Just Say "I Don't": Lack of Concordance Between Teen Report and Biological Measures of Drug Use

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KEY WORDS
cocaine, opiates, teen, drug use

ABBREVIATIONS
SES—socioeconomic status
APS—Adolescent Psychopathology Scale
LOD—limit of detection
GEE—generalized estimating equation
MTF—Monitoring the Future
OR—odds ratio
CI—confidence interval

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WHAT'S KNOWN ON THIS SUBJECT: With few exceptions, previous information on the prevalence of teen drug use in nonclinical samples has been derived exclusively from confidential or anonymous self-reported surveys and suggest that few US teens use cocaine or opiates.

WHAT THIS STUDY ADDS: From 1 of the first large, nonclinical teen studies with biological testing, data show that teens were 52 times more likely to test positive for cocaine compared with self-reported use. Reliance on self-report information alone could lead to inaccurate assessments.

abstract

BACKGROUND: Prevalence estimates of illicit drug use by teens are typically generated from confidential or anonymous self-report. While data comparing teen self-report with biological measures are limited, adult studies identify varying degrees of under-reporting.

METHODS: Hair analyses for cocaine, opiates and marijuana were compared to confidential teen self- and parent-reported teen drug use in a longitudinal cohort of >400 high-risk urban teens and parents.

RESULTS: Both teens and parents substantially underreported recent teen cocaine and opiate use. However, compared with parents, teens were more likely to deny biomarker-verified cocaine use. Teen specimens (hair) were 52 times more likely to identify cocaine use compared with self-report. Parent hair analyses for cocaine and opiate use were 6.5 times and 5.5 times, respectively, more likely to indicate drug use than were parental self-report. The lack of concordance between self-report and bioassay occurred despite participant's knowledge that a "certificate of confidentiality" protected both teen and adult participants, and that the biological specimens would be tested for drugs.

CONCLUSIONS: These findings confirm prior reports of adult underreporting of their own drug use while extending our understanding of teen's self-admitted drug use. The lack of concordance between teen self- or parent-reported teen drug use and biomarkers confirm our concerns that both teen- and parent-reported teen drug use is limited, at least for youth in high-risk urban settings. Methods of ascertainment other than self- or parent-report must be considered when health care providers, researchers and public health agencies attempt to estimate teen drug-use prevalence. *Pediatrics* 2010;126:887–893

Accurate estimates of teen drug use are essential to understanding mechanisms of use/abuse and to inform development of effective intervention and prevention programs, yet teen drug-use information in nonclinical populations is typically derived from anonymous or confidential reports. We hypothesized that when faced with sensitive questions, teens, like adults,[1–4] may give socially acceptable but untruthful answers by just saying "I don't."

We evaluated the concordance between confidential self-and parent report of teen cocaine and opiate use with biomarkers (hair analysis) in a prospective cohort of high-risk urban youth. We hypothesized that teen biological tests (ie, drug analytes in hair) would be greater than either teen self- or parent-reported teen drug use.

METHODS

Data for this study were obtained from a prospective evaluation of teen behavior, and previous approval from the Wayne State University institutional review board was obtained. Parents/primary caregivers provided informed consent and parental permission for teens. Teens gave informed assent. Consents and assents clearly indicated that participation included hair specimens for drug testing and that a certificate of confidentiality provided participant protection. Specifically, only 2 kinds of information could not be kept confidential: child abuse or plans to hurt themselves or others. Teens were told that no other information would be shared with anyone, including their parents. All participants received a modest incentive for study completion. Incentives were independent of the teen's or caregiver's willingness to provide a hair sample.

Procedures

Teens were initially identified through a prospective urban, low socioeconomic status (SES) pregnancy study[5] with assessments at ages 7 and 14 years. On the basis of a predominance of black women at the antenatal clinic (>90%), enrollment was limited to a single race. Teens and a primary caregiver, usually the biological mother (80%), were evaluated independently by trained female research assistants blind to participant history. All caregivers are referred to as "parent."

Drug Use

Teen drug-use information was collected by (1) teen self-report, (2) parent report about teen, and (3) teen hair analyses (for cocaine, opiates, and marijuana). Teens unwilling to provide hair were asked to provide an alternative sample (urine or sweat patch). However, because hair reflects longer periods of drug assessment (up to 3 months), biological data are limited to hair analyses in this report. A similar strategy was used for parents, except teens were not asked about their parent's drug use.

Teen self-reported use of tobacco, alcohol, marijuana, cocaine, and heroin was assessed with a version of the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* Schedule for Affective Disorders and Schizophrenia for School-Age Children, Present and Lifetime Version;[6] the Child Health and Illness Profile, Adolescent Edition;[7] and Adolescent Psychopathology Scale (APS).[8] Lifetime use and frequency of use for the past 6 months were identified on the Schedule for Affective Disorders and Schizophrenia for School-Age Children. The Child Health and Illness Profile, Adolescent Edition, identified lifetime and teens reported last use. APS substance-use questions examined the frequency of use in the past 6 months (never to nearly every day). Parent report of teen drug use was obtained with the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, and APS parent version. Parent self-report substance use was collected using a modified addiction severity index[9] that queries lifetime and past year use. For the purposes of this article, hair analysis was compared with parental report of past-year drug use.

Teen hair specimens were collected by research staff. For this report, data that compared self-report and drug analyte concentrations in hair were limited to participants for whom the interval between self-report and hair collection was ≤3 months to minimize discrepancies that resulted from biological detection of drug use that began after survey completion. The majority of analyses focused solely on cocaine and opiate use because of known poor detection of marijuana or its metabolites in hair.[10–14]

All hair assays for drugs and metabolites were performed by Omega Laboratories, Inc (Mogadore, OH). Each specimen was weighed and washed with an organic solvent to remove possible external contamination. Hair was pulverized, subjected to solid phase extraction, and analyzed by gas chromatography, mass spectroscopy. All specimens were analyzed at the lowest reportable assay cutoff (method limits of detection [LOD]). For cocaine, the LOD was 50 pg/mg. A test was considered positive if cocaine was present at ≥100 pg/mg (the limit of quantification), and if benzoylecgonine, norcocaine, or cocaethylene was present at a LOD of ≥20 pg/mg hair. For opiates (heroin, morphine, codeine, or methadone), a positive result was reported for the teen if either morphine or 6-acetylmorphine was present at the limit of quantification (≥100 pg/mg), and heroin use was reported only if

6-acetylmorphine was present at the LOD or greater. Caregivers who tested positive only for codeine were not considered positive because of the potential for legitimate prescription codeine use.

Statistical Analyses

Generalized estimating equations (GEEs) were used to assess differences in response between teens and parents for self-report and hair analysis, and to compare teen and parent denial rates.[15] The design for the analysis was a (2 × 2) repeated measures design with a dichotomous outcome in which the 2 repeated factors were methods of drug identification (self-report/hair analysis) and person (teen/parent). GEE was used because it provides tests for the main effect of method (self-report/biological sample), the main effect of person (teen/parent), and the method by person interaction (whether differences between self-report and hair analysis are different for teens and parents) in a single analysis with dichotomous. For opiates, there were no positive teen reports, so the odds ratios (ORs) and overall GEE model for opiates were undefined. Thus, the McNemar exact conditional test for related proportions (StatXact 6.3 [Cytel Inc, Cambridge, MA]) provided exact significance tests and confidence intervals (CIs).

RESULTS

Recruitment

Among the 556 children who participated at age 7, 529 children (95%) were eligible for participation at age 14. Data for excluded or teens lost to follow-up are provided (Table 1). The 432 teens evaluated (50.5% female) represent 82% of the available age-7 sample. Participants at teen follow-up did not differ from those not tested on maternal IQ or age, parent education, SES, or prenatal alcohol exposure.

TABLE 1 Sample Characteristics

	n	Mean or %	SD	Range
Parent				
Education, y	431	12.2	2.0	2–21
Marital status, % married	431	24.1	—	—
SES[a]	432	28.5	11.4	8–66
Age at 14-y visit, y	430	43.4	9.8	27.0–79.6
Primary caregiver, % mother	431	80.8	—	—
Teen				
Age at the 14-y visit, y	432	14.5	0.9	12.9–17.8
Gender, % male	432	49.5	—	—

Reasons for ineligible teens at age 14: 15 families moved out of state; 2 children had closed adoptions; 6 teens were incarcerated; 3 teens died (1 of leukemia and 2 by homicide); and 1 child was missing and presumed to be a runaway. Additional losses to the teen follow up ($n = 97$) included 27 teens (5%) whose family could not be located, 39 teens (7%) whose parent refused, and 31 teens (6%) who, despite agreeing to participate, failed to attend any scheduled appointment.
[a] Based on the Hollingshead Four Factor Index of Social Status (A. B. Hollingshead, unpublished data, 1975).

TABLE 2 Reasons for Missing Hair Specimens or Specimens Excluded From This Report

	Teens ($N = 432$)		Parents ($N = 431$)	
	Cocaine Results Missing/ Excluded, *n* (%)	Opiate Results Missing/ Excluded, *n* (%)	Cocaine Results Missing/ Excluded, *n* (%)	Opiate Results Missing/ Excluded, *n* (%)
Quantity not sufficient	8 (1.9)	38 (8.8)	9 (2.1)	52 (12.1)
Refused hair specimen	55 (12.7)	55 (12.7)	99 (23.0)	99 (23.0)
Hair too short for sampling	87 (20.1)	87 (20.1)	14 (3.2)	14 (3.2)
Hairstyle (braids, weave, etc)	14 (3.2)	14 (3.2)	10 (2.3)	10 (2.3)
Teen did not complete testing	10 (2.3)	10 (2.3)	11 (2.6)	11 (2.6)
Laboratory error	—	—	3 (0.7)	3 (0.7)
No caregiver (teen in group home)	—	—	1 (0.2)	1 (0.2)
Total missing a hair specimen	174 (40.3)	204 (47.2)	147 (34.1)	190 (44.1)
Specimen and report >3 mo apart	47 (10.9)	47 (10.9)	40 (9.3)	28 (6.5)
Total missing/excluded hair specimens	221 (51.2)	251 (58.1)	187 (43.4)	218 (50.6)
Total hair specimens reported	211 (48.8)	181 (41.9)	244 (56.6)	213 (49.4)

Teen participants were more likely to have married parents ($\chi^2 = 5.5$; $P = .019$) and live with their biological mother ($\chi^2 = 16.2$; $P = .001$) than those not tested.

Study Sample

Less than 2% of the 432 teens and 431 parents chose not to provide teen drug-use information. Table 1 contains participant characteristics, and Table 2 provides reasons for excluded or missing hair specimens. Hair from 266 teens and 248 parents was analyzed for at least 1 drug. Because the primary study focus was cocaine, if there was inadequate hair for all assays, cocaine was analyzed first. Thus, there is more missing opiate than cocaine data. In addition, hair analysis data are not reported for 51 cases for which the interval between self-report and hair sampling was >3 months. Delayed acquisition of hair was primarily a result of difficulties collecting the initial specimen (hair too short, braids/weaves). Results from hair analyses are reported for 215 teens and 248 parents with self-reported drug use and hair specimens obtained within a 3-month window. Teens who provided a hair sample did not differ from teens who did not provide a sample on SES, alcohol, tobacco, or marijuana report, caregiver education, or maternal change in custody. In contrast, more boys refused ($\chi^2 = 5.67$; $P = .017$) and had inadequate hair for sampling ($\chi^2 = 101.10$; $P < .001$).

TABLE 3 Teen Drug-Use Prevalence by Self, Parent, or Combined Report

Drug	Teen Report		Parent Report		Combined Report	
	n	%	*n*	%	*n*	%
Alcohol	426	25.4	397	9.6	428	29.0
Tobacco	426	12.7	402	4.2	427	14.3
Marijuana	426	16.9	423	9.5	428	19.9
Opiates	408	0.0	402	0.0	411	0.0
Cocaine	426	0.7	423	0.5	428	1.2

Nine of the 55 teens (16.4%) and 33 of the 99 (33.3%) parents who refused hair sampling provided either urine or sweat specimens. However, because of the limited duration of metabolite presence in either sweat or urine, these alternate specimens are not included in this report.

TABLE 4 Comparison of Self-report to Biological Evidence of Illicit Drug Use for Teens and Parents

Drug	*n*	Source	
		Positive Self-report, *n* (%)	Positive Hair Specimen, *n* (%)
Teens			
Opiates	181	0 (0.0)	12 (6.6)
Cocaine	211	2 (0.9)	69 (33.7)
Marijuana	202	43 (20.0)	9 (4.5)
Parents			
Opiates	213	7 (3.3)	15 (7.0)
Cocaine	244	15 (6.1)	69 (28.3)
Marijuana	233	79 (31.6)	16 (6.9)

The self-report denominator is limited to only the specimen used in biological analyses ($n = 215$ for teens and $n = 248$ for caregivers).

TABLE 5 Parent Drug-Use Prevalence by Self-report

Drug	*n*	Positive Parent Report, *n* (%)
Alcohol	424	291 (68.6)
Tobacco	425	226 (53.2)
Marijuana	426	117 (27.5)
Opiates: heroin/ methadone only	425	9 (2.1)
Cocaine	426	19 (4.5)

Concordance Between Teen and Parent Report of Teen Drug Use

Data from teen self-report and parent-reported knowledge of teen cocaine and opiate use (Table 3) suggested a low incidence of lifetime use for these drugs, similar to Monitoring the Future (MTF).[16,17] No teen or parent gave a positive report for teen opiate use. Teen cocaine use was endorsed only by 2 parents (0.5%) but denied by both teens. Combined teen cocaine use identified by either teen or parent report was 1.2%. Study teens reported marijuana use that was virtually identical to current MTF[18] data, but lower than current MTF reports for tobacco and alcohol use. However, compared with teens, parents underreported teens use of all 3 drugs (Table 3). Among the teens who admitted marijuana use, only 39% of parents reported their child used marijuana, whereas when the parent acknowledged teen use, 69% of teens admitted to marijuana use. Concordance between parent and teen report of teen alcohol and tobacco use was even lower (22% for both). However, when teens admitted to alcohol or tobacco use, ~60% of their parents also reported teen use.

Teen Self-reported Drug Use: Comparison With Biological Data

More than 4 times as many participants reported marijuana use than the biological measure indicated (Table 4). This lack of sensitivity has previously been reported[10–14] but not confirmed by a large, epidemiologic survey. As a result, valid biological confirmation of teen marijuana use was not possible.

Only teens with both self-report and hair specimens are included in the analyses that follow. Teens were 52 times more likely to be positive on the biological measure for cocaine metabolites than on self-report (Wald $\chi^2 = 29.93$; $P < .001$) (Table 4). Whereas only 2 teens (<1%) reported cocaine use, biomarker evidence of use was present for one-third of teens (69 of the 211 hair specimens). When combined with the additional 2 positive reports of teen cocaine use (from 1 teen and 1 parent) for whom a positive teen hair specimen was not available, the incidence of teen cocaine use was 33.6%. Because no teens admitted to opiate use, the exact conditional McNemar test was used and revealed that teens also significantly underreported their opiate use (OR: ∞ [95% CI: 3.007 to ∞]; $P = .001$).

Intermethod agreement was also examined using the symmetric measure Cohen's κ. Comparing teen cocaine self-report to the bioassay yielded poor reliability ($\kappa = 0.02$; $P = .46$). Because there was no teen admission of use, κ cannot be computed for teen opiate self-report/biosample comparison.

Parent Self-reported Drug Use: Comparison With Biological Data

To provide contextual information about the families assessed in this report, parents' biological testing for opiates and cocaine (Table 4) and their report of their own tobacco, alcohol, marijuana, cocaine, and opiate (Table 5) use is provided. Parents were 3.2 times more likely to refuse hair sampling than their teens (99 vs 55; OR: 3.2 [95% CI: 1.89–5.46]; $P < .001$). However, samples were 9.1 times more likely to be obtained from parents than their children because more children had hair too short for adequate sampling (14 vs 87; OR: 9.1 [95% CI: 4.43–19.39]; $P < .001$). This difference occurs at least in part because most of the parents were female, whereas half of the teens were male. A total of 69 parents (28.3%) had a hair assay positive for cocaine, including 15 (6.6%) who admitted to current cocaine use. Like their teens, parents significantly underreported cocaine (Wald $\chi^2 = 53.92$; $P < .001$). Parents were 6.5 times more likely to have a hair assay positive for cocaine than to have a positive self-report. Significantly more parents tested positive for opiates ($n = 15$ [7%]) than admitted to opiate use (3.3%). Two of the parents who admitted to opiate use tested negative. The self-reported incidence of opiate use (3.3%) was significantly different from the biological measurement for

opiates (7.0%), also confirming parental underreporting of opiates (McNemar change test, OR: 5.5 [95% CI: 1.305–34.65]; $P = .022$).

Intermethod agreement was also examined using the symmetric measure Cohen's κ and demonstrated poor reliability (cocaine: $\kappa = 0.29$ [$P < .001$]; opiate: $\kappa = 0.16$ [$P < .001$]). Although both κ values reached statistical significance, a κ value of <0.70 is not considered acceptable interrater, in this case intermethod, reliability. Study values are below even the more liberal judgment of moderate reliability (0.40).[19]

Comparison of Teen and Parent Cocaine and Opiate Use

For cocaine, there was a significant difference in the incidence of teen and parent use identified by biotesting (Wald $\chi^2 = 7.30$; $P < .001$), with teens 7.9 times more likely to underreport cocaine than their parents. Because of no positive self-report for teen opiate use, we were not able to compare underreporting of opiate use between parents and teens. We did compare the positive rates between parents and teens for the biological and self-report measures. Both parents and teens underreported opiate use (teens: OR: ∞ [95% CI: 3.007 to ∞]; $P = .001$) (parents, OR: 5.5 [95% CI: 1.305–34.65] $P = .022$). However, there was no difference between teens and parents in biological positive rate and self-report rate using the McNemar change test (biological measure: OR: 1.00 [95% CI: 0.239–4.184; $P = 1.000$) (self-report: OR: ∞ [95% CI: 0.583 to ∞]; $P = .25$).

DISCUSSION

Although both teen and parent hair analysis identified cocaine and opiate use at higher rates than reported, denial of cocaine use was higher for teens. Our low SES, high-risk urban teens self-reported marijuana, opiate, and cocaine use at rates similar to national anonymous surveys of black youth,[18] yet biomarkers demonstrated that cocaine and opiate use was greater; 52 times greater for cocaine. Parent acknowledgment of their teen's alcohol, tobacco, and marijuana use was also underreported compared with teen self-report.

Few teen studies compare biological measures with self-or parent-reported teen cocaine and opiate use. An addiction center that used urine testing found that the majority (64%) of teens who tested positive for marijuana admitted to use.[20] In contrast, no teen admitted to cocaine use, and >70% of those who tested positive for opiates denied use. Mieczkowski et al[21] found demographic site-specific variations in reports from adjudicated teens, with a lower incidence of cocaine-positive hair (5.8%) in a sample of mainly white youths that included both boys and girls (St Petersburg, FL) compared with 55% in a 100% male sample of mostly black youths (Cleveland, OH). The 2 samples were similar in past 30-day use admission rates (Cleveland, 4.7; St Petersburg, 2.1). As far as we are aware, only 1 other nonclinical, nonadjudicated study compared teen cocaine self-report with biological assessment.[22] This non peer-reviewed study reports a low incidence of positive urine tests for cocaine (1.4%), but a 79% concordance between anonymous cocaine self-report and urine testing.[22] An additional 0.7% admitted to cocaine use but had a negative urine sample; urine testing identifies only the most recent[23–26] and possibly the heaviest cocaine users. Two additional differences between our report and this study is use of anonymous testing[27] and the high environmental drug use in our study, which may also account for some interstudy differences (V.D.-B., L.M.C., J.H.H., et al, unpublished data, 2009).[28]

Identification of significant underreporting (25%–50%) of cocaine use from nonclinical, nonadjudicated adult samples is not new.[29,30] Even higher rates of underreporting of cocaine,[30,31] but not heroin[32] have been identified in adult neighborhood studies. In contrast, highly accurate reports have been identified from adults beginning (89% for cocaine and 96% for heroin) but not after drug treatment programs (51%–67%).[33] Previous adult studies confirm that both black participants and residents of highly segregated neighborhoods, such as Detroit, are more likely to underreport drug use.[34] Differences in SES and drug-use social desirability have been related to the likelihood of adult study participants accurately self-reporting drug use.[35,36] Researchers have hypothesized that for adults, the perceived threat of legal consequences from acknowledging illicit drug use may contribute to the relative poor sensitivity of self-report.[37]

Although some data from clinical and adjudicated samples exist, the rate of teen underreporting from a nonclinical, nonadjudicated sample has not been adequately addressed. The substantial discordance between self-reported teen, parent-reported teen drug use, and biomarker results in our cohort suggests that both teen- and parent-reported teen drug use, at least in a high-risk sample, can seriously underestimate teen illicit substance use. Although parents were 8 times more likely than teens to admit their own cocaine use, the adult caregivers in this study still significantly underreported their own cocaine and opiate use. It is possible that our teens may have felt more threatened by the potential for identification of their cocaine and opiate use than even their caregivers. However, inconsistent with this hypothesis was the lower rate of teen re-

fusal of hair sampling compared with that of their parents.

Environmental contamination must be considered, although the commercial laboratory methods included pretest de-contamination of specimens and measurement of both cocaine and metabolites (ie, benzoylecgonine, norcocaine, and cocaethylene). Controversy remains about whether hair from cocaine-abstinent persons in chronic, casual environmental contact with cocaine is likely to test positive.[37,38] Confidence in the validity of cocaine-positive hair in our study was bolstered by the presence of cocaine metabolites in hair, although this may not always effectively exclude contamination.[37] We also confirmed prevalence rates for different sample batches and found that teen cocaine prevalence was consistent across time. Although we cannot fully exclude passive hair contamination,[39] home exposure cannot explain all cocaine-positive cases. Almost half of cocaine-positive teens were from households in which the parent was negative by report and bioassay. Although Huestis[40] noted that individual results from hair analyses do not meet a judicial standard of proof, hair analysis is especially useful in aggregate data analysis and epidemiologic research.[24]

We note several limitations. Participation and quantity of hair collected, particularly for males, was problematic. We now offer a stipend for haircuts for teens whose hairstyle prevents obtaining an adequate specimen. Our findings are not based on a representative sample and may not generalize to drug use among other groups. Although recent data suggest that almost 12% of US teens live with at least 1 parent who depended on or abused alcohol or illicit drugs,[41] in this cohort 23% of caregivers had Michigan Alcoholism Screening Test scores of $\geq$5, which suggests alcohol-related problems,[42] and 11% had a *Millon Clinical Multiaxial Inventory, Third Edition*, drug dependence scale score of $\geq$75, which suggests drug abuse. Earlier studies of adult marijuana users have suggested that a history of maternal heroin or cocaine use may increase the quantity of drug use.[43] Thus, it is quite possible that the high incidence of parent drug use affected the prevalence of teen drug use in this study. However, teen denial of drug use, not the prevalence of teen drug use, was the focus of this report. Additional factors that may account for the high incidence of cocaine use among the teens and parents in our urban, low SES cohort include high levels of exposure to community drug use and community violence (V.D.-B., L.M.C., J.H.H., et al, unpublished data, 2009). Ensminger et al[44] found similar lifetime rates of illicit drug abuse among their adult high-risk urban participants from a Chicago neighborhood >10 years ago.

Combined use of a biological measure self-report to assess teen and parent drug use in a large, nonclinical, nonadjudicated sample of teens, and the high rate of underreporting of teen cocaine and opiate use, are novel features of our study. These data clearly show significant underreporting of cocaine use by teens and parents, and of opiate use by teens, although participants were informed that a hair specimen would be obtained for drug testing. Even with the addition of parental suspicion of teen drug use, in this study simply asking adolescents and their parent if the teen was using illicit drug failed to identify at-risk youth.

Researchers, clinicians and policy makers should be cautioned that self-reported drug-use data, even in the presence of a "certificate of confidentiality," substantially underestimate cocaine and opiate use among urban teens. Perceived social acceptability of reporting drug use, concern about the potential risks of drug-use admission, or perhaps anxiety that their parents might become aware of their drug use may all have accounted for teens' preference to just say "I don't."

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