The Relationship of Cocaine Use and Human Immunodeficiency Virus Serostatus to Incident Sexually Transmitted Diseases Among Women

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Background and Objectives: To assess the incidence of sexually transmitted diseases (STD) in a group of heterosexual women as a function of human immunodeficiency virus (HIV) serostatus and to ascertain the effect of crack cocaine use on these relationships.

Study Design: At baseline, 445 HIV type 1 (HIV-1) seronegative and 232 seropositive women were provided interviews ascertaining demographic and behavioral risk factors. All participants were tested for Chlamydia trachomatis, Neisseria gonorrhoeae, and Trichomonas vaginalis at baseline and at 6-month intervals.

Results: HIV serostatus was not related to STD incidence. Although HIV-positive women reported more condom use than did HIV-negative women (P < .01), only 65% reported using them consistently. Increases in the frequency of crack cocaine use, measured on a 4-point scale, were positively associated with rates of new STDs (relative risk [RR] = 1.23, P < .01). Crack cocaine use was also associated with greater numbers of sexual partners and less consistent condom use. The relationship between HIV status and the probability of acquiring an STD was not influenced by frequency of crack use.

Conclusion: Women infected with HIV or who use crack cocaine are at risk for transmitting HIV and acquiring other STDs. Whether women are infected with or at risk for HIV, programs are needed to prevent and treat crack addiction. Interventions should target high-risk sexual practices among both female crack users and women living with HIV.

THE INCREASING rate of human immunodeficiency virus (HIV) infection among women in the United States has been widely reported, although inadequately addressed from the standpoint of prevention. Over 92,000 cases of acquired immunodeficiency syndrome (AIDS) have been reported among women to date. These numbers have obvious repercussions for children. In 1994, there were at least 12,240 children living with vertically acquired HIV. Despite both the recognition of, and an increased emphasis on, interdisciplinary approaches to curbing infection rates, there have been few gains made in understanding the complex set of determinants of HIV risk reduction behavior in women. Given the potential contribution of ongoing unprotected sexual activity to the spread of HIV and other sexually transmitted diseases (STD), there is a clear need for research identifying moderators of the relationships between HIV testing outcomes and changes in levels of risk behavior. One relevant set of such factors that has been generally overlooked in studies examining the behaviors of seropositive women is the role of crack cocaine use. Studies linking substance use to high-risk sexual behavior have provided considerable evidence that crack use is related to HIV and STD acquisition through its link with sexual risk behavior, although these relationships have not been specifically examined in women with HIV.

For a positive HIV diagnosis to result in decreases in levels of sexual risk behavior, a seropositive woman must possess both the motivation and the ability to make relevant changes in her life. Those who maintain high levels of crack cocaine use may not possess these two resources. Thus, it is predicted that the relationship between HIV status and sexual risk behavior (as indexed in the present investigation via incident cases of Neisseria gonorrhoeae, Trichomonas vaginalis, and C trachomatis) will be associated with the frequency of crack use such that the difference in risk for STD in those with and without HIV infection will be smaller for those who engage in higher levels of crack use.
The present study was conducted to determine the influence of HIV serostatus on STD incidence and to consider the role of crack use on this relationship. As such, it represents one of the first large-scale attempts to assess the relationships between crack use, HIV status, and risk behavior in a sample of heterosexual women.

**Methods**

Between 1990 and 1994, a total of 677 women completed a baseline and a minimum of one follow-up study visit. Women with HIV infection (N = 232) were recruited from HIV care clinics, and women without HIV infection (N = 445) were recruited from medical care and drug treatment programs and from community health centers. All recruitment sites serve urban minority populations in Brooklyn, NY. Eligibility requirements included that participants were nonpregnant at study entry and were planning to maintain residence in the New York City area for the length of the study. For women who were HIV positive at baseline, study participation also required a positive HIV antibody test and absence of a diagnosis with an AIDS-defining illness. For HIV-negative women, inclusion criteria were a negative HIV antibody test at study entry, no injection drug use in the year before the baseline interview, and at least one sexual partner in the year before study entry. Although women who inject drugs were allowed into the HIV-positive cohort, only two reported sharing needles since their HIV diagnosis. Of those approached and eligible, 90% of the HIV-infected women and 63% of the uninfected women agreed to participate. Of women who were approached and who completed a baseline interview, approximately one third of the HIV-negative and one fifth of the HIV-positive cohorts did not complete a second study visit.

At the first study visit, an interviewer-administered questionnaire was provided that assessed demographic characteristics, sexual risk behavior, and drug and alcohol history. Seropositive women were asked to report the date that they first learned their serostatus. All respondents were also asked to report the consistency with which condoms were used during vaginal sex and to report the number of sexual partners in the past year. Condom consistency was grouped into two categories; those who used condoms always or almost always versus those who used condoms less consistently. Frequency of alcohol use was ascertained by asking respondents to estimate, on average, how many times per week they drank alcohol. The item was scored on a scale of 1 to 7, with responses ranging from “never,” “less than once a month,” “one to three times a month,” “once a week,” “two to six times a week,” “one to three times a day,” to “more than four times a day.” Frequency of crack use was assessed using the same scale. Response scales such as these have been found to have good psychometric properties. In studies analyzing the reliability and validity of alcohol and other drug use self-reports, this format was found to have high average test-retest reliability, with coefficients ranging from 0.83 to 0.87, and demonstrated convergent and discriminant validity.\(^{11,12}\) Estimates for number of partners and for alcohol and crack use were based on a 1-year time period and on time since knowledge of HIV infection for those women who had known their serostatus for less than 1 year.

All study visits also involved a pelvic examination including cervical cultures for *C. trachomatis* and *N. gonorrhoeae* and vaginal specimens for culture of *T. vaginalis*. Laboratory techniques are described elsewhere.\(^{13}\) Any woman who tested positive for any of these STDs was treated and then educated about prevention and treatment. A positive culture at follow-up was defined as an incident case only if (1) the woman did not test positive for that disease at baseline, but did at some point during the follow-up, or if (2) the woman tested positive for the disease at baseline, was treated, tested negative at a follow-up, and then was diagnosed with a new STD at a subsequent follow-up visit. Follow-up study visits and laboratory cultures were scheduled at 6-month intervals.

A series of Cox regression equations were conducted via SPSSX (Chicago, IL). These assessed the impact of baseline knowledge of serostatus and crack cocaine use on STD incidence. Tests were also conducted to assess whether the frequency of crack cocaine use moderated the relationship between STD incidence and HIV serostatus. Multiple and logistic regression was used to test associations between HIV serostatus, crack use frequency, and sexual risk behavior.

**Results**

Participants identified themselves as not married (77%) and having had achieved, at a minimum, a high school diploma or equivalent (61%). Fifty-one percent of the participants in the study reported a yearly total income of less than $10,000, and the average age was 32 years. The seropositive and seronegative groups were similar in terms of income, drug use, and number of partners, and differed along several demographic factors (Table 1). Data were available up to 3 years after study entry, with an average follow-up time of 15 months.

Women who were seropositive when they entered the study had known their serostatus for an average of 22 months, ranging from those who found out their serostatus at baseline to those who had known for 8.5 years. One hundred one respondents had known their serostatus for less than a year (43.5% of the HIV seropositive sample). At baseline, 188 members of the overall sample (27.8%) had positive cultures for either *N. gonorrhoeae*, *C. trachomatis*, or *T. vaginalis*. Among seropositive women, 54 (23.3%) had at least one STD at baseline, and among seronegative women, 134 (30.1%) had at least one STD ($\chi^2 (1) = 3.55, P = .06$). Frequencies with which each STD occurred are
presented in Table 2; 2 HIV-positive women and 11 HIV-negative women received a dual diagnosis.

At baseline, 198 (29.2%) of the study participants reported that they had not consumed alcohol ($M = 2.53, SD = 1.54$), and 566 (83.6%) respondents reported no crack use ($M = 1.64, SD = 1.61$). Several of the response categories for crack use were very low; less than 1% of the sample reported using crack one to three times a day, and only 1.2% reported using crack once a week. For this reason, response categories were collapsed into four categories: (1) never (83.6%), (2) not more than three times a month (4.4%); (3) one to six times a week (6.1%); and (4) one to four times a day (5.9%).

Over the course of the study, 116 women (17.1%) acquired a new STD, and 567 did not develop a new case (Table 2). Among HIV-positive women, two received a dual diagnosis, and one tested positive for all three STDs. Four HIV-negative women received a dual diagnosis at follow-up. New cases of STD occurred in 83 per 598.61 person-years (13.86 per 100 person-years) in the HIV-negative women, and 33 per 285.31 person-years (11.57 per 100 person-years) in the HIV-positive women (relative risk $[RR] = 1.07, 95\%$ confidence interval $[CI] = 0.71$ to 1.61).

A Cox regression was conducted, predicting STD incidence from HIV serostatus at baseline (positive vs. positive) and frequency of crack cocaine use (Table 3). Diagnosis of an STD at baseline and frequency of alcohol consumption were included as covariates. This analysis showed a significant reduction in variability between the model including a constant and one that included the four predictors (STD at baseline, HIV serostatus, alcohol frequency, crack frequency), $\chi^2(4) = 12.69, P < .01$. In this model, seronegative women were no more likely to acquire a new STD than were seropositive women, after controlling for crack and alcohol use frequency. In addition, neither having an STD at baseline nor frequency of alcohol consumption were statistically significant predictors of STD incidence. Increases in the frequency of crack cocaine use (measured on a 4-point scale) were associated with a higher probability of STD incidence, such that for every one standard unit increase in self-reported crack frequency, the odds of having an incident STD increased, on average, by a factor of 1.23. Among women who reported no crack use, incident STDs occurred at a rate of 10.62 per 100 person-years, whereas for those who reported crack use on a monthly, weekly, and daily basis, rates for STDs were 28.84, 25.74, and 22.83 per 100 person-years, respectively. These relationships were maintained in an expanded model that included several demographic variables as covariates. Specifically, the relationships between HIV serostatus, crack cocaine use, and STD incidence were not changed when marital status, education, age, and race/ethnicity were included in the model.

A model was examined that incorporated the moderating influence of serostatus on the relationships between the remaining predictors and STD incidence. Three interaction terms were considered. These product terms included the relationship of serostatus with (1) frequency of crack cocaine use, (2) alcohol frequency, and (3) the presence of an STD at baseline. This analysis showed no difference between the main effects model and one that included the three product terms ($\chi^2(3) = 4.02, NS$), indicating that neither alcohol, crack use frequency, nor diagnosis of an STD at baseline influenced the relationship between HIV serostatus and STD incidence.
The lack of differences found between seropositive and seronegative women in STD incidence may be obscured by trends in the behavior of seropositive women over time. For instance, women more recently informed of their serostatus may not have yet adopted safer sexual practices. To assess whether STD incidence varied as a function of how long serostatus was known, a new variable was created that reflected length of time since diagnosis, with seronegative women grouped into the zero time category. Responses were as follows: (1) seronegative (65.9%); (2) diagnosis known for less than a year (15.0%); (3) 1 to 2 years (8.4%); (4) 2 to 3 years (3.9%); (5) 3 to 4 years (2.4%); and (6) greater than 4 years (4.4%). A Cox regression was conducted with STD incidence predicted from crack use frequency, time since diagnosis, alcohol frequency, and the presence of an STD at baseline. Time since diagnosis was not statistically significant, and its inclusion did not change the magnitude or statistical significance of any of the other predictors. In addition, interaction terms between time since diagnosis and (1) STD at baseline, (2) crack use, and (3) alcohol use did not contribute significant variance to the model.

A series of regression analyses were conducted to assess the relationships between HIV serostatus (HIV negative = 0, HIV positive = 1), frequency of crack use, and sexual risk behavior. The first model examined condom consistency as an outcome (consistent = 1, inconsistent = 0) with HIV serostatus and frequency of crack use. The overall equation for the logistic regression model was statistically significant, \( \chi^2 (2) = 202.95, P < .01 \), with both crack use frequency and HIV serostatus predicting condom consistency. The relationship between crack use (assessed on a 4-point scale) and consistency was negative (odds ratio \( OR = .66, P < .01 \)), suggesting that as the frequency of crack use increases, the likelihood of consistently using condoms decreases. HIV-seropositive women were nearly 20 times more likely to report always or almost always using condoms than were HIV-negative women (\( OR = 19.65, P < .01 \)). Nonetheless, of those seropositive women who reported at least one sexual partner (\( N = 178 \)), only 65% reported consistent condom use. A correlation coefficient calculated between condom use consistency and STD incidence demonstrates that these variables are negatively related to one another (\( r = -.15, P < .05 \)). A logistic regression analysis was also conducted among seropositive women to assess the relationship between condom consistency, length of time serostatus was known, and crack use. The resulting model was not statistically significant (\( \chi^2 (2) = 4.01, NS \)).

A third model examined the relationship between number of sexual partners as a function of HIV serostatus and frequency of crack use (Table 4). The overall equation was statistically significant, \( F (2, 673) = 32.63, P < .01 \), multiple \( R = .30 \). Although there were no differences in number of sexual partners before baseline as a function of HIV serostatus, increases in the frequency of crack cocaine use were associated with greater numbers of sexual partners in the

<table>
<thead>
<tr>
<th>Variable</th>
<th>( B )</th>
<th>SE ( B )</th>
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<tbody>
<tr>
<td>Serostatus (HIV- = 0, HIV+ = 1)</td>
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<tr>
<td>Crack Use Frequency*</td>
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<td>.14</td>
</tr>
<tr>
<td>Crack Use × Serostatus*</td>
<td>1.94</td>
<td>.31</td>
</tr>
<tr>
<td>(Constant)</td>
<td>0.77</td>
<td>.26</td>
</tr>
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* \( P < .05 \).

time before baseline (\( B = 1.14, P < .05 \)). In addition, an interaction added to the model significantly improved the fit of the model (\( P < .05 \)). Among respondents who were HIV negative, the number of partners increased by 0.64 (\( P < .01 \)) for each category of increased crack use, whereas for HIV-positive women, the number of partners increased by 2.59 (\( P < .01 \)) for each category of increased crack use. Thus, there is a greater association between crack use and number of partners for HIV-positive women than for HIV-negative women. Among seropositive women, length of time that serostatus was known was not correlated with the number of male sexual partners reported (\( r = .04, NS \)).

Besides reporting greater numbers of partners, women who used crack in this sample also reported engaging in a series of sexual risk behaviors while under the influence of the drug. Of the 111 women who used crack in the time before baseline, 32.4% reported having had sex to obtain crack, 27% reported having had sex with an unknown person while using crack, and 33% reported that they were less likely to use protection if they were having sex while on crack.

**Comments**

The current study demonstrates that both HIV-seropositive and HIV-seronegative women have similarly high rates of STD incidence and that new STDs in both groups are associated with crack use. Although high levels of sexual risk behavior among crack users have been established in previous research,\(^4\) this study documents similar patterns of behavior in crack-using women with HIV infection, an observation with important public health implications. There are various risks attributable to these behaviors, including the possibility of transmission to sexual partners, the increased probability of transmitting HIV to a heterosexual partner if that partner has an STD,\(^5\) and the increased complications posed to a seropositive woman's health that can occur if she acquires an STD.\(^6\)

The current study found that (1) rates of STD infection were similar across seropositive and seronegative women; (2) seropositive women report more consistent condom use, and (3) the number of sexual partners reported did not differ by HIV serostatus. In addition, although the HIV seropositive women in our sample reported higher rates of condom use, these rates were still inadequate to confer protection to unim-
fected partners; only 65% reported always or almost always using condoms.

Besides finding associations between number of partners, condom consistency, STD incidence, and crack use, and between HIV serostatus and condom consistency, there was also an interaction detected between HIV serostatus and crack use, such that crack use was associated with a greater increase in number of sexual partners for seropositive women. However, the implications of this association are difficult to assess because it relies on cross-sectional self-report data. It is not possible to ascertain without longitudinal data whether these relationships reflect sustained, increased, or decreased levels of risk behavior. Further research is needed to help delineate these relationships.

Few studies have been devoted to the sexual risk behavior of women who are infected with HIV, but those that do support the present findings. In one investigation, the occurrence of new cases of STDs after receipt of HIV test results was not significantly different in seronegative versus seropositive patients followed for 2 years (HIV negative = 9.8%, HIV positive = 11.4%).17 Other studies have shown self-reports of continued risk-taking behavior (e.g., inconsistent condom use) in women aware of their positive serostatus.4,18 Although the demographic composition of this sample reflects that of women most at risk for HIV (i.e., low income, minority women living in an HIV endemic area), more research needs to be established on incident STD and concomitant sexual risk behaviors across more diverse patient populations.

Some qualifications of the present data are in order. First, there was some variation in the time period delineated for behavioral self-reports. For the seronegative group, women were asked to estimate behaviors in the year before baseline, whereas seropositive women were asked to estimate behaviors in the time period between knowledge of their HIV status to baseline. If the participant had known her serostatus for more than 1 year, she was asked to estimate average intake over the past year. Thus, 43% of the seropositive women used a time frame shorter than 1 year to estimate their risk behaviors. This is less of a problem for the condom use and alcohol and crack measures, which involved estimates of the average frequency of behaviors over time. Although the null results produced when serostatus was used to predict number of sexual partners may have been partly owing to an underestimate in the HIV-positive cohort, we found that the mean number of partners reported by HIV seropositive women who knew their serostatus for less than a year (M = .89) was not statistically different from the mean number of partners reported by the HIV-seronegative women (M = 1.63, NS).

We found that women infected with HIV were more likely than seronegative women to report consistent condom use. Although every effort was made to remove barriers to honest responses in this study, it is possible that these differences were not because of actual behavioral differences but rather reflect social desirability. Another potential problem is the differences in loss to follow-up that occurred in the HIV-negative and HIV-positive cohorts. In light of the fact that the women in the HIV-positive cohort are in care, they had lower loss to follow-up over time than the negative group. The possibility therefore exists that those HIV-seronegative individuals who did not return for their 6-month appointments may have different levels of risk than those who remained in the study. However, rates of STD prevalence at baseline in the seronegative group who completed the study (30%) were similar to those who did not complete it (27%).

Little attention has been paid to the sexual behaviors of women who are infected with HIV. Data from the present study suggest that these women are in need of services and intervention that will assist them in removing barriers to consistent condom use. There is no basis for the assumption that diagnosis with HIV alone provides the ability for women to change their behaviors, even if it does provide the impetus. These findings suggest the importance of routine screening for STDs in this population. In addition, research is needed to more clearly delineate the barriers that HIV-positive women face in negotiating safe sexual encounters. Effective intervention efforts are required to reduce high-risk sexual practices among female crack users, especially those who are living with HIV.

References


