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Prevalence of hepatitis C virus and HIV infection among injection drug users in two Mexican cities bordering the U.S.

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Abstract

Objective—To estimate the prevalence of the hepatitis C virus (HCV) and HIV infection and associated risk behaviors among injection drug users (IDUs) in two northern Mexican cities.

Material and Methods—Between February and April 2005, IDUs were recruited in Tijuana (N=222) and Ciudad Juarez (N=206) using respondent-driven sampling (RDS), a chain referral sampling approach. Interviewer-administered questionnaires assessed drug-using behaviors during the prior six months. Venous blood was collected for immunoassays to detect HIV and HCV antibodies. For HIV, Western blot or immunofluorescence assay was used for confirmatory testing. Final HCV antibody prevalence was estimated using RDS adjustments.

Results—Overall, HCV and HIV prevalence was 96.0% and 2.8%, respectively, and was similar in both cities. Most IDUs (87.5%) reported passing on their used injection equipment to others, and 85.9% had received used equipment from others.

Conclusions—HIV prevalence was relatively high given the prevalence of HIV in the general population, and HCV prevalence was extremely high among IDUs in Tijuana and Ciudad Juarez. Frequent sharing practices indicate a high potential for continued transmission for both infections. HCV counseling and testing for IDUs in Mexico and interventions to reduce sharing of injection equipment are needed.

Keywords

hepatitis C virus; human immunodeficiency virus; injection drug use; Mexico; needle sharing

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It is estimated that 170 million people worldwide are infected with the hepatitis C virus (HCV).[1] HCV is a single stranded RNA flavivirus, originally identified in 1989 as the major cause of non-A and non-B hepatitis.[2] Although only a small proportion of acute HCV infections are symptomatic, HCV progresses to chronic infection in approximately 80% of cases and is an important cause of chronic liver disease worldwide.[3,4] Approximately 15 to 20% of persons who acquire HCV infection progress to potentially serious cirrhosis and end-stage liver disease.[5] Mexico has an HCV prevalence of approximately 0.7% to 1.6% in the general population.[6-10] These estimates are somewhat lower than the 1.7% HCV prevalence for the Americas, and the global prevalence of 3%.[1]

HCV is transmitted most effectively through parenteral exposures to infected blood. Prior to the virus' discovery, transfusion of blood or blood products was a major mode of transmission. Since testing of blood supplies began, new cases of transfusion-transmitted hepatitis C has been virtually eliminated. Sexual transmission of HCV appears to be inefficient as most sexual risk behaviors have not been shown to be associated with HCV infection.[4,11] Nosocomial transmission of HCV is possible if infection control measures are inadequate, such as the use of multidose vials, dialysis, and colonoscopy.[12] HCV is readily transmitted through microtransfusions of infected blood through the shared use of syringes and other injection paraphernalia used to inject illicit drugs. Currently, the major mode of HCV transmission worldwide is injection drug use.[11,12] In the United States, at least two-thirds of new HCV infections are associated with injection drug use.[13]

Injection risk behaviors such as the multi-person use (sharing) of injection equipment (i.e., needles/syringes, cookers, cotton, rinse-water) can transmit HCV, and potentially HIV and other blood-borne pathogens.[4,14] HIV seroprevalence in Mexico is currently low, at 0.3% of the general population. However, seroprevalence among injection drug users (IDUs) in northwestern Mexico is significantly higher, and recent studies suggest that IDUs are increasingly practiced behaviors that could increase their risk for HIV.[15,16] Since most HCV-infected persons are asymptomatic, serologic studies are needed to describe the epidemiology and develop interventions for HCV infection. Since HCV is about 10 times more infectious than HIV, and is usually the first infection to strike IDU populations,[17] estimating the prevalence of HCV infection among IDUs in Mexico can serve as an early indicator of the potential spread of HIV.[18]

The purpose of this paper is to contribute to the epidemiological profile of HCV among IDUs in Mexico by estimating the HCV prevalence and describing risk behaviors among IDUs in Ciudad Juarez and Tijuana. To the knowledge of the authors of this study, this is the first community-based study of HCV seroprevalence among IDUs in these cities.

Material and Methods

Between February and April, 2005, IDUs were recruited in Tijuana and Ciudad Juarez for a cross-sectional study of behavioral and contextual factors associated with HIV and HCV infections. Eligibility criteria for the study included: having injected illicit drugs within the past month, confirmed by inspection of injection stigmata ('track marks'); aged 18 years or older; ability to speak Spanish; willingness and ability to provide informed consent; and not having had previously been interviewed for the study. Subjects gave their written informed consent to participate in the study. Study methods were approved by the Institutional Review Board of the University of California, San Diego and the Ethics Board of the Tijuana General Hospital. Programa Compañeros, which is a trusted and well-respected non-governmental organization (NGO) that has been providing services to and conducting studies of IDUs in Ciudad Juarez for decades, reviewed the protocol as it pertained to this city and approved it on ethical grounds.

Respondent-driven sampling (RDS), a chain referral sampling approach, was used to recruit participants.[19,20] Briefly, a diverse group of "seeds" (heterogeneous in age, gender, drug of choice, and recruitment venue) were selected to initiate the process. The seeds were current IDUs who project outreach workers identified as having large social networks and were popular among their peers. Although individuals tend to recruit participants similar to themselves, studies of RDS have shown that balance is reached within approximately four to five waves of recruitment, ensuring that bias introduced from initial seed selection is eliminated.[19] After providing informed consent, seeds were interviewed, briefly educated on how to refer other eligible IDUs, and then given three uniquely coded coupons for referring their peers. Waves of recruitment continued as subjects returning with coupons were given three coupons to recruit members from their own social network. The study name, locations where subjects could participate, and a brief explanation were printed on each coupon.

In Ciudad Juarez, interviews were conducted at a clinic run by Programa Compañeros. In Tijuana, CIRAD, an NGO started in 1991 to work with drug users, enrolled participants during weekly trips to three geographically diverse neighborhoods in the city: Zona Norte, Grupo Mexico, and Sepanal. Recruitment at these three sites was facilitated through the use of a modified recreational vehicle that operated as a mobile clinic (the "Prevemovihl").

Upon enrollment, trained staff administered quantitative surveys eliciting information on socio-demographic and behavioral characteristics. The questionnaire included: age at first injection; years of injecting; the number of times in the last six months that the interviewee let another person use their needle, cooker, cotton filter, or rinse water after they themselves had used it (classified as distributive sharing); the number of times in the last six months that the interviewee had used any of these items after they were used by another IDU (classified as receptive sharing); and the number of times in the last six months that the interviewee had divided drugs by filling one syringe with drug solution and then expelling a portion into the hub (frontloading) or barrel (backloading) of a second syringe. Participants were also asked about lifetime history of HCV and HIV testing ("Have you ever been tested for hepatitis C/HIV before today?"), hepatitis C knowledge ("Do you know what hepatitis C is?"), and HIV knowledge ("Do you know how HIV/AIDS is spread?"). All interviews and test results were given in Spanish, by staff members trained in obtaining informed consent and conducting interviews on HIV-related risk factors. Recruitment and data collection were conducted under the supervision of study investigators and senior field survey supervisors.

Blood samples were obtained by venipuncture by a certified nurse trained in collecting and handling biological specimens, and serum was stored at the municipal health clinic before being shipped frozen to either the New Mexico State Laboratory or the San Diego County Health and Human Services Laboratory where antibody testing was performed. HCV antibody testing was performed using an enzyme immunoassay (EIA) test (Ortho Diagnostic Systems EIA 3.0, Raritan, NJ, USA). Reactive specimens were retested in duplicate using EIA and determined to be positive if either or both of the repeat tests were reactive. This method has been used in prior studies and found to be reliable due to the high positive predictive value of this testing algorithm when used in high prevalence populations.[21-23] Pre- and post-test counseling and referral to treatment, where indicated, was provided to all participants, consistent with guidelines published in the U.S. and applicable in Mexico.[12,24] All participants testing anti-HCV positive were counseled about avoiding behaviors such as sharing injection equipment that could spread HCV, avoiding use of alcohol and drugs that could accelerate liver damage, availability of treatment for HCV infection, and recommendations to be evaluated by a physician if they had hepatitis symptoms.

All participants were screened on-site in Mexico for HIV with the Determine rapid test (Abbott Laboratories, Abbott Park, IL, USA). Samples that were positive or had uncertain results from

the rapid test were sent to laboratories in the U.S. for confirmatory testing. Tijuana samples were tested by the San Diego County Health and Human Services Agency using HIV EIA followed by Western blot and HIV immunofluorescence assay on reactive samples. Ciudad Juárez samples were tested by the New Mexico State Department of Health using HIV EIA followed by Western blot on reactive samples. The determine rapid test has a very high sensitivity (100%) and specificity (99.4% − 100%).[25-27] Furthermore, there was 100% concordance between rapid test and confirmatory test results in the current study, reassurance of the Determine assay's high positive predictive value in this population. All participants with confirmed HIV-positive results were referred to a doctor at the municipal health clinic in their city for clinical evaluation. Pre- and post-test counseling and referral to treatment, where indicated, was provided to all participants.

Adjusted HCV prevalence was calculated using the RDS population estimator which accounts and adjusts for three types of potential biases: i) what the sample composition would have been if all IDU seeds were recruited equally; ii) if the group of recruits referred by each wave of seeds had possessed equal homophily (i.e., the tendency of individuals to refer others similar to themselves); and iii) if all of these groups had equal network sizes.[19,28]

Results

Of the 428 IDUs who completed the survey and provided a blood sample, 222 (51.9%) were recruited in Tijuana and 206 (48.1%) were recruited in Ciudad Juarez. The majority of the study participants were men (91.8%), which was similar across cities. One quarter of the study participants drank alcohol at least once a week and 6.7% drank alcohol every day (table I). The median age of first injection was 19.5 years (interquartile range [IQR]: 16−25 years), and the median number of years since first injection was 12.5 years (IQR: 8−19 years).

Overall, only 19.0% reported a prior history of HCV testing and 36.7% said that they knew what hepatitis C was. A higher percentage of IDUs (34%) reported having been previously tested for HIV, and 89% of participants said that they knew how HIV/AIDS was spread.

Overall HCV and HIV antibody prevalence was 94.6% and 2.8%, respectively. RDS adjusted HCV prevalence results (96.0%) were similar to crude results. HCV prevalence increased with greater duration of injection drug use, yet even among IDUs who had injected for less than three years, HCV prevalence was 84.6% (figure 1).

The prevalence of all HCV-associated risk behaviors was extremely high among the IDUs surveyed (table II). There was a high percentage of involvement in both distributive (87.3%) and receptive sharing (85.3%) of injection equipment in the last six months. The extremely high anti-HCV prevalence precluded extensive analysis of associations between risk behaviors and infection; however, the difference in the prevalence of receptive sharing of any injection equipment between anti-HCV-positive (85.9%) and anti-HCV-negative (70.6%) participants was marginally significant (p=0.08) even though the statistical power to detect a difference between these groups was only 16% (data not shown).

Discussion

Among IDUs in Tijuana and Ciudad Juarez –two Mexican cities that border the U.S.– a relatively high prevalence of HIV in comparison to the general population prevalence was observed, as well as an extremely high prevalence of HCV infection. Given the fact that nearly all IDUs in both cities were HCV-positive, it was not possible to identify statistically significant associations between HCV infection and injection behaviors known to be risk factors for blood-borne viral infection.[23,29] Nonetheless, the observed prevalence of all of these behaviors was extremely high and greater among HCV-positive compared with HCV-negative participants.

The potential for continued high prevalence of HCV and increased transmission of HIV and other blood-borne infections is high in these cities. Tijuana is reported to have the highest prevalence of drug use in Mexico and has a large number of "picaderos," or shooting galleries, which are noted for their high-risk syringe-sharing practices.[15,30] In 2003, an estimated 6 000 −10 000 IDUs in Tijuana injected in "picaderos."[31,32] Ciudad Juarez is believed to have the second highest prevalence of drug use in Mexico, with an estimated 6 000 IDUs in the city.[31] These findings suggest that HIV infection could spread rapidly among IDUs in Mexican cities bordering the U.S., as has been observed in other parts of the world,[33,34] unless interventions to decrease risky injection behaviors are rapidly implemented.

HCV prevalence estimates among IDUs worldwide range from 55 to 95% and approaches 100% seropositivity in long-term users.[18,35-37] While anti-HCV prevalence as high as 95% has been observed in U.S. urban IDU populations, lower prevalence has been observed in Latin American countries. A recent study of IDUs in Argentina found an anti-HCV prevalence of 55%, and studies from Brazil have reported anti-HCV prevalence estimates ranging from 53 to 75%.[38-41] However, in a 1999 study of prison inmates in Ciudad Juarez, Mexico, anti-HCV prevalence was found to be 100%.[42] The high HCV prevalence found in the inmates in the Ciudad Juarez study, along with the high prevalence found in our study, reflects how closely associated injection drug use and HCV seropositivity can be. In the past, blood transfusion was the major mode of transmission and most prevention efforts were aimed at blood banks. From more recent studies, including the one presented herein, it is clear that injection drug use is now the major mode of transmission, and therefore, prevention efforts need to be targeted appropriately.

Treatment for HCV is expensive, complicated, and not always effective. Currently, the best treatment available consists of pegylated interferon alpha plus ribavarin, which produces a sustained virologic response in 30 to 80% of treated patients.[43] Response rates vary depending on the HCV genotype of the patient, with lower response rates of 30 to 40% seen in patients infected with genotype 1, which is the most common genotype that has been found in patients in Mexico.[9,44,45] In Mexico, treatment with pegylated alpha 2a interferon costs $3 000 pesos per week ($270US) and needs to be taken weekly for six months to one year.[46] Side effects of therapy can be severe, with patients experiencing flu-like symptoms, fatigue, and bone-marrow suppression. In addition, treatment may result in neuropsychiatric effects, such as apathy, irritability, and depression, which may be of special concern to IDUs, many of whom likely already suffer from such symptoms.[47] Furthermore, the need for weekly interferon injections could be a psychological "trigger" for relapsing into injection drug use for patients who have stopped injecting. Therefore, drug abuse treatment should be a part of the treatment plan during and following treatment for HCV infection.

Due to the high expense and frequent complications of HCV treatment, measures aimed at preventing HCV transmission and reducing HCV disease progression should be expanded. However, only one-fifth of the IDUs in the study presented herein had ever been previously tested for HCV, and nearly two-thirds did not know what HCV was, illustrating the need to improve availability of HCV testing and education. Even in the absence of HCV treatment, screening for HCV is useful as a secondary prevention measure for educating infected persons about steps they can take to reduce their risk of developing end-stage liver disease and avoiding further transmission of the virus.

Secondary prevention measures for HCV-infected IDUs include vaccination against the hepatitis A and B virus, as co-infection has been shown to contribute to the severity of hepatocellular damage.[48-50] In addition, patients chronically infected with HCV should be encouraged to avoid consuming alcohol, as even moderate intakes have been shown to enhance

disease progression.[51] In this study, over one-quarter of participants consumed alcohol at least once a week.

When accompanied by appropriate counseling, HCV antibody testing may also encourage behavioral risk reductions, thereby preventing transmission of HCV, HIV and other blood-borne pathogens. Primary prevention measures for anti-HCV-negative IDUs should include access to sterile injection equipment and education on proper injection practices. The use of any injection equipment that has been contaminated with HCV-infected blood, such as needles, syringes, cottons, and cookers, has been shown to be an independent risk factor for seroconversion.[23,52] Not surprisingly, in this study the receptive sharing of injection equipment was associated with HCV infection and there was a high prevalence of sharing of all types of injection equipment. Despite the fact that a statistically significant difference in risk behaviors between the HCV antibody-negative and -positive groups could not be detected, due to the overall high prevalence of HCV infection in the population, the prevalence of each risk behavior was higher in the HCV positive group, indicating that there is much room for behavioral change. This is consistent with what has been found in studies in other parts of the world.[23,29,52] Some studies have found the sharing of cookers that are used in the heating of drug preparations to be the single most important risk factor for seroconversion, after controlling for syringe sharing.[23,53] Therefore, measures aimed at reducing HCV infection in IDUs who cannot or will not stop injecting drugs should not only focus on encouraging sterile syringe usage but also on the use of sterile cottons and cookers. Currently, Tijuana has one small needle exchange program and only two methadone clinics, both of which are privately operated. IDUs should be advised on where to obtain sterile equipment and should be shown how to properly sterilize equipment with bleach when new equipment is not available, as this may reduce the risk of HCV transmission.[54] Since the study present here and others show that HCV infection occurs very soon after initiating injection drug use, a special effort needs to be made to reach out to new and short-term injection drug users.[18,35]

The high prevalence of anti-HCV found in this study shows the potential for other blood-borne infections to spread in this population. Of particular concern is HIV, which has been shown to spread rapidly amongst IDUs in other settings.[33,34,55] Mexico is considered by UNAIDS to be a country of low HIV prevalence but high risk, ranking 23rd in the Americas in HIV prevalence but third in total number of cases.[56] The prevalence of HIV in IDUs has thus far remained low for this risk group; however, current estimates in the study presented herein show it is over nine times more prevalent than in the general population, and the near saturation of HCV infection among IDUs in these cities may signal a looming HIV epidemic and a window of opportunity in which to prevent that from occurring. HCV infection has been found to be a significant independent risk factor for HIV seroconversion among IDUs.[57] In many studies, over 90% of HIV-infected IDUs are coinfected with HCV.[58,59] Furthermore, HIV infection causes HCV infection to progress more rapidly, and end stage liver disease is now the leading cause of death in HIV-HCV coinfected patients.[58,60] HIV infection is also associated with increased sexual transmission of HCV, which could promote HCV spread to the non-IDU population.[35,61]

A few limitations of this study must be acknowledged. All risk behaviors were self-reported and possibly subject to bias from recall and socially desirable responding. IDUs may have tried to downplay the frequency of behaviors that they feel are socially undesirable, such as sharing injection equipment, on behavioral surveys. To minimize this possibility, indigenous outreach workers were used to conduct the interviews, and participants were assured that their responses would be kept confidential. Given the high proportion of participants who reported sharing injection equipment, it appears that socially desirable responding did not greatly influence this study's results, possibly because the IDUs in this study were not aware that sharing injection equipment is risky. Disease knowledge was also self-reported, although almost all of those

claiming to know what HIV is correctly identified ways in which HIV is transmitted. Another limitation of this study is that, of those testing anti-HCV-positive, the proportion of actively infected individuals was not measured, as viral RNA was not determined by RT-PCR among seropositive subjects.

The high prevalence of anti-HCV found in this study illustrates the great potential for the parenteral spread of HIV and other blood-borne viruses among IDUs in Tijuana and Ciudad Juarez, Mexico. This study indicates that there is an urgent need to expand HCV counseling and testing for IDUs in Mexico, and to implement interventions that will decrease HCV- and HIV-associated injection risk behaviors in order to prevent a possible surge in the incidence of HIV infection in this population.

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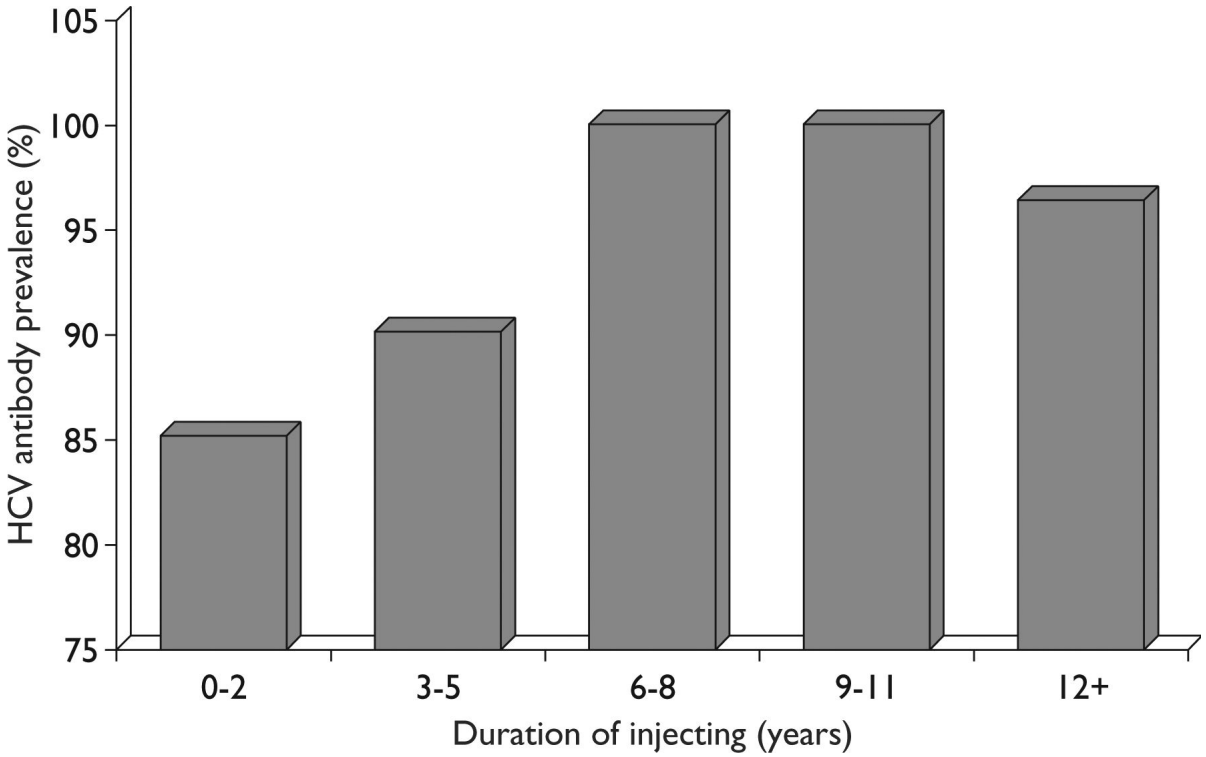

Figure 1.
HCV antibody prevalence by duration of injection drug use among injection drug users recruited from Tijuana and Ciudad Juarez, Mexico, 2005

Table I

Characteristics and viral infection prevalence among injection drug users in Tijuana and Ciudad Juarez, Mexico, 2005

Characteristic	Total	% (n)
Male Gender	428	92 (393)
Drink alcohol ≥ once a week	371	26 (98)
Drink alcohol every day	371	7 (25)
Years Injecting [median (IQR)]	426	13 (8−19)
Age at First Injection [median (IQR)]	426	20 (16−25)
History of prior HCV testing	426	19 (81)
Knows what HCV is	417	37 (153)
History of prior HIV testing	428	34 (146)
Knows how HIV is spread	428	89 (381)
HCV-antibody positive (Tijuana)	222	95.5 (212)
HCV-antibody positive (Ciudad Juarez)	206	93.7 (193)
HCV-antibody positive (Overall)	428	94.6 (405)
HIV-antibody positive	428	2.8 (12)

Table II

Prevalence of self-reported injection practices by Hepatitis C virus (HCV) antibody serostatus among injection drug users in Tijuana and Ciudad Juarez, Mexico, 2005

		HCV negative	HCV positive
Risk Behavior	**N**	**%**	**%**
Distributive needle sharing	420	58.8	70.5
Distributive cooker sharing	418	64.7	74.7
Distributive cotton sharing	392	64.7	66.8
Distributive water sharing	392	64.7	71.2
Receptive needle sharing	417	52.9	71.5
Receptive cooker sharing	414	64.7	76.5
Receptive cotton sharing	388	52.9	69.8
Receptive water sharing	391	52.9	73.2
Frontloading and/or backloading*	418	58.8	59.7
Distributive sharing of any instruments	415	76.5	87.7
Receptive sharing of any instruments	412	70.6	85.9

*A method of splitting drug solution between two users by squirting a portion of the drug from one syringe into the front (frontloading) or back (backloading) of another syringe