Risk behavior and HIV seroprevalence among injecting drug users in Rio de Janeiro, Brazil

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Objective: To characterize HIV seroprevalence and risk behavior among injecting drug users (IDUs) in Rio de Janeiro, Brazil, between 1990 and 1996.

Design: We report data from three separate cross-sectional samples of IDUs in Rio de Janeiro: the World Health Organization (WHO) sample ($n = 479$), the Proviva sample ($n = 138$) and the Brasil sample ($n = 110$). These data provide the most comprehensive view available, to date, of this understudied population in Rio.

Methods: Demographic characteristics, HIV/AIDS risk behavior and HIV seroprevalence were compared across the three samples and combined analyses were performed to determine the factors associated with injecting risk behavior, sexual risk behavior and HIV seropositivity.

Results: The overall HIV seroprevalence among IDUs was 25%. Two encouraging findings of the present analysis were the lower levels of needle-sharing among participants recruited in the latest years (1995–1996) and the lower HIV seroprevalence in the Proviva sample composed mainly of less educated, poorer IDUs living in deprived neighborhoods. No trends toward safer behavior were found for sexual risk, younger age being the principal factor associated with high risk.

Conclusions: Levels of needle-sharing and sexual risk among IDUs in Rio remain high, demonstrating the urgent need to increase the limited preventive measures undertaken so far. Seroprevalence levels for HIV remain significantly lower in the most deprived sample, arguing for the fundamental importance of prompt and effective prevention strategies to keep infection rates from rising among the poorest and largest strata of Rio's IDUs.

Introduction

Brazil is one of the countries with the largest absolute number of reported AIDS cases in the world. Of 82 852 AIDS cases reported in Brazil as of June 1996, approximately one-fifth were registered among injecting drug users (IDUs) [1]. The role of IDUs in the dynamics of the AIDS epidemic changed dramatically after the middle of the 1980s. Between 1982 and 1986, IDUs represented only 3% of Brazilian AIDS cases. Since 1991, they have

Table 1. Basic characteristics of the samples.

Sample	Duration	Interview (n)	Site of recruitment	HIV test (no. %)	Sampling focus
WHO	1990–1992	479	32% street, 68% treatment center	131 (27%)	General
Proviva	1993–1996	138	100% street	138 (100%)	Low income areas, slums, shantytowns, etc.
Brasil	1994–1996	110	24% street, 76% treatment center	106 (96%)	General

WHO, World Health Organization.

represented 20% or more of the cases [1,2]. Cocaine is the main drug injected in Brazil [3,4], and the registered AIDS cases among IDUs are concentrated along the main cocaine-trafficking routes [5].

IDUs also play an important role in vertical and heterosexual HIV transmission in the country, as 23% of the women diagnosed with AIDS in the last 5 years were IDUs, and among the heterosexual infections, 33% were sexual partners of male IDUs [6,7]. In addition to HIV transmission, drug injection practices cause other infectious diseases and clinical problems secondary to viral hepatitis (hepatitis B, C and G) and human T-cell leukemia virus (HTLV) I/II infections and tuberculosis [4,6,8–11].

Although injecting drug use is a primary vector for HIV transmission in Brazil, there are very few published studies on the epidemiology of HIV in this population. In Rio de Janeiro, which has the second highest number of AIDS cases in the country [1], we know of two published studies dealing specifically with this population [3,12]. These and other studies presented at AIDS conferences as abstracts [13–18] have shown a generally moderate to high HIV seroprevalence rate among IDUs in Rio (14–33%) and high levels of risk behavior. In most of these reports, detailed analyses of risk behaviors and time trends were not undertaken.

Drawing data from three cross-sectional samples recruited between 1990 and 1996, we attempted to characterize HIV seroprevalence and risk behaviors among IDUs in Rio de Janeiro, Brazil. These data provide the most comprehensive view so far available of this understudied population in Rio, and indicate future directions for intervention and research.

Subjects and methods

Setting
The IDU population in Rio de Janeiro is considered marginal both socially and legally. Even among non-injecting users of drugs, they are viewed with some prejudice. IDUs in Rio de Janeiro lack any kind of self-run organization, often live in social isolation, are discriminated against by society in general and are especially per-

secuted by the police. As a consequence, they seldom show up at substance abuse treatment centers, and when they do, they have difficulties in follow-up and compliance with treatment. This social isolation and marginalization imposed on IDUs in Rio has created recruitment difficulties for researchers. In addition to being difficult to find, IDUs are suspicious about research projects and interview staff.

During the period of the present studies, the only legal source of sterile needles and syringes was drugstores. Syringes can be bought without any restriction at moderate prices (around US$1 each). Most drugstores are closed outside commercial hours and on weekends, making it difficult to obtain sterile injecting equipment. There are no specific places in Rio where drugs are injected ('shooting galleries'), so this is not currently an avenue for the distribution of sterile syringes. At the time the present samples were recruited and interviewed (1990–1996) there had been no systematic campaign in Rio de Janeiro to encourage IDUs to use new and sterile 'works'. Participants in one of the samples studied here (Proviva) did undergo a structured intervention in which IDUs were encouraged to use sterile works and taught how to efficiently clean their injecting equipment. This intervention was not given until after the study participants had been interviewed.

Three samples
We report interview data obtained from three separate samples of IDUs in Rio de Janeiro termed WHO, Proviva and Brasil (Table 1). All samples included only subjects who reported injecting drugs in the 6 months before the interview.

The WHO sample (n = 479) was recruited as part of a WHO multicenter collaborative study, involving 13 cities around the world [16]. IDUs in the Rio de Janeiro sample were recruited in 1990–1992 from both street and treatment settings. The street IDUs were recruited from several different sources, including public places, night clubs and bars, and from several geographic areas of Rio. Treatment IDUs were recruited mainly from the Nucleo de Estudos e Pesquisa em Atencao ao uso de Drogas (NEPAD), a unit of the State University of Rio de Janeiro that carries out treatment and research on drug use and AIDS and which operated the only public outpatient drug treatment center in Rio de Janeiro at that

time. Treatment IDUs were recruited consecutively and were asked to complete the research interviews at or near the time of admission to treatment, so their responses reflect behavior in the period preceding treatment admission. Refusal to participate was infrequent, although no exact records were kept by the WHO interview team. No financial reimbursement was provided to the WHO clients. HIV tests and pre-/post-test counseling were offered to all participants. However, these services could only be performed at one hospital, located in an isolated region of the city, one hour and a half by bus from the center, with scarce public transportation access. Probably because of this, a low proportion of participants in the WHO sample had undergone HIV testing.

The Proviva sample was drawn from a larger sample of over 1000 cocaine users, 138 of whom were IDUs. They were recruited during 1993–1996, as part of a multicenter study by the United States National Institute of Drug Abuse (NIDA). All participants were street-recruited and the aim was to recruit IDUs from groups that were poorly represented in previous studies, particularly those living in low-income areas of the city like slums and shantytowns. IDUs have easy access to the slums, travel into the slums to buy drugs and are even 'guided' and 'protected' by the drug dealer's personnel during their visit. The slums are the sites of most of the drug-dealing in Rio de Janeiro. The general population, who live outside slums, consider these areas unsafe and routinely avoid them. Even the police are known to avoid certain inner slum areas that are controlled by drug-dealers. This emphasizes both the difficulty and the importance of recruiting IDUs from these areas. The Proviva project was nevertheless able to recruit IDUs from these areas. Recruiters reported that there was a low rate of refusal to participate in the study protocol, and less than 5% of those contacted failed to show up for the scheduled interview.

The Brasil sample ($n = 110$) was recruited during 1994–1996 as part of an ongoing Brazilian Ministry of Health multicenter project on IDUs. Like the WHO project, this study used mixed recruitment, including both street and drug treatment-center sampling. Street IDUs were recruited from the same venues as those in the WHO study. Treatment IDUs were recruited mainly from two private drug treatment clinics, Credeq and Unidade Certa, both with inpatient services applying the Minnesota method for addict recovery. Recruitment was also undertaken at NEPAD, but the number of IDUs seeking treatment at that clinic decreased to a very low number during this period. The treatment sample was recruited and interviewed at the time of admission, and again showed a very low refusal rate. There was a small financial reimbursement for participation in the study (US$6). The blood drawn for HIV testing and the pre-/post-test counseling/intervention were provided at the same place as the interview; most participants (96%) agreed to be tested.

The questionnaires

The three samples used somewhat different interview instruments, so that individual questions concerning IDU characteristics and risk behaviors varied across studies. The WHO study used an internationally developed questionnaire applied in the collaborative study [16]. The Proviva study adopted a multicenter questionnaire, as part of NIDA's community outreach projects [19]. The Brasil study used a modified version of the WHO questionnaire, as part of the Brazilian Ministry of Health multicenter project on IDUs [18]. While the questionnaires were not identical, they included many similar or identical items. Data are presented here only for items included in all three questionnaires.

Procedures for HIV testing

In the WHO sample, anti-HIV tests were performed by the Federal University of Rio de Janeiro, as part of a study evaluating HIV-1 and tuberculosis co-infection among IDUs [9]. Serum samples were tested for HIV-1 antibody by enzyme-linked immunosorbent assay (ELISA; Organon Teknika, Boxtei, the Netherlands). All ELISA positive samples were analysed using the Western blot immune assay on strips provided by Dupont (Wilmington, Delaware, USA). The samples were considered positive when they reacted to both the ELISA and the Western blot methods.

In the Proviva sample, tests were performed by the Department of Immunology of the State University of Rio de Janeiro Hospital. Serum samples were tested for antibody to HIV by ELISA (Organon Teknika, Boxtei, the Netherlands) or by anti-HIV-1/HIV-2 ELISA (Roche Diagnostics Systems, Basel, Switzerland) and confirmed by Western blot (Organon Teknika) and immunofluorescence (Biomanguinhos, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil).

In the Brasil sample, tests were performed by the Department of Immunology of the Oswaldo Cruz Foundation, as part of an ongoing collaborative project on HIV molecular epidemiology and evaluation of co-infections [20]. Sera were evaluated for the presence of HIV-1 antibody by ELISA (Abbott HIV-1 recombinant EIA, third generation, Abbott Laboratories, Diagnostic Division North, Chicago, Illinois, USA) and confirmed by Western blot (Cambridge Biotechnical Corp., Worcester, Massachusetts, USA).

Analytic plan

Our analyses were designed to: (1) compare demographic characteristics across the three samples; (2) describe HIV/AIDS risk behavior and HIV seroprevalence and compare these across the three samples; (3) compare risk behavior according to site of recruitment (street versus treatment centers); and (4) investigate factors associated with high risk behavior and HIV infection.

To explore factors associated with injecting risk behaviors, we developed a logistic regression model in which sharing a needle/syringe within the last 30 days was the observed outcome. The variables entered into the model were age, sex, year of recruitment, education, place recruited and frequency of injection. Age was categorized in three groups: <22 years, 22–34 years and >34 years. Years of recruitment were categorized as 1990–1992, 1993–1994 and 1995–1996. Education was characterized as less than high school and high school or more. Place recruited was categorized as street and treatment center. Frequency of injection was divided into three categories: 1–3 days a month (low frequency), 4–12 days a month (moderate frequency) and >12 days a month (high frequency).

To explore factors associated with sexual risk behaviors, we again developed a logistic regression model, using high-risk sexual activity in the last 30 days as the observed outcome. The high-risk category consisted of those IDUs who reported having more than one sexual partner and making inconsistent use of condoms, having male homosexual intercourse (reported condom use with this behavior is very low) or having sex for money or drugs. All others, including those who had not been sexually active in the past 30 days, were classified as low-risk. The variables entered into this model were age, sex, education, place recruited and frequency of injection, categorized in the same way as described above.

We developed another logistic regression model to explore factors associated with HIV serostatus, using the presence or absence of HIV antibodies as the observed outcome. In addition to the same factors used in the two previous models, categorized in the same way, we included the factors sharing a needle/syringe within the past 30 days and having had high-risk sex in the past 30 days. For the three logistic regressions described above, we present for each predictor variable both the crude (bivariate) odds ratio and the adjusted odds ratio resulting from the multivariate model.

Data from the questionnaires and laboratory testing were entered using EPI INFO, version 5.0 (USD, Inc., Stone Mountain, Georgia, USA). Statistical analysis and data-merging were performed using the Statistical Analysis System (SAS) version 6 statistical package for IBM-PC [21].

Results

Demographic characteristics

As seen in Table 2, the samples differed in a number of demographic variables. Specifically, the Proviva sample recruited more men and the subjects had less education, were less likely to have been arrested, less likely to be employed and more likely to live in lower income residential areas compared to the other two samples (except

Table 2. Demographic characteristics of three samples of injecting drug users in Rio de Janeiro (1990–1996).

	Brasil (n = 110)	Proviva (n = 138)	WHO (n = 479)
Mean (SD) age[†] (years)	33.1 (7.6)	30.6 (8.2)	27.6 (5.5)
Female* (%)	15.5	9.4	12.9
Education* (%)			
Less than high school	49.5	83.3	56.4
High school and more	50.5	16.7	43.6
Lives with sex partner* (%)	33.3	29.0	19.1
Jail or prison* (%)			
Never	26.6	68.1	39.4
1–4 times	50.5	28.3	47.2
≥5 or more times	22.9	3.6	13.4
Source of income* (%)			
Employed	44.5	29.0	48.2
Temp., benefit, related	47.3	45.1	35.2
Illegal (prost., drugs, etc.)	8.2	25.9	16.6
Residential area* (%)			
Low income	44.8	87.8	–
Middle class	55.2	12.2	–

WHO, World Health Organization; temp., temporary work; prost., prostitution. *$P < 0.01$ between groups, by χ^2-test; [†]$P < 0.001$ between groups, by analysis of variance.

Table 3. Risk behavior by study sample.

	Brasil (n = 110)	Proviva (n = 138)	WHO (n = 479)
Age at first injection (years)	19.3 (5.1)	20.5 (6.1)	19.4 (3.9)
Duration of injecting* (years)	13.5 (9.1)	9.4 (6.8)	8.2 (5.8)
Frequency of injection* (%)			
1–3 times a month	25.7	46.4	29.6
1–3 times a week	32.4	34.0	37.6
>3 times a week	41.9	19.6	32.8
Frequency of needle-sharing in last 30 days* (%)			
0	77.7	72.6	69.6
1–2 times	6.4	16.3	23.7
3–5 times	5.3	9.6	3.0
>6 times	10.6	1.5	3.8
Sex partners last 6 months (no.)	4.1 (5.0)	2.7 (7.8)	2.9 (4.1)
Sexual intercourse last 30 days* (%)	60.4	83.9	81.4
Always used condoms* (%)	10.9	12.5	4.6
High-risk sex* (%)	71.7	49.1	67.1
Sex for money or drugs* (%)	32.1	6.5	5.2
Male homosexual intercourse* (%)	25.6	12.0	5.3
Always used condoms (%)	28.6	26.7	9.1

Where applicable, values are means (SD). WHO, World Health Organization. *$P < 0.01$ between groups.

that residential area was unavailable in the WHO sample), as might be expected from its sampling focus.

We also compared the samples by site of recruitment (street versus treatment center). The WHO street and treatment samples were quite similar. In the Brasil sample, treatment IDUs were less educated and less likely to have been in prison/jail. Even when compared only with street-recruited subjects in the WHO and Brasil samples, the Proviva sample remained substantially different, reflect-

ing the socioeconomic differences between these samples.

HIV risk behavior

High levels of HIV risk behavior were reported in each sample (Table 3). Needle-sharing was reported by 22% of the Brasil sample, 27% of the Proviva sample and 30% of the WHO sample, and in most cases methods of cleaning shared needles and syringes were inadequate, as almost all IDUs interviewed in the three samples reported that when they cleaned their works they did so only with tap water. Similarly, among those who were sexually active, high-risk sex was reported by 71.7, 41.9 and 67.1% in the Brasil, Proviva and WHO samples respectively. In the Brasil sample, a higher percentage of participants reported male homosexual intercourse and sex for money and drugs. Reviewing this issue more closely, we found that 88% of those reporting homosexual intercourse associated this activity with sex for money or drugs.

Multivariate analyses

Results of logistic regressions showing factors associated with needle-sharing are presented in Table 4. Younger

IDUs (<22 years; 34.4 versus 19.5%) and middle-aged IDUs (22–34 years; 30.3 versus 19.5%) were more likely to report needle-sharing in the past 30 days than older IDUs. IDUs recruited between 1990 and 1992 (30.4 versus 15.5%) and between 1993 and 1994 (37.2 versus 15.5%) were more likely to share than those recruited in 1995–1996. Those who injected more frequently were more likely to report needle-sharing than those who injected less frequently (42.0 versus 16.7%).

Study sample (WHO, Proviva, Brasil) was confounded with time period because all WHO participants were recruited in 1990–1992, while all Proviva and Brasil participants were recruited in 1993–1996. To determine whether needle-sharing might vary only by study sample rather than by time period, we repeated the logistic analysis while substituting study sample for time period. In that analysis, study sample was not associated with needle-sharing (i.e. time was the more important factor), suggesting a temporal trend toward decreasing needle-sharing.

Results of the logistic regression for high-risk sex are presented in Table 5. In this model, younger IDUs (<22

Table 4. Logistic regression showing factors associated with needle-sharing among injecting drug users in Rio.

	Crude		Adjusted	
	OR	95% CI	OR	95% CI
Age <22 years	1.3	(0.8–2.1)	2.5	(1.3–5.0)**
Age 22–34 years	1.2	(0.9–1.8)	2.0	(1.1–3.4)*
Female	1.1	(0.7–1.8)	1.5	(0.9–2.5)
Site of recruitment (street)	1.0	(0.7–1.4)	1.1	(0.7–1.6)
Education (less than high school)	1.4	(1.0–2.0)	1.3	(0.9–1.9)
Moderate frequency of injection	1.0	(0.7–1.4)	2.2	(1.4–3.5)**
High frequency of injection	2.4	(1.7–3.4)**	4.6	(2.9–7.4)**
Year recruited (1990–1992)	1.2	(0.9–1.8)	2.0	(1.1–3.6)*
Year recruited (1993–1994)	1.5	(1.0–2.3)	3.3	(1.7–6.6)**

OR, odds ratio; CI, confidence interval. Reference groups: age, reference group older than 35 years; year of recruitment, clients interviewed in 1995 or 1996, for both groups; frequency of injection, compared with low-frequency group; reference group education, high-school graduates or higher; site, reference group recruited in treatment centers. *$P < 0.05$, **$P < 0.01$.

Table 5. Logistic regression showing factors associated with high-risk sex among injecting drug users in Rio.

	Crude		Adjusted	
	OR	95% CI	OR	95% CI
Age <22 years	1.7	(1.1–2.6)*	2.2	(1.2–3.9)**
Age 22–34 years	1.0	(0.7–1.4)	1.3	(0.9–2.1)
Female	0.8	(0.5–1.3)	0.8	(0.5–1.3)
Site of recruitment (street)	0.8	(0.6–1.1)	1.0	(0.7–1.3)
Education (less than high school)	1.1	(0.8–1.5)	1.1	(0.8–1.5)
Moderate frequency of injection	1.4	(1.1–2.0)*	1.5	(1.0–2.1)*
High frequency of injection	0.8	(0.6–1.2)	1.0	(0.7–1.5)
Year recruited (1990–1992)	1.2	(0.9–1.6)	0.8	(0.5–1.2)
Year recruited (1993–1994)	0.7	0.4–1.0)	0.5	(0.3–0.9)*

OR, odds ratio; CI, confidence interval. Reference groups: age, reference group older than 35 years; year of recruitment, clients interviewed in 1995 or 1996, for both groups; frequency of injection, compared with low-frequency group; reference group education, high-school graduates or higher; site, reference group recruited in treatment centers. *$P < 0.05$, **$P < 0.01$.

Table 6. Logistic regression showing factors associated with HIV-positive serostatus.

	Crude		Adjusted	
	OR	95% CI	OR	95% CI
Age <22 years	0.3	(0.1–0.9)*	0.5	(0.2–1.8)
Age 22–34 years	2.0	(1.2–3.2)**	1.7	(0.9–3.1)
Sex (female)	1.3	(0.7–2.5)	1.3	(0.6–2.6)
Site of recruitment (street)	0.5	(0.3–0.8)**	0.6	(0.3–1.0)
Education (less than high school)	0.7	(0.4–1.1)	0.8	(0.5–1.4)
Moderate frequency of injection	0.5	(0.3–0.9)*	0.7	(0.3–1.3)
High frequency of injection	2.1	(1.3–3.4)**	1.5	(0.8–2.7)
Year recruited (1990–1992)	2.0	(1.2–3.1)**	1.1	(0.6–2.1)
Year recruited (1993–1994)	0.5	(0.3–0.8)*	0.9	(0.4–1.9)
Needle-sharing	1.3	(0.8–2.1)	1.4	(0.8–2.4)
High-risk sex	0.8	(0.5–1.2)	0.7	(0.4–1.2)

OR, odds ratio; CI, confdence interval. Reference groups: age, reference group older than 35 years; year of recruitment, clients interviewed in 1995 or 1996, for both groups; frequency of injection, compared with low-frequency group; reference group education, high-school graduates or higher; site, reference group recruited in treatment centers. *$P < 0.05$, $P < 0.01$.

years) were more likely to report high-risk sex in the past 30 days (63.9 versus 45.1%) than older IDUs (>34 years), as were IDUs who had a moderate frequency of injection (59.1 versus 49.8%) compared to those with a low frequency of injection. IDUs recruited during the years 1993 and 1994 were less likely to report high-risk sex (44.4 versus 58.1%) than those recruited in 1995 and 1996, suggesting that sexual risk among this population may be increasing.

Serological testing
The HIV seroprevalence was 28.7% for Brasil, 15.2% for Proviva and 34.3% for WHO. No statistically significant differences ($P < 0.05$) were found between the street and treatment subsamples in either the Brasil or WHO samples that might have helped to explain why in the sample composed only of street-recruited interviewees (Proviva) seroprevalence was lower than in the other two samples.

Results of the logistic regression for HIV+ serostatus are presented in Table 6. In this model, confidence intervals were wide, and we did not find any factors significantly associated with HIV serostatus. Trends were towards higher rates of infection among those aged 22–35 years, women, those recruited at treatment centers, those with a high frequency of injection and those who reported needle-sharing.

Discussion
The goal of this study was to describe the demographic characteristics and HIV risk behavior of IDUs in Rio de Janeiro with the ultimate aim of slowing the spread of HIV in this population. We approached this task by combining the three largest studies of this population in Rio de Janeiro, with different and complementary recruit-

ment focuses. In all three samples, the mean age of first injection was very similar (around 19.5 years), and males greatly outnumbered females. Age of first injection, other demographic characteristics and risk behaviors seem to be comparable with those of studies done elsewhere in Brazil and the rest of the world [4,12,16,22,23].

The different recruitment strategies resulted in different sample characteristics. Sociodemographic differences found between the Proviva versus the Brasil/WHO samples (education, income, residential area) appeared to reflect differences in the focus of recruitment. It is clearly essential to sample the very large numbers of people living in shantytowns in Rio since they form a rapidly increasing proportion of Rio's total population.

The population studied in the three samples reported high levels of HIV risk behavior. Needle-sharing was frequent, despite a high level of knowledge about AIDS. Those reporting this behavior during the 30 days before the interview ranged from 22.3 to 30.4%, depending on the sample.

In a logistic regression, age, year of study and frequency of injection were related to IDU risk behavior. Specifically, young IDUs reported more needle-sharing, IDUs recruited in the most recent years reported a lower rate of this behavior, and those who injected with a higher frequency were more inclined to share. High levels of sexual risk behaviors were present in all the samples, the factors associated with this behavior being younger age and a moderate frequency of injection; IDUs recruited in years 1993–1994 reported a lower rate of risk behaviors. No significant associations were found in the logistic regression for HIV serostatus, though trends were generally in the expected direction.

One encouraging finding of this study is the lower level of needle-sharing among participants recruited in recent

years (1995–1996), perhaps because of growing AIDS awareness among IDUs. A similar trend has been observed in several studies in many different settings and countries, including one in Italy using a serial cross-sectional design and the same WHO Multicenter Study questionnaire and methodology [22]. This finding was further supported by data obtained in focus group meetings taking place in the Proviva Project, where many had experienced living with HIV/AIDS or known other IDUs in this situation. Even if IDUs in Rio de Janeiro have reduced needle-sharing in recent years, current rates of needle-sharing and sexual risk behavior remain high, and represent a major route for HIV transmission.

Seroprevalence levels for HIV were significantly lower in the Proviva sample, even though this sample was recruited over a similar period of time to that of the Brasil sample. One possible explanation may be found in the broad epidemiological trends described elsewhere by two of the authors of this paper [24,25]: the 'impoverishment' of the Brazilian AIDS epidemic. The epidemic in Brazil began among the rich and upper middle class and gradually moved to less skilled, less educated, poorer persons living in deprived neighborhoods of Brazilian big cities and, more recently, middle-size cities. As described above, Proviva recruited unequivocally poorer IDUs, perhaps affected only recently by the epidemic, and so now presenting lower seroprevalence levels. This indicates the fundamental importance of effective prevention strategies among the poorest and largest strata of Rio's IDUs as the best opportunity to reduce future infections.

In addition to the main findings reported, two issues may have particular methodological implications for IDU research in Rio de Jainero. One is the reported history of incarceration. The number of times in jail/prison was significantly lower in the poorer Proviva sample than in the Brasil and WHO samples. While surprising at first glance, this may be explained by the peculiar slum/shantytown environment in Rio, a complex labyrinth with small streets and houses, where even the police have very restricted access. IDUs have a minimal risk of being arrested in the slums, where drug-dealing usually takes place. The slums are mostly located on the slopes of mountains, with only a few main access points to the other streets of the city. It is at these access points and outside the slums in Rio where IDUs run the greatest risk of arrest. Therefore, the Proviva participants, who live in the slums, may be less exposed to police and the risk of arrest.

Another finding of these three samples is that IDUs seem to be getting more difficult to reach in recent years. For example, the Brasil and Proviva samples were much smaller than the WHO sample despite investing greater resources into recruiting. It is not clear whether this is a consequence of greater social isolation, which makes access to them even more difficult, or whether drug users are changing their routes of drug-taking. Either possibility is consistent with the decreasing trend over the last 10 years in

the number of IDUs attending the only public drug treatment clinic in Rio [26]. Crack cocaine is not easily found in Rio (unlike São Paulo, a neighbor state) and does not seem to be used as a substitute for the injection habit. Focus group findings suggest that many IDUs are falling ill and interrupting their drug habits while others have stopped using the intravenous route due to the impurities added to the available cocaine (e.g. marble powder, effervescent medicine, flour), which in many cases make injection almost impossible.

There are important limitations to the present study. First, the three samples were recruited at different times during the years 1990–1996, resulting in confounding of time with sample, and complicating the investigation of changes in risk behavior over time. Second, there is a lack of uniformity among the three samples, in terms of how the subjects were recruited and the specific questions they were asked. Each study targeted a somewhat different IDU population and, even when two of the studies targeted in-treatment IDUs, these IDUs were recruited from different clinics. The use of different questionnaires in each study, all with slightly different questions, restricted analyses to those few variables that were similar across studies, or that could be reduced to a common denominator across studies. This limited the number of variables available for analysis, and forced reliance on dichotomous or categorical measures of risk behavior. Last, although the studies targeted different subpopulations of IDUs, there may be subpopulations that were not included in any of these sampling schemes, and about whom little or nothing is known.

An important strength to this work is that it is one of very few studies on IDU risk behavior in Rio de Janeiro. More information about this population is needed to guide preventive strategies. This population will continue to play an important role in HIV spread, both through their high-risk injecting and sexual habits and, to a lesser extent, through vertical transmission. As shown in other studies [27], preventive interventions among this population can be effective in reducing high-risk behaviors, especially injecting habits.

Unfortunately, Rio de Janeiro still does not have a systematic AIDS prevention program for IDUs. The Ministry of Health is currently attempting to launch a harm-reduction program in Rio and other Brazilian cities, but this is facing substantial political opposition, particularly from law-enforcement officials. The findings of the present study emphasize that such programs are urgently needed to prevent further spread of HIV among drug users and to the rest of the population.

Acknowledgments

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