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Prevalence of hepatitis C virus in young people who inject drugs in four Colombian cities: A cross-sectional study using Respondent Driven Sampling

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Abstract

Background: Colombia has a growing population of young people who inject drugs (PWID). Despite the previously reported association of injection drug use with hepatitis c virus (HCV) in other countries, studies on HCV prevalence in PWID in Colombia are lacking. The objective of this study is to determine the prevalence, demographics, and correlations of risky injection behaviours in HCV seropositive PWID in four Colombian cities (Armenia, Bogotá, Cúcuta and Pereira).

Methods: This was a cross-sectional study carried out between January and June of 2014 that included 918 PWID from four Colombian cities, recruited by Respondent Driven Sampling. A survey was administered to each participant, and blood samples were collected. Binary logistic regression and multivariate analyses for each city were conducted.

Results: Average participant age was 26 years (SD 6.5). Of all participants, 27.3% of PWID were HCV seropositive, of which 52% were 25 years old or younger. In Pereira, increased risk of HCV infection was found for PWID that: had a history of injection drug use of 5 years or more (AOR: 3.0, CI: 1.7–7.8); were between 25 and 28 years of age (AOR: 5.2, CI: 1.0–26.3); had higher injection frequency (AOR: 2.5, CI: 1.4–4.2), and daily use of gifted, sold, or rented needles or syringes (AOR: 4.5, CI: 1.0–7.1). Additionally, in Cucuta, being HIV seropositive appeared to be greatly associated with risk of HCV seropositivity (AOR: 16.9, CI: 3.5–81.5).

Conclusion: Although prevalence of HCV in PWID in Colombia is lower than that reported for other countries, the described demographic characteristics and diverse risky injection behaviors on each city, in the context of a young PWID population with a short injection drug use history,

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should be taken into account in order to guide efforts towards preventing and reducing risk of HCV infection in PWID in Colombia.

Keywords

Colombia; Drug abuse; Drug injection; Hepatitis C virus

Introduction

Over the past few years, intravenous drug use has becomean increasingly growing global health concern (Ezzati, Lopez, Rodgers, & Murray, 2004). According to the World Drug Report, in 2015, it was estimated that up to 12.9 million people injected drugs (United Nations Office on Drugs & Crime, 2015). Furthermore, over the past few decades, intravenous drug use has become a growing concern for mid- and low-income countries such as Colombia, which has shifted from being a drug-producing country to having increasing rates of non-injection and injection drug use (Gobierno Nacional de la Republica de Colombia, 2008, 2013; PAHO, 2009; UNODC Colombia, 2015).

First reports of injectable use of cocaine and alcohol in Colombia date back to the 1980s (Miguez, Page, & Baum, 1997; Motta, Gómez, & OM de la, 2003); however, injectable drug use was not widespread until the 1990s, when prevalence of local heroin use in Colombia started rising as a consequence of greater availability of cheap, low-quality, water-soluble heroin (Miguez et al., 1997; Motta et al., 2003; Hacker, Malta, Enriquez, & Bastos, 2005). Continuously growing consumption has been reported since then (Corporación Rumbos, 2018; Gobierno Nacional de la Republica de Colombia, 2008, 2013; Pérez Gómez, Peña Amaya, Sco, & ppetta Díaz-Granados, 2002), as corroborated by national estimates of lifetime heroin injectors rising from 5200 people in 1992 to 31,900 people in 2013 (Gobierno de Colombia, 2015). Moreover, heroin injection in Colombia is rapidly rising and is more common than previously assumed (Castaño Pérez & Calderón Vallejo, 2012; Pérez, Alonso, Vallejo, & Adolfo, 2010).

The main burden of disease associated to injection drug use is attributed to hematogenously transmitted viral diseases such as hepatitis C virus (HCV) (Degenhardt & Hall, 2012). Risky injection behaviors – such as assisted injection, and needle and drug-preparation equipment sharing – have been previously associated to increased risk of infection with HCV and human immunodeficiency virus (HIV) (Hagan & Des Jarlais, 2000; Hagan et al., 2001; Mathei et al., 2006; Nelson et al., 2011; Thiede, 2001). Moreover, longer duration of injection, increased frequency of injection, HIV seropositive status, and injecting with other people, have been directly associated to a greater risk of transmission and reduced time to primary HCV infection (Hickman et al., 2007; Lopes et al., 2009; Rolls et al., 2013; Rondy et al., 2013; Zhang, Zhang, Chen, Zou, & Ling, 2013; Zhou et al., 2012).

Variation in HCV prevalence, as well as in patterns of risky injection behaviours may be dependent on recruiting strategies, research protocols, demographic differences, and local drug use practices of the study target population (Aceijas & Rhodes, 2007; Reynolds, Fisher, & Napper, 2012; Rondy et al., 2013). The latest global epidemiology report on HCV in people who inject drugs (PWID), conducted in 2017, estimated that 52.3% of PWID,

equating to 8.2 millions globally, had HCV seropositive status (Degenhardt et al., 2017). Unfortunately, 14 Latin-American countries were not included in that multistage systematic review, because information was either unavailable or limited. To our knowledge, to date there is only one previous peer-reviewed publication addressing HCV prevalence in PWID in Colombia, which was carried out in the city of Armenia, and in a sample of 265 participants reported a 22.3% seroprevalence of HCV among the studied population (Berbesi-Fernández, Segura-Cardona, Montoya-Vélez, & Castaño-Perez, 2015).

In Colombia, only two local harm reduction programs have been implemented so far. "CAMAD", which provided primary care health at the street level for 21,759 people who used drugs in Bogotá between 2012 and 2014, but was discontinued in 2016 (Interamerican Development Bank, 2005; Quintero, 2012); and "CAMBIE", a pilot needle/syringe exchange and naloxone dispending program established in Pereira in 2014, and expanded to Bogotá and Cali in 2015, which has provided comprehensive services to 2200 PWID (Corporación ATS, 2018). Moreover, lack of information and knowledge regarding HCV in PWID in Colombia along with the limited implementation and coverage of harm reduction strategies in the country may hinder drug consumption prevention and behaviour modification efforts that aim to avoid virus transmission and infection, as well as to reduce the spread of HCV and its associated consequences (Bowring et al., 2013; Nelson et al., 2011).

In an effort to contribute to the scarce literature and future public policy planning and implementation, in this article we describe demographic characteristics and injection practices of PWID in four Colombian cities during the year 2014, and report their association with HCV seropositivity.

Methods

Study design and site

This was a cross-sectional study carried out between January and June of 2014 in four Colombian cities: Armenia, Bogotá, Cúcuta, and Pereira. Site selection was based on a previously reported national cross-sectional study of HIV in PWID conducted in several Colombian cities (Berbesi-Fernández, Segura-Cardona, Montoya-Velez, & Lopez-Ramirez, 2018; Universidad CES - Observatorio de Drogas de Colombia, 2015) that represent urban epicentres of different Colombian regional areas and report high and growing rates of injection drug use, mainly heroin and to a lesser extent cocaine, and opioids (Gobierno de Colombia, 2015; Observatorio de Drogas de Colombia (ODC) (2016)).

Bogotá, the Colombian capital, is the city with the largest population in Colombia, and is the main economic, cultural, political, and industrial centre in the country (Gobierno de Colombia, 2013; Perez, 2010). Armenia, located in the Andean region southwest of Bogotá (Berbesi-Fernández et al., 2015); Cúcuta, located in the country's northeast, borders with Venezuela (DANE, 2005); and Pereira, located in western Colombia's coffee-growing region and has previously been shown to exhibit high rates of injection drug use (Berbesi, Segura-Cardona, Montoya-Vélez, & Mateu-Gelabert, 2013). Due to the lack of previous studies regarding HCV infection in PWID in Colombia, these cities were selected as the best

possible approach to develop evidencebased knowledge of HCV prevalence and risk factors of PWID across Colombia.

Sample and participant recruitment

Sample size was calculated using the formula for a proportion with an absolute precision of 5%, confidence level of 1-α = 95%, yielding a minimum sample size of 184 participants per city. All participants met the following inclusion criteria: being between 18 and 59 years of age; having actively injected any type of illegal drug during the previous 6 months; and providing signed informed consent.

Participants were recruited using Respondent Driven Sampling (RDS), a recruitment method used to evaluate hard-to-reach populations, such as PWID, which uses a coupon system with individual identifiers that allow tracing and linking of participants' existing social network in order to obtain a sample that approximates to the study population (McCreesh et al., 2013). This study followed the STROBE RDS checklist (White et al., 2015) to strengthen methodology and reporting of the results.

During the first phase of this study, we conducted exploratory street level fieldwork and established ties with PWID to identify scenarios (known locations where PWID congregate, shooting galleries, HIV clinics and other health services for drug users) and subjects (staff of non-profit drug user organizations, former drug users, government experts and drug researchers) that assisted in the search of seeds and the activation of social networks of PWID in each city. Subsequently, in each city, three PWID with diverse characteristics (age, gender, socio-economic status, potential PWID network) were selected, and acted as seeds from which recruitment chains were initiated by means of RDS coupons (three) given to each participant, until the required number of participants was reached. Each participant was given a primary monetary incentive for participating in the study ($4 USD), and up to three secondary incentives for each new successfully recruited participant ($5 USD).

Data collection

Data were collected using the applied and revised 2010 PWID instrument, which was previously used in two Colombian cities (Berbesi, Montoya, Segura, & Mateu-Gelabert, 2010), and was based on the instrument designed and developed in the year 2000 by the World Health Organization (WHO) in Bogotá, Colombia (Mejía & Gómez, 2005). This quantitative survey included general questions of the instrument (e.g. date, interview number, interviewer code), sociodemographic characteristics (e.g. age, gender, education level, social status, socio-economic level, source of income, years of consumption), as well as injection behaviours during the 6 months previous to the interview (e.g. sharing of mix, syringe, and ancillary injection equipment; use of water to clean previously used needle and syringes; obtaining drug dose from a drug mix shared by others; injection in indoor/outdoor injection gallery, being injected by someone that charges to inject, daily infection frequency, give or sale used syringes to another person, average number of persons with whom they inject).

In order to avoid bias, prior to data collection interviewers underwent proper training on data collection, and were additionally instructed, and provided with tools, to assist participants if

required. The interviewer met with each participant, and the protocol was initiated by confirming participant's eligibility and subsequent registration of his/ her RDS coupon. Following coupon registration, the informed consent was explained by interviewer, and approved and signed by subjects willing to participate in the study. Individuals not meeting all of the inclusion criteria were not included in the study. Finally, the survey was administered on an average time of 60 min, and four capillary blood samples were collected on site by trained healthcare personnel and placed on filter paper for subsequent HCV and HIV seropositivity analysis.

At the end of the interview, participants were informed by the interviewer of the possibility of voluntarily recruiting up to 3 more PWID, using referral coupons, explaining the relevance of their participation in the study, as well as the monetary incentives received for each successfully recruited participant.

Viral titres

Diagnostic HCV and HIV testing of the collected blood sample was performed by a clinical laboratory specialized in diagnosis of infectious diseases.

HCV was detected using indirect immunoenzymatic assay *Umelisa HCV*. Positive HCV antibodies were defined as obtaining a positive reaction in this assay, and could mean active (acute or chronic) or resolved infection. HCV negative samples were defined as obtaining no reaction in this assay.

HIV was detected using indirect immunoenzymatic assay *Umelisa HIV1 + 2* and western blot. Positive HIV status was defined as obtaining a positive result in 2 *Umelisa HIV1 + 2* assays that was confirmed by western blot.

Ethical considerations

The Ethics Review Committee of CES University approved this project. It was classified as minimal risk according to resolution 8430 of 1993 for clinical research in Colombia (Gobierno de Colombia, 1993). Participant's information, confidentiality, wellbeing, and integrity were respected throughout the duration of the study. In order to guarantee participant's information confidentiality, blood samples were identified with a code associated to each participant's interview, which allowed participant's identification for post-test counselling or referral to the national healthcare network for additional medical attention if necessary.

Statistical analysis

RDSAT® (Version 5.6) software was used to estimate the number of waves required to reach equilibrium for key demographic characteristics (age, gender, education, civil status, socioeconomic level, and total number of participants), as well as for homophily, and other RDS estimates that allow control of recruitment bias.

Initially, a description of characteristics and patterns of injection of PWID was performed. Contingency tables were designed to establish association between independent risk factors and the dependent variable (Positive HCV antibody test result). For statistical analysis, chi-

square and Fischer's exact tests were performed, and raw and adjusted odds ratios (OR) were calculated with a 95% confidence interval. Data loss was less than 10% for all variables; therefore, this information was not taken into account in the analysis.

For each city, a binary logistic regression model and a multivariate analysis were conducted. All tests were two-tailed, and a $p < 0.05$ was used as cut-off for statistical significance. Statistical analysis was performed using SPSS software (version 21.0; SPSS Inc., Chicago, USA).

Results

Recruitment

A total of 918 PWID from the four selected cities participated in the study. Eight waves were required to recruit 265 participants in Armenia; ten waves were required to recruit 193 participants in Bogotá; nine waves were required to recruit 210 participants in Cúcuta, and seven waves were required to recruit 250 participants in Pereira. Median network size, and network member range per city are shown in Table 1.

Based on homophily values in demographic characteristics and risky injection behaviours, bias in recruitment patterns were not identified. RDS adjusted estimates of key demographic characteristics were performed for each city. However, considering that the observed proportion and adjusted estimates were comparable, only unadjusted results were included in the analyses (Table 2). Given the differences identified on the results between each city's sample, data were analysed per city instead of a total sample.

Sociodemographic characteristics

The global estimated prevalence of HCV seropositivity in PWID was 27.3%, with the highest prevalence per city identified in Pereira (44.4%). On the other hand, lower prevalence of HCV seropositivity was found in Bogotá, Cúcuta, and Armenia, being 6.7%, 21.4% and 30.9%, respectively (Table 2).

Over half of the total sample (51.9%) was 25 years old or younger. Of all HCV seropositive PWID, 28.8% were 22 years old or younger, and 23.1% were between 23 and 25 years old; also, 86% of the HCV seropositive participants were male, 75.7% had low-income socio-economic level and 21.5% had higher education (technical, technological, or college-level studies).

Sociodemographic associations with HCV infection

In Pereira, an increased risk of HCV infection in PWID was identified by bivariate and multivariate analyses in PWID reporting 5 or more years of injection drug use (OR: 3.1, CI: 1.3–7.2; AOR: 3.0, CI: 1.7–7.8); An increased risk was also identified in Armenia in PWID reporting two to four years of injection drug use (AOR: 2.6, CI: 1.0–6.6). In addition, on the bivariate analysis, higher association with HCV seropositivity was found among PWID in Pereira who were between 21–24 years old (OR: 1.9, CI 1.2–6.9), and this risk increased in the 25–28 year-old group (OR: 3.2, CI: 1.3–7.9); These results remained statistically

significant on the multivariate analysis (AOR: 5.8, CI: 1.3–25.4; AOR: 5.2, CI: 1.0–26.3) (Tables 3 and 4).

Association of HCV infection and injection of drugs during the previous 6 months

Variables showing association with HCV infection in PWID presented differently among the four included cities (Tables 3 and 4). In Pereira and Armenia, high risk of being HCV seropositive was found for PWID who reported high injection frequency (4 or more times per day) (AOR: 2.0, CI: 1.1–3.6; AOR: 2.5, CI: 1.4–4.2). Interestingly, on Armenia's bivariate analysis, having injected at an indoor site to which people go to inject drugs was found to increase the risk for HCV seropositivity (OR: 2.2, CI: 1.1–4.6); However, this was not the case for Pereira where the same behaviour was associated with reduced risk for HCV seropositivity (AOR: 0.4, CI: 0.1–0.9).

Furthermore, on the bivariate analysis of Pereira, the odds of testing HCV positive increased with the increased frequency of using gifted, sold, or rented needles or syringes: weekly (OR: 2.2, CI: 1.1–4.4) and daily (OR: 3.9, CI: 1.7–8.7; AOR: 4.5, CI: 1.0–7.1). Moreover, other variables such as having used water to clean previously used needles and syringes in Pereira (OR: 2.1, CI: 1.3–3.6), and having been injected by someone that charges to inject drugs in Cúcuta (OR: 2.8, CI: 1.1–7.2) were associated with HCV seropositivity in the bivariate analysis, but did not reach statistical significance in the multivariate analysis.

HIV seropositivity in patients infected with HCV

In the bivariate analyses of Bogotá, Cúcuta, and Pereira we found HIV seropositivity as a high risk factor for HCV infection (OR: 6.3, CI: 1.1–36.5; OR: 13.5, CI: 3.4–52.3; OR: 2.7, CI: 1.0–6.9). However, this finding only remained statistically significant in Cúcuta's multivariate analysis (AOR: 16.9, CI: 3.5–81.5) (Table 3).

Discussion

This study was carried out in four cities in Colombia, one of the largest Latin American countries by surface area and population. We have characterized the association of HCV seropositivity and risky injection behaviours in samples of PWID residing in four of the largest cities in Colombia. While our results show on average a high prevalence of HCV seropositivity (27.3%) in our global population estimate, this is lower than that reported for other Latin-American countries such as Mexico, Brazil, and Argentina (Degenhardt et al., 2017; Nelson et al., 2011).

Importantly, prevalence of HCV seropositivity between cities presents a wide disparity. Despite being Colombia's capital city, and the most populated, Bogotá has the lowest prevalence of HCV. Moreover, Pereira and Armenia, present the highest HCV prevalence despite having smaller population size. A possible explanation for this finding might be related to the geographical location of Pereira and Armenia (located at the epicentre of Colombia's heroin distribution), which in turn indicates a longer presence of heroin local markets in those two cities. By 2008, Pereira had consolidated as the trafficking epicentre of heroin produced in Colombia and by 2014 reports indicated an oversupply in the local heroin market (Gobierno de Colombia, 2015). Also, the national study on psychoactive

substance use conducted in 2013, indicated Armenia and Pereira reported psychoactive drug consumption rates of 6.8% and 6.4% as compared to 3.5% in Bogotá (Gobierno Nacional de la Republica de Colombia, 2013); Moreover, the 2010 national study on psychoactive substance use indicated Pereira's population had a lifetime heroin consumption prevalence of 0.9% compared to the 0.2% national prevalence (Observatorio de Drogas del Eje Cafetero, 2010), and a prior National heroin consumption report evidences that, among the main Colombian cities, Pereira, Armenia, and Cúcuta have the highest daily injection frequencies, while Bogotá exhibited the lowest (Gobierno de Colombia, 2015).

There might be several factors accounting for the variations on HCV prevalence and injection risk behaviours among cities. It is worth noting that the size of PWID networks in each city varied. In Pereira, where the highest HCV seropositive prevalence was found, the median network size was 18 members. On the other hand, in Bogotá, where the lowest prevalence of HCV seropositivity was found, the median network size was 5 members. Also, Armenia and Cúcuta, which have higher HCV seropositive prevalence than Bogotá, presented high median network sizes. These observations are consistent with transmission model studies in which a greater number of contacts and injection partners was associated to reduced time to primary HCV infection (Hellard et al., 2014; Rolls et al., 2013; Vickerman, Martin, Turner, & Hickman, 2012) Thereby, future public policies and risk reduction efforts in Colombia should include network outreach approaches to reduce network related risk behaviours (Richard & Needle, 2005).

Additionally, even though statistically significant associations with HCV seropositive status were not established between socioeconomic status and higher education, these factors should be considered as part of the analysis. In Bogotá, 63% of the participants reported middle-high socioeconomic status, and 70.4% indicated having higher education, as opposed to Pereira, Armenia, and Cúcuta where only 5.6%, 15.2%, and 32.9% of the participants reported middle-high socioeconomic status, respectively, and 1.2%, 12.4%, and 15.5% indicated having higher education. These findings may suggest that PWID in Pereira, Armenia, and -to a lesser extentin Cúcuta, have limited access to self-care education, to knowledge on how to avoid risky injection behaviours, or may lack financial resources to acquire sterile injecting equipment for each injection episode, which could potentially increase their risk of HCV infection and transmission, and may account for the differences identified in our study. Thereby, the implementation of programs aiming to educate PWID on safe injection practices and harm reduction interventions, could potentially decrease their risk of HCV seropositivity.

In this study, we identified statistically significant associations between different PWID age ranges (21–24, and 25–28 years old) and HCV seropositivity in Pereira. Similarly, previous studies in Iran, and the United States (Chicago and Baltimore) reported older age to be associated with a greater risk of HCV infection (Boodram, Golub, & Ouellet, 2010; Zamani et al., 2010). Furthermore, some studies have reported that being 30 years of age or older is an independent risk factor for HCV infection (Huntington et al., 2010; Lopes et al., 2009). Significantly, around half of HCV seropositive PWID in our sample were 25 years old or younger, which is a younger age than that reported in several other studies (Hagan et al., 2007). Nonetheless, the fact that the PWID in the included cities are still young suggests that

there may be a window of opportunity to implement drug use-prevention and harm reduction strategies.

In agreement with previous studies (Holtzman et al., 2009; Miller, Hellard, Bowden, Bharadwaj, & Aitken, 2009; Reyes et al., 2006; Zamani et al., 2010; Zhang et al., 2013; Zhou et al., 2012), we found that PWID with history of injection drug use of two to four years in Armenia, and 5 or more years in Pereira, were at higher risk of being HCV seropositive. In the context of our sample, this finding should not be underestimated given the fact that around 54% of all PWID in our study reported a history of injection drug use of 4 years or less, suggesting that it's a population with short history of injection drug use. Thus, the timing for implementing policies and effective prevention plans aiming at reducing the risk of HCV transmission or infection, as well as its associated comorbidities, may still be appropriate for this population. Failing to implement preventive practices may lead to a considerable increased prevalence of HCV once PWID accumulate more than 5 years of injection drug use.

Our results indicate that, during the six months previous to the interview, a high frequency of daily injection was associated with being HCV seropositive in Armenia and Pereira. These results are consistent with previous studies in which an increased risk of HCV infection in PWID was associated to high frequency of injection (Boodram et al., 2010; Holtzman et al., 2009; Zhou et al., 2012). Moreover, the implementation of drug consumption reduction programs like opioid substitution therapy to decrease frequency of injection, could positively limit the rate of HCV infection and transmission in this at-risk population.

Interestingly, our results evidence that HCV seropositive PWID in Pereira were more likely to use water to clean needles or syringes, indicating that PWIDs might mistakenly think that rinsing syringes with water eliminates the risk of HCV infection, hence unknowingly placing themselves at risk. This result has two implications for prevention: a) the immediate need to expand HCV prevention knowledge among PWID; and b) the practice of cleaning syringes might indicate that, despite the very limited number of harm reduction services, PWIDs in some Colombian populations are actively engaged in efforts to reduce risk. Therefore, the fact that PWID are already trying, on their own, to reduce harm suggests that PWID may be responsive to harm reduction education.

Our research found the strongest association with HCV seropositive status in Cúcuta and Bogotá was being HIV seropositive. This result is in agreement with previous studies reporting a clear association of HCV infection in people infected with HIV (Bowring et al., 2013; Huntington et al., 2010; Rotman & Liang, 2009). This finding is explained by the fact that HCV transmission is more effective than that of HIV (Gerberding, 1995), and it requires less amount of infected blood in order to be infectious (Hagan et al., 2001). Also, Bogotá and Cúcuta have the smallest median network size and member network range, which might lead to more intimate social relationships among their members and facilitate that HIV seropositive PWID engage in unsafe injection risk and sexual behaviours among other HIV seropositive PWID of their own injection network, underestimating the risk of contagion and transmission of other infections such as HCV. Nonetheless, the percentage of HIV seropositive patients co-infected with HCV is lower than the rate reported by the countries

involved in the CAESAR study (Amin et al., 2004). This may be explained by additional variables not included in our study such as risky sexual behaviour, which in PWID is more strongly associated with HIV than with HCV (Shapatava, Nelson, Tsertsvadze, & del Rio, 2006).

One limitation of our study is that RDS is a non-random sample selection that must meet certain criteria to be considered as statistically representative in order to achieve results that are likely to approximate true prevalence. Therefore, to reduce possible bias, seeds were selected by means of an exploratory fieldwork that guaranteed an inclusive, heterogeneous, and diverse beginning of each of the recruitment chain. Additionally, resulting recruitment chains were extensive, allowing proper penetration into the target population. Even though trained personnel collected the data, the implemented survey included self-reports on injection episodes and risky behaviours, which may be affected by participants' honesty while answering. Furthermore, while in this study we quantified HCV antibody titres to indicate exposure to HCV (Amin et al., 2007), it is possible that some cases of HCV infection were still in the window period, and could thus not be identified (Bowring et al., 2013). Finally, as this is a cross-sectional study, causal relationships between the analyzed risk factors and HCV seropositivity cannot be established. Nevertheless, while future studies are needed in order to overcome the described limitations, our study provides initial findings regarding the situation of HCV in PWID in Colombia.

Conclusion

This study describes a high global prevalence of HCV seropositivity in PWID in Colombia. Furthermore, differences in prevalence and injection risk conducts were described by city. Moreover, in some of the cities, we identified an association of increased risk of HCV seropositivity in PWID of 21–28 years of age, history of injection drug use of 5 or more years, higher injection frequency (4 or more times daily); use of gifted, sold, or rented needles/syringes, and having used water to clean needles/syringes previously used by another person. In addition, in Cúcuta and Bogotá we found a significant association between being HIV seropositive and an increased risk of being HCV seropositive. While the overall HCV prevalence found in this study was lower than that reported for other Latin-American countries, the understanding and analysis of these results requires taking into account that compared to previous studies our study population was younger and had a shorter history of injection drug use.

Our overall results, and disparities in prevalence and injection risk patterns among city's samples, may serve as a starting point to design and implement high scale and broad coverage drug use prevention and risk reduction strategies such as risk reduction education campaigns, opioid substitution therapy, and syringe exchange programs (Abdul-Quader et al., 2013; Des Jarlais, Feelemyer, Modi, Abdul-Quader, & Hagan, 2013; Holtzman et al., 2009; Platt et al., 2017; Vickerman et al., 2012). The effective and timely implementation of these interventions according to each city's pattern of risk injection behaviours, along with integrated public health policies and educational programs that aim at expanding knowledge on safe injection practices to modify the causal chain of risk behaviours (Mateu-Gelabert et

al., 2014), could contribute to avoid an epidemic growth of HCV infection and its associated morbidities among Colombian PWID.

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Table 1

Recruitment waves by key demographics, median network size, and network member range across cities.

Demographic Characteristics		City			
		Armenia	Bogotá	Cúcuta	Pereira
Recruitment waves for reaching sample equilibrium Needed/depth)	Age	3/6	2/6	3/6	3/6
	Gender	2/6	2/6	2/6	4/6
	Education	3/6	3/6	3/6	2/6
	Civil status	3/6	3/6	2/6	4/6
	Socio-economic status	3/6	3/6	2/6	2/6
Recruitment waves needed to reach minimum sample		8	10	9	7
Number of participants (% Of total sample)		265 (28.8%)	193 (21.02%)	210 (22.8%)	250 (27.2%)
Median network size		55	5	10	18
Network member range		3−200	20-Feb	Mar-50	5−100

Table 2

Demographic characteristics of PWID population sample from four cities in Colombia (2014).

	Total sample			Armenia			Bogotá			Cúcuta			Pereira		
	n	*%*	*CI*	*C%*	*A%*	*CI*	*C%*	*A%*	*CI*	*C%*	*A%*	*CI*	*C%*	*A%*	*CI*
Age (Years)															
18 to 24	416	45.3	42.0–48.5	42	39.2	34.0–49.4	47	41.1	38.4–55.4	54.9	50.5	48.1–60.7	51	50.4	43.8–59.1
25 to 34	421	45.8	43.5–49.1	48	51.3	40.7–56.1	43.9	47.9	34.9–53.2	38.5	40	32–6-45.3	44	43.5	36–51.1
35 to 44	60	10.8	4.8–8.1	7.1	7.2	3.8–10.7	7	8.9	3.3–11.7	3.9	5.7	2.0–6.6	3.9	4.8	1.7–6.6
45 or more	21	2.2	3.4–6.3	2.9	2.3	0.7–5.8	2	2.1	0.4–4,6	2.7	3.8	0.9–4.7	1	1.2	0.0–2.4
Gender															
Male	785	86	83.7–88.3	87.3	87	82.3–92.8	70.2	73.9	62.3–78.7	91.4	93.3	87.0–95.5	85.3	86.6	80.7–91.0
Female	127	13.9	11.6–16.2	12.7	13	7.2–17.1	29.8	2.1	21.3–37.7	8.6	6.7	4.5–13.0	14.2	12.9	8.7–19.0
Civil status															
Single	704	78.6	75.9–81.3	76.2	73.4	70.6–81.8	80.5	82.5	72.7–88.1	82.7	80.5	77.3–88.2	87.9	87.2	84.6–92.9
Married / Domestic partnership	148	16.5	14.0–19.0	17.2	18.9	12.0–22.8	11.7	13.1	5.7–17.5	13.5	14.5	8.2–18.2	10.4	11.5	14-Jun
Separated / divorced	43	4.8	3.3–6.3	5.6	6.9	2.8–8.7	7.9	4.4	2.3–15.2	3.8	5	1.6–7.0	1.8	1.2	0–3.2
Socioeconomic level															
Low	692	75.7	72.8–78.5	84.8	83.3	78.8–89.1	41.8	33.2	33.1–48.4	67.2	70	60.9–73.1	94.4	93.5	91.3–97.1
Medium	205	22.4	19.6–25.1	14.2	15.2	9.6–19.8	52.8	45.5	45.7–62.2	31.3	28.6	25.3–37.6	4.9	5.2	2.3–8.0
High	17	1.8	0.9–2.7	1	1.5	0–3.4	5.4	1.4	1.4–10.4	1.6	1.4	0.0–3.6	0.7	1.2	0.0–1.6
Education															
Elementary school	78	8.5	6.6–10.4	11.4	10.9	6.7–16.3	1.2	1.2	0.2–2.9	71.6	72.1	65.6–78.5	7.7	9.7	4.4–11.8
High school	631	69.3	66.2–72.3	75.8	75.8	68.7–82.1	28.4	30.6	20.4–35.3	1.4	1.4	65.6–78.5	91.2	89.1	86.8–94.7
Higher education	196	21.5	18.8–24.2	12.4	12.8	7.7–18.5	70.4	67.4	63.3–78.5	15.5	25	19.0–31.1	1.2	1.2	0–2.6
None	5	0.5	0.1–1.2	0.4	0.4	0–1.2	–	–	–	1.5	1.4	0.0–3.3	–	–	–
HIV serologic status															
Negative	871	94.8	93.4–96.3	95.9	96.2	92.2–98.7	97	96.4	93.3–99.4	93.3	94.3	89.2–96.9	91.1	92.9	86.4–95.1
Positive	47	5.1	3.6–6.6	2.7	2.6	0.4–6.0	3	3.6	0.6–6.7	6.7	5.7	2.3–9.0	8.9	7.1	4.9–13.6
HCV serologic status															
Negative	667	72.6	69.7–75.5	69.1	64.9	64.9–80.3	92.4	93.3	86.7–96.8	79	78.6	73.6–84.3	55.6	53.7	45.0–61.4
Positive	251	27.3	24,4–30.2	30.9	35.1	25.1–36.6	6.7	7.6	3.2–13.3	21	21.4	15.7–26.4	44.4	46.3	38.6–55.0

C%: Crude percentage; A%: Adjusted percentage; CI: Confidence interval.

Table 3

Bivariate and multivariate analysis results for Armenia and Pereira.

		Armenia										Pereira									
		HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p	HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p
		Positive		Negative								Positive		Negative							
		n	%	n	%							n	%	n	%						
Demographic characteristics																					
Socioeconomic level	Low	66	80.5	153	83.6	0.8	0.4–1.5	0.53	0.6	0.3–1.5	0.38	103	92.8	130	93.5	0.8	0.3–2.3	0.81	0.7	0.2–2.6	0.62
	Medium-high	16	19.5	30	16.4	1.0			1.0			8	7.2	9	6.5	1.0			1.0		
Age	20 years old or younger	10	12.2	15	8.2	1.0			1.0			9	8.1	26	18.7	1.0			1.0		
	21 to 24 years old	26	31.7	53	29.0	0.7	0.2–1-8	0.51	0.5	0.1–1.7	0.33	46	41.4	45	32.4	1.9	1.2–6.9	0.01	5.8	1.3–25.4	0.01
	25 to 28 years old	21	25.6	50	27.3	0.6	0.2–1.6	0.34	0.8	0.2–2.5	0.70	36	32.4	32	23.0	3.2	1.3–7.9	0.01	5.2	1.0–26.3	0.04
	Over 28 years old	25	30.5	65	35.5	0.5	0.2–1.4	0.23	0.8	0.2–2.4	0.70	20	18.0	36	25.9	1.6	0.6–4.0	0.32	1.2	0.2–7.2	0.73
Years of injection drug use	1 or less	14	17.1	40	21.9	1.0			1.0			10	9.0	23	16.5	1.0			1.0		
	2−4	33	40.2	45	24.6	2.0	0.9–4.4	0.05	2.6	1.0–6.6	0.03	31	27.9	65	46.8	1.0	0.4–2.5	0.83	0.9	0.3–2.6	0.95
	5 or more	35	42.7	98	53.6	1.0	0.4–2.0	0.95	0.8	0.3–2.0	0.77	70	63.1	51	36.7	3.1	1.3–7.2	<0.001	3.0	1.7–7.8	0.02
injection behaviour during the previous 6 months																					
You have shared drug mix with another person, passing from one syringe to another	Yes	20	26.7	33	19	1.5	0.8–2.9	0.17	2.8	1.0–7.8	0.04	45	40.9	42	30.4	1.5	0.9–2.6	0.08	1.2	0.6–2.4	0.57
	No	55	73.3	141	81	1.0			1.0			65	59.1	96	69.6	1.0			1.0		
You have shared cotton, rinsing water, or spoons.	Yes	35	45.5	79	43.1	1.1	0.6–1.8	0.72	1.0	0.4–2.3	0.89	68	62.4	80	58	1.2	0.7–2.0	0.48	0.7	0.2–1.7	0.48
	No	42	54.5	103	56.9	1.0			1.0			41	37.6	58	42	1.8					
You have used water to clean needles and syringes previously used by another person	Yes	16	19.5	37	20.2	0.9	0.4–1.8	0.89	1.1	0.3–3.5	0.78	61	55	50	36	2.1	1.3–3.6	<0.01	1.1	0.3–3.8	0.78
	No	66	80.5	146	79.8	1.0			1.0			50	45	89	64	1.0			1.0		
You have obtained drug dose from a drug mix shared by others	Yes	15	19	35	19.4	0.9	0.4–1.9	0.93	0.5	0.1–1.8	0.35	59	53.6	64	46.4	1.3	0.9–2.2	0.25	1.2	0.5–2.8	0.57
	No	145	80.6	64	81	1.0			1.0			51	46.4	74	53.6	1.0			1.0		
You have injected at an indoor site to	Yes	68	86.1	132	72.9	2.2	1.1–4.6	0.02	2.2	0.9–5.4	0.07	83	75.5	113	81.9	0.6	0.3–1.2	0.21	0.4	0.1–0.9	0.03
	No	11	13.9	49	27.1	1.0			1.0			27	24.5	25	18.1	1.0			1.0		

		Armenia										Pereira									
		HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p	HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p
		Positive		Negative								Positive		Negative							
		n	%	n	%							n	%	n	%						
which people go to inject drugs																					
You have injected at an outdoor site to which people go to inject drugs	Yes	65	83.2	142	78.9	1.2	0.6–2.4	0.5	0.7	0.3–1.7	0.47	100	90.9	127	92	0.8	0.3–2.1	0.75	1.4	0.4–4.6	0.51
	No	14	17.7	38	21.1	1.0			1.0			10	9.1	11	8	1.0			1.0		
You have been injected by someone that charges to inject drugs	Yes	18	23.1	38	21	1.1	0.5–2.1	0.70	1.7	0.5–2.5	0.68	20	18.2	23	16.7	1.1	0.5–2.1	0.75	1.2	0.5–2.6	0.57
	No	60	76.9	143	79.0	1.0			1.0			90	81.8	115	83.3	1.0			1.0		
Number of times in the day you inject yourself	≥4	36	46.2	60	36.8	1.4	0.8–2.5	0.16	2.0	1.1–3.6	0.01	83	75.5	61	44.5	3.8	2.2–6.6	<0.001	2.5	1.4–4.2	0.001
	1–3	42	53.8	103	63.2	1.0			1.0			27	24.5	76	55.5	1.0			1.0		
You have gifted or sold a used syringe to another person	Yes	39	47.6	85	46.4	1.0	0.6–1.7	0.86	1.1	0.5–2.3	0.64	60	54.1	65	46.8	1.3	0.1–2.2	0.25	1.0	0.5–2.0	0.87
	No	43	52.4	98	53.6	1.0			1.0			51	45.9	74	53.2	1.0			1.0		
Frequency with which you have used needles or syringes gifted, sold or rented by another person	Monthly	14	17.3	35	19.6	0.8	0.6–1.7	0.54	0.4	0.1–1.3	0.16	21	19.1	25	18.1	1.8	0.8–3.3	0.15	1.8	0.5–6.5	0.32
	Weekly	4	4.9	15	8.4	0.5	0.1–1.6	0.29	0.3	0.0–1.8	0.20	25	22.7	22	15.9	2.2	1.1–4.4	0.02	2.0	0.5–7.1	0.25
	Daily	7	8.6	16	8.9		0.3–2.2	0.88	0.3	0.0–1.7	0.20	24	21.8	12	8.7	3.9	1.7–8.7	<0.01	4.5	1.0–7.1	0.04
	Not applicable	56	69.1	113	63.1	1.0			1.0			40	36.4	79	57.2	1.0			1.0		
HIV status																					
HIV serological status	Positive	4	4.9	3	1.6	3.0	0.6–14.0	0.14	1.1	0.1–6.9	0.89	14	12.6	7	5	2.7	1.0–6.9	0.03	2.7	0.9–8.5	0.07
	Negative	78	95.1	180	98.4	1.0			1.0			97	87.4	132	95	1.0			1.0		

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Table 4

Bivariate and multivariate analysis results for Cúcuta and Bogota.

		Cucuta										Bogota									
		HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p	HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p
		Positive		Negative								Positive		Negative							
		n	%	n	%							n	%	n	%						
Socioeconomic level	Low	33	73.3	114	69.1	1.2	0.5–2.5	0.58	1.2	0.4–3.3	0.66	7	53.8	86	47.8	1.2	0.4–3.9	0.6	2.6	0.5–12.0	0.21
	Medium-high	12	26.7	51	30.9	1.0			1.0			6	46.2	94	52.2	1.0			1.0		
Age	20 years old or younger	10	22.2	44	26.7	1.0			1.0			1	7.7	19	10.6	1.0			1.0		
	21 to 24 years old	15	33.3	37	22.4	1.7	0.7–4.4	0.21	2.5	0.7–8.4	0.13	2	15.4	58	32.2	0.6	0.0–7.6	0.73	1.8	0.0–56.3	0.71
	25 to 28 years old	8	17.8	31	18.8	1.1	0.4–3.2	0.81	0.6	0.1–3.2	0.63	7	53.8	45	25.0	2.9	0.3–25.7	0.32	8.8	0.3–206.2	0.17
	Over 28 years old	12	26.7	53	32.1	0.9	0.3–2.5	0.99	0.6	0.1–2.7	0.56	3	23.1	58	32.2	0.9	0.0–10.0	0.98	2.0	0.0–61.1	0.68
Years of injection drug use	1 or less	8	17.8	32	19.4	1.0			1.0			3	23.1	32	17.8	1.0			1.0		
	2−4	21	46.7	76	46.1	1.1	0.4–2.7	0.83	1.3	0.3–4.4	0.66	3	23.1	59	32.8	0.5	0.1–2.8	0.46	1.4	0.1–11.6	0.69
	5 or more	16	35.6	57	34.5	1.1	0.4–2.9	0.81	1.7	0.4–6.9	0.44	7	53.8	89	49.4	0.8	0.2–3.4	0.80	0.9	0.1–6.1	0.93
injection behaviour during the previous 6 months																					
You have shared drug mix with another person, passing from one syringe to another	Yes	10	25.6	30	19.5	1.4	0.6–3.2	0.39	1.1	0.2–4.6	0.86	1	7.7	45	25.9	0.2	0.03–1.8	0.17	0.1	0.0–1.7	0.12
	No	124	80.5	29	74.4	1.0			1.0			12	92.3	129	74.1	1.0			1.0		
You have shared cotton, rinsing water, or spoons.	Yes	17	38.6	47	29.7	1.4	0.7–2.9	0.26	1.6	0.5–4.9	0.33	7	53.8	101	56.1	0.9	0.2–2.8	0.87	0.9	0.2–4.5	0.17
	No	27	61.4	111	70.3	1.0			1.0			6	46.2	79	43.9	1.0			1.0		
You have used water to clean needles and syringes previously used by another person	Yes	10	22.2	33	20	1.1	0.5–2.5	0.7	1.9	0.1–20.8	0.59	2	15.4	27	15	1.0	0.2–4.9	0.97	2.1	0.2–22.9	0.52
	No	35	77.8	132	80	1.0			1.0			11	84.6	153	85	1.0			1.0		
You have obtained drug dose from a drug mix shared by others	Yes	8	18.6	30	18.4	1.0	0.4–2.4	0.97	0.5	0.1–2.6	0.48	9	69.2	113	63.5	1.2	0.3–4.3	0.67	3.0	0.6–15.7	0.17
	No	35	81.4	133	81.6	1.0			1.0			4	30.8	65	36.5	1.0			1.0		
You have injected at an indoor site to which people go to inject drugs	Yes	34	77.3	121	74.7	1.1	0.5–2.5	0.72	1.1	0.3–3.4	0.77	7	53.8	70	39.1	1.8	0.5–5.6	0.30	1.5	0.3–7.0	0.58
	No	10	22.7	41	25.3	1.0			1.0			6	46.2	109	60.9	1.0			1.0		

		Cucuta										Bogota									
		HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p	HCV antibodies				Raw OR	CI 95%	p	AOR	A CI 95%	A p
		Positive		Negative								Positive		Negative							
		n	%	n	%							n	%	n	%						
You have injected at an outdoor site to which people go to inject drugs	Yes	34	81	132	81.5	0.96	0.4–2.2	0.96	0.7	0.2–2.4	0.69	12	92.3	118	65.6	6.3	0.8–49.6	0.08	6.2	0.6–60.8	0.11
	No	8	19	30	18.5	1.0			1.0			1	7.7	62	34.4	1.0			1.0		
You have been injected by someone that charges to inject drugs	Yes	9	20.5	13	8.2	2.8	1.1–7.2	0.02	1.5	0.3–6.1	0.55	0	0	2	1.1	0.0	0.0	0.99	0.0	0.0	0.99
	No	35	79.5	145	91.8	1.0			1.0			13	100	178	98.9	1.0			1.0		
Number of times in the day you inject yourself	≥4	20	45.5	64	39	1.3	0.6–2.5	0.4	0.7	0.3–2.0	0.63	6	46.2	56	31.3	1.8	0.6–5.8	0.27	1.8	0.7–4.7	0.18
	1–3	24	54.5	100	61	1.0			1.0			7	53.8	123	68.7	1.0			1.0		
You have gifted or sold a used syringe to another person	Yes	18	40	60	36.4	1.1	0.5–2.2	0.65	1.4	0.5–3.7	0.44	5	38.5	93	51.7	0.58	0.1–1.8	0.36	0.4	0.0–1.9	0.27
	No	27	60	105	63.6	1.0			1.0			8	61.5	87	48.3	1.0			1.0		
Frequency with which you have used needles or syringes gifted, sold or rented by another person	Monthly	4	8.9	29	17.6	0.4	0.1–1.4	0.18	0.1	0.0–2-0	0.16	4	30.8	63	35	0.7	0.2–2.5	0.67	0.8	0.1–5.9	0.85
	Weekly	3	6.7	11	6.7	0.9	0.2–3.5	0.9	0.5	0.0–7.0	0.61	0	0	3	1.7	0.0	0.0	0.99	0.0	0.0	0.99
	Daily	4	8.9	8	4.8	1.7	0.4–6.0	0.39	1.5	0.1–22.9	0.75	0	0	5	2.8	0.0	0.0	0.99	0.0	0.0	0.99
	Not applicable	34	75.6	117	70.9	1.0			1.0			9	69.2	109	60.6	1.0			1.0		
HIV status																					
HIV serological status	Positive	9	20	3	1.8	13.5	3.4–52.3	<0.001	16.9	3.5–81.5	<0.001	2	15.4	5	2.8	6.3	1.1–36.5	0.03	17.4	0.9–316.5	0.05
	Negative	36	80	162	98.2	1.0			1.0			11	84.6	175	97.2	1.0			1.0		