HIV-1 Seroprevalence and Risk Behaviors in an Urban African-American Community Cohort

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ABSTRACT

Objectives. Previous attempts at obtaining population estimates of human immunodeficiency virus type 1 (HIV-1) seroprevalence have been beset by problems of cooperation bias. As part of the fourth round of study with an urban African-American community cohort, the following investigation was aimed at assessing HIV-1 prevalence and the relative importance of sex and drug injection as risk factors in infection.

Methods. Personal interviews were conducted in the home with 364 respondents, followed by voluntary blood sample collection from 287 of these individuals.

Results. Blood assays showed a point prevalence of 8.4% HIV-1 seropositivity in this community cross section, with a higher female-to-male ratio than appears among acquired immunodeficiency syndrome (AIDS) case reports. Most infected persons were unaware and unsuspecting of their infection.

Conclusions. First, findings underscore the need to focus on risk behaviors rather than on risk groups. Second, the smaller than 2:1 ratio of infected men to women suggests that current AIDS case reports seriously underestimate HIV-1 infection among certain cohorts of African-American women. Finally, widespread ignorance of own infected status and inaccurate risk assessment signal the substantial task for community health educators in reaching inner-city African-American men and women at risk. (*Am J Public Health.* 1993;83:1390–1394)

Introduction

Estimates of future health service needs and social costs engendered by the changing course of human immunodeficiency virus type 1 (HIV-1) infection have had to rely on analyses of reported acquired immunodeficiency syndrome (AIDS) cases and on statistical models derived from them.[1,2] In addition, most HIV prevention and education efforts have been driven by such reports, as well as by models most often developed from the earliest studied risk group: gay and predominantly White men. Particularly needed, yet sorely lacking, are epidemiological data that describe infection among the more recently identified risk groups of minority injecting drug users and of the heterosexuals who are infected by them—chiefly, minority women and their children.[3]

Any attempts that have been made to obtain population representative estimates of risk behaviors, infection vectors, and seropositivity have faced difficult and eventually overwhelming political, ethical, and methodological hurdles.[4,5] Still, such epidemiological estimations (of changing rates and rates of change, classified by infection group and by ethnicity, age, and gender) are a needed complement to ongoing surveillance activities such as surveys of special populations (e.g., newborns, college students, army recruits, etc.) conducted by the Centers for Disease Control and Prevention (CDC).[5] In fact, given the geographic variability in infection rates that persists within the United States, community and area representative surveys may be especially useful.[6,7] Prevention and education efforts could then be grounded in local conditions and needs vis-à-vis HIV-related behaviors.

The primary methodological concern has been nonresponse bias. Previous attempts to develop HIV-1 seroprevalence estimates have been beset by the nonrandom loss from study of those individuals with the very risk factors (male homosexual behavior and drug injection) whose consequences were to be estimated. The problem was so apparent in the CDC's pilot study in Dallas County, Texas, that the effort to conduct a national seroprevalence survey was aborted.[8,9]

The present study is focused on three particular questions: (1) What is the prevalence of HIV-1 antibody positivity in the African American study group? (2) To what extent might this estimate be compromised by nonparticipation in the voluntary serologic assay of those at highest risk for HIV infection? (3) What are the relative risks of transmission from sexual and injecting drug behaviors?

Answers to these questions are intended to assist in developing community education for HIV-1 prevention that is relevant, specifically, for urban African Americans. The findings are generalizable to urban African Americans with family origins in the southern United States, particularly those born in the 1950s. Despite the substantial geographic variability that marks HIV infection rates in the United States, findings from this study cohort regarding salient vectors of infection, even though drawn from a single metropolitan locale, should have application to other urban African-American cohorts. Findings cannot be generalized, however, to

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cohorts of different ages or ethnoracial composition prior to replication on samples of those groups.

Methods

Source of Sample

The study cohort is chiefly of southern descent, with birth years 1952 through 1957. They originally comprised a representative community sample of 12- to 17-year-olds, drawn in 1968 to 1969 from two successive annual multistage area probability samples of 1 in 25 housing units in the Central Harlem (New York City) Health District. That survey was initiated to provide estimates of the health care needs of African-American adolescents. (See Brunswick and Josephson's "Adolescent Health in Harlem"[10] for details on sampling frame and procedures.)

That same adolescent cohort is now part of a life history study of health, substance use, and life outcomes that has been ongoing for more than 20 years.[11] The data reported here were derived from the fourth round of study, conducted between August 1989 and December 1990; 72% of the original cohort, corrected for attrition from death and area ineligibility (i.e., those dwelling beyond 60 miles of New York City), remain in study. Of these, 43% identify current residences within Central Harlem, with another 22% in the Bronx, also a socioeconomically distressed area (see Table 1). At their current ages, the study cohort represents the population subgroup that is at high risk of HIV-1 infection in the United States: urban African Americans aged 30 to 40. Gender composition is 49% men and 51% women, about the same ratio of 48:52 that appears in adult household cross sections regardless of race, thereby attesting to careful sample retention. Analysis for sample bias on other demographic variables (age, birthplace, education, and welfare) similarly revealed no biased loss on these variables.

Data Collection

Trained interviewers matched for race and gender completed the 364 personal home interviews, which averaged 2-1/2 hours to conduct. At the close of the interview and after obtaining voluntary informed consent, trained phlebotomists collected blood samples for "research purposes only" (i.e., to obtain community prevalence estimates, not to make individual diagnoses) from 81% (144) of the interviewed men and 76% (143) of the interviewed women. Problems of legitimacy and access were alleviated by the cohort's prior experience with the study, its advisory committee of local health leaders, and distribution of a brochure that emphasized community benefits that had resulted from the research. Respondents were compensated $35 for participating in both the interview and the immunoassay segments of the study.

Two hundred and seventy-six individuals provided blood specimens, most of which were analyzed by the New York City Health Department using enzyme-linked immunosorbent assay (ELISA) and confirmatory Western blot on cases that screened positive. Another five individuals consented to the institutional exchange of results from a prior HIV-1 test. Saliva HIV antibody assay was performed in an additional six cases using immunoglobulin capture ELISA (GACELISA HIV-1+2), immunoglobulin capture radioimmunoassay (GACRIA HIV-1), and Wellcozyme HIV-1+2 monoclonal ELISA and Western blot (WB HIV-1).[12–14] Two of six saliva specimens were repeatedly positive by GACELISA and Wellcozyme and were confirmed by Western blot; of the four saliva samples that were negative by GACELISA and Wellcozyme, three were also negative by GACRIA and Western blot and the fourth was insufficient for analysis.

In compliance with mandates of the principal investigator's University Health Sciences Institutional Review Board, immunoassays were performed as "research-blind" procedures, and study members did not receive their test results. Assay results concerning seropositivity or seronegativity were processed and stored with a unique "blood number" unrelated to the ongoing study identification numbers and stripped of all personal identifiers and other study information. Study participants were told that, just as the interview information was used as a sample to estimate community health needs, blood (or saliva) specimens were collected as samples to estimate rates of HIV infection in the community. Respondents were encouraged to obtain their own personal tests, advised about nearby testing sites, provided with an informative booklet listing testing places and phone numbers, and given $5 carfare. When community prevalence results were tabulated, a letter was sent to study participants advising them that a "small number" had tested positive and repeating our recommendation that all go for their own personal tests. A list of testing locations was enclosed again with this letter.

Measures

HIV-transmission risk behaviors were assessed through detailed drug and sex histories. Drug risks focused on heroin and cocaine injection histories (onset, duration, frequency) and needle care practices (sources, sharing, cleaning). Sex histories included self-classification of sexual orientation; history of same-sex behaviors among live-in, long-term not live-in, and short-term partners; history of giving or receiving money or drugs for sex; type of sex practiced and condom use; sex partners' exposures to risky drug and sex practices; and own and sex partners' transfusion histories. Note that same-sex risk practices for these analyses were scored from behavior and not from the self-classification of sexual orientation.

Analysis Methods

In addition to cross-classification analysis, univariate and multivariate odds ratio analyses were performed for the relative risk of infection from different transmission-linked behaviors.

Results

Cohort Characteristics

Demographic and other personal characteristics within this homogeneously African-American longitudinal cohort are informative in their own right and are also a basis for judgments regarding the generalizability of findings. Three quarters of the men and two thirds of the women were in their mid-30s (ages 33 to 36 years) at the time of the last study (Table 1). Approximately one fifth of both the men and the women had not yet completed high school; a similar proportion of the men and slightly more of the women had received a two- or four-year college degree. Half of both groups had never married; 35% of the men and 22% of the women were currently married and living with spouse. Similarly, a third of the men and a fifth of the women had no children; however, only 20% of the men had three or more children versus 28% of the women. Nearly 7 in 10 men and 6 in 10 women were employed.

Seroprevalence Estimate by Gender

Of the 287 respondents with test results, 22 tested positive for a weighted* cur-

*All findings reflect a small sample adjustment—or weighting—for differential ratios in initial recruitment into the sample of younger (ages 12 to 15) adolescents, who were twice as likely to be selected as older (ages 16 to 17) adolescents. Fractional weights were applied to avoid inflating the aggregate numbers.[10]

TABLE 1—Demographic Characteristics of the Study Cohort, 1989 through 1990

	Men (n = 177), %	Women (n = 187), %
Cohort		
Born 1952–1954	45	52
Born 1955–1957	55	48
Age at interview, y		
31–32	11	12
33–34	39	33
35–36	37	34
37–38	13	21
Education		
Incomplete high school	19	19
Completed high school	63	58
College		
AA degree	8	9
BA or higher	10	14
Marital status		
Never married	50	54
Currently married	35	22
Separated/divorced	15	24
Living arrangements		
Living with spouse	35	22
Living with partner	18	16
Living without spouse or partner	47	62
Fertility		
Baby by age 17	9	23
Children, n		
0	34	20
1–2	46	52
3+	20	28
Current activity		
Work/work and school	69	58
School only	2	5
Armed forces	1	...
Jail	6	...
Unemployed		
Looking for work	17	10
Not looking for work	5	27
Income sources (respondent)[a]		
Regular job	69	59
Odd jobs	13	6
Public assistance[b]	18	35
Hustling	5	2
Private (family, boyfriend)	2	1
Institutionalized	6	...[c]
Residence		
Central Harlem	43	43
Other Manhattan	17	19
Bronx	20	26
Brooklyn	5	3
Queens	7	1
Other New York	4	5
New Jersey	4	3

[a]Multiple response.
[b]Includes welfare, veterans/unemployment benefits, etc.
[c]Less than 0.5%.

TABLE 2—Participation in Immunoassay: Tests for Bias[a]

	Men, %			Women, %		
	Participant (n = 144)	Non-participant (n = 33)	P	Participant (n = 143)	Non-participant (n = 44)	P
Birth cohort						
1952–1953	27	33		39	34	
1954–1955	50	46		34	32	
1956–1957	23	21		27	34	
Education (last degree)						
None	51	27	.040	43	23	.051
High school, GED	12	15		15	16	
AA, BA, MA+	37	58		42	61	
Gainfully occupied: work, school, or military	68	85	.046	57	79	.006
Rate own health: fair or poor	19	9		24	16	
Perceived infection risk						
Very/fairly high	11	16		14	5	
Fairly low	56	63		58	68	
No chance	33	22		28	27	
Ever injected drugs[b]	15	3	.059	8	9	
Used crack	28	6	.009	18	9	
Received money or drugs for sex	8	3		13	5	
Homosexual or bisexual (self-report)	6	9		5	5	
Any short-term/one-time sex partners since 1985	50	65		38	32	
Male-to-male sex since 1978	6	9		NA	NA	
10+ heterosexual partners since 1978						
Yes	22	23		5	2	
No	78	77		95	98	

[a]*P* values for difference between participants ("yes") and nonparticipants ("no").
[b]Injecting drug user includes those who skin-popped and only those who used drugs more than experimentally (i.e., more than once or twice).

rent prevalence of 8.4% (95% confidence interval [CI] = ±3.3). Men had 1.8 times the infection rate of women (10.8% vs 6.0%; 95% CI = ±5.1 and ±4.0, respectively). This compares with a male/female ratio of 3.9 in reported actual AIDS cases throughout New York City among African Americans of the same age as this sample.[15] When six male deaths and three female deaths among the study cohort are included,** the cumulative HIV-AIDS incidence becomes 10.8%—13.8% among men and 7.6% among women.

**The six male deaths (one each year from 1984 to 1989) were identified on death certificates as resulting from AIDS; five of the six were among injecting drug users. However, the three female deaths (two in 1985 and one in 1987) were only imputed to be from AIDS. All three had histories of injecting drug use reported on interview. Their death certificates indicated narcotism and pneumonia and/or other acute infection, but diagnostic tests for HIV had not been performed.[16,17]

Awareness of Seropositivity

Of the 15 men who tested positive in the antibody assay, only 3 knew from a prior test that they were infected. One additional man considered it likely that, were he to be assayed, he too might prove to be infected. Thus, nearly three quarters of the infected men were unaware of their infection status or even of its likelihood. Of seven infected women, only one knew her positive status from a prior HIV-1 test (although five women in all reported having taken a prior test). Another two women considered a positive serologic result likely. Thus, as was the case with men, the majority of the infected women were unaware and unsuspecting of their positive serologic status.

Bias in Seroprevalence Estimate

Contrary to the CDC's experience[9] and to assumptions made by other investigators,[18] our findings provided no evi-

TABLE 3—HIV Transmission Risk Behaviors of Study Cohort

Risk Category	Interviewed Sample, %			Assayed Sample, %					
				Men			Women		
	Men (n = 177)	Women (n 187)	Total (n = 364)	HIV+ (n = 15)	HIV− (n = 129)	Total (n = 144)	HIV+ (n = 7)	HIV− (n = 136)	Total (n = 143)
Intravenous drug use since 1978[a] (only)	5.6	2.7	4.1	17.6	5.0	6.4	20.0	0.6	1.8
Male/male sex (only)	5.1	...	2.5	17.6	2.9	4.5	...	...	...
Intravenous drug use and male/male sex[b]	0.5	...	0.2	5.9	...	0.6	...	...	...
Intravenous drug use and sex with injecting drug user[c]	3.6	3.1	3.4	...	5.0	4.5	40.0	1.9	4.2
Intravenous drug use and received money/drugs for sex	0.5	3.1	1.9	...	0.7	0.6	30.0	2.5	4.2
Intravenous drug use and gave money/drugs for sex	1.0	...	0.5	11.8	...	1.3	...	...	...
Male/male sex and received money/drugs for sex	0.5	...	0.2	5.9	...	0.6	...	...	...
Male/male sex and gave money/drugs for sex	0.5	...	0.2	5.9	...	0.6	...	...	...
Sex with injecting drug user only	3.1	12.5	7.9	...	2.9	2.5	10.0	11.5	11.4
Sex with bisexual male only (for women)	...	0.4	0.2	...	...	...	...	0.6	0.6
Received money/drugs for sex	3.1	7.6	5.4	...	2.9	2.5	...	9.6	9.0
Gave money/drugs for sex	3.6	...	1.7	5.9	3.6	3.8	...	...	...
None of the above	72.8	70.5	71.6	29.4	77.1	72.0	...	73.2	68.9

Note. Table represents a nonoverlapping classification of risk exposure into single or joint categories.
[a]Since 1978, a 2-year band of error has been allowed in the 11- to 12-year retrospective report of last injection.
[b]Includes one male whose risk exposures also included having sex with an injecting drug user and receiving money/drugs for sex.
[c]Includes one female whose risk exposures also included receiving money/drugs for sex.

dence of diminished participation in the antibody assay among those reporting HIV risk behaviors. The overall rate of participation in the assay was 79% (81% for men and 76% for women). Administrative failure (the phlebotomist could not find the respondent's address and/or arrived late; the lab lost the specimen) accounted for 13% of nonparticipation; only dislike of needles, which, interestingly, was cited by more men than women (24% vs 14%) accounted for a greater proportion of nonparticipation (18%).

There was no disproportionate loss of participation by either sexual orientation or injecting drug status (Table 2). Among men who had ever injected or skin-popped (subcutaneous insertion) drugs and among men who reported using crack (highly overlapping subgroups), rates of participation in the immunoassay were actually higher. Higher social attainment (employment and education) rather than HIV-1 risk behaviors was associated with nonparticipation.

HIV-Transmission Risk Behaviors

Briefly, about a third of the seropositive men (35%) had a history of injecting drug use and another third (35%) acknowledged male-to-male sex; only one man reported both behaviors. About 30% of the infected men reported no identifiable HIV risk behavior (Table 3).

All the infected women reported one or more risk behaviors on interviews: 90% had a history of injecting drug use, 70% both had injected drugs and reported heterosexual risk (from having sex with a partner who injected drugs and/or from selling sex for money or drugs). The remaining woman (10% of the infected sample) reported only heterosexual risk exposure (i.e., sex with an injecting drug user).

The relative risk of infection among those with a history of drug injecting vs noninjectors was 3:1 for men (24% vs 8%) and 53:1 for women (53% vs 1%).

Odds Ratio Test of Transmission Risk

Using maximum likelihood chi-square,[19] information on relative risks was used to calculate the infection odds ratios for several risk categories: individuals who had injected or skin-popped drugs, individuals who were involved in sexual relations with an injecting drug user, and men who were involved in sexual relations with other men. Men with homosexual relationships had 16:1 infection odds ($z = 3.71, P < .0001$). Men who reported sex with a female injecting drug user did not show an increased likelihood of infection relative to those without this behavior; however, a woman's odds of infection, given a male sex partner who injected drugs, were 6:1 ($z = 2.42, P < .01$).

The odds of infection for men and women who had injected drugs differed vastly: the odds of infection for drug-injecting women relative to non-drug-injecting women exceeded 100:1 ($z = 4.41$, $P < .0001$), whereas the odds of infection for drug-injecting men relative to non-drug-injecting men was 4:1 ($z = 2.37$, $P < .01$). When homosexual practices and injecting drug use were combined into a single category of primary risk behaviors for men, the odds of infection were 8:1 ($z = 3.76, P < .0001$). This risk, while significant, was considerably smaller than the 100:1 risk for drug-injecting women compared with non-drug-injecting women.

Discussion

Analysis for participation bias in the serologic examination in this African-American community cohort revealed no significant loss from the study of those engaging in HIV-transmission risk behav-

iors. To the contrary, male injecting drug users and crack users (overlapping groups) were more likely to participate. Higher social attainment was more likely to deter individuals of both genders from providing a blood or saliva specimen. Although being part of a longitudinal study cohort may have exerted some influence, this finding suggests a willingness to participate in public health HIV efforts when the mobility and erratic time schedules of the target population are taken into account.[20]

A history of injecting drug use characterized 90% of the surviving women who tested positive for HIV-1. However, their concomitant higher rate of heterosexual risk exposure (compared with that of male injecting drug users) raises the possibility that heterosexual transmission may have been a contributing factor in their infection. Meanwhile, the absence of heterosexual experience with an injecting drug user as a vector of men's infection is consistent with differences in men's and women's heterosexual risks that have been noted elsewhere.[21] With regard to the men, at the ages studied here among those surviving into their mid-30s, the odds of infection through homosexual exposure (16:1) were greater than those through drug injection (4:1), and both were considerably smaller than the odds of infection among women with a history of injecting drug use (100:1). We cannot forget in this regard, however, the predominance of injecting drug use among male AIDS decedents in this sample.

Such findings as those cited above are consistent with a call for community HIV education programs to focus on the behaviors that set people at risk instead of on risk groups as such. These findings are a reminder as well that risk behaviors often cross both sex and needle exposures. In this study, 30% of the infected men and 70% of the infected women, by their own reports, combined the two vectors of exposure.

The relatively high (8.4%) HIV-1 seropositivity prevalence noted in this African-American community cohort was distributed disproportionately between men and women. The male-to-female ratio of less than 2:1, however, was considerably narrower than what data from other sources have suggested. This might be accounted for by one or more of the following: a more rapid increase in infection among African-American women represented in the study cohort than among their male counterparts; later (i.e., more recent) seroconversion among women; or a greater concentration of HIV-positive women in those sections of New York where the study sample was located than in other parts of the city. The inconsistency of the ratio with that of actual AIDS cases reported among African Americans, however, suggests that the latter seriously understates the trajectory for HIV-1 infection among non-Hispanic Black women. Similarly, the increased likelihood of infection among women who have been injecting drug users is a factor to be reckoned with in forward projections of HIV-related illness.

But if reported AIDS rates appear to understate the level of seropositivity observed among the urban African-American women in this sample, no gender disparity existed in awareness of own infected status or in self-assessment of infection likelihood among those who were infected: two thirds of the women and three quarters of the men neither knew they were infected nor considered it likely. This is a clear signal for the urgency in undertaking community education to increase awareness of the benefits of early diagnosis both for reducing transmission risk and for improving, through early detection, the quality of life once infection occurs. □

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