The social epidemiology of HIV transmission among African American women who use drugs and their social network members

M. MILLER¹, C. T. KORVES², & T. FERNANDEZ²

¹New York Medical College, and ²Columbia University

Abstract
Despite 15 years of prevention efforts, recent increases in HIV infection have been documented for Black women in the US. Little is known about the role played by HIV status disclosure in high HIV prevalence communities. 180 Black women who used drugs in the past 30 days were recruited between May 2002 and May 2004 in New York City. Women were administered a structured network questionnaire and HIV serotested. Risk practices, HIV status disclosure within networks and mixing patterns by known HIV status are examined. Most (85%) women had used crack in the past 30 days; 48 (27%) had injected drugs, 65 (36%) reported anal sex, and 99 (55%) reported sex work at some time. Forty (22%) women were HIV-seropositive; 29 (16%) knew their seropositive status. Of high risk individual behaviours, only a history of sex work was associated with an HIV-seropositive status [(aOR = 3.0; 95%CI: 1.3–7.3), p < .01]. Few (7%) of 600 network members disclosed an HIV positive status, although 73% were sex or drug use partners. Women who knew themselves to be HIV-infected were more likely than other women to report HIV-infected network members [(OR = 1.5; 95%CI: 1.1–6.4), p < .03]. However, only 51% of network members disclosed an HIV status and women disclosed to 50% of their network members. In a context of high background HIV prevalence and low levels of HIV status disclosure, serodiscordant mixing patterns likely facilitate transmission.

Introduction
Despite 15 years of prevention efforts, recent increases in HIV infection have been documented for Black women (http://www.cdc.gov/hiv/stats/2003SurveillanceReport/table22.htm). Furthermore, heterosexual transmission has replaced injecting drug use (IDU) as the primary mode of HIV acquisition among Black women (Centers for Disease Control and Prevention, 1997). Moreover, high risk sex practices and subsequent HIV infection are increasingly linked to women’s non-injected drug use, particularly crack cocaine use (Holmberg, 1996; Centers for Disease Control and Prevention, 1997; Miller et al., 2002). However, with few exceptions (Wechsberg et al., 2004; Sterk et al., 2003), implementing HIV preventive interventions for reducing sex risk for crack using populations has not been a priority.

While sex practices are notoriously difficult to change, HIV sexual transmission requires both unprotected sexual contact AND sexual intercourse between HIV serodiscordant partners. Therefore, one point of intervention is the prevention of HIV serodiscordant partnerships. Social network methodologies allow researchers to examine network characteristics, including social and sex mixing patterns. Disassortative mixing patterns (e.g. older with younger sex partners) have been identified as a risk factor for the transmission of sexually transmitted infections (STIs), including HIV (Aral et al., 1999; Service et al., 1995; Laumann et al., 1999; Morris et al., 1995; Gregson et al., 2002; Tortu et al., 1994), and represent a proxy for HIV serodiscordant partnerships. However, even assortative mixing patterns can increase the risk of exposure to HIV and subsequent transmission. For example, women who use drugs are very likely to have male sex partners who also use drugs (Miller et al., 2002). Therefore, assortative mixing based on drug use status may also influence HIV infection prevalence and incidence, because of the higher background HIV prevalence found among drug users relative to the general population. Moreover, the level of HIV status disclosure between network members in drug using populations is largely unknown, but could facilitate serodiscordant sex mixing patterns. Research to understand the effect of mixing patterns and HIV disclosure within and from crack using populations on HIV transmission risk will be crucial to developing network level interventions to disrupt HIV transmission.
Among a cohort of Black women who use drugs from a New York City community with a high HIV prevalence (http://www.nyc.gov/html/doh/html/ah/hivtables2002.shtml) we examine: 1. the prevalence of the highest risk individual practices (i.e. IDU, anal sex and sex work); 2. the mixing patterns by known HIV status between women and their personal (i.e. egocentric) network members; and 3. the possible role of HIV infection status disclosure in transmission dynamics; that is, the actual knowledge individuals have to inform a personal HIV risk assessment. In addition, we explore if individual high risk practices known to be associated with HIV infection status underlie high HIV prevalence or if, rather, high background HIV prevalence within networks fuels the epidemic, regardless of participation in individual high risk practices. We also examine the correlates of a woman’s knowledge of her HIV status, since knowledge is prerequisite for accurate HIV status disclosure to network members.

**Methods**

**Study population**

Data were obtained from baseline-structured interviews with the first 180 Black women participants recruited between May 2002 and May 2004 for a social network cohort study. Women were recruited in central Brooklyn, where drug markets and drug use have been established for many years. Recruitment methods used included targeted sampling, street outreach and chain-referral methods that have been successfully used to recruit ‘hidden’ populations of drug users since the 1980s (Watters et al., 1989; Friedman 1999).

Eligible women met the following criteria: 1. self-identified as Black or African American; 2. were at least aged 18, or aged 16 and 17 and living as emancipated minors; 3. used heroin, crack or non-crack cocaine in the past 30 days or used marijuana daily; and 4. had no plans to change residence in the year following enrollment. A broad drug use eligibility criteria was instituted to capture a range of women in this high HIV prevalence community, as well as to limit incentives to lie about drug use. Therefore, women who had used drugs were eligible for inclusion, regardless of mode of administration. In addition to the initial screening interview, eligibility was verified through ongoing processes, including urine toxicologies for cocaine, opiates and THC metabolites; a visual inspection of arms to detect fresh injecting marks; and inconsistency of self-reported data. For example, six women who reported drug use when they were screened, but who denied drug use during the study interview and who tested negative on the urine toxicology were eliminated.

Of 737 women screened for participation, 229 (31%) were Black women eligible for inclusion in the study. 180 (79%) eligible women agreed to participate and provided complete questionnaire and laboratory data. The main reasons for ineligibility were a failure to use the drugs of interest (41%) and non-residence in the catchment area (20%). The main reason for non-participation was failure to keep an appointment. No significant differences between eligible participants and eligible non-participants existed for any of the screening variables.

**Research protocol**

Women were confidentially administered a questionnaire at a community based research site. After completion of the interview, women were pre-test counselled and serotested for HIV infection. Women were provided with compensation for study participation. All respondents provided informed consent. The study protocol was approved by the Columbia University Institutional Review Board.

**Measures**

Women’s sociodemographic information, drug use practices, sex behaviours and participation in sex work, and self-reported knowledge of HIV status were assessed. Women were asked to nominate up to 15 people (i.e. egocentric network members) with whom they had had more than casual contact in the past three months. Nominees in social network research are individuals with whom respondents typically interact. The types of non-mutually exclusive individuals nominated included: 1) those who provided social support (emotional and material support assessed separately); 2) sex partners; and 3) drug use partners. For each nominated network member, women were asked if they had disclosed an HIV status (i.e. positive, negative or unknown) to the network member; women were then asked if each network member had disclosed a self reported HIV status to them; the actual HIV serostatus of network members was unknown. Therefore, each woman provided an absolute count of the number of known HIV infected individuals in her network. Data were dichotomized to indicate the presence or absence of known HIV infection in the network and were limited to network members seen in the past 30 days.

Blood specimens were collected using venipuncture. A repeated EIA (Vironostika; Durham, NC) with Western blot confirmation (Bio-Rad; Redmond, WA) was administered to detect HIV antibodies.
Statistical analysis

Recruitment through chain referral has the potential to result in dependent data. Nineteen (11%) women were recruited through chain referral. To assess the impact of potentially dependent data, all comparative analyses were conducted twice. The first set of analyses employed univariate and logistic regression techniques and the second set employed generalized estimating equation (GEE) methodologies (Diggle et al., 1994) to account for potential correlation in the data. The estimates were identical; therefore, results from the first set of analyses are presented here.

In univariate analyses that examined the relationships between women's behaviour (i.e. a history of IDU, anal sex or sex work) and HIV infection status (both serostatus and self reported status), as well as those that examined the relationships between women and network members' HIV status, χ² tests were used. For continuous variables, the mean is reported; medians and ranges contextualize non-normal variable distributions, (e.g. number of sex partners). Logistic regression models assessed the independent correlates of the women's HIV status (i.e. individual risk behaviours, a known HIV infected network member, and potential sociodemographic confounders). Crude odds ratios (ORs) are reported for univariate analyses and adjusted odds ratio (aORs) are reported for multivariable analyses. Two-tailed P-values are significant at less than .05. Fisher exact test P-values are reported when cells have expected counts of less than five. SAS version 9.1.3 was used for all data analysis (SAS Institute; Cary, NC).

Results

HIV testing, seroprevalence and knowledge

Of the 180 Black women who had used drugs in the last 30 days, more than one-fifth (22%) tested HIV seropositive, though only 29 (16%) knew themselves to be infected. 155 (86%) women reported having been HIV tested: 113 (75%) of the 151 women who believed themselves to be HIV negative had been tested in the past year. Four of the 11 HIV infected women unaware of their status, had never been HIV tested.

Sociodemographic characteristics

Table I describes the sociodemographic characteristics of 180 Black women by their HIV infection and knowledge status. The women had a mean age of 35. Typical of marginalized women who use drugs, they reported low incomes, averaging $342 in the past 30 days. An HIV seropositive status (regardless of one's knowledge) as compared with an HIV seronegative status was significantly associated with higher levels of income [(OR = 4.8; 95%CI: 2.1, 10.7), p < .0001], employment [(OR = 3.3; 95%CI: 1.5,
6.9) p = .001], and being over age 30 [(OR = 2.8; 95% CI: 1.0, 7.7), p = .04].

Drug use practices

Polydrug use in the past 30 days was common: 153 (85%) used crack, 118 (66%) used heroin, 73 (41%) used non-crack cocaine and 27 (15%) used speedball (a combination of heroin and cocaine). Moreover, 82 (46%) reported using ‘hard’ drugs (i.e. crack, heroin, cocaine or speedball) at least daily. Alcohol and marijuana use were also ubiquitous: 132 (73%) drank alcohol and 152 (84%) smoked marijuana in the past 30 days. A minority of women (27 or 15%) had injected drugs in the last 30 days. Approximately one-quarter of the women indicated a lifetime history of IDU: 10 (34%) who knew themselves to be HIV infected, 3 (27%) who were unaware of their HIV seropositive status and 35 (25%) HIV seronegative women (p = .58). Forty-three (24%) women were currently enrolled in substance use treatment programmes and 113 (63%) women had a history of substance use treatment. HIV seropositive status was associated with crack cocaine use [(OR = 4.1; 95% CI: 0.9–18.3), p = .05]. No other significant differences between HIV serostatus and substance use were identified, including IDU.

Sex practices and partnerships

Table II shows the risk practices of the index women. 153 (86%) of the 180 women were sexually active in the past 30 days. Of the sexually active, 141 (91%) women reported having sex with men only, 6 (4%) with women only and 8 (5%) with both men and women. On average, for the past 30 days, women reported 3.9 sex partners (median 1.0, range 0–90); 59 (33%) women reported at least two sex partners. Fifty-one (28%) women reported currently participating in sex work and 99 (55%) had a lifetime history of sex work. Sex work was significantly associated with an HIV seropositive status: 24 (83%) who knew themselves to be HIV infected, 6 (55%) who were unaware of their HIV seropositive status and 69 (49%) HIV seronegative women (p = .004) reported a history of sex work.

In the past 30 days, all 149 women sexually active with men reported having had vaginal sex and 20 (13%) reported having had anal sex. Almost all (98%) heterosexually active women reported inconsistent condom use during vaginal sex, while seven (5%) reported inconsistent condom use during anal sex. More than one-third (36%) of all women reported having ever had anal sex. Anal sex was not significantly associated with an HIV seropositive status: nine (31%) who knew themselves to be HIV infected, three (27%) who were unaware of their HIV seropositive status and 53 (38%) HIV seronegative women (p = .64) reported a history of anal sex.

Women’s egocentric network members

The 180 women provided detailed information about 600 total egocentric network members with whom they had had contact in the past 30 days, 436 (73%) of whom were risk network members (i.e. they were drug use and/or sex partners). On average, women reported having 4.3 egocentric network members, of whom 2.4 were risk network members: 1.9 were drug use partners and 1.2 were sex partners. Thirty-five (19%) women reported at least one network member known to be HIV infected; on
average, women reported 0.2 (median 0.0) HIV infected network members; 41 (7%) network members were known to be HIV infected.

Ten (34%) of the 29 women who knew themselves to be HIV infected, 0 of the 11 women who were unaware of their HIV seropositive status and 25 (18%) of the 140 HIV seronegative women reported having network members known to be HIV infected (p = .01).

**HIV status disclosure between women and their network members**

Women reported discussing their HIV status with 299 (50%) of their 600 network members, and women reported that 305 (51%) of their network members had disclosed an HIV status to them. Table III reports the HIV disclosure matrix between the 180 women and their 600 network members, by the HIV status of network members as reported to index women. Among women who were aware of their HIV serostatus, only one HIV infected woman and two HIV negative women were not truthful. Women who knew themselves to be HIV infected were significantly more likely than other women to report having HIV infected network members [(OR = 2.7; 95%CI: 1.1–6.4), p = .03]. However, this finding was not replicated among women who tested HIV seropositive [(OR = 1.5; 95%CI: 0.7–3.5), p = .30].

**Correlates of women's HIV status**

The logistic regression model that examined correlates of women's HIV infection included the three individual risk factors (i.e. histories of anal sex, sex work or IDU), a known HIV infected network member, monthly income less than $500, age and current crack cocaine use. Women's HIV seropositive status was significantly associated with a history of sex work [(aOR = 3.0; 95%CI: 1.3–7.3), p = .01], and a higher monthly income [(aOR = 5.0; 95%CI: 2.3–11.1), p < .0001]. Women's knowledge of their HIV positive status was significantly associated with reporting an HIV infected network member (aOR = 3.6 95%CI = 1.3, 10.0, p = .02), as well as with a history of sex work [(aOR = 5.6; 95%CI: 1.8–17.7), p = .003] and a higher monthly income [(aOR = 6.4; 95%CI: 2.5–16.4), p = .0001].

**Discussion**

In this predominantly crack using population in which few women had injected drugs, more than one-fifth were HIV infected. Among the individual risk behaviours examined, only a history of sex work was associated with current HIV infection. Moreover, despite the presence of many network members at increased risk of being HIV infected (three-quarters of close personal network members were sex partners, drug use partners or both), only 7% of network members were known to be HIV infected. Serious discussions evaluating HIV transmission risk were not occurring within many networks, since only half of the women and half of their network members discussed and disclosed an HIV status. In a context of high background HIV prevalence, low levels of HIV status disclosure, and a notable lack of knowledge of one’s own HIV status, mixing patterns virtually insures contact between infectious and susceptible individuals. The lack of association between HIV infection and histories of anal sex or IDU indicates that these individual risk behaviours may add little additional risk of infection when one’s network has high HIV prevalence.

These data support previous research that documents strong linkages between crack use and sexually mediated HIV transmission among Black women (Sterk et al., 2003; Miller et al., 1998; Wechsberg et al., 2004; Ebrahim et al., 2005). Once HIV infection is introduced into a woman’s network, the mechanisms that facilitate the rapid spread of infection (e.g. high levels of unprotected sex with multiple partners) are already in place (Youm et al., 2002). Additionally, the skewed ratio of female to male residents in this community (United States Census Bureau, 2004), facilitates mixing patterns that create linkages between partners at higher and lower risk of being HIV infected (Laumann et al., 1999). A skewed gender ratio that favours men has already been found to be associated with a high HIV prevalence in an urban community (Over, 1998).

Most women reported being members of networks in which high levels of risk practices, particularly sex risk, occurred. Despite the high proportion of reported risk network members, only 41 (7%) of 600 nominated network members were known to be HIV infected, (a prevalence three times lower than that found among the women). While overall HIV status disclosure by the women was accurate, only half of the population discussed HIV at all. The stigma associated with a positive HIV infection status, combined with a collective denial surrounding the HIV epidemic often found in the communities most affected, likely contributes to the silence maintained within women's egocentric networks (Poundstone et al., 2004; Valdiserri 2002; Parker et al., 2003). Moreover, knowing one’s positive HIV infection status in this community did not automatically translate to effective care, arguably the strongest incentive to learn one’s serostatus. There is considerable evidence that HIV infected Black Americans are less likely to receive antiretroviral therapy than others (Blair et al., 2002; Menke et al., 2003; Andersen et al., 2000; Shapiro et al., 1999),

(Blair et al., 2002; Menke et al., 2003; Andersen et al., 2000; Shapiro et al., 1999)
<table>
<thead>
<tr>
<th>Women's HIV status N = 180</th>
<th>Network member's HIV status as reported by women</th>
<th>Total number of nominated network members N = 600</th>
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<tbody>
<tr>
<td>HIV + N = 41</td>
<td>HIV + N (%)</td>
<td>HIV – N (%)</td>
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<tr>
<td>HIV + status known N = 29</td>
<td>6 (50%)</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>HIV + status unknown N = 11</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>HIV – status N = 140</td>
<td>2 (7%)</td>
<td>19 (66%)</td>
</tr>
<tr>
<td>HIV – or unknown status N = 264</td>
<td>264 (100%)</td>
<td>HIV + N (%)</td>
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<td>HIV transmission among African American women 863</td>
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particularly if they also use illicit drugs (Celentano et al., 1998). Until systems are in place that insure comprehensive, quality care for HIV infected individuals, particularly for those who are or become uninsured, it is unlikely that the stigma and denial surrounding HIV will be ameliorated (Parker et al., 2003).

Much of the data used in this study are based on self-report; therefore, the associations should be interpreted with caution. Self reported data may underreport individual and/or network practices. In addition, the directionality of women and network relationships are difficult to ascertain since data are cross-sectional, although the focus of this analysis was to identify mixing patterns by HIV status within networks rather than causality. The 30-day risk assessment period provides a snapshot of risk and network membership and may be a conservative estimate of mixing patterns. Although a variety of strategies were used to access women in this hidden community, future research efforts should consider other methodologies, such as respondent-driven sampling (Heckathorn, 1997; Thompson et al., 1996), as well as conducting multi-site studies to increase sample size and diversity.

Given a context in which individuals cannot effectively assess their risk of infection, there is a considerable probability of HIV serodiscordant mixing patterns. Now that the US HIV epidemic has become solidly concentrated among Black Americans, it is imperative that HIV preventive interventions explicitly target affected communities. A continued focus on individual level risk behaviours is unlikely to have an impact on reducing HIV incidence in communities similar to this; therefore, there is a need to broaden both research and intervention efforts to address the social and structural factors that facilitate HIV transmission. The importance of knowing one’s HIV serostatus, as well as that of one’s network members, is a social network level message that is not widely disseminated, but that may have an impact on mixing patterns of those at risk of acquiring or transmitting HIV infection.

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