

### The impact of cocaine and marijuana use on low birth weight and preterm birth: A multicenter study

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**OBJECTIVE:** Our aim was to evaluate prospectively the effects of cocaine and marijuana use on pregnancy outcomes.

**STUDY DESIGN:** A prospective multicenter cohort study was conducted at seven university-based prenatal clinics in the United States from 1984 to 1989. The cohort described herein consisted of a multiethnic population of 7470 pregnant women. Information on the use of drugs was obtained from personal interviews at entry to the study and assays of serum obtained during pregnancy. Pregnancy outcome data (low birth weight [ $<2500$  gm], preterm birth [ $<37$  weeks' gestation], and abruptio placentae) were obtained with a standardized study protocol.

**RESULTS:** A total of 2.3% of the women used cocaine and 11.0% used marijuana during pregnancy. Cocaine use was not associated with having a low-birth-weight infant (adjusted odds ratio 0.7, 95% confidence interval 0.4 to 1.3) or a preterm birth (1.3, 0.9 to 2.0). There was no association between short-term exposure to cocaine and preterm delivery (1.1, 0.3 to 4.0). However, cocaine use was strongly associated with abruptio placentae (adjusted odds ratio 4.2, 1.9 to 9.5). Marijuana use was not associated with low birth weight (1.1, 0.9 to 1.5), preterm delivery (1.1, 0.8 to 1.3) or abruptio placentae (1.3, 0.6 to 2.8). By comparison, 35% of the women smoked cigarettes during pregnancy, and cigarette smoking was positively associated with low birth weight (1.5, 1.2 to 1.8).

**CONCLUSIONS:** In this population of women receiving prenatal care, cocaine use was uncommon and was not related to most adverse birth outcomes. Marijuana use was relatively common and was not related to adverse pregnancy outcomes. Tobacco is still the most commonly abused drug during pregnancy, 15% of all cases of low birth weight in this study could have been prevented if women did not smoke cigarettes during pregnancy. (*Am J Obstet Gynecol* 1995;172:19-27.)

**Key words:** Cocaine, marijuana, pregnancy, prenatal care

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The number of reports linking illicit drug use with adverse pregnancy outcomes has increased dramatically,<sup>1</sup> paralleling the growing popularity of cocaine in the United States during the 1980s. In 1990 it is estimated that 2.1 million women used cocaine and 8.8 million used marijuana.<sup>2</sup> Among women, these drugs were most commonly used by those in the age group 18 to 34 years—the age range when pregnancy is most likely. Previous research linking illicit drug use and adverse pregnancy outcomes has been inconclusive because studies were confined to very small or highly selected subgroups,<sup>3,4</sup> relied exclusively on self-reports or used medical records to determine whether drugs were used,<sup>5</sup> or did not control for important confounding factors.<sup>6,7</sup> Nevertheless, these observations have fueled important public policy debates and concerns



about the rights of women and the interests of their fetuses.<sup>8</sup>

The purpose of this analysis of data from a multicenter study was to determine prospectively the prevalence of cocaine and marijuana use in a cohort of 7470 pregnant women and the effects of these drugs on the outcome of their pregnancies. This study, the largest birth outcome study reported to date, applied unbiased methods to measure both drug exposure and pregnancy outcomes. Drug use during pregnancy was documented by both personal interview and serum assay. Data were also systematically obtained on a large number of other potential confounding factors, including cigarette smoking, alcohol drinking, and vaginal infections. Finally, infant birth weight, gestational age, and obstetric complications were measured according to standardized protocols.<sup>9</sup>

### Methods

The women selected for this study participated in the Vaginal Infections and Prematurity Study.<sup>9</sup> The study population consisted of 13,914 women who received prenatal care during the years 1984 to 1989 at one of five clinical centers: University of Oklahoma, Oklahoma City; Columbia University, New York; Louisiana State University Medical Center, New Orleans; University of Texas, San Antonio (stopped recruitment in November 1986); and the University of Washington, Seattle (stopped recruitment in June 1986). To increase the enrollment of women who were colonized with the organisms that were being evaluated in the trial, two additional centers were added in 1987 (Tulane University, New Orleans, and Harlem Hospital, New York). The study protocol was approved by the institutional review boards of the seven participating sites.

Women were interviewed at 23 to 26 weeks' gestation about a variety of risk factors thought to be associated with adverse pregnancy outcomes. Women were excluded if they had one of the following: diabetes requiring insulin, hypertension or heart disease requiring medication, chronic renal disease, multiple pregnancy, Rh sensitization, current use of corticosteroids, history of cervical incompetence or cerclage, receipt of antibiotics in the past 2 weeks, use of tocolytic agents before enrollment in the study, and intent to deliver at a nonstudy hospital.

Data on exposure to cocaine and marijuana during pregnancy were obtained from two independent sources, self-report and serum assay. At study entry all women were asked by study research nurses about various demographic and lifestyle factors such as age, ethnicity, pregnancy history, smoking, drinking, prepregnant weight, frequency of sexual intercourse, and use of illicit drugs. Specifically, the women were asked, "At any time during this pregnancy have you used any

of the following? Drugs to control nausea or vomiting, tranquilizers or sedatives, amphetamines, marijuana, methadone, heroin, LSD, PCP, cocaine, other." Women who responded positively were also asked about the weekly frequency of their use of these drugs. The study protocol also required that serum be obtained at entry into the study (23 to 26 weeks' gestation) for all women, during the third trimester (31 to 36 weeks' gestation) for a randomly selected subsample of 12% of the women, and at delivery for most women, particularly those women delivered of preterm infants. Since the primary reason for serum collection was to detect acute infection with various genital organisms as indicated from rising antibody titers, we studied only women from whom sufficient volumes of serum (at least 4 ml) were collected. In practice, slightly less than 2 ml was generally available for drug assays. Written informed consent, which included a statement that the sera collected would be used to help identify potential causes of low birth weight or preterm delivery, was obtained from all women. To protect the confidentiality of the women enrolled in the study, the only individual identification number maintained was the study identifier, which cannot be linked to the woman's name or hospital record number.

Blood samples were collected in "red top" tubes, which contained no anticoagulants or preservatives. At each study site blood was drawn, stored in a refrigerator for up to 3 days, separated and decanted into 1.8 ml cryotubes, frozen at  $-70^{\circ}\text{C}$ , and shipped to a central repository on dry ice. In 1991 serum samples selected for this study were sent to the Center for Human Toxicology at the University of Utah to be analyzed for the presence of cocaine and marijuana metabolites. Serum was screened by radioimmunoassay (RIA) (Roche Abuscreen, Nutley, N.J.) for the presence of the cocaine and marijuana metabolites benzoylecgonine and 11-nor- $\Delta^9$ -carboxy-tetrahydrocannabinol (THC-COOH), respectively. A methanol extraction procedure was performed on serum before the RIA for THC-COOH. Serum that was positive by RIA for benzoylecgonine ( $>25$  ng/ml) and/or THC-COOH ( $>10$  ng/ml) was confirmed by gas chromatography-mass spectrometry. Serum was extracted by liquid-liquid procedures with deuterated internal standards and analyzed by positive (benzoylecgonine)<sup>10</sup> or negative (THC-COOH)<sup>11</sup> chemical ionization with a Finnigan 4500 mass spectrometer (Finnigan MAT, San Jose, Calif.). Serum was defined as positive if it contained any amount of benzoylecgonine or THC-COOH detected by mass spectrometry. The intraassay variability was 3.9% for benzoylecgonine and 5.1% for THC-COOH. The interassay variability over 1 year was 7.0% for benzoylecgonine and 8.3% for THC-COOH.

Gestation at entry into the study was determined by the examining physician on the basis of the woman's



**Table I.** Self-report versus serum assay to detect drug use during pregnancy\*

	Analysis of serum		Significance
	Positive	Negative	
Cocaine use during pregnancy			
Self-report			
Positive	8	82	$p < 0.001$
Negative	85	7295	
Marijuana use during pregnancy			
Self-report			
Positive	180	237	$p < 0.001$
Negative	405	6648	

$p$  Values are from overall  $\chi^2$  tests.

\*Cocaine use detected by interview or serum assay at 23 to 26 weeks of pregnancy.

last menstrual period, supplemented by uterine measurements, detection of fetal heart tones, and ultrasonographic information (when available). Gestational age at delivery was calculated with the gestation at entry and the date of delivery. The baby's birth weight and date of birth were obtained from a review of medical records or in limited instances from the mothers themselves, if the delivery occurred outside of the study hospitals or if their medical records could not be located. In addition, in very rare instances birth certificates were obtained where possible if the data on birth weight and birth date could not be obtained from the other sources. Information about delivery complications was obtained by review of the mother's obstetric records. Infants were defined as being low birth weight if they weighed  $< 2500$  gm at birth. Preterm birth was defined as delivery of an infant before 37 completed weeks of gestation. Abruptio placentae was clinically diagnosed and confirmed in women having at least two of the following complications: vaginal bleeding, rapid painful labor, evidence of disseminated intravascular coagulation, tender uterus, fetal distress, or retroplacental clot.

A total of 13,913 women were enrolled at seven sites across the United States. There were 10,695 (77%) women who had blood samples obtained at the time they entered the study. The remaining 23% of the women refused to have blood drawn, primarily because blood had already been drawn for other routine prenatal testing and they did not want to have blood drawn twice in 1 day. An additional 3225 women had less than 4 ml of sera available and therefore were not eligible to be included in this study. Thus a total of 7470 women were eligible and were included in this study.

**Statistical analysis.** Bivariate analyses were done by  $\chi^2$ .<sup>12</sup> If an individual cell contained fewer than five observations, then the exact variance and  $p$  values were computed.<sup>13</sup> Multivariable analysis was done with logistic regression.<sup>12</sup> Factors that were statistically significant ( $p < 0.05$ ) in bivariate analysis or that were previously

described confounders were included in the multivariable models. In cases where there were very small numbers of women with the outcome and exposure (abruptio placentae), we calculated the odds ratio adjusted for smoking according to Mantel-Haenszel estimates. Population-attributable risks, which estimate the maximum proportion of an outcome attributable to an exposure, were calculated by the formula of Levin and Bartell.<sup>14</sup>

## Results

In our study cohort there were 7470 women who were enrolled from seven university-based prenatal clinics (University of Oklahoma ( $n = 2170$ ), Columbia University ( $n = 1271$ ), Louisiana State University ( $n = 1803$ ), University of Texas ( $n = 842$ ), Tulane University ( $n = 686$ ), University of Washington ( $n = 395$ ), and Harlem Hospital ( $n = 303$ ). Forty-three percent of the women identified themselves as African-American, 24% as Hispanic, and 33% as white or other; 42% had less than a high school education; 50% of the women lived with a husband or partner, 40% worked during pregnancy; and 10% had family incomes of  $\geq \$15,000$ .

**Cocaine and marijuana use during pregnancy.** Of the 7470 women, 175 (2.3%) of the women either had cocaine metabolites in serum or reported using cocaine. Cocaine metabolite (benzoylecgonine) was detected in the sera of 93 women (1.2%); 90 women (1.2%) reported using cocaine, and 8 (0.1%) both reported use and had metabolites detected (Table I). Thus only 8 out of 93 women (8.6%) whose sera tested positive for cocaine also admitted using it. Most (59%) of the women who admitted to using cocaine during pregnancy also stated that they had used the drug very infrequently (less than once a month) or had quit using the drug in early pregnancy.

For marijuana 822 (11.0%) of the women had THC-COOH in the serum or reported using marijuana. THC-COOH was detected in the sera of 585 (7.8%) women; 417 (5.6%) women reported using marijuana,

Table II. Description of cocaine or marijuana users during pregnancy\*

	No.	Cocaine (%)	Marijuana (%)
Institution			
University of Oklahoma	2170	1.7	16.3
Columbia University	1271	3.5	4.0
Louisiana State University	1803	1.6	9.7
University of Texas	842	0.8	7.4
Tulane University	686	2.3	8.9
University of Washington	395	6.6	25.3
Harlem Hospital	303	5.6†	6.6†
Study year			
1984	182	3.3	14.8
1985	2058	2.4	13.0
1986	1946	2.2	11.4
1987	1309	1.5	11.2
1988	1598	3.3	8.0
1989	377	1.1‡	8.2†
Maternal age			
16-19 yr	1859	1.6	8.0
20-24 yr	2732	2.4	12.9
25-29 yr	1716	2.9	13.8
30-34 yr	837	3.1	7.8
> 34 yr	326	1.2‡	5.5†
Maternal education			
< 9 yr	535	1.3	6.2
9-11 yr	2605	2.8	13.8
12 yr	2924	2.2	10.4
> 12 yr	1400	2.1§	9.0†
Ethnicity			
African-American	3212	2.4	9.3
Hispanic	1796	2.0	3.5
White, Asian, Pacific Islander	2462	2.6§	18.7†
Income			
< \$5,000	2280	2.5	13.3
\$5,000-\$9,999	1674	2.2	10.8
\$10,000-\$14,999	1039	1.5	11.8
\$15,000-\$19,999	331	2.7	14.8
> \$19,999	410	2.2	8.1
Refused or unknown	1736	2.7§	7.7†
Employed during pregnancy			
Yes	2961	2.4	12.0
No	4506	2.3§	10.3‡

\*Cocaine and marijuana use detected by interview or serum assay at 23 to 26 weeks of pregnancy.

† $p < 0.001$ .‡ $p < 0.05$ .§Not significant ( $p \geq 0.05$ ).|| $p < 0.01$ .

and 180 (2.4%) both reported use and had THC-COOH detected. Of the 585 women whose sera tested positive for marijuana, 180 of them (30.8%) also reported marijuana use, whereas 180 out of 417 (43.2%) women who reported marijuana use also had a positive serum assay result. We combined the results of the serum assays and self-reports for all remaining analyses to have the most comprehensive definition of drug use during pregnancy.

Women who used cocaine during pregnancy were more likely to have enrolled for care at the Seattle or New York institutions, been aged 25 to 34 years, lived alone, started sexual intercourse before age 15, had *Trichomonas vaginalis* infection, and had a body mass index below the 25th percentile (Table II). Cocaine use

was also associated with study year; however, study year was highly correlated with institution because many of the institutions participated in different study years. If the analysis is limited to those institutions participating in all the study years (University of Oklahoma, Columbia University, and Louisiana State University), then the use of cocaine varied by study year ( $p = 0.02$ ), although not in a consistent way over the time period ( $p$  for trend = 0.8). Cocaine users were also significantly more likely to use cigarettes and alcohol during pregnancy.

Women who used marijuana during pregnancy were more likely to have been enrolled in Seattle or Oklahoma City, been in their 20s, had a high school education, been white, and lived alone. Marijuana use was also associated with *Trichomonas vaginalis* infection, hav-



Table II—Cont'd

	No.	Cocaine (%)	Marijuana (%)
Living arrangement			
With spouse or partner	3699	1.9	11.1
With other family or other children	3085	2.6	10.1
Alone	450	4.0	15.3
Other	234	2.1†	13.3
Smoked during pregnancy			
Yes	2612	4.5	24.0
No	4858	1.2†	4.0†
Drank alcohol during pregnancy			
Yes	2549	4.3	19.9
No	4921	1.3†	6.4†
No. of living children			
0	3224	2.8	10.6
1	2260	1.8	11.7
2	1202	2.2	12.0
≥ 3	763	2.4§	9.3§
Body mass index percentile (weight/height <sup>2</sup> )			
1st-24th	1755	3.1	15.3
25th-49th	1765	3.2	11.4
50th-74th	1733	2.1	9.8
75th-100th	1752	1.3	8.7
Unknown	465	1.5†	6.7†
Vaginal isolation of <i>Trichomonas vaginalis</i>			
Yes	1009	4.6	16.3
No	6403	2.0†	10.1†
Cervical isolation of <i>Chlamydia trachomatis</i>			
Yes	745	2.7	9.8
No	6639	2.3§	11.1§
Age at first sexual intercourse			
< 15	1127	4.0	19.9
15-17	3822	2.5	12.2
18-20	1833	1.6	6.2
≥ 21	569	1.1	1.8
Unknown	118	0.9†	6.8†
Low-birth-weight infant and/or preterm birth in immediately preceding pregnancy			
Yes	377	1.9	17.2
No	2877	1.8	10.1
No previous live births	4207	2.8†	11.1†
TOTAL	7470	2.3	11.0

ing given birth to a low-birth-weight infant in the most recent prior pregnancy, starting sexual intercourse before age 15, being below the 25th percentile of weight/height,<sup>2</sup> drinking alcohol, and smoking cigarettes. After data from the institutions that did not participate in all study years were excluded, the prevalence of use of marijuana decreased from 12.2% in 1985 to 7.9% in 1988 ( $p < 0.05$ ).

**Effects of drug use on low birth weight and preterm birth.** Cocaine use during pregnancy was not associated with having a low-birth-weight infant (unadjusted odds ratio 0.8, 95% confidence interval 0.5 to 1.5) or a preterm birth (1.4, 0.9 to 2.0) (Table III). The frequency of cocaine use and the serum concentration of benzoylecgonine were also not associated with low birth weight or preterm birth. Statistical adjustment for various confounding variables did not result in substantial changes from the unadjusted odds ratios (Tables IV and V). Among the women whose serum was positive for

cocaine metabolites, compared with women whose serum tested negative for cocaine, neither low birth weight nor preterm birth rates were increased (odds ratios adjusted for cigarette smoking 1.1, 0.6 to 2.2 and 1.5, 0.9 to 2.6, respectively). There was no evidence of an interaction between cocaine, cigarette smoking, or drinking alcohol and birth outcome. In addition, no difference ( $p = 0.25$ ) was observed in mean infant head circumference among women who used cocaine (33.9 cm) and women who did not (34.0 cm). Adjustment for potential confounders did not result in important changes in these means.

To determine whether acute exposure to cocaine was associated with preterm birth, sera collected at delivery from 616 women who gave birth to preterm infants were compared with sera obtained at 31 to 36 weeks' gestation from 927 women who went on to deliver at term (at least 37 completed weeks' gestation). Cocaine metabolites were detected in the sera of 0.81% (5/616)

**Table III.** Rates of low birth weight and preterm birth

	No.	Low birth weight (%)	Preterm birth (%)
Smoked during pregnancy			
Yes	2612	10.0	12.4
No	4858	7.0*	11.7†
Drank alcohol during pregnancy			
Yes	2549	8.4	11.1
No	4921	7.8†	12.5†
Cocaine use during pregnancy (from self-report or serum assay)‡			
Yes	175	6.9	15.4
No	7295	8.1†	11.9†
Marijuana use during pregnancy (from self-report or serum assay)‡			
Yes	822	11.0	13.4
No	6648	7.7§	11.8†
Frequency of cocaine use during pregnancy‡			
Never	7298	8.0	11.9
Less than monthly and serum assay negative	61	3.3	11.4
Monthly or more or serum assay positive	111	9.0†	17.1†
Serum concentration of cocaine metabolite			
0 ng/ml	7369	8.0	11.9
<10 ng/ml	47	10.6	21.3
10-44 ng/ml	15	6.7	20.0
45-104 ng/ml	15	6.7	6.7
≥105 ng/ml	16	12.5†	12.5†
Serum concentration of marijuana metabolite			
0 ng/ml	6885	7.6	11.7
<16 ng/ml	211	15.2	12.8
16-45 ng/ml	251	10.4	14.7
≥45	123	13.0*	18.7†
TOTAL	7470	8.0	12.0

\* $p < 0.001$ .† $p \geq 0.05$ .

‡Cocaine and marijuana use detected by interview or serum assay at 23 to 26 weeks of pregnancy.

§ $p < 0.01$ .

of the women who had preterm infants, compared with 0.76% (7/927) of women delivered at term (unadjusted odds ratio 1.1, 0.3 to 4.0).

Marijuana use was not associated with having a preterm birth (unadjusted odds ratio 1.2, 0.9 to 1.4) but was moderately associated with giving birth to a low-birth-weight infant (1.5, 1.2 to 1.9) (Table III). A statistically significant relationship between the serum concentration of THC-COOH and preterm birth was not observed (Table III). However, women who had any THC-COOH in the sera were at slightly increased risk of having a low-birth-weight infant. After statistical adjustment for confounding variables, the odds ratio for low birth weight among marijuana users decreased to 1.1, 0.9 to 1.5, and was not statistically significant (Table IV). Most of the association between low birth weight and marijuana use was removed after we adjusted for the effects of cigarette smoking. When marijuana was detected in the serum, slight increases were observed in the odds ratios (adjusted for cigarette smoking) for both low birth weight (1.5, 1.2 to 2.0) and preterm birth (1.3, 1.0 to 1.7). However, no association was observed when exposure was determined by interview (odds ratio adjusted for cigarette smoking 1.0, 0.7 to 1.4 and 1.1, 0.8 to 1.6, respectively).

To put into perspective the potential impact of using cocaine and marijuana compared with tobacco and alcohol during pregnancy, the population-attributable risks for low birth weight (Table IV) and preterm birth (Table V) were calculated and compared separately. The population-attributable risk uses the odds ratio and prevalence of the exposure to estimate the maximum proportion of low birth weight or preterm births that could be prevented if the population were free of the exposure (if we assume there is a causal relationship between the exposure and outcome). In our study only cigarette smoking had the potential to decrease the proportion of infants born with low birth weight—nearly 15% of the low-birth-weight infants could have been prevented if these women had not smoked.

**Drug use and abruptio placentae.** Abruptio placentae occurred in 58 (0.8%) of the births. Women who had abruptio placentae were significantly more likely to have used cocaine during pregnancy (10.3%) than women without abruptio placentae (2.3%) (unadjusted odds ratio 5.0, 2.3 to 10.8). Adjustment for cigarette smoking decreased the odds ratio to 4.2, 1.9 to 9.5. Because the use of cocaine was rare, the population-attributable risk for cocaine and abruptio placentae was very small (2.5%) in spite of the high odds ratio. No



**Table IV.** Predictors of low birth weight from logistic regression odds ratios, 95% confidence intervals, population prevalences, and population-attributable risks

Factor	Odds ratio	95% Confidence interval	Prevalence (%)	Population-attributable risk (%)
Cigarette smoking	1.5	1.2-1.8	35.0	15.0
Alcohol drinking	0.9	0.8-1.1	34.1	-2.2
Marijuana	1.1	0.9-1.5	11.0	1.4
Cocaine	0.7	0.4-1.3	2.3	-0.7

Additional variables in the model that were statistically significant at  $p < 0.05$  were bearing a low-birth-weight infant in the immediately preceding pregnancy, institution, ethnicity, body mass index (quartiles of weight/height<sup>2</sup>), and *Trichomonas vaginalis* infection. This analysis was based on 7403 pregnancies resulting in 586 infants born weighing  $<2500$  gm.

**Table V.** Predictors of preterm birth from logistic regression odds ratios, 95% confidence intervals, population prevalences, and population-attributable risks

Factor	Odds ratio	95% confidence interval	Prevalence (%)	Population-attributable risk (%)
Cigarette smoking	1.1	0.9-1.3	35.0	4.0
Drinking alcohol	0.9	0.7-1.0	34.1	-5.2
Marijuana	1.1	0.8-1.3	11.0	0.7
Cocaine	1.3	0.9-2.0	2.3	0.7

Variables in the model that were statistically significant at the  $p < 0.05$  level were having a low-birth-weight infant in the immediately preceding birth, institution, ethnicity of mother, body mass index (quartiles of weight/height<sup>2</sup>), mother's living arrangement, income, and *Trichomonas vaginalis* infection. This analysis was based on 7401 women, of whom 884 had a preterm birth.

association was observed between marijuana use and abruptio placentae (adjusted odds ratio 1.3, 0.6 to 2.8).

# Comment

The relation between cocaine and marijuana use during pregnancy was evaluated in a large multicenter prospective cohort of 7470 women. Information about exposure to drugs was obtained from serum assay and personal interview. The prevalence of cocaine use during pregnancy was 2.3%, and the prevalence of marijuana use was 11.0%. In comparison, 35% of the women smoked cigarettes during pregnancy. The prevalences observed in our study are similar to the rates observed in other unselected population-based studies.<sup>13, 16</sup> Reported rates of cocaine and marijuana use vary widely, ranging from  $<1\%$ <sup>17</sup> to 46%<sup>18</sup> for cocaine and from 1.2%<sup>19</sup> to 27%<sup>20</sup> for marijuana. Population-based screening of pregnant women by means of biochemical markers of drug metabolites has consistently resulted in much lower prevalence rates (1.1% for cocaine and 1.9% for marijuana)<sup>15</sup> than screening of hospital-based groups<sup>20</sup> or special populations.<sup>3</sup> Studies that rely solely on drug testing are likely to underestimate the prevalence of drug use over a long period of time, because drug metabolites are detectable in urine or blood for only a few days after the drugs were last used.<sup>21</sup> Studies that rely solely on medical records or self-reports may also underestimate drug prevalence, because not all health care providers routinely obtain information about drug use. In addition, many women are reluctant to admit to using illicit drugs.

Our finding that use of cocaine or marijuana was not associated with an increased risk of low birth weight or preterm birth is contrary to most previously published studies.<sup>1, 5, 20, 22</sup> There are several possible reasons why we found no effect of cocaine use on birth outcome in our study. The amount of cocaine used may have been too low to detect an effect on birth outcome or the women may have stopped using cocaine after study entry. However, when we compared serum obtained at the time of preterm delivery with serum obtained at comparable gestational ages among women delivered at term, we did not find an adverse effect of cocaine use on pregnancy outcome. This suggests that changes in cocaine use after study enrollment are unlikely to have caused our negative findings. The results of our study do confirm the very strong association between the use of cocaine and abruptio placentae observed in several other studies,<sup>5</sup> this provides evidence that our data on illicit drug use detected at 23 to 26 weeks' gestation have relevance to peripartum events.

The results of our study reemphasize the difficulties of obtaining reliable information about drug use during pregnancy.<sup>20, 23</sup> Most pregnant women do not disclose use of illicit drugs to their physicians; 91% of the women we studied who had positive serum assay results for cocaine denied using it. Our data also indicate that the majority of women who disclosed use of cocaine were likely to be occasional users and to report that they had quit using the drug. Thus reliance on reported cocaine use may underestimate the true prevalence and may be biased either toward women who are infrequent



users or toward women who no longer use cocaine. Reliance on a single blood test also underestimates the prevalence of drug use and may be biased toward long-term or heavy users, because they are more likely than occasional users to be detected in cross-sectional screening. Indeed, when we analyzed our data using the results from the serum assay alone there was evidence of a slight increase in risk of preterm birth among women who had cocaine or marijuana metabolites detected in the serum and a slight increase in risk of low birth weight among women who had marijuana metabolites detected. Whereas the small increased risks observed in our study are lower than those reported in most previous studies,<sup>1, 5, 20, 22</sup> these increases indicate that rates of preterm birth and low birth weight may be somewhat higher among women who are long-term, heavy users of cocaine or marijuana. However, in our study very few women had evidence of cocaine in the blood (1.2%), which indicates that these increases in risk may be confined to a small subgroup of pregnant women.

In future outcome studies data on drug use during pregnancy might be obtained from serial blood or urine tests and serial interviews; analysis of mother's or infant's hair; and/or the analysis of meconium.<sup>6</sup> However, tests that detect historic exposure such as hair or meconium are obviously not useful in illicit drug screening efforts to detect current users. Such drug screenings should ideally occur very early in pregnancy, so that women can be educated about the potential problems associated with drug use and be offered assistance with quitting. Unfortunately, long-term drug users are a group of women who are the least likely to obtain prenatal care; therefore screening programs aimed at women already in prenatal care will not reach the women who are at highest risk for illicit drug use.

In conclusion, the low prevalence of cocaine use observed in this large, multicenter, prospective study suggests that widespread drug screening for cocaine among women who receive early prenatal care may not be a productive strategy to identify women who use illicit drugs during pregnancy. In our population cocaine use by pregnant women was uncommon and not consistently related to adverse birth outcomes. No evidence of a widespread epidemic of drug use was observed. These negative findings support the contention<sup>23</sup> that the media, as well as researchers, may have rushed to premature judgment about the extent and severity of the effects of cocaine use on pregnancy outcome. If an epidemic of cocaine abuse by pregnant women is occurring, it appears to be occurring among the few women who do not obtain prenatal care<sup>19, 22</sup> or it may be local in nature. Thus, rather than focusing on detecting drug use during pregnancy in the general population, public policy should focus on increasing

access to and participation in prenatal care and providing appropriate drug counseling and therapy for those pregnant women who ask for assistance with quitting drug use. Attempts to criminalize drug use by pregnant women<sup>24</sup> may keep away from prenatal care the women who need it most.<sup>25</sup>

Tobacco is still the most commonly abused drug during pregnancy. Nearly 15% of all cases of low birth weight in this cohort might have been prevented if the women did not smoke cigarettes during pregnancy. New efforts should focus on educating women and physicians about the dangers of cigarette smoking, helping women to stop smoking before becoming pregnant, and preventing young women from starting to smoke cigarettes. In the United States cigarette smoking remains the single largest preventable cause of adverse pregnancy outcomes.

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