HCV and HIV infection and co-infection: injecting drug use and sexual behavior, AjUDE-Brasil I Project

Infecções e co-infecções pelos vírus HCV e HIV: uso de drogas injetáveis e comportamento sexual, Projeto AjUDE-Brasil I

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Abstract

This study aimed to characterize sexual and drug-use behaviors in injecting drug users (IDUs) in relation to single hepatitis C virus (HCV) and human immunodeficiency virus (HIV) infection and HCV/HIV co-infection. The sample consisted of 272 IDUs enrolled in the AjUDE-Brasil I Project, a cross-sectional multi-center study conducted in five Brazilian cities in 1998. Data were collected with a structured questionnaire using self-reported risk behavior, and HCV and HIV serological status used ELISA on filter paper. IDUs were clustered in four distinct groups: HCV/HIV seronegative; HCV mono-infected; HIV mono-infected; and HCV/HIV co-infected. Active sharing of injecting equipment was associated with HCV infection (p = 0.001). Sexual behavior variables, especially male same-sex sexual relations, were consistently associated with HIV infection. HCV/HIV co-infection was associated with both sexual and drug use variables. It was possible to distinguish different behavioral indicators for HCV and HIV infection and co-infection in this population.

Intravenous Drug Abuse; Sexual Behavior; Hepatitis C Virus; HIV

Introduction

Hepatitis C virus (HCV), human immunodeficiency virus (HIV), and their co-infection present common transmission routes, thus making the study of factors associated with these events complex in population groups with various behaviors making them vulnerable. The presence of "facilitating" conditions favors the rapid and extensive spread of these infections among injecting drug users (IDUs). The efficiency of blood-borne transmission of these viruses and the interaction among social networks involving sharing of injecting equipment increase the dynamic of the HIV/AIDS epidemic in this group.

The World Health Organization (WHO) estimates that 170 million individuals are currently infected with HCV worldwide, that is, 3% of the world population [1]. In Brazil, HCV prevalence is in the 2.5 to 10% range, with some of the highest rates recorded in South America [2]. Contact with contaminated blood is the principal route of HCV infection, and the most common forms are reutilization of contaminated sharps and sharing of needles and syringes. Thus, IDUs show a higher HCV prevalence than the overall population, with infection rates greater than 50% [3]. A prospective study of IDU in Canada (Vancouver Injection Drug Users Study – VIDUS) [4] showed an HCV incidence rate of 37.3 per 100 person-years. In Brazil, the

prevalence of this infection among IDUs participating in the AjUDE-Brasil I Project was 53.1% [5].

The principal risk factors HCV infection in IDUs relate to the characteristics of initiation into injecting drug use, age at initial drug use, time and frequency of use, type of injected drug, and sharing of needles and syringes [6]. Sexual transmission of HCV is debated in the current literature. Some authors consider it an inefficient route for transmission of the virus [7], corroborating findings that the report of unprotected same-sex sexual relations and receiving money or drugs for sex are not associated with infection [8]. Other studies point to this route as a possible means of HCV infection, especially among men with HIV/AIDS, non-drug users, and those who report unprotected sexual relations with other men [9,10].

As for HIV, an estimated 39.4 (35.9-44.3) million individuals are currently infected worldwide, with 4.9 million new cases in 2004. Case distribution is uneven between regions, and one-fourth of individuals living with HIV/AIDS in Latin America are in Brazil, with an overall prevalence of 0.7% (0.3-1.1) [11]. Specific groups like IDUs show a mean prevalence of 60% worldwide [11]. When analyzing this high prevalence, one should consider the broad variation in HIV seroprevalence in various populations. In Brazil, different levels of maturity in the HIV/AIDS epidemic have been observed in the various regions of the country [12], with an HIV prevalence of 47.7% among IDUs participating in the AjUDE-Brasil I Project [5].

HIV/HCV co-infection affects more than one-third of HIV-infected individuals worldwide [13]. In Brazil, HCV prevalence in patients treated at health services in the Amazon was 16% (95%CI: 12.4-19.6) [14]. A study of HIV-infected individuals in the city of Santos showed a 36.2% co-infection rate (95%CI: 31.9-40.4), significantly higher among IDUs than non-IDUs ($p < 0.001$) [15]. According to this same study, sharing of syringes and positive serology for hepatitis B virus (HBV) and HTLV-I/II were significantly associated with HCV/HIV co-infection, while the number of lifetime sexual partners, history of sexually transmitted diseases (STDs), and sexual relations with sex workers did not show such an association [15]. The results of a multi-center study (CAESAR Study) [7] in Canada, Australia, Europe, and South Africa showed that individual participation in at least one of the exposure categories for HIV, whether sexual or parenteral, was a strong predictor of HIV/HCV co-infection.

Following the introduction of antiretroviral therapy (ART), HCV infection has been considered the principal cause of morbi-mortality among HIV-infected individuals [16]. Co-infected individuals show a higher mortality rate than singly HIV-infected, and HCV infection is considered a predictor of mortality [17]. Treatment of HCV infection becomes important for achieving longer survival and better quality of life in co-infected individuals. Peg-interferon (pegIFN) and ribavarin (RBV) have been considered standard treatment for HCV infection [16,18], despite presenting a worse adverse event profile and lower effectiveness in co-infected as compared to mono-infected individuals [16].

IDUs represent a population group at particular risk for co-infection as compared to other groups, thus undergoing greater socioeconomic and health impact, expressed by increased risk of death, liver complications like cirrhosis, and complications arising from the antiretroviral treatment itself [16,18,19].

The current study aims to evaluate the prevalence of HCV/HIV co-infection in Brazilian IDUs and its potential association with risk behavior for each of the infections.

Methods

AjUDE Brasil I Project

This study is part of the AjUDE-Brasil I Project, a multi-center cross-sectional study in 1998 with 287 IDUs recruited from syringe-exchange program (SEP) in five Brazilian cities: São Paulo, Sorocaba, and São José do Rio Preto in the State of São Paulo; Itajaí in Santa Catarina; and Porto Alegre in Rio Grande do Sul. Structured interviews applied by previously trained interviewers covered socio-demographic information (including fixed residence and any type of work in the previous six months), sexual behavior (lifetime reported sexual relations of men with other men), and injecting drug use, in addition to any history of arrest or incarceration. After reliability studies, serological tests were performed for HIV and HCV infection, using blood samples on filter paper and the Sanofi-Pasteur® and Abbott® ELISA kits for HIV serology and the Umelisa® HCV kit for HCV serology [20].

Study sample

The sample of IDUs participating in the AjUDE-Brasil I Project was situated within the calculated limits, considering the lowest (20%) and highest (66%) HIV seroprevalence in this population group, 80-90% power, 95% confidence

interval (95%CI), and odds ratio (OR) of 2 [20]. The sample consisted of 272 IDUs among the 287 participants in the AjUDE-Brasil I Project. Inclusion criteria were: a positive serology for at least one of the target viral infections (HIV and/or HCV) or negative serology for both these infections. IDUs who presented positive serology only for HTLV-I/II were excluded.

Statistical analysis

According to serology, the IDUs were grouped into four mutually exclusive groups: seronegative (negative serology for HCV and HIV); HCV mono-infected (positive serology for HCV only); HIV mono-infected (positive serology for HIV only); and HIV and HCV co-infected (positive serology for both viruses).

Descriptive analysis used frequency distributions, measurements of central tendency, and dispersion. In all procedures in the comparative stage, seronegative individuals were used as the reference group. Associations between discrete variables were evaluated by chi-square or Fisher's exact test, as necessary. The magnitude of these associations was estimated by the OR and respective 95%CI. Possible associations between continuous variables were analyzed by the Student t test. Logistic, binary, and multinomial regression analyses were performed, using the infection/non-infection groups as the dependent variable. The independent variables were selected according to the magnitude of the association as shown in the bivariate tests ($p < 0.25$), biological plausibility, and epidemiological relevance [21]. The software used was SPSS, version 11.5 (SPSS Inc., Chicago, USA).

The research was approved by the Institutional Review Board of the Universidade Federal de Minas Gerais, case review no. ETIC 056/98.

Results

Participating IDUs were distributed according to serology in 103 (37.9%) seronegative, 28 (10.3%) HCV mono-infected, 25 (9.2%) HIV mono-infected, and 116 (42.6%) co-infected, totaling 47 women (17.3%) and 224 men (82.7%), with a mean age of 29.25 ± 8.04 years and a median of 28 years. In relation to skin color, 49.5% of the IDUs were classified as white. The majority reported being able to read (87.5%) and having any work (69.8%) and a residence (71.9%) in the six months prior to the interview. An important proportion reported ever having been arrested or incarcerated (69.9%), of whom 38.1% reported having been arrested or incarcerated in the six months prior to the interview (data not shown). The socio-demographic and drug use information, described in the following paragraphs, are shown in Tables 1 and 2, respectively.

All the infected groups showed mean ages significantly greater than for the seronegative, except for the HCV mono-infected group, which also showed higher values, but not statistically significant ($p = 0.19$).

White skin color was significantly associated with HIV mono-infection (OR = 2.74; 95%CI: 1.0-7.53) and co-infection (OR = 2.09; 95%CI: 1.18-3.73). The other socio-demographic variables showed no significant association with the target infections. The following paragraphs separately describe the injecting drug use and sexual behavior variables.

Injecting drug use

Mean ages at initiation of injecting drug use were similar among the infected groups and were higher than the mean for the seronegative group (16.8 ± 4.1 years). However, the only significant difference was observed between the mean age at initiation of drug use in the co-infected as compared to the seronegative group ($p = 0.05$).

Mean time of injecting drug use was greater among infected IDUs, and again there was a statistically significant difference between the HIV/HCV co-infected ($p = 0.03$) and the seronegative IDUs.

As for variables related to sharing of injecting equipment, the majority of the IDUs who reported ever having received/borrowed (78.8%) or given/lent syringes (77.4%) to other IDUs belonged to one of the infected groups. Reported lifetime giving/lending of syringes to other IDUs was significantly associated with both HCV mono-infection (OR = 4.33; 95%CI: 1.66-11.45) and co-infection (OR = 3.03; 95%CI: 1.63-5.69). Reported lifetime receiving/borrowing of syringes was significantly associated with HIV mono-infected (OR = 2.76; 95%CI: 1.08-7.14) and HIV/HCV co-infected (OR = 4.28; 95%CI: 2.25-8.19).

As for variables related to recent sharing of injecting equipment (in the six months prior to the interview), a reversal was observed in the association as compared to lifetime sharing. This reversal occurred in all the serological groups, but without statistical significance for the tested associations as a whole (data not shown).

Table 1

Socio-demographic characteristics of IDUs according to serological status, AjUDE-Brasil I Project, 1998.

Variable	HCV-/HIV-* (n = 103)		HCV+/ HIV-** (n = 28)		HCV-/ HIV+*** (n = 25)			HCV+/HIV+# (n = 116)		
	n (%)## $\bar{X} \pm \sigma$	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###
Male gender§	81 (21.4)	22 (21.4)	1.00	0.99	20 (80.0)	1.09	0.88	101 (87.8)	1.96	0.07
Age (years)	27.1 ± 7.9	29.5 ± 9.1	–	0.19	31.04 ± 5.9	–	< 0.02	30.7 ± 8.0	–	< 0.01
White skin color§§	39 (37.9)	15 (53.6)	1.89	0.13	15 (62.5)	2.74	0.03	65 (56.0)	2.09	0.01
Can read§§	90 (87.4)	21 (75.0)	2.31	0.11	23 (95.8)	3.32	0.47	103 (88.8)	1.14	0.74
In last 6 months§§										
Any work§§§	68 (66.0)	20 (76.9)	1.62	0.35	16 (69.6)	1.11	0.84	81 (70.4)	1.16	0.62
Arrest†	28 (27.2)	3 (15.8)	0.26	0.38	5 (26.3)	0.50	0.22	33 (43.4)	1.07	0.84
Residence††	79 (76.7)	21 (0.75)	0.91	0.85	15 (62.5)	0.51	0.15	79 (68.7)	0.68	0.19
Lifetime§§										
Arrest†	69 (67.0)	19 (67.9)	1.04	0.93	19 (82.6)	2.34	0.14	81 (70.4)	1.17	0.58

Seronegative individuals comprised the reference category.
* Seronegative IDUs;
** HCV mono-infected IDUs;
*** HIV mono-infected IDUs;
# Co-infected IDUs;
The number does not include the total, since not all subjects answered all the questions;
Obtained for seronegative IDUs from the t-test or χ^2 test;
§ Female gender: reference category;
§§ No: reference category;
§§§ Any type of work reported during the interview;
† Answer the following question: "Were you arrested or imprisoned during the last six months?";
†† Fixed residence.

Table 2

Characteristics of injecting drug use in IDUs, according to serological status, AjUDE-Brasil I Project, 1998.

Variable	HCV-/HIV-* (n = 103)		HCV+/ HIV-** (n = 28)		HCV-/ HIV+*** (n = 25)			HCV+/HIV+# (n = 116)		
	n (%)## $\bar{X} \pm \sigma$	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###
Injecting drug use (years)										
Age at initiation	16.8 ± 4.1	17.5 ± 4.2	–	0.47	18.0 ± 4.7	–	0.24	18.2 ± 5.9	–	0.05
Time of use	10.3 ± 7.6	12.0 ± 9.4	–	0.33	11.0 ± 6.7	–	0.11	12.5 ± 7.6	–	0.03
≤ 10	61 (59.2)	14 (50.0)			9 (37.5)			53 (45.7)		
>10	42 (40.8)	14 (50.0)	1.45	0.38	15 (62.5)	2.42	0.05	63 (54.3)	1.73	0.05
Lifetime syringe sharing§										
Active	24 (23.3)	16 (57.1)	4.33	< 0.01	10 (41.7)	2.32	0.12	56 (48.3)	3.03	< 0.01
Passive	21 (20.4)	7 (25.0)	1.29	0.62	10 (41.7)	2.76	0.03	61 (52.6)	4.28	< 0.01

Soronegative IDUs comprised the reference category.
* Seronegative IDUs;
** HCV mono-infected IDUs;
*** HIV mono-infected IDUs;
# Co-infected IDUs;
Number does not include the total, since not all the individuals answered all the questions;
Obtained for seronegative IDUs by the t-test or χ^2 test;
§ No: reference category.

Sexual behavior

Table 3 shows the sexual behavior variables. Seronegative IDUs were not differentiated from the various infected groups, except for mean age at sexual debut (13.3 ± 2.9 years) and first same-sex sexual relations with men (15.2 ± 4.2 years), with the lowest values in the seronegative and co-infected groups, respectively. HIV mono-infected IDUs showed longer intervals between the first and last same-sex sexual relations with men (7.75 ± 6.6 years).

A major proportion of interviewees reported no lifetime sexual relations with other men (68.2%). During the six months prior to the interview, the majority reported sexual relations with the opposite sex (90%), not having genital discharge (91.1%) or lesions (93.4%), not having sexual relations with the opposite sex in exchange for drugs (91.3%), or men who have sex with men (MSM) sexual relations (82.1%). Some 60% reported not having used condoms in their sexual relations with partners of the opposite sex.

Genital discharge in the six months prior to the interview was significantly associated with HCV mono-infection (OR = 4.57; 95%CI: 1.27-16.62), while exchanging sex for drugs showed borderline significance (p = 0.06) in relation to HIV mono-infection, and no significant association was observed with HCV mono-infection or HIV/HCV co-infection. Lifetime sexual relations with other men was statistically associated with HIV mono-infection (OR = 8.08; 95%CI: 2.40-28.17) and HIV/HCV co-infection (OR = 3.06; 95%CI: 1.44-6.59). In the six months prior to the interview, reported condom use, exchanging sex with other men for drugs, and condom use with partners of the opposite sex were not statistically associated with presence or absence of HIV, HCV, or HIV/HCV infection.

Multivariate models

Using the single infection and co-infection groups as the dependent variable as compared to the seronegative, in the multinomial analy-

Table 3

Sexual behavior characteristics of IDUs, according to serological status, AjUDE-Brasil I Project, 1998.

Variable	HCV-/HIV-* (n = 103)	HCV+/ HIV-** (n = 28)			HCV-/ HIV+*** (n = 25)				HCV+/HIV+# (n = 116)	
	n (%)## $\bar{X} \pm \sigma$	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###	n (%)## $\bar{X} \pm \sigma$	n (%)## $\bar{X} \pm \sigma$	Odds ratio	(p)###	n (%)## $\bar{X} \pm \sigma$	n (%)## $\bar{X} \pm \sigma$
Age at sexual relations (years)										
Debut	13.3 ± 2.9	13.9 ± 2.7	–	0.38	13.8 ± 4.0	–	0.50	13.8±2.7	–	0.19
MSM debut§	16.9 ± 5.6	17.4 ± 2.8	–	0.27	18.1 ± 8.3	–	0.32	15.2 ± 4.2	–	0.81
Last MSM§	19.1 ± 4.3	19.0 ± 3.3	–	0.97	23.3 ± 8.0	–	0.11	18.8 ± 6.0	–	0.68
Interval between 1st and last MSM§ (years)	5.75 ± 4.7	4.0 ± 1.4	–	0.63	7.75 ± 6.6	–	0.50	6.92 ± 8.2	–	0.71
In previous 6 months with opposite sex										
Sexual relations	94 (91.3)	26 (92.9)	1.24	1.00	21 (87.5)	0.67	0.70	101 (88.6)	0.74	0.52
Condom use	36 (35.0)	11 (73.3)	1.16	0.74	8 (38.1)	0.97	0.96	46 (45.5)	1.32	0.34
Sex for drugs	5 (4.9)	3 (11.5)	2.32	0.37	4 (19.0)	4.19	0.06	9 (9.0)	1.76	0.32
MSM relations§	1 (8.3)	4 (33.0)	5.50	0.32	0	–	–	7 (18.4)	2.48	0.66
Genital symptoms in previous 6 months										
Wound	5 (4.9)	1 (3.6)	0.73	1.00	1 (4.2)	0.85	1.00	11 (9.6)	2.07	0.18
Discharge	7 (6.8)	7 (25.0)	4.57	< 0.01	1 (4.2)	0.60	1.00	9 (7.9)	1.18	0.76
Lifetime MSM§	14 (17.5)	5 (22.7)	1.39	0.55	12 (63.2)	8.08	< 0.01	39 (39.4)	3.06	< 0.01

Soronegative individuals comprised the reference category.
* Seronegative IDUs;
** HCV mono-infected IDUs;
*** HIV mono-infected IDUs;
# Co-infected IDUs;
The number does not include the total, since not all individuals answered all the questions;
Obtained for seronegative IDUs by the t-test or χ^2 test;
§ Male IDUs who reported sexual relations with other men.

sis the following variables were candidates for the model: history of arrest, giving and receiving syringes, sexual relations with other men (all of which as lifetime reports) and time of injecting drug use. Due to the strong correlation between the variables giving and receiving syringes and needles (r = 0.66), two models were created, each presenting a different marker for possible parenteral exposure. These models, shown in Table 4, will be described below.

Lifetime active syringe sharing was the only variable independently associated with HCV mono-infection, about fourfold (OR = 4.30; 95%CI: 1.57-11.75) that of lifetime passive sharing (OR = 1.68; 95%CI: 0.56-5.10), with the latter not significant for this event. In relation to the models adjusted for HIV mono-infection, none of the variables related to sharing injecting equipment (giving or receiving syringes) was independently associated with the outcome. Meanwhile lifetime sexual relations with other men was independently associated with HIV infection in the models adjusted for mono-infection (OR = 8.17; 95%CI: 2.67-25.02) and co-infection (OR = 8.01; 95%CI: 2.63-24.45). In relation to the two models of HCV/HIV co-infection, sharing of injecting equipment (giving and receiving syringes and needles) and same-sex sexual relations were independently associated with the outcome. In relation to HIV mono-infection, lifetime passive syringe sharing was associated with the outcome at twice the rate (OR = 4.58; 95%CI: 2.25-9.33) of active sharing (OR = 2.96; 95%CI: 1.50-5.86).

The multivariate models adjusted by IDUs recruiting site (SEP) showed no difference in terms of either the explanatory variables or the respective magnitude of association.

Discussion

Different behaviors by IDUs were associated with the risk of HCV and HIV infection. Variables related to injecting drug use itself were associated with HCV infection, while lifetime reported same-sex relations were associated independently with HIV infection. Meanwhile HIV/HCV co-infection showed a pattern suggestive of a combination of factors linked to sexual behavior and injecting drug use. In both situations, the exposures referred to lifetime behavioral patterns and not to the recent expression of these same behaviors.

The association observed in the current study between lifetime sharing (especially giving) syringes and HCV mono-infection is consistent with Hagan et al. [22], suggesting that the parenteral route constitutes the principal form of transmission for this virus, with special relevance among IDUs due to their unsafe injecting practices. Recent findings of an association between unprotected same-sex relations and HCV infection HCV [10] merit further research, especially in the IDUs population, which is subject to the risks involved in double exposure (sexual and parenteral).

Some studies have shown that equipment-sharing practices differ among sub-groups of IDUs stratified according to specific characteristics, especially in relation to time of drug use, indicating that novice IDUs present higher-risk

Table 4

Final multinomial models for each serology group according to equipment sharing, AjUDE-Brasil I Project, 1998.

	HCV+/ HIV-*		HCV-/HIV+**		HCV+/HIV+***	
	Odds ratio	95%CI	Odds ratio	95%CI	Odds ratio	95%CI
Lifetime active syringe sharing	4.30	1.57-11.75	1.52	0.49-4.68	2.96	1.50-5.86
MSM sexual relations#	1.17	0.35-3.85	8.17	2.67-25.02	2.76	1.32-5.78
Final -2 log likelihood	78.37					
	(p = 0.000)					
Lifetime passive syringe sharing	1.68	0.56-5.10	2.08	0.66-6.51	4.58	2.25-9.33
MSM sexual relations#	1.41	0.44-4.55	8.01	2.63-24.45	2.72	1.28-5.77
Final -2 log likelihood	85.176					
	(p = 0.000)					

Soronegative individuals comprised the reference category.
* HCV mono-infected IDUs;
** HIV mono-infected IDUs;
*** co-infected IDUs;
# Male IDUs who reported sexual relations with other men.

behavior (as compared to more experienced users), contributing to the high HCV seroconversion rates, especially among younger and/or less experienced users [23,24]. The similarity shown by the current study between the profiles of HCV mono-infected and seronegative IDUs in relation to both chronological age and time of injecting drug use (lower as compared to other study participants), suggests that both groups consist mostly of less experienced IDUs, some of whom were already infected and others at substantial risk of becoming infected, given that the study by Garfein et al. [8] shows that HCV infection generally takes place during the initial months of injecting drug use.

Sexual transmission of HCV is debated in the current literature. Some studies suggest low efficiency for this route [7], while others point to the relevance of this form of transmission, principally among HIV infected individuals [9,10,15]. Our bivariate analysis showed a significant association between genital discharge in the previous six months and HCV mono-infection. However, this variable did not remain in the final model, adjusted for other exposure markers such as sharing syringes and needles, corroborating the hypothesis that the principal transmission route for HCV in this group of IDUs is parenteral.

Sexual behavior variables were consistently associated with HIV infection (both single and co-infection). Sexual relations with other men remained significantly associated with the outcome, both in the bivariate and multivariate analysis, suggesting that even among individuals with diverse risk behaviors for parenteral transmission of infections, such as IDUs, sexual exposure is still a particularly relevant transmission route for HIV [25]. In this sense, sexual transmission of this virus appears to increase the complexity of the dynamics of the HIV/AIDS epidemic, considering the context of the social network to which this population group belongs [26].

Another variable that can contribute to cumulative exposure time to HIV is the time during which the individual has unprotected sexual relations and (in the case of the male interviewees in the current study) unprotected relations with other men. As shown in the literature, exposure time is a fundamental component in the determination of infections [24], especially for pathogens with a relatively low transmission rate per exposure event, as with HIV. A recent study showed substantial variation in the sexual transmission of HIV-1 according to the stage of infection, with significantly higher transmission rates soon after seroconversion of the source individual [27].

The Brazilian literature has further shown that young or inexperienced Brazilian IDUs display sexual behavior characterized by highly frequent same-sex sexual relations and occasional relations with sex partners of the opposite sex [28], as well as inconsistent condom use [4].

HIV/HCV co-infection, observed in the majority of the IDUs in this study, suggests the presence of a mature epidemic, since this population appears to display injecting drug use risk behaviors over a longer period of time. In this sense, simultaneous exposure to HCV and HIV for a longer period has probably led to a depletion of susceptible individuals in this population group [12].

Studies show that HCV/HIV co-infection alters the clinical course of both infections and the immune status of affected individuals [13,19], increasing the plasma HCV-RNA and liver damage and limiting the benefits of interferon therapy [19]. HCV infection, a central predictor of morbi-mortality in HIV infected individuals in the ART era [17], merits special attention, since the results of a prospective study [4] showed that co-infection poses a virtually universal health problem among IDUs, thus highlighting the need to promote social and psychological stability, aimed at greater adherence to HCV treatment in this group [29].

Interventions at the primary health care level thus become crucial, especially among young IDUs, in order to prevent the spread of different sexually transmitted and blood-borne pathogens from reaching saturation levels in relatively small population groups with remarkably intense and recurrent social interaction. Interventions in social networks are capable of encouraging behavior changes among IDUs, thereby reducing their risks [30].

Co-infected IDUs display quite distinct behaviors from their seronegative peers, both in relation to age at initial drug use and time of use as well as sharing injecting drug equipment. These findings relate in turn to the dynamic of changes in attitudes among IDUs (impossible to observe in the current study, since it was cross-sectional) over the course of years of injecting drug use in relation to equipment-sharing, especially after becoming aware of their own HIV serological status or that of their partners. A qualitative study on the concept of risk and prevention in this same population showed quite distinct attitudes towards the adoption of preventive practices by IDUs after learning of their serological status. IDUs who knew they were infected tended to adopt preventive measures aimed at protecting only their partners, since they did not believe in the ben-

efits for their own health, given that they were already infected [31]. One can thus hypothesize that an IDUs who knows he is infected would avoid giving or lending his injecting equipment to other IDUs, but would not refuse to receive or borrow equipment from other IDUs.

Unlike the CAESAR Study [7], our findings show that IDUs who have sex with other men show a higher frequency of equipment sharing (as compared to those who do not have sex with other men), suggesting that some male same-sex relations may be associated with riskier use of injecting drugs. This corroborates findings from another Brazilian study in which male same-sex relations were a means to obtain drugs, since IDUs who had sex with other men injected more frequently than other IDUs, and the majority were unemployed [32].

Although previous studies have shown a significant association between history of arrest/incarceration and parenterally and sexually transmitted infections [4,25], the same association was not shown in the current study.

Various limitations in this study should be addressed. As for the cross-sectional design, the results should be interpreted with caution, since the research subjects may show a lower prevalence of risk behaviors than those who failed to survive one or both infections (HIV and HCV), both of which are determinants of major morbi-mortality, especially when combined. The impossibility of randomizing the interviewees and a possibly tendentious recruiting bias for participating IDUs probably created a selection bias. Likewise, an information bias may have occurred, especially in the variables covering a chronological dimension (initiation in injecting drug use and sexual relations) and those which could lead the interviewee to jeopardize the veracity of responses due to fear of legal sanctions or moral judgments concerning their conduct. In order to increase the reliability of answers related to undesirable social behaviors, studies have used the audio computer-assisted interview format (ACASI), with results that are at least comparable to other data collection strategies [33].

Another point relates to the effect of so-called "socially desirable answers", which underestimate exposure. According to one group of authors, the possibility of this bias in an IDUs cohort [4] impeded the verification of an association between syringe sharing and HCV infection. In the current study this association was demonstrated, perhaps due to this population group's scarce knowledge on HCV infection, which is less stigmatized than HIV infection in various contexts and populations, thus probably allowing us to obtain more reliable information on this association.

Other important limitations refer to the study's external validity and serological procedures. As for external validity, although the results cannot be generalized to all IDUs, they do reflect the injecting drug use and sexual behavior of IDUs participating in a set of Brazilian harm reduction projects.

In relation to serological tests, although the confirmatory text for HCV was not performed, the results can be considered valid for population screening studies. To the extent that the study population shows a high prevalence for this infection, one expects a high positive predictive value in relation to the testing strategy employed [34]. Furthermore, HCV antibody testing is known to show decreased sensitivity in individuals with advanced immune deficiency, and in some cases the infection may not even be detected. Even so, in the CAESAR Study [7], only two out of more than a thousand samples considered negative according to HCV antibody testing proved positive according to HCV-RNA, allowing one to conclude that the prevalence of HIV/HCV co-infection in the study population appears not to have been influenced by the low sensitivity of the HCV antibody test among individuals with major immune deficiency.

Despite the limits described above, the results indicate that even with the presence of some overlapping risk factors and transmission routes between HIV and HCV infections, it is possible to distinguish variables specifically associated with each separate infection in the IDUs population. Variables related to syringe sharing that favor parenteral transmission are associated with HCV infection, while those related to sexual behavior are basically related to HIV infection. This study creates prospects for future research on the natural history of bloodborne infections and diseases in injecting and other drug users, since comparable behavior patterns are observed between seronegative and mono-infected individuals, while quite different patterns are observed between the seronegative and the co-infected. It is thus important to highlight the need for primary health care interventions in this population group, aimed at maintaining the serological status of its seronegative members.

Resumo

Este estudo objetivou analisar grupos de usuários de drogas injetáveis (UDIs) infectados e co-infectados pelos vírus da hepatite C (HCV) e da imunodeficiência adquirida (HIV), em relação ao comportamento sexual e uso de drogas. A população de estudo foi composta por 272 UDIs participantes do Projeto AjUDE-Brasil I, *estudo transversal multicêntrico realizado em cinco cidades brasileiras, em 1998. Os dados analisados foram coletados através de entrevistas estruturadas e testes sorológicos, utilizando-se papel filtro e a técnica ELISA, para HIV e HCV. Os UDIs foram agrupados em quatro grupos sorológicos distintos, a saber: (1) soronegativos, (2) monoinfectados pelo HCV, (3) monoinfectados pelo HIV e (4) co-infectados. Relato de ter "dado seringa", na vida, apresentou-se significantemente associado à infecção pelo HCV (p = 0,001). Em relação à infecção pelo HIV, variáveis de comportamento sexual, em especial, o relato de relação homossexual (p < 0,001), mostraram-se consistentemente associadas à infecção. Para a co-infecção, tanto variáveis de comportamento sexual quanto de uso de drogas injetáveis mostraram-se associadas. Dessa forma, foi possível determinar indicadores distintos de comportamento para essas infecções, na população em estudo.*

Uso Indevido de Drogas Parenterais; Comportamento Sexual; Vírus da Hepatite C; HIV

Contributors

K. B. F. Zocratto was responsible for the literature review, data analysis, and drafting of the article. W. T. Caiaffa participated in the study design, data collection and analysis, and drafting of the article. F. A. Proietti, A. B. Carneiro-Proietti, and S. A. Mingoti accompanied the paper during its elaboration, analysis, and drafting. G. J. C. Ribeiro was responsible for the paper's initial analyses.

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