria for the larger study included: 1) age 18 or older, 2) Structured Clinical Interview for DSM-IV Axis I Disorders (SCID; 9) diagnosis of

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schizophrenia or schizoaffective disorder, 3) partially remitted outpatient (persons who benefited from antipsychotic medications but who remained symptomatic or suffered significant side effects), 4) Medicaid recipient, 5) current service recipient (at least one service every 3 months for the past 6 months), and 6) prescribed medications consistent with entry into one of the sub-studies (monotherapy with any non-clozapine antipsychotic medication or polypharmacy with any two non-clozapine antipsychotic agents). Individuals were excluded if they: 1) had symptoms or side effects so severe that a medication change was indicated immediately, 2) experienced an exacerbation of psychotic symptoms resulting in significant intervention within the 3 months prior to the consent appointment (e.g., psychiatric hospitalization or services in a psychiatric emergency department), 3) resided in a nursing facility for a physical condition or disability, 4) had criminal charges pending, or 5) were pregnant or breast-feeding. Individuals were eligible to participate independent of drug or alcohol use; hence, the study included individuals who did not use alcohol or drugs, those who used only alcohol, those who used only drugs of abuse, and those who used both alcohol and drugs of abuse.

As part of this larger study, we asked individuals to self-report drug use and to provide urine and hair samples to test for drugs of abuse. We obtained written informed consent following a complete description of the study to the participants. During the consent process, we informed participants that results of drug tests would not be made available to anyone outside of the research team. Additionally, we informed study participants that, except for women at baseline (who were required to provide a sample of urine for pregnancy testing), all hair and urine samples were voluntary. We reimbursed individuals separately for each interview (\$60 for a baseline interview including a clinical interview to establish diagnosis and \$30 for each follow-up interview), urine sample (\$5), and hair sample (\$5). Where possible, hair and urine samples were collected the same day as a study interview, though participants who declined or were unable to provide samples on the day of the interview were allowed to provide samples on a subsequent day. After the 40th participant, for budgetary reasons, we eliminated hair samples. Because raters often met study participants in community settings (e.g., group home, public library), we only obtained hair samples from individual's heads; hence, if an individual was bald, had a shaved head, or had hair extensions, we did not obtain a hair sample from an alternative location on the body such as the participant's chest, armpit, or groin.

We asked study participants to provide a hair sample approximately 1 ½ inches long and the diameter of a shoelace tip plus urine samples every three months for one year. We also asked participants to provide urine samples on two additional occasions (at the week 2 and 1 month assessments); however, this report focuses on the assessments where we requested both urine and hair samples (baseline, 3 months, 6 months, 9 months, and 12 months). Study participants provided self-report of drug use using the Time-Line Follow-Back Calendar (1,7) at the baseline, 3 month, 6 month, and 12 month assessments which resulted in 18 continuous months of self-reported drug use (6 months before baseline through 12 months following randomization).

Psychemedics Corporation tested hair samples for the presence in the prior three months of cocaine, opiates, PCP, methamphetamine (including MDMA) and marijuana using

Radioimmunoassay of Hair (RIAH) and gas chromatography/mass spectrometry (GC/MS) to confirm positive results. Clinical raters analyzed urine samples using the OnTrak TesTcup® (manufactured by Varian Products) for cocaine, morphine, PCP, amphetamines, methamphetamines, THC, and benzodizepines. According to Varian, OnTrak TesTcup® meets established Substance Abuse and Mental Health Services Administration cutoff detection levels and demonstrates accuracy comparable to GC/MS methods.

Using SPSS, we applied descriptive statistics to characterize study participants and to compare agreement between hair and urine samples, between hair and self-reported use in the prior three months, and between urine and self-reported use in the prior month. The small sample size precluded the use of statistics (e.g., McNemar) to assess whether any method (hair, urine, or self-report) was superior in detecting any of the drugs assessed (cocaine, opiates, hallucinogens, amphetamines, or THC).

Results

Between June 2003 and February 2005, we approached 40 individuals to provide both a hair and urine sample. The majority were male ($n=22$, 55%), non-Latino ($n=36$, 90%), and African American ($n=26$, 65%). An additional 12 (30%) were Caucasian and 2 (5%) were of mixed or other race. The average age was 48 ($SD=7.8$, range=33–66).

Of 40 individuals, 31 (77.5%) agreed to provide at least one hair sample, 3 (7.5%) declined (each was asked to provide only one sample), and 6 (15%) were not sampled because they did not have enough hair on their head to collect a sample or had hair extensions (each was asked to provide only one sample). Nearly every participant (39, 98%) provided urine; one individual was unable to provide urine during the baseline assessment; after we stopped collecting hair samples, this participant provided urine during 5 of 6 subsequent assessments. In combination, these 40 individuals had 64 opportunities to provide both a hair and urine sample, and on only 9 (14%) occasions did participants provide hair and urine samples on different days (all within a week of one another except for two where a participant chose to provide a hair sample 12 days and 33 days after the urine sample). Of these 64 opportunities, hair samples were provided on 49 (76.6%), declined on 5 (7.8%), and unable to be sampled on 10 (15.6%) occasions. On the other hand, we obtained urine samples on 62 (97%) of the 64 occasions (1 individual was unable to provide a sample and 1 declined).

As might be expected given the longer window for drug detection, hair analyses produced more positive results for drugs of abuse than did urine samples, particularly cocaine (Table 1). Interestingly, a similar pattern of results was found when comparing hair to self-reported drug use during the same 3 month window (Table 1). Although to the small sample size precluded our assessing statistically the advantage of hair samples to detect cocaine compared to other drugs, the percentage of additional positives detected by hair samples for cocaine (27% when compared to urine and 22% when compared to self-report) was nearly double the percentage of additional positives for THC (15% when compared to urine and 12% when compared to self-report) and four or more times the percentage of additional positives for opiates and hallucinogens when compared to urine or self-report (7% and 4%

for opiates and hallucinogens respectively when compared to urine, and 4% for both opiates and hallucinogens when compared to self-report). Concordance between urine and self-report for use during the prior month was near or above 90% (Table 1). Compared to other drugs, results for detecting THC were more mixed. In one case, urine detected THC when hair did not. Additionally, self-reported use of THC in 2 and 5 individuals was not confirmed with hair and urine, respectively.

To assess the potential impact of missing hair samples, we examined results of urine analysis for the 9 individuals who did not provide a hair sample. Among the 3 individuals who declined to provide a hair sample, urine analyses suggested no drug use. Among the 6 individuals who did not have enough hair to provide a sample, urine analyses suggested that 2 had used THC, 2 had used cocaine, and 2 had no drug use. Hence, 4 (44%) of the 9 individuals who did not provide a hair sample did show recent drug use in urinalysis.

Discussion

Consistent with a prior study (8), study participants voluntarily provided more urine (98%) than hair samples (78%). The most common reason study participants did not provide a hair sample was that they did not have enough hair, or they had hair extensions, and raters did not collect hair from more intimate body locations (e.g., chest, armpit, or groin). Because choice of hairstyles is often confounded with gender, age, race, and ethnicity, these findings suggest that researchers collecting samples under similar conditions (e.g., in more public settings where chest, armpit, or hair samples are not feasible) should be mindful that there may be differential collection rates between groups. Additionally, researchers should be aware that some individuals may choose to shave their hair as a means to conceal less recent drug use. Despite the modest differences in collection rates, individuals were willing to provide samples on most occasions, perhaps in part due to the small (\$5), additional reimbursement for voluntary samples.

As noted in this and prior studies (4–6,8), hair analyses produced more positive results for drugs of abuse than did urine or self-report; this appeared to be particularly true for cocaine. More specifically, about 25% more of the hair samples tested positive for cocaine, about 15% more for THC, and about 5% more for opiates and hallucinogens when compared to urine samples or self report. One reason that hair analyses produced more positive results overall may be that hair samples can detect drug use for several months while urine samples detect only very recent drug use (typically a few days to two weeks for drugs other than marijuana), and individuals are likely poorer historians for drug use beyond recent weeks. Hence, studies wishing to document drug use during longer retrospective periods may consider including hair samples, with the addition of urine samples if the researcher also wants to document more precisely when use occurred. On the other hand, if the goal is to document only recent use, urine samples may suffice. Additionally, given the apparent advantage of hair over other methods to detect cocaine use, studies wishing to document cocaine use may consider using hair samples, even if the goal is to document only very recent use.

Similar to prior studies (3,8), the information gained by urine samples in addition to self report was minimal. One reason for this finding may be that, because participants knew they would be asked to provide a urine sample, they were more likely to admit recent use. Alternatively, study participants may accurately report substance use when raters develop good relationships with them and insure confidentiality of results. While testing the accuracy of self-report in the absence of any biological samples may not be possible in the context of research studies, future studies can explore the impact of less-frequent, but random urine testing on the accuracy of self-report.

This study has several limitations that may impact the interpretation of findings. First, clinical raters did not observe the collection of urine samples; participants provided the sample privately into a collection cup and handed it to the rater for testing. Although raters made note of samples that seemed to be of a temperature or color different than expected, it is possible that some participants delivered an inappropriate sample (e.g., diluted or from another individual in the bathroom). Given the high concordance between urine and self-report, however, we believe that this happened rarely, if ever. Second, because clinical raters assured study participants that results of their drug testing and self-report of drug use would remain confidential, study participants may have been more willing to provide a sample and be honest about their past use. This, in addition to the fact that individuals with schizophrenia who are willing to participate in a study of medication effectiveness may differ from those who do not agree to participate, means that the findings from this study may not generalize to broader clinical populations and settings where results become part of a clinical record and carry potential consequences. However, the purpose of this brief report was to examine the utility of hair versus urine samples to test for drugs of abuse in research studies; hence, the results should generalize to research studies where confidentiality of results is assured. Third, the purpose of this brief report was to compare the utility of hair versus urine samples for detecting drug use and these methods are not relevant to alcohol abuse, a commonly abused substance among individuals with schizophrenia. Future studies should examine which methods of alcohol detection may be preferred and under which circumstances. Fourth, because we designed the study to allow individuals to participate whether they declined to provide samples and to leave open the possibility that participants might choose to provide samples on a subsequent day, raters did not ask participants to provide reasons for declining to provide samples. Hence, we do not know whether the 3 individuals with “clean” urine who declined to provide a hair sample did so to conceal remote drug use or for another reason. Finally, given the small study sample (n=40), results from this brief report are suggestive, rather than conclusive.

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Table 1

Comparison of Hair, Urine, and Self-reported Drug Use

Comparison of Hair and Urine Samples (n (%))					
	Cocaine	Opiates	Hallucinogens	Amphetamines	THC
Negative (both)	26 (58%)	43 (93%)	45 (96%)	47 (100%)	31 (76%)
Positive (both)	7 (15%)	0	0	0	3 (7%)
Pos. Hair, Neg. Urine ^a	12 (27%)	3 (7%)	2 (4%)	0	6 (15%)
Neg. Hair, Pos. Urine	0	0	0	0	1 (2%)
Comparison of Hair and Self-reported Substance Use in Prior 3 Months (n (%))					
	Cocaine	Opiates	Hallucinogens	Amphetamines	THC
Negative (both)	27 (59%)	44 (94%)	46 (96%)	48 (100%)	31 (74%)
Positive (both)	9 (19%)	1 (2%)	0	0	4 (9%)
Pos. Hair, Neg. Self-Report	10 (22%)	2 (4%)	2 (4%)	0	5 (12%)
Neg. Hair, Pos. Self-Report	0	0	0	0	2 (5%)
Comparison of Urine and Self-reported Substance Use in Prior 1 Month (n (%))					
	Cocaine	Opiates	Hallucinogens	Amphetamines	THC
Negative (both)	37 (77%)	47 (98%)	48 (100%)	48 (100%)	38 (79%)
Positive (both)	7 (15%)	0	0	0	4 (8%)
Pos. Urine, Neg. Self-Report	2 (4%)	0	0	0	1 (2%)
Neg. Urine, Pos. Self-Report	2 (4%)	1 (2%)	0	0	5 (10%)

^a Hair was collected 12 days after urine for one individual where cocaine was positive in the hair sample but negative in the urine sample; hair was collected 3 days before urine for one individual where opiates was positive in the hair sample but negative in the urine sample; and hair was collected 33 days after urine for one individual where marijuana was positive in the hair sample but negative in the urine sample.