Assessing Drug Use in the Workplace: A Comparison of Self-Report, Urinalysis, and Hair Analysis

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ABSTRACT

A random sample of 1,200 employees of a steel plant in the western United States was randomly assigned to four different self-report methods of assessing illicit drug use: individual interview in the workplace, group-administered questionnaire in the workplace, telephone interview, and individual interview off the worksite. Urine specimens were collected and analyzed on all 928 subjects participating in the study, and hair analysis was conducted on 307 of the subjects. Although self-reports produced higher prevalence rates than the chemical tests, analyses combining the results of the three assessment methods showed that the actual prevalence rate was approximately 50 percent higher than the estimate produced by self-reports alone. The group-administered questionnaire method produced prevalence rates that were roughly half those of the other self-report methods. The findings cast doubt on the validity of self-reports as means of estimating drug use prevalence and suggest the need for multiple assessment methods.

INTRODUCTION

Working adults constitute a large proportion of the users of illicit drugs, particularly workers between 18 and 34 years of age. In the most recent National Household Survey on Drug Abuse for which employment data are available, 13.1 percent of full-time employees reported illicit drug use in the past year (National Institute on Drug Abuse (NIDA) 1993). Within the 18- to 25-year-old group, 26.9 percent of those employed full-time reported illicit drug use in the past year, and among 26- to 34-year-olds, the prevalence rate was 17.7 percent. Drug use among workers has been linked to increased absenteeism (Normand et al. 1990), higher accident rates (CONSAD 1989; Crouch et al. 1989), more costly use of medical benefits (Winkler and Sheridan 1989), and job withdrawal (Lehman and Simpson 1992).

Researchers with interests in exploring issues of illicit drug use in the workplace have long been concerned about the validity of self-reported drug use. Two decades ago, research was conducted on drug use preva- lence assessment methods in organizational settings by comparing self-reports to urinalysis data in the military (Cook et al. 1976; Hurst et al. 1975). Although those early studies generally supported the validity of self-reports, more recent research has cast considerable doubt on a worker's willingness to disclose drug use, despite assurances of confi-dentiality and anonymity (Cook 1989). Chemical testing methods, particularly urinalysis, have also been used to estimate drug use preva- lence (Anglin and Westland 1989). Self-reports and chemical testing methods would appear to offer contrasting strengths and weaknesses as prevalence assessment techniques. Self-reports offer the capability of producing data that are rich with information on frequencies, patterns, and consequences, but they are extremely susceptible to threats to validity. On the other hand, the basic validity of urinalysis is rarely disputed, despite continuing concerns about accuracy (Blanton et al. 1992). However, urinalysis typically provides only a single datum (i.e., whether the individual has recently used a drug). The vulnerability of self-reports to underreporting biases seems exacerbated in the workplace, where workers may fear that admission of illicit drug use could result in disciplinary actions or even job loss. However, as recently noted, despite continued research on workplace drug use, "very little data are currently available for assessing the validity of self-report substance use measures within organizations in populations not otherwise identified as drug users" (Lehman and Simpson 1992, p. 310).

On a broader level, new concerns about the general validity of self-reports of drug use have recently been voiced. Both the National Household Survey on Drug Abuse and the Monitoring the Future survey—perhaps the foremost national indicators of drug use—have been criticized by the General Accounting Office (GAO) for their reliance on self-reports of drug use, and the GAO has recommended the use of hair analysis in a limited field trial to study "the general level of agreement between self-reports and hair analysis in anonymous survey situations" (GAO 1993, p. 59).

Although the technology of hair analysis is still in its relative infancy, it offers the prospect of a biological indicator that is potentially as accurate as urinalysis, but that also provides a wider detection period, one that is limited only by the length of the hair sample (Baumgartner et al. 1989). An inch of hair typically contains a

record of approximately 2 months of potential drug use. Although a variety of criticisms have been leveled at hair analysis, recent tests of its validity with addicts and arrestees have resulted in qualified support for the validity and utility of the technique (Magura et al. 1992; Mieczkowski et al. 1993).[1] To date, there has been no research on the use of hair analysis as a method for assessing drug use in the workplace.

The currrent study had multiple objectives. Its original purpose was to compare different techniques of self-report to each other and to urinalysis as methods for assessing illicit drug use in the workplace. Workers were randomly assigned to four different modes of self-report, and were also assessed by urinalysis. In a second phase, an additional sample of workers was assigned to two of the self-report conditions, and both urinalysis and hair analysis were conducted on all subjects. Preliminary findings from the first phase were previously published as a research note by Cook and Bernstein (1994). This chapter presents results for both phases of the research.

METHODS

Design

The study was conducted in two phases. In the first phase, 800 employees of a large steel plant were randomly selected (using simple random sam-pling) from a workforce of approximately 2,400 total employees and randomly assigned to one of four conditions of self-report: (1) individual interviews in the workplace, (2) questionnaire administration in small groups, (3) telephone interviews, and (4) individual interviews off the worksite. Urine specimens were collected and analyzed on all subjects. In the second phase, another 400 employees were randomly selected and randomly assigned to two conditions of self-report: (5) individual inter-view in the workplace, and (6) questionnaire administration in small groups. In these two conditions, both urine specimens and hair samples were collected on all subjects.

Pilot tests of the data-collection procedures were conducted in the fall of 1990; the first phase was conducted in 1991 and the second phase in 1992. This steel plant was selected for study mainly because its workforce was sufficiently large and varied, and also had a considerable proportion of young, blue-collar male empolyees, among

whom the use of alcohol and illicit drugs is especially concentrated (Cook 1989).

The results from hair analysis, urinalysis, and four different self-report techniques were compared to each other. Preliminary findings from the first phase were reported previously by Cook and Bernstein (1994). Of the 1,058 employees available for participation, a total of 928 agreed to participate.

Subjects

All eligible subjects were asked to report information about their age, gender, ethnicity, and other demographic variables after responding to questions measuring their drug use. As shown in table 1, the vast majority of the subjects were white males, most of whom were married and between the ages of 18 and 54. Nearly all subjects were high school graduates, and about half reported some amount of college education. Most subjects reported annual salaries between $30,000 and $50,000.

Procedures

Generous incentives were offered to bolster participation rates. The selected employees were notified that they would be paid $5 just to attend a recruitment session, and $15 if they agreed to participate in the research. By participating, they would also be eligible for a raffle cash prize of $1,000. The interviewers emphasized that the data collection was anonymous and confidential. Matching code numbers (no names) were placed on the questionnaires and specimen containers. The interviewers explained that the research was being conducted by a private research firm; that no one but the research team would know their answers; and that no one would be informed if there were a positive result of the chemical tests. The fact that pilot tests involving approximately 25 employees were conducted several months before main data collection without any negative effects to participants probably enhanced the credibility of the confidentiality assurances.

TABLE 1. *Background characteristics of subjects[1] (N=928).*

Characteristics	Percent of sample
Ethnicity	
White	96.6
Hispanic	1.6
Other	1.2
Asian	0.2
Black	0.1
Gender	
Male	93.0
Female	7.0
Marital status	
Married	85.0
Unmarried	12.0
Age	
18-34	34.2
35-44	37.5
45-54	20.6
55-64	7.3
65 and older	0.2
Education	
Some high school	4.0
High school diploma	34.0
Some college	52.3
College graduate	9.8
Annual salary	
less than $12,000	1.6
$12,000 to 19,999	3.3
$20,000 to 29,999	23.1
$30,000 to 39,999	49.9
$40,000 to 49,999	15.6
$50,000 and over	6.1

KEY: 1 = Percentages may not total 100 percent due to rounding and/or missing data.

Urine samples were collected from subjects in the telephone interview self-report condition after the initial recruitment interview. All other urine samples were collected from subjects at the time of self-report data collection. Hair samples were also taken from groups 5 and 6 at the time of self-report data collection. Analysis of the urine specimens, conducted by the Center for Human Toxicology at the University of Utah, was performed in three stages: an initial test of the urine for suitability for further testing (pH and specific gravity), an initial radioimmunoassay screen, and confirmational analysis using gas chromatography/mass spectrometry (GC/MS) for any specimens testing presumptively positive by the screen. Cutoff concentrations for specific drug groups are shown in table 2a, along with the specific analyte for which the specimens were tested. Most of the cutoff concentrations were considerably lower than Department of Health and Human Services (DHHS) recommended levels, as the analyses were being conducted for research purposes only.

Hair samples were collected by cutting small locks of hair just above the scalp from the back of the subject's head. The samples were sent to a commercial laboratory for analysis, where an initial radioimmunoassay screen was performed to determine the presence of marijuana, cocaine, opiates, phencyclidine (PCP), and methamphetamines. Unlike the urinalysis, the hair analysis did not include testing for barbiturates or benzodiazepines. Once collected, the hair samples were sectioned, washed four times to remove any external contamination, and then subjected to wash kinetic analysis.[1] The samples were then assayed using radioimmunoassay of hair (RIAH) Standard Screen B for cocaine, methamphetamines, opiates, PCP, and marijuana (Psychemedics 1991).

Positive RIAH screening results for cocaine, methamphetamines, and PCP were reassayed and followed by GC/MS confirmation. In addition, the results of all washes (including the final wash) were assayed for evaluation of three wash kinetic criteria. If the wash criteria did not eliminate the probability of external contamination, additional work was performed (referred to as abnormal wash kinetic or AWK) to further examine the possibility of contamination (Psychemedics 1991).

Because marijuana may not wash off hair in a manner similar to other drugs, wash kinetics are not useful in detecting external contamination.[1] Therefore, GC/MS confirmation for carboxy-THC (tetrahydrocannabinol) was conducted to reduce the probability of external contamination of hair by marijuana smoke (Psychemedics 1991). GC/MS confirmation was also conducted for presumptive positive results for marijuana,

TABLE 2a. *Urinalysis cutoffs.*

Drug group	Specific analyte	Screening cutoff	Confirmation cutoff
Cannabinoids	Delta-9-tetrahydrocannabinol-	20 ng/mL	10 ng/mL
	9-carboxlic acid (carboxy-THC)		
Cocaine			
metabolite	Benzoylecognine	25 ng/mL	10 ng/mL
Opiates	Morphine/codeine	50 ng/mL	5 ng/mL
PCP	PCP	10 ng/mL	5 ng/mL
Amphetamine	Amphetamine	300 ng/mL	50ng/mL
Methamphetamine	Methamphetamine		
Benzodiazepines	Diazepam, nordiazepam,	100 ng/mL	100 ng/mL
	fluorazpam, N-desalkylfluorazpam,		
	chlordiazepoxide		
Barbiturates	Amobarbital, butalbital,		
	pentobarbital, phenoabarbital,		
	secobarbital		

methamphetamine, PCP, opiates, and cocaine. Cutoff levels for the drugs tested by standard RIAH screening are listed in table 2b.

TABLE 2b. *Hair analysis cutoff levels.*[1]

Drug group	Cutoff levels
Cocaine and benzoylecognine (metabolite)	5 ng/10 mg of hair
Methamphetamine	5 ng/10 mg of hair
Opiates (codeine and morphine)	5 ng/10 mg of hair
PCP	3 ng/10 mg of hair
Total THC (marijuana)	1 ng/10 mg of hair

KEY: 1 = Hair cutoff values cannot be compared to urinalysis cutoff values.

SOURCE: Psychemedics 1991.

Instruments

The self-report questionnaire/interview protocol contained items adapted from NIDA's National Household Survey (Turner et al. 1992). Subjects were asked about their frequency of use of alcohol and 10 major types of drugs in the past 6 months and in the past 30 days. The drug types included marijuana or hashish, cocaine or crack, inhalants, heroin, other opiates, hallucinogens, stimulants, tranquilizers, sedatives, and analge-sics. Descriptions and examples of each type of drug were provided to all subjects. Only nonmedical use of drugs was categorized as illicit drug use. If the subject reported prescription drug use and tested positive for that drug, it was classified as a negative self-report and negative urinalysis or hair analysis (i.e., it was classified as medical use and not illicit use of drugs).

Except for the telephone interview condition, all drug use data were collected by means of self-administration of the questionnaire, the technique in which the subject marks on the questionnaire rather than telling the interviewer the answer. This technique has been found to yield higher rates of drug use disclosure than the orally administered interview method (Turner et al. 1992). Thus the individual interviews in the workplace and outside of the workplace were conditions in which one interviewer met in privacy with one subject, explained the study and the questionnaire, then provided the subject with a questionnaire and a pencil so that he or she could self-administer the questionnaire.

There were seven interviewers (four men and three women), all of whom were white and ranged in age from midtwenties to early forties. Four had masters degrees, three had bachelors degrees, and all had experience in both interviewing and in working with drug and alcohol users.

RESULTS

Participation Rates

In each of the six conditions, a small number of workers were unavailable due to vacation, termination, illness, or working at another location. The participation rates among the remaining eligible workers across the four self-report conditions are shown in table 3. The participation rates ranged from 81.1 percent in the offsite condition to 96.6 percent in the individual onsite interview condition.

	Self-Report Condition						
	#1 Workplace interview	#2 Group questionnaire	#3 Telephone interview	#4 Off-site interview	#5 Workplace interview	#6 Group questionnaire	Total
Initial sample	200	200	200	200	200	200	1200
Unavailable	12	17	26	20	21	34	130
dropped	9	3	0	0	0	0	12
Number eligible	179	180	174	180	179	166	1058
Number refusals	6	23	29	34	18	20	130
Number completed	173 (96.6%)	157 (87.2%)	145 (83.3%)	146 (81.1%)	161 (89.9%)	146 (88.0%)	928 (87.7%)

Drug Use Prevalence Rates by Drug and by Assessment Method

Figure 1 displays prevalence rates for each drug as yielded by each assessment method. Because the hair analysis was conducted on only 307 subjects and for fewer drugs, the results across methods are not precisely comparable. Marijuana was clearly the most prevalent drug used in this sample: By all three methods, more workers were identified as marijuana users than users of all other drugs combined. Although there are some distinct differences by assessment technique, there is a general concordance among the methods, especially between the rates generated by urinalysis and hair analysis.

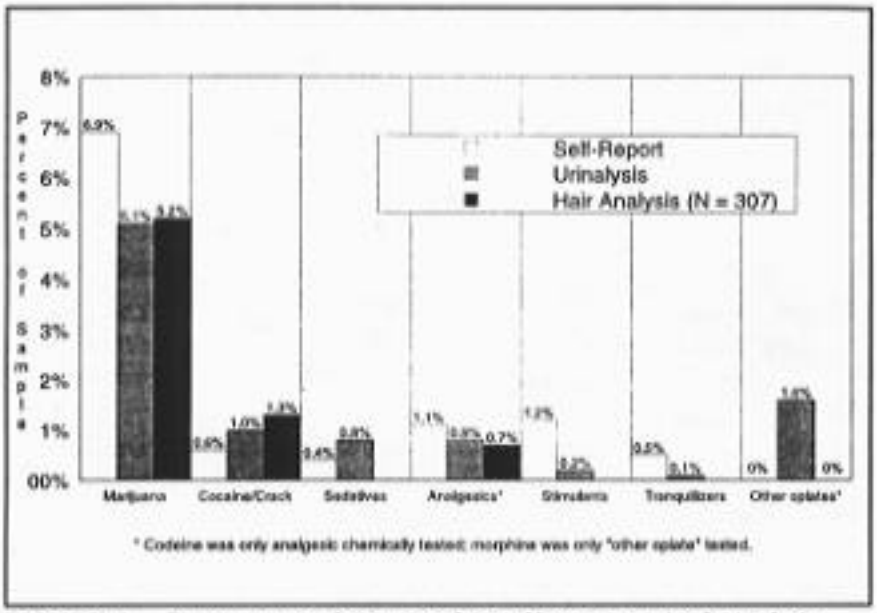

FIGURE 1. *Drug use prevlence results: self-report, urinalysis, hair analysis (N = 928).*

Comparisons of Self-Reports and Urinalysis

Conditions (1) and (5) employed the same self-reporting technique, an individual interview in the workplace. The overall results (any drug) from self-reports and urinalysis for these two conditions are shown in table 4. Included among the 283 subjects who reported no drug use and

TABLE 4. *Comparisons of urinalysis and self-report results for conditions 1 and 5, workplace interview.*

Self-report result	Urinalysis Result		
	Negative	Positive	Total
Negative	283	14	297
Positive	27	10	37
Total	310	24	334

tested negative are 17 subjects who reported legal use of prescription drugs and tested positive for those drugs.

The combined agreement rate (the percentage of subjects classified the same—positive or negative—by both techniques) for the first and fifth self-report conditions was 87.7 percent. Among the discrepancies, 14 subjects tested positive but did not admit to using drugs. Thirty-seven subjects (11.1 percent) self-reported illicit drug use, 27 of whom were found negative by urinalysis. A total of 24 subjects was found positive by urinalysis (7.2 percent), only 10 of whom self-reported illicit drug use. Comparisons of overall results (any drug) from self-reports and urinalysis for the two group questionnaire administration conditions (2 and 6) are shown in table 5. The agreement rate for these conditions was 91.4 percent. In this condition, 16 subjects tested positive but did not admit using drugs, and 10 subjects admitted drug use but tested negative. Seven subjects self-reported drug use and were also found positive by urinalysis.

Comparative results for the third condition (telephone interview) are shown in table 6. The agreement rate between self-report and urinalysis for the telephone interview was 91.0 percent. In this condition, 16 subjects self-reported drug use and 13 subjects tested positive. However, eight of the self-reported drug users tested negative, and five of those testing positive did not report any drug use.

The comparative results for the fourth condition (individual interview off the worksite) are shown in table 7. The agreement rate between urinalysis and self-reports in this condition was 91.1 percent. Seventeen subjects self-reported drug use and 12 subjects tested positive. Nine of the

TABLE 5. *Comparisons of urinalysis and self-report results for conditions 2 and 6, group questionnaire.*

	Urinalysis Result		
Self-report result	Negative	Positive	Total
Negative	270	16	286
Positive	10	7	17
Total	280	23	303

TABLE 6. *Comparisons of urinalysis and self-report results for condition 3, telephone interview.*

	Urinalysis Result		
Self-report result	Negative	Positive	Total
Negative	124	5	129
Positive	8	8	16
Total	132	13	145

17 self-reported drug users tested negative, and 4 of those testing positive did not report any drug use.

The comparative results from self-reports and urinalysis for all conditions combined are shown in table 8. The overall agreement rate across these 928 subjects was 90.0 percent, with 72 subjects testing positive and 87 self-reporting drug use. However, 39 subjects tested positive but did not admit any drug use, and 54 subjects who reported drug use tested negative.

Among the 39 subjects reporting no drug use but testing positive, 8 tested positive for morphine/codeine combined while 7 were positive for morphine alone. Because morphine often appears as a metabolite of codeine, it is likely that many of these subjects may simply have failed to report prescription use of a codeine-based medication. Similarly, the

TABLE 7. *Comparisons of urinalysis and self-report results for condition 4, offsite interview.*

Self-report result	Urinalysis Result: Negative	Positive	Total
Negative	125	4	129
Positive	9	8	17
Total	134	12	146

TABLE 8. *Comparisons of urinalysis and self-report results for all conditions.*

Self-report result	Urinalysis Result: Negative	Positive	Total
Negative	802	39	841
Positive	54	33	87
Total	856	72	928

seven subjects who reported no drug use but tested positive for sedatives may also have simply failed to report prescription use. Unfortunately, there is no way of knowing which of these 20 subjects (2 subjects tested positive for both morphine/codeine and sedatives) simply failed to report prescription use and which were using the drugs illegally.

A total of 54 subjects across all conditions admitted drug use but tested negative by urinalysis. The central reason for discrepancies in this direction is that of the 48 subjects who responded, all but 2 reported a frequency of use—only 1 or 2 days in the past month (or less)—that would place them beyond the range of detection by urinalysis.

Comparisons of Self-Reports and Hair Analysis

Comparisons of overall results (any drug) from self-reports and hair analysis for the individual onsite interview (condition 5) are shown in table 9.

TABLE 9. *Comparisons of hair analysis and self-report results for condition 5, workplace interview.*

	Hair Analysis Result		
Self-report result	Negative	Positive	Total
Negative	141	4	145
Positive	10	6	16
Total	151	10	161

The agreement rate for this condition was 91.3 percent. However, four subjects tested positive but did not admit to using drugs. Sixteen subjects (9.9 percent) self-reported illicit drug use, 10 of whom were found negative by hair analysis. A total of 10 subjects in this condition were found positive by hair analysis (6.2 percent), 4 of whom reported no illicit drug use.

Comparisons of overall results (any drug) from self-reports and hair analysis for the group questionnaire administration (condition 6) are shown in table 10. The overall agreement rate for this condition was 92.5 percent. In this condition, seven subjects tested positive but did not admit using drugs, and four subjects admitted drug use but tested negative. Three subjects self-reported drug use and were also found positive by urinalysis.

The comparative results from self-reports and hair analysis for both conditions combined are shown in table 11. The overall agreement rate across these 307 subjects was 91.9 percent, with 20 subjects testing positive and 23 self-reporting drug use. However, 11 subjects tested positive but did not admit any drug use, and 9 subjects who reported drug use tested positive.

TABLE 10. *Comparisons of hair analysis and self-report results for condition 6, group questionnaire.*

Self-report result	Hair Analysis Result		
	Negative	Positive	Total
Negative	132	7	139
Positive	4	3	7
Total	136	10	146

Among the 11 subjects reporting no drug use but testing positive, 3 tested positive for codeine alone. As previously mentioned, this may result from subjects' failure to report prescription use of a codeine-based medication.

TABLE 11. *Comparisons of hair analysis and self-report results for both conditions.*

Self-report result	Hair Analysis Result		
	Negative	Positive	Total
Negative	273	11	284
Positive	14	9	23
Total	287	20	307

As shown in table 11, a total of 14 subjects across both conditions admitted drug use but tested negative by hair analysis. Of these, five admitted use of tranquilizers, analgesics (other than codeine), or sedatives, drugs that were not screened by hair analysis. Of the remaining nine drug users who tested negative by hair analysis, only one marijuana user reported using the drug three to six times per week. The other drug users reported using the drug twice a month or less, with the last use occurring more than 1 week before testing.

Comparisons of Urinalysis and Hair Analysis

The comparative results from hair analysis and urinalysis for conditions 5 and 6 combined are shown in table 12. The overall agreement rate across these 307 subjects was 94.8 percent, with 20 subjects testing positive by hair analysis and 22 testing positive by urinalysis. There were few discrepancies, with seven subjects testing

positive by hair analysis but not by urinalysis, and nine subjects testing positive by urinalysis but not by hair analysis.

Of the seven subjects testing positive by urinalysis and negative by hair analysis, two tested positive for use of a morphine/codeine combination (counted as four positives), three tested positive for morphine alone, and two were positive for marijuana use. The presence of morphine com-bined with codeine possibly suggests the use and subsequent metaboli-zation of codeine, which was screened by both urinalysis and hair analysis. The remaining two subjects tested positive by urinalysis and

TABLE 12. *Comparisons of hair analysis and urinalysis results for conditions 5 and 6.*

	Hair Analysis Result		
Urinalysis result	Negative	Positive	Total
Negative	278	7	285
Positive	9	13	22
Total	287	20	307

negative by hair analysis for marijuana use. Although the hair analysis procedure did detect several marijuana users, the laboratory has indicated that the detection of marijuana is the most problematic of the drugs for which hair analysis is conducted.

Among the seven subjects testing positive by hair analysis and negative by urinalysis, three tested positive for marijuana use, three tested positive for cocaine use, and one tested positive for codeine. Of these subjects, only one reported use of any illicit drugs. This subject reported cocaine

	Self-Report Condition						
Assessment method	#1 Workplace interview	#2 Group questionnaire	#3 Telephone interview	#4 Off-site interview	#5 Interview phase 2	#6 Quest. phase 2	To
Self-report	12.1%	6.4%	11.0%	11.6%	9.9%	4.8%	9.4
Urinalysis	6.9%	8.3%	9.0%	8.2%	7.5%	6.8%	7.8
Hair analysis					6.2%	6.8%	6.5

use to be 1 or 2 days within the past month. The subjects last use was reported to be more than 1 month ago, which could explain the lack of detection by urinalysis.

As mentioned above, 14 subjects in conditions 5 and 6 yielded conflicting chemical test results; however, 13 of these 14 subjects reported no illicit drug use. Had these subjects reported use of these drugs, more information would be available to explain the possible causes of discrepancies between the chemical analysis techniques.

Calculation of Drug Use Prevalence Rates

Drug use prevalence rates can be calculated for this workforce based on the specific testing methods employed. As shown in table 13, the drug use prevalence rates based on self-reports are generally around 11 percent, except for the group administration condition, which generated a prevalence rate less than half that of the other conditions. The aggregate prevalence rate for urinalysis was 7.8 percent across the entire sample of 928, while the self-report method produced a prevalence rate of 9.4 percent. Across the sample of 307 for conditions 5 and 6, the hair analysis prevalence rate was 6.5 percent and the urinalysis preva-lence rate was 7.2 percent.

However, the actual prevalence rate is clearly higher than indicated by any of these methods used alone. A better estimate of drug use prevalence is obtained by combining the number of employees self-reporting illicit drug use with those testing positive by either the urinalysis or hair analysis but not admitting drug use. Using this estimation, 87 workers self-reported illicit drug use, another 39 not admitting use were found positive by urinalysis, and 6 who did not report drug use were found positive by hair analysis but negative by urinalysis. Therefore at least 132 workers, or 14.2 percent of the workforce, may be classified as drug users.

DISCUSSION

The Prevalence of Illicit Drug Use in the Workforce Sample

The rate of illicit drug use found in this study (14.2 percent) was perhaps somewhat lower than might have been expected, as the National Household Survey on Drug Abuse reported a rate of 13.1 percent among employed adults, a rate based solely on self-reports (NIDA 1993). In this study, the prevalence rate produced by self-

reports alone was only 9.4 percent, a rate that was clearly suppressed by the group administration conditions. Indeed, the rate produced by the individual interview conditions (a method very similar to that used in the National Household Survey) ranged between 9.9 percent and 12.1 percent. In addition, the workforce in this study was located in a medium-sized western city, away from any of the major urban areas where drug use is relatively high. Therefore, although the prevalence rate may be considered low in comparison to other populations and regions, it is quite comparable to the rates reported by other investigators during the past few years (e.g., Lehman and Simpson 1992).

The Validity of Self-Reported Drug Use in the Workplace

This study may be viewed as a classic criterion validity design in which the chemical tests (urinalysis and hair analysis) are the objective criteria against which the self-report is compared. Although the chemical tests are susceptible to error, the urinalysis techniques are generally considered quite accurate, particularly when initial positives are confirmed by GC/MS. Questions remain about the accuracy of hair analysis, especially with respect to environmental contamination (Harkey and Henderson 1988). In this sample, the rates of false negatives and false positives for hair analysis appear quite low, and many of the false positives are probably attributable to the wider window of detection in comparison to urinalysis, the typical criterion measure used (Magura et al. 1992; Mieczkowski et al. 1993). This is not to suggest that the chemical tests are perfect criterion measures. The three methods are measuring constructs of drug use that overlap yet are distinctly different; therefore, one would not expect complete congruence among the three methods. Indeed, when subjects disclosed their drug use but produced a negative (i.e., drug-free) urinalysis result, the discrepancies were shown to be almost entirely a function of the subject's low frequency of drug use. However, when the discrepancy lies in the other direction (self-reports of no drug use accompanied by a positive urinalysis), there is little doubt that the urinalysis result is correct and the self-report is not. Thus, the urinalysis serves as a partial, but effective, validity criterion. In this study, hair analysis serves a similar criterion function. Because of its putatively longer period of detection, hair analysis should provide results that are temporally more isomorphic to self-reports than are those of urinalysis. However, the technology of hair analysis often (as in the current instance) does not provide tests for as many drugs as urinalysis.

The comparisons of self-report and chemical testing raise serious questions about the validity of self-reports of illicit drug use in the workplace. Of the 72 subjects whose urinalysis showed them to have recently ingested an illicit drug, less than half admitted any drug use in the past 6 months. Mitigating this effect somewhat is the likelihood that some fraction of these nondisclosers may have used prescribed codeine. Yet it is also likely that given the limited detection period of urinalysis, there were additional subjects who were nondisclosing drug users but whose last use was sufficiently in the past that they were beyond the detection range of urinalysis. The comparison of hair analysis results with self-reports produced similar findings. Of the 20 subjects whose hair analysis showed them to have used an illicit drug, less than half (i.e., 9 subjects) admitted any drug use in the past 6 months.

Stated differently, these comparisons show that the drug use prevalence rate in a workplace is likely to be approximately 50 percent higher than the estimate based on self-reports. When the subjects who refused to participate are taken into account, the actual rate might be higher still—although probably not substantially higher. The prevalence rate in the first condition (individual interview in the workplace), where the refusal rate was only 3.4 percent, was virtually the same as the fourth condition (offsite interview), where the refusal rate was 18.9 percent. If the refusal group was heavily laden with drug users, it is likely (though by no means necessary) that the fourth condition, with its high refusal rate, would produce a prevalence rate considerably lower than the first condition. Moreover, the detected nondisclosers are current (and perhaps frequent) drug users—the people in whom one would be most interested if one were studying the effects of worker drug use.

These findings have significant implications for studies that are attempting to determine relationships between illicit drug use and any number of job performance issues and are relying on self-reports as the primary measure of drug use. Based on these data, it appears that such studies will be missing a sizable, important group of drug-using workers. The findings also cast considerable doubt on the accuracy of workforce prevalence estimates based solely on self-reports. However, these results do not necessarily invalidate studies of drug use in the workforce that have relied heavily on self-reports. If one is not developing prevalence estimates but rather conducting research on general issues of drug use in the workforce, the problem of underreporting is less consequential.

Although these results are most relevant to studies of drug use in the workplace, they may also have implications that reach beyond the work-place to the general question of the validity of drug use self-reports. For several years, Wish (1990) has contended that prevalence estimates based on self-reports (including the National Household Survey) underestimate the rates of drug use, a contention based mainly on the lack of self-disclosing drug use among arrestees tested in the Drug Use Forecasting system. This study provides one of the few comparisons of self-reports and chemical tests in a normal (i.e., nonarrestee, nonaddict) population. One might expect a great deal of denial of drug use among arrestees questioned by law enforcement authorities in a jail. Less expected was the considerable denial of drug use among employed adults when assessed by a research team under conditions of anonymity and confidentiality. Although the setting is different, the data-collection procedures and the population were quite similar to those used in the National Household Survey (NIDA 1993). The underreporting found in this study also lends support to the position taken by GAO in a recent report expressing concern that the two major prevalence assessment activities of the Federal Government—the National Household Survey and the Monitoring the Future Survey—rely solely on self-reports (GAO 1993). Both that report and a recent NIDA publication on drug use survey methodologies discuss the need for "direct assessment of the *validity* of the measurements themselves" (Turner et al. 1992, p. 305).

Caution must be exercised, however, in the interpretation of these particular results, as the sample was drawn from only one company's workforce and did not contain a large number of drug users. Moreover, with the exception of marijuana, no specific type of drug was reported or detected with high frequency.[1]

Comparisons of Different Modes of Self-Report

Because the subjects were randomly assigned to the four different self-report conditions, one would expect the samples to be roughly equivalent in composition and in druguse prevalence rates. In fact, three of the four conditions produced drug use rates remarkably similar to each other, between 9.9 percent and 12.1 percent across the three conditions and four groups. It seems to matter little whether the mode of self-report is an individual interview/questionnaire in the workplace, a telephone interview in the worker's home, or an individual interview/questionnaire outside of the workplace. However, the group questionnaire method produced self-

report drug use rates that were roughly half those of the other conditions. This lower rate was produced by the group method in the first phase of the research, and was essentially replicated in the second phase. In the first phase, the group rate was 53 percent of the rate produced by the workplace interview method; in the second phase, it was 48 percent of the workplace interview method. It seems clear that this difference is not a function of there being fewer actual drug users in the group condition. In the first phase, the rate of urinalysis positives in the group condition was 8.3 percent, compared to an average of 8.0 percent in the other three conditions. In the second phase, the urinalysis rates across the two conditions were similar. There seems to be little doubt, therefore, that in this workplace, the group situation greatly suppressed self-reports of illicit drug use.

The fact that the telephone interview produced drug use rates that were comparable to the in-person individual interview was unexpected and stands in some contrast to the findings of Gfroerer and Hughes (1992), who found that surveys conducted by telephone tend to produce under-estimates of drug use prevalence compared to in-person interviews. The higher disclosure rates found in the current study probably occurred, at least in part, because the telephone interview subjects in this study were first recruited through individual in-person sessions; the actual interview was later conducted by telephone. This initial, in-person recruitment session doubtless helped to engender trust and rapport that would otherwise not be gained in a telephone interview.

These data indicate that the general underreporting of drug use noted above is greatly exacerbated when the self-reports are collected from groups in the workplace. This group suppressor effect may also be present in other studies of drug use, both in and outside the workplace, where data are collected in groups. For example, it is noted that as the Monitoring the Future survey (Johnston et al. 1993) is conducted in classrooms, the self-reporting of illicit drug use may be further suppressed—although students are quite accustomed to providing a variety of information in group conditions.

The Uses of Urinalysis and Hair Analysis in Drug Use Prevalence Assessment

By themselves, urinalysis and hair analysis typically provided estimates of drug use prevalence that were substantially lower than those produced by self-reports. Only in the group administration condition did the urinalysis and the hair analysis generate higher

prevalence rates than self-reports. Of the 87 subjects who self-reported drug use, a sizable majority (54) pro-duced a negative urinalysis result, mainly due to the constricted detection window of urinalysis. Similarly, of the 23 subjects who self-reported drug use in the last two groups (from whom hair samples were taken), a comparable majority (14) tested negative on hair analysis. The latter finding was somewhat unexpected, as hair analysis is reputed to provide a wider period of detection. Although 6 of the 14 subjects were using drugs not screened by hair analyses in this study, 7 of the remaining 8 subjects reported marijuana use. It appears that the hair analysis procedures are especially prone to false negatives in cases of marijuana use, particularly if the use is infrequent.

In short, as prevalence assessment methods, the chemical tests—when used alone—perform even more poorly than the self-report methods. It should be pointed out, however, that this investigation into hair analysis was more exploratory than definitive; future research should test for more drugs on larger samples.

On the other hand, when the chemical tests are used in combination with self-reports, they become a powerful addition to the prevalence assess-ment methods, doubtless providing a drug use prevalence rate that is much closer to the true rate. Thus, when the urinalysis and hair analysis results are combined with self-report, the resultant prevalence rate (14.2 percent) was 51 percent higher than the rate based on self-report alone. Indeed, given these findings, it would seem evident that the best strategy would be to combine self-report with chemical testing—not only for the workplace, but for surveys of the general population as well, and not only for validation purposes, but for prevalence assessment purposes. In response to a GAO recommendation that the National Household Survey include hair testing (on a limited test basis), NIDA officials expressed concern that response rates might be depressed as a result (GAO 1993). This study showed that with adequate incentives and confidentiality assurances, response rates equivalent to those currently achieved by the National Household Survey (80 to 85 percent) are possible even when biological specimens are obtained from respondents (GAO 1993).

ENDNOTE

1. Refer to the Technical Note at the end of the Introduction (p. 13).

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ACKNOWLEDGMENTS

This study was supported by grant 5-R01-DA05691 from the National Institute on Drug Abuse. The authors wish to thank Thadeus Arrington of the Institute for Social Analysis and Gordon Marshall of CONSAD for their contributions to this research.

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