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Prevalence of HCV Risk Behaviors Among Prison Inmates: Tattooing and Injection Drug Use

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Abstract

Hepatitis C virus (HCV) is the most common blood-borne chronic viral infection in the United States and it is over represented in incarcerated populations. This study estimates if in prison tattooing is associated with self reported HCV infection in a probabilistic sample of 1,331 sentenced inmates in Puerto Rico prisons anonymously surveyed in 2004, who had previously been tested for HCV. Analysis were carried out with the total sample and among non-injectors ($n=796$) to control for injection drug use (IDU) and other confounders. Nearly 60% of inmates had acquired tattoos in prison. HCV was reported by 27% of subjects in the total sample and by 12% of non-injectors who had undergone tattoos in prison. IDU was the strongest predictor of HCV in the total sample ($OR=5.6$, 95% $CI=3.2-9.7$). Among non injectors, tattooing with reused needles or sharp objects and/ or reusing ink was positively associated with HCV self-report ($OR=2.6$, 95% $CI=1.3-5.5$). Tattooing is a common occurrence in this prison setting. Findings suggest that preventive interventions are required to reduce the risk of HCV transmission through unsterile tattooing and injection practices.

Keywords

Hispanic; Latino; Puerto Rico; prison; HCV; BBVs; injection drug use; tattoo; prisoners; inmates; risk factors; hepatitis c; blood borne virus; IDU

Hepatitis C virus (HCV) infection has become a global disease.¹⁻³ Estimated to affect 3% of the world population (170 million people), it is one of the leading causes of chronic hepatitis, cirrhosis, and hepatocellular carcinoma.^{4,5} Although HCV infection is endemic worldwide, prevalence varies across countries⁶⁻¹⁴ with the highest prevalence reported in Africa, the Eastern Mediterranean, South-East Asia, and the Western Pacific (greater than 2.2%) and the lowest in Europe and North America (1.0%–1.7%).¹⁵

Hepatitis C virus infection is a preventable condition efficiently transmitted by blood through sources such as hemodialysis, organ donation, transfusion of blood products, and injecting drugs with contaminated equipment.^{1,16-18} Approximately 60% to 80% of the

HCV infections in industrial countries occur among injection drug users (IDU) through percutaneous exposure to infected blood.^{17,19–21} Hepatitis C virus may also be transmitted by other exposures such as tattooing in an unsafe environment; unprotected sex; use of intranasal cocaine; and risky ear-piercing in men.^{1,14,18,22–31}

Although HCV is the most common blood-borne chronic viral infection in the United States,^{8,18} vulnerable populations such as the homeless, injection drug users, and those in correctional institutions are disproportionately affected.^{32–39} Hepatitis C virus prevalence estimates for incarcerated populations range between two to 40 times greater than that estimated for the general population.^{14,23,32,34,40–42} For injection drug users (IDUs), imprisonment is a common event because of the illegality of their behavior in many countries and because many are forced to commit crimes against property to procure their drug of dependence. Studies report that between 56% and 90% of IDUs have been imprisoned.^{43,44,45,46}

According to data from the Bureau of Justice, in 2006, one in 100 U.S. adults lived behind bars,⁴⁷ and the majority of incarcerated adults eventually return to their communities. Prisons around the world are recognized as high-risk environments for transmission of blood-borne viruses (BBVs) and sexually transmitted infections.^{23,48–50} The overrepresentation of drug users in prison suggests that the disparity in HCV infection observed in this setting can be explained by the high risk of infection among drug users entering prison and/or incident cases occurring as a result of risky behaviors during imprisonment.^{51–55} The lack of preventive measures, such as clean syringes and condoms, plus the element of adverse social conditions under which drug use and other behaviors associated with percutaneous contact with blood (such as tattooing) take place, may account for incident cases.^{22,49,56–61} Studies have shown that inmates tend to engage in risky behaviors, such as drug use involving sharing contaminated injection equipment, unprotected sex with multiple partners, and unsafe tattooing practices.^{23,48,62–65} Emerging data suggest that HCV infection occurs in U.S. prisons.

Macalino and colleagues⁶³ demonstrated the association between IDU and HCV incidence among inmates in a U.S. correctional institution. While their study finds that IDU in prison is a risk factor for HCV incidence, they do not control for tattooing practices. The potential contribution of within-prison tattooing practices to HCV infection in U.S. penal institutions requires further exploration. A study conducted by Hellard and colleagues⁶¹ measured the prevalence and factors associated with HCV antibody-positive inmates in an Australian prison. Prisoners infected with HCV were more likely to have injected drugs prior to incarceration and to have continued their use while in prison. Hellard and colleagues also reported tattooing as being significantly associated with being HCV positive even when adjusting for other risk behaviors. Another study conducted in prison found that tattooing was the most likely mode of transmission of HCV among non-injectors.⁴⁸ The combinations of high risk behaviors (such as previous IDU or continued use during imprisonment) plus unsafe tattooing practices within prison, provide opportunities for the transmission of HCV and other BBVs.^{61,66}

On the other hand, confinement provides an opportunity for public health interventions that can reduce the risk of HCV transmission within and outside of the prison setting.^{40,67} The present study explores the prevalence and correlates of self reported HCV infection in a Latino prison population, including tattooing within prison. Latinos constitute 40% of the U.S. prison population.⁶⁸ To date, there has been limited information regarding the burden of HCV infection and its correlates among Latino inmates in U.S. correctional facilities. Attempts to understand the epidemiology of HCV transmission within correctional settings are necessary in order to design contextually appropriate and culturally sensitive interventions for health promotion and disease prevention that address risk behaviors for HCV transmission. The present study takes advantage of a system-wide HCV testing initiative conducted among inmates of the Puerto Rico prisons in 2003 and explores if tattooing within prisons is associated with self reported HCV infection. Use of self-report of HCV, based on previous testing, provides an opportunity to enhance our understanding of the epidemiology of HCV among inmates and enables us to explore the association of multiple risk factors for HCV infection in a U.S. prison population.

Methods

Sample and procedure.

This study uses data from a cross-sectional anonymous survey of sentenced inmates in the state prisons of Puerto Rico (PR) commissioned by the Puerto Rico Department of Correction and Rehabilitation conducted in 2004–2005 to assess drug treatment needs and inform health services planning.⁶⁹ The study sample consisted of 1,331 randomly selected sentenced inmates from 26 penal institutions, out of the 39 in the Puerto Rico prison system during 2004, representing 13% of the total sentenced inmate population.⁷⁰ Description of the sampling design has been previously reported.⁷¹

A complex probabilistic, multistage sampling design was developed based on four sampling stages. The first stage consisted of stratifying by type of institution (adult men, juvenile men, and women) that included all three institutions housing women and juveniles tried as adults. For the second sampling stage institutions were stratified based on the prevalence of positive urine for illegal drugs as reported by the prison authorities for the year preceding the initiation of the study and grouped in four categories (very high, 26%–50%; high, 15%–25%; normal, 1%–14%; and unknown) using as reference the prevalence of illicit drug use in the general population of Puerto Rico. For the third stage, institutions were further stratified by security level (maximum, medium, minimum, and admission center). If there were more than two institutions at a given security level, two were randomly selected, with probability of selection proportional to the institutions' population. Finally, for each of the 26 institutions selected and depending on their size, a random sample was obtained constituting 5% to 39% of the inmate population. Subject selection was carried out anonymously by the research team two days prior to initiating interviews. At each institution, one psycho-social staff member was assigned to collaborate with the researchers. Two days prior to the arrival of the research team a list without identifiers was generated with the sequence of numbers corresponding to the total number of inmates in the institution's census. Systematic sampling was used by the research team to select the

sample and prepare a final list with the selected numbers which corresponded to the location of the inmates in the census list. The staff member conveyed the invitation to attend the orientation that was provided by the research team. After the orientation, inmates orally consenting to participate were interviewed. Interview facilities provided privacy and protected confidentiality. A total of 1,179 individuals participated in the study, for an 89% response rate.

Two computerized interview modalities were used for data gathering: CAPI (Computer Assisted Personal Interview) and ACASI (Audio Computer Assisted Self Interview). Trained interviewers conducted the computerized personal interview and were available to answer questions during the self-administered interview. The study was reviewed and approved by the University of Puerto Rico Medical Sciences Campus Institutional Review Board, which included a prisoners' advocate.

Measures.

Self-report of HCV infection is the dependent variable. Although the gold standard for detection of HCV is the enzyme-linked immunosorbent assay (ELISA)–polymerase chain reaction (PCR) test,^{72,73} for the present study we used self-report of HCV (due to financial and time constraints). Given the anonymous nature of the study, it was not possible to obtain linked data from clinical records. The paucity of information on risk factors for HCV transmission within U.S. correctional institutions, particularly regarding the association of HCV infection and non-professional tattoos,⁷⁴ merits taking advantage of the opportunity provided in this study setting to link epidemiological data to self reported infection. Prevalence of HCV status was determined using the following question: *Are you currently infected or have you ever been infected with the Hepatitis C Virus?* Responses were categorized as *yes* or *no*.

Decision to rely on self-reported infection was based on the following evidence. Self-report of HIV infection, a highly stigmatized condition, has been found to be reliable in epidemiological and intervention studies.^{75–79} In a large multi-site study of young IDUs in metropolitan areas throughout the U.S. the predictive validity of HCV positivity was estimated as 94%.⁸⁰ The PR Department of Corrections conducted serologic tests for HCV in nearly all inmates in 2003 and informed them of results. A chart review in 2003 from a representative sample of the total inmate population in this system found a sero-prevalence of 33.9%.⁸¹ At the time of the interview for the present study the average number of years in prison was 3.64 while the median was 2, suggesting that a significant proportion of this study's population had been tested for HCV at least once during confinement.⁶⁹

Sociodemographic variables measured included gender, age, and educational level. Risk factors for HCV infection included: lifetime diagnosis of drug abuse/dependence measured with University of Michigan-Composite International Diagnostic Interview UM-CIDI, which is a modified version of the Composite International Diagnostic Interview (WHO-CIDI)^{82,83}; tattooing in prison (the variable was coded *yes* if the respondent had ever obtained one or more tattoos during incarceration regardless of ever having obtained a professional tattoo outside of prison, and *no* if respondents denied acquiring a tattoo ever or in prison or reported obtaining tattoos only outside of prison); and injection drug use in/out

of prison or both. IDU was recoded as yes/no since the majority of IDUs had injected both in and outside of prison. Tattoo risk behaviors included sharing of needles or sharp objects as well as re-using ink. Responses were coded as *yes* if one or both behaviors were reported and *no* if both of the behaviors were denied. Other covariates measured included lifetime blood transfusion and self-reported infection with HIV or HBV. Finally criminal justice variables included in the study are age at first incarceration and number of previous incarcerations.

Statistical analysis.

All statistical analysis were conducted using SUDAAN software release 10.0. Specialized software is needed because of the multistage complex design of the sample. For our analysis we took into consideration stratification of the primary sampling units (PSU), unequal weights and correlation between subjects induced by cluster sampling. Because of the large sampling fraction all statistics were estimated using a without replacement design using Taylor series linearization methods. For the statistical model we used logistic regression for correlated data which in SUDAAN would be analogous to Generalized Estimating Equations (GEE) for simple random samples with correlated data. All standard errors reported for the logistic regression are robust standard errors.

Two sets of analysis are reported, one with the total sample that includes injectors and non-injectors to assess if tattooing has an independent effect on HCV infection and a second set of analysis performed only on the sub-sample of subjects that included those reporting drug use but never injecting drugs as well as non-drug users (non-injectors). Frequencies and proportions are reported for categorical variables. For bivariate analysis, chi-squared was used as the measure to test the association of self reported HCV infection to hypothesized risk factors and other covariates of interest. Weighted percentages and 95% Confidence Intervals (CI) are presented. Finally, multiple logistic regression analyses were used to determine if tattooing in prison is associated with self-reported HCV infection when controlling for confounders. All predictor variables with a p value $< .05$ on tests of association were entered in the final models. The first multivariate model specified included the total sample to determine if tattooing in prison and IDU had independent effects on HCV infection when controlling for confounders. A second model was estimated only with the sub-group consisting of non-injectors to control for injection drug use. Adjusted odds ratios (AOR) and 95% confidence intervals were calculated and reported. Significance level for all analysis was established at $p .05$. Goodness of fit was estimated for the final regression model with non-injectors utilizing the Hosmer Lemeshow test.⁸⁴

Results

Table 1 shows frequencies and proportions for the sociodemographic characteristics, behavioral risk factors, incarceration history, and self-reported BBVs in the study population. Infection with hepatitis C was reported by more than one fourth of the subjects. All percents are weighted. Results show that more than three-fourths of the participants were male; half were aged between 25 and 34 years; and more than half had less than a high school education.

More than half of the sample fulfilled criteria for lifetime drug abuse/dependence. Regarding behavioral risk factors, ever injecting drugs was reported by more than one-third of participants. About one out of ten had received a blood transfusion during their lifetime.

Nearly 60% of inmates had acquired a tattoo in prison. The blood-borne virus with the second highest prevalence reported was hepatitis B (13.2%). Data on incarceration history reveals that nearly a third of respondents were younger than 18 years when they were first incarcerated, and more than-half had been incarcerated previously.

Table 1 also includes bivariate logistic regression analyses describing the association between HCV infection and sociodemographic characteristics, behavioral risk factors, self-reported blood-borne viruses, and incarceration history. The odds of reporting HCV infection was four times higher for participants age 35 or older. A large and positive association with HCV infection was found for IDU (Odds Ratio [OR] = 13.7), fulfilling a diagnosis of lifetime drug abuse/dependence (OR=8.5), reporting HBV (OR=9.3) or HIV (OR=10), and a history of previous incarcerations (OR=4.3). Acquiring tattoos in prison shows a moderate, positive association with HCV (OR=2.3).

Table 2 presents the results of multivariate logistic regression models exploring the association of tattoos in prison and HCV infection. The effect of tattoo in prison is modified by the inclusion of other confounders that reached statistical significance in tests of association with HCV and are also significant in the multivariate model (from an unadjusted OR=2.3, 95% CI=1.4–3.5 to an adjusted OR=1.7, 95% CI=1.1–2.7). These include HBV (OR=3.9, 95% CI=2.1–7.3), drug abuse/dependence lifetime (OR=3.0, 95% CI=1.7–5.2), previous incarcerations (OR=2.0, 95% CI=1.2–3.2), and age older than 36 years (OR=2.6, 95% CI=1.1–6.2). When IDU is entered in the third model (OR=5.6, 95% CI=3.2–9.7), tattoo in prison loses significance.

To clarify the association between tattoos in prison and HCV infection given the large proportion of IDUs that undergo tattoos, a second level of analysis was carried out using the sub-sample consisting only of non-injectors (n=796 or 65.2% of the sample). Table 3 presents the results of descriptive and bivariate analysis testing the association between risk factors and control variables with HCV infection among non-injectors. All proportions are weighted. Nearly half of non-injectors report obtaining a tattoo in prison and 16% of these had incurred in risky tattoo behaviors. Nearly 10% report ever receiving a blood transfusion, nearly 7% report infection with HBV and 2% with HIV. Almost 38% fulfill diagnostic criteria for drug abuse dependence and more than half have been incarcerated previously. Tests of associations indicate that risky tattoo behaviors have a significant effect on HCV infection (OR=3.14, 95% CI=1.6–6.2) whereas undergoing tattoo in prison is significant at a p value <.10 (p=.09). Significant associations are obtained with history of blood transfusions (OR=2.6, 95% CI=1.1–6.4), HBV (OR=4.9, 95% CI=2.0–12.2), lifetime diagnosis of drug abuse/dependence (OR=4.5, 95% CI=2.0–10), and previous incarcerations (OR=6.6, 95% CI=2.6–16.8).

A final logistic regression model was specified entering risky tattoo behaviors as the hypothesized independent variable controlling for all the confounders that attained

significant association with HCV in bivariate analysis. Incurring in at least one risky tattoo behavior is significantly associated with HCV infection with an adjusted OR of 2.6 (95% CI=1.3–5.5). Significant effects were also encountered for HBV, previous incarcerations, and a lifetime diagnosis of drug abuse/dependence. A Hosmer Lemeshow goodness of fit test was performed on this model which was non significant.

Discussion

The prevalence of HCV infection (by self-report) obtained in the total sample is 27% and nearly 10% among non-injectors. A population-based survey conducted in Puerto Rico that included HCV serologic tests estimated an HCV prevalence of 6.3% among 15–64 year old household residents.²⁹ This highlights the burden of HCV infection in the Puerto Rican correctional setting, which is consistent with results of studies that have assessed the disparities in HCV infection experienced by jail and prison inmates.^{6,48,63,85–91} The findings of this study reveal that HCV infection is associated with both tattooing risk behaviors in prison and injection drug use, the risk factor with the greatest effect on HCV self report. When controlling for injection drug use, a positive independent association of acquiring a tattoo in prison with self-reported HCV infection was encountered when tattoos are performed with shared needles, sharp objects and/or re-used ink. Using risk factors increases the magnitude of the OR of the association with HCV by nearly 50% when compared to that obtained when solely inquiring if the respondent has ever obtained a tattoo in prison. While drug injection is the most important risk behavior leading to HCV transmission, risky tattooing practices incurred in non-professional settings have been associated with transmission of HCV.²² The relationship between tattooing and HCV infection has been identified in studies among inmates of Norwegian and Australian prisons.^{92,93} Tattooing in prison occurs in a setting where IDU is known to take place and where a high proportion of inmates are already infected with HCV.^{50,61} In the present study nearly 60% of IDUs reported HCV infection and only 10% denied ever obtaining a tattoo. Of the remaining 90% with a history of tattoos, 74% had obtained a tattoo while in prison (data not shown). Although tattoos do not appear to be the primary source of HCV transmission, the high prevalence of HCV in prisons coupled with the frequency with which tattooing involving shared equipment occurs in this setting attest to the possibility of infection via this route. The moderate adjusted association encountered in this study could be due to a number of factors that include the contagiousness of HCV through needle pricks, the amount of bleeding encountered during the procedure, the prevalence of chronic infection in this population, and the probability that tattoo equipment and ink reservoirs become infected.⁹⁴ Prisons house primarily young males who are more likely than older males to acquire tattoos among which there will be a flow of susceptible individuals. These results suggest the need for additional research to understand the dynamics of the epidemic in prisons and identify public health interventions to reduce the potential for HCV transmission from tattoos performed in this context.

Butler and colleagues found that inmates with previous incarcerations were aware of the role of injecting drug use in HCV transmission, but had less knowledge (2%) about the association of unsafe tattooing practices and HCV infection.⁴⁴ We must recognize that tattooing among inmates is widespread and highly unlikely to cease; therefore there is an

urgent need for the introduction of effective preventive strategies. Our study did not explore the relationship between knowledge of HCV transmission and tattooing practices among inmates, but our findings suggest the need to explore this association in future studies to inform risk reduction practices.

Serving time in prison also increased the likelihood of HCV infection. Participants with previous incarcerations had a higher risk for HCV contagion. Koulierakis and colleagues found that for every year of imprisonment, the risk of injection in prison increases about 17%.⁹⁵ Butler and colleagues found similar associations between HCV infection and previous incarcerations.⁵⁰ More than two-thirds of our study population had been previously incarcerated and participants whose first incarceration occurred before they were 18 years old had a higher risk of HCV infection, which is similar to what has been previously reported.⁹⁶ Age is a relevant factor since it is typically associated with length of drug use, therefore increasing exposure to HCV.⁹⁷

Participants who had both HIV and HBV had a higher risk of HCV infection. This is due to the fact that there is a high degree of epidemiological similarity between these viruses regarding routes of transmission and associated risk factors.^{98,99} Additionally, participants in prison may engage in risky behaviors, which can increase the transmission rate of blood-borne viruses.¹⁰⁰ Cheng et al. found incarceration to be associated with a higher risk of injection initiation, because the initiation drug was associated with a larger likelihood of transition into injection,^{101,102} a situation that might increase the risk of HCV transmission. Finally, our data indicate that participants with a substance use disorder (lifetime drug abuse/dependence) had a higher risk of HCV infection. Substance use disorders are common among those who have HCV infection,^{103–105} and effective drug treatment is a recommended prevention measure in the criminal justice setting.³⁴

Prisons provide opportunities to reduce the extent of HCV transmission. Culturally sensitive drug treatment and education programs should be implemented in Puerto Rican prisons. These should include low-threshold services such as HCV counseling; needle and syringe exchange; distribution of cookers and other sterile injection equipment; voluntary HCV and HIV testing; HBV vaccination; medication-assisted treatment to those who are opiate dependent; and information and skills regarding safer injection drug use, and tattooing practices. Additionally, HIV testing should always be offered to people with HCV. Co-infection of HIV and HCV is associated with a greater risk of liver cirrhosis, a significant cause of death among individuals with chronic HCV.¹⁰⁶ Prevention services in prisons should be equivalent to those provided in the community. If needle exchange is not immediately possible in prisons, bleach or other disinfectants should be provided, alongside relevant training for prisoners and staff on proper sterilization techniques in order to reduce the risk of HCV. The recent lifting of the federal ban for the funding of needle exchange programs should help provide the conditions to extend this prevention service to the correctional setting.

This study has several additional implications for public health practices within penal institutions.^{23,28,40,41,48,51,54,66,86} Prisoner populations should be included in surveillance programs to provide a better estimate for HCV infection and other blood-borne viruses,

along with other conditions such as drug use and mental illness.^{3,6,63,85,91,107,108} The circulation of infected individuals between community and prison underscores the importance of developing inter-agency collaborative agreements that would help establish funding priorities to address the disease burden in the prison population.^{66,109–111}

Our study has several limitations. The primary study did not include measures of other risk behaviors associated with HCV infection that may be frequent in the correctional setting such as sharing personal hygiene or non-injection drug use equipment. In addition, risk factors for sexual transmission, although less effective, were not explored for lack of sufficient data. This could lead to an over estimation of the effect of prison based tattooing and HCV. The nearly 6% prevalence of HCV infection reported by non-injectors who deny ever acquiring tattoos suggests that these factors may be involved. The fact that the study population is almost entirely comprised of Puerto Ricans requires caution in extrapolating the findings to other U.S. prison populations.^{112,113} Nevertheless, Hispanics constitute a large proportion of incarcerated individuals in the U.S. (18% of all male inmates in custody in 2007¹¹² and 33% of federal inmates in 2011¹¹²) and a group that may be significantly at greater risk for prison acquired HCV through unsafe tattooing based on reports from community studies that find Hispanics more likely than non-Hispanic whites and African Americans to engage in this practice.^{114,115,116} The cross-sectional design precludes determining causality and only allows us to test associations between self-reported contagion and measured risk factors.

We also recognize the limitation raised by measuring HCV status using self-report. Additional data has emerged since we conducted the present study supporting the validity of self-reported HCV. Oglin and Schmit (2010) linked epidemiological and serologic data for HIV, HBV, and HCV in a survey with out of treatment drug users and found that specificity of self-reports was very high for HBV and perfect for HCV and HIV. HCV attained a sensitivity of 0.80 and a Kappa score between test and self-report of 0.65. In this study, biased estimates are likely to occur among those reporting that they are HCV negative, which would lead to an underestimation of associations between the various risk factors and HCV. These caveats notwithstanding, our findings behave in the direction reported by community studies of risk factors for HCV transmission.^{10,12,20,29} In a recently published meta analysis that evaluated risks related to tattooing and other risk factors of transmission of hepatitis C infection, the association of tattooing and hepatitis C from all studies was 2.74 (2.38–3.15) which is comparable to what is reported in the present study.⁷⁴ In addition, the difference in HCV prevalence estimates encountered in this study between injectors and non-injectors is comparable to other estimates reported with community samples.¹¹⁷ The magnitude of association assessed in this study of other risk factors for HCV behave in the expected direction. The fact that a population-wide HCV serologic study had been conducted two years prior to our interviews in the prison system should reduce the margin of error of negative reports. Admissions and releases occurring after the serologic study was undertaken as well as the likelihood that a fraction of tested individuals either did not receive their results or refused to disclose them, likely explain the discrepancy between the HCV prevalence reported by the Correctional Health Services and that assessed in this study. In spite of these limitations, this study contributes to the developing literature on HCV in U.S. correctional institutions and that which explores the association between tattoos and HCV.

The availability of a large and representative sample of a sentenced prison population within a U.S. jurisdiction and our ability to control in the analysis for whether tattooing occurred in prison or outside, where less risky professional tattooing is available, contributes to the identification of factors associated with HCV infection in criminal justice populations and supports the need to address transmission prevention within the correctional setting.

This study has several strengths. It was conducted with a random sample of sentenced inmates in the Puerto Rican Correctional System, which enables us to reduce biases associated with studies that are based on convenience samples; furthermore, we used interview techniques that encourage truthful responses.^{69,118–120} The risk factor of interest, in prison tattoos, was available for a large proportion of inmates. The sample included an adequate number of non-injectors engaging in tattooing within prison to explore the association between tattooing and HCV controlling for injection drug use. This minimizes incurring in a type two error which is likely to occur when the association between tattoos and HCV is tested in populations comprised primarily of injection drug users, as evidenced by the first regression model we estimated in this study using the total sample in which the effect of tattoo did not remain when IDU was entered. Lastly, it should contribute to raise awareness of the need to further explore and subsequently address HCV transmission through unsafe tattoos in the U.S. correctional setting which is currently not a HCV prevention priority.

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Notes

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Table 1.

DISTRIBUTION OF SAMPLE CHARACTERISTIC AND ASSOCIATION WITH HCV (N=1,168)

	Total Sample N=1,168	Self-reported Hepatitis C Virus status N=1,168	
	n (weighted%)	Yes n=317 n (weighted%)	Unadjusted Odds Ratio (95% Confidence Interval) p-value
Sociodemographic characteristics			
Gender			
Male	948 (97.1)	250 (26.9)	1.0
Female	220 (2.9)	67 (30.3)	1.1 (0.8–1.5)
			0.443
Age (years)			
18–24	273 (24.5)	36 (14.7)	1.0
25–34	559 (50.9)	157 (25.2)	1.9 (0.9–4.1)
			0.105
35 or more	336 (24.6)	124 (43.1)	4.3 (1.8–10.0)
			0.003
Education			
Less than high school	600 (50.8)	159 (27.8)	1.0
High school or more	568 (49.2)	158 (26.2)	0.9 (0.6–1.3)
			0.567
Behavioral Risk Factors			
Drug abuse/dependence diagnosis (lifetime)			
Yes	615 (53.3)	260 (43.6)	8.5 (4.8–15.1)
			<.001
No	553 (46.7)	57 (8.2)	1.0
Injection Drug Use Lifetime ^a			
Yes	368 (34.9)	237 (59.8)	13.7 (8.0–23.4)
			<.001
No	796 (65.1)	79 (9.6)	1.0
Tattoos			
None	508 (40.5)	84 (17.6)	1.0
In prison	660 (59.5)	233 (33.4)	2.3 (1.4–3.5)
			0.002
Blood transfusion (lifetime)			
Yes	120 (9.4)	39 (31.1)	1.2 (0.7–2.2)
			0.431
No	1048 (90.6)	278 (26.6)	1.0
Self-reported STD's and Blood-Borne Viruses			
Hepatitis B			
Yes	167 (13.2)	120 (71.0)	9.3 (5.3–16.6)
			<.001
No	1001 (86.8)	197 (20.4)	1.0

Total Sample N=1,168		Self-reported Hepatitis C Virus status N=1,168	
	n (weighted%)	Yes n=317 n (weighted%)	Unadjusted Odds Ratio (95% Confidence Interval) p-value
HIV ^b			
Yes	63 (5.1)	45 (76.4)	10.0 (4.1–24.2)
No	1102 (94.9)	271 (24.4)	<.001
Incarceration History			
Age first time incarcerated (years)			
Before 18	398 (36.0)	122 (28.6)	1.3 (0.7–2.3)
18–21	351 (32.5)	98 (28.5)	0.394
22 or more	419 (31.5)	97 (23.8)	1.3 (0.8–2.2)
Previous incarcerations ^a			0.311
None	423 (31.1)	51 (10.9)	1.0
Yes	743 (68.9)	265 (34.3)	4.3 (2.7–6.8)
			<.001

^aSample size variation due to missing data

Table 2.

ADJUSTED ODDS RATIOS (OR), 95% CONFIDENCE INTERVAL (CI), AND P-VALUES FOR HCV INFECTION (N=1,168)

	Adjusted Odds Ratio (95% CI) p-value		
	Model 1 ^a	Model 2 ^b	Model 3 ^c
Tattoo in prison			
Yes	2.3 (1.4–3.5)	1.7 (1.1–2.7)	1.3 (0.8–2.2)
	0.002	0.033	.232
No ^d	1.0	1.0	1.0
Age (years)			
18–24		1.0	1.0
25–35		1.6 (0.7–3.8)	1.5 (0.7–3.5)
		0.244	.303
36 or more		2.9 (1.2–6.9)	2.6 (1.1–6.2)
		0.023	.035
Blood transfusion (lifetime)			
Yes		1.0 (0.5–1.8)	1.2 (0.6–2.4)
		0.880	0.671
No		1.0	1.0
Hepatitis B Virus			
Yes		5.2 (2.9–9.3)	3.9 (2.1–7.3)
		<0.001	<.001
No		1.0	1.0
HIV			
Yes		3.8 (1.3–11.5)	2.2 (0.8–6.3)
		0.020	0.138
No		1.0	1.0
Previous incarcerations			
Yes		2.1 (1.3–3.4)	2.0 (1.2–3.2)
		0.005	.011
No		1.0	1.0
Drug abuse/dependence (lifetime)			
Yes		5.5 (3.1–9.6)	3.0 (1.7–5.2)
		<0.001	.002
No		1.0	1.0
Drug injection			
Yes			5.6 (3.2–9.7)
			<.001
No			1.0

^a Tattooing in prison only

^b Adjusted odds ratio without drug injection predictor

^c Adjusted odds ratio including drug injection predictor

^d Includes inmates who have never obtained a tattoo or that have only obtained a tattoo outside of prison

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Table 3.

DISTRIBUTION OF NON-INJECTORS CHARACTERISTIC AND ASSOCIATION WITH HEPATITIS C VIRUS (N=796)

Total non-injectors ^a N= 796		Self-reported Hepatitis C Virus status N=794	
	n (weighted%)	Yes n= 79 n (weighted%)	Unadjusted Odds Ratio (95% Confidence Interval) p-value
Tattoo in prison			
Yes	389 (51.0)	58 (12.8)	2.0 (0.9–4.7)
			.087
No ^b	407 (49.0)	21 (6.3)	1.0
Tattoo behaviors ^c			
Yes	127 (16.0)	34 (21.3)	3.14 (1.6–6.2)
			.003
No	669 (84.0)	45 (7.5)	1.0
Age (years)			
18–24	222 (27.9)	11 (5.2)	1.0
25–34	370 (46.5)	43 (10.0)	2.0 (0.7–5.8)
			.181
35 or more	204 (25.6)	25 (15.0)	3.1 (0.8–11.5)
			.086
Blood transfusion (lifetime)			
Yes	81 (9.6)	13 (19.3)	2.6 (1.1–6.4)
No	715 (90.4)	66 (8.6)	.038
Hepatitis B Virus			
Yes	53 (6.7)	18 (32.4)	4.9 (2.0–12.2)
			.003
No	743 (93.3)	61 (8.4)	1.0
HIV ^d			
Yes	17 (2.0)	5 (36.0)	5.0 (0.9–28.4)
			.070
No	777 (98.0)	74 (9.4)	1.0
Drug abuse/dependence diagnosis (lifetime)			
Yes	302 (37.9)	50 (18.8)	4.5 (2.0–10.0)
			.002
No	494 (62.1)	29 (4.5)	1.0
Previous incarcerations			
Yes	444 (60.7)	68 (14.3)	6.6 (2.6–16.8)
			.001
No	351 (39.3)	11 (2.4)	1.0

^aIncludes drug users who deny ever injecting drugs as well as non-drug users

^bIncludes inmates who have never obtained a tattoo or that have only obtained a tattoo outside of prison

^cIncludes sharing ink and/or sharing needles or other sharp objects

^dSample size variation due to missing data

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Table 4.

LOGISTIC REGRESSION MODEL FOR HEPATITIS C VIRUS INFECTION AMONG NON-INJECTORS^a
(N=793)

Adjusted Odds Ratio (95% Confidence Interval) p-value		
Risky tattoo behaviors ^b		
None	1.0	
At least one	2.6 (1.3–5.5)	.015
Age (years)		
18–24	1.0	
25–35	1.7 (0.6–5.3)	.298
36 or more	2.6 (0.7–10.2)	.146
Blood transfusion (lifetime)		
Yes	1.9 (0.7–4.8)	.168
No	1.0	
Hepatitis B Virus		
Yes	2.8 (1.3–6.3)	.015
No	1.0	
HIV		
Yes	1.5 (0.4–5.5)	.538
No	1.0	
Previous incarcerations		
Yes	4.5 (1.7–12.3)	.007
No	1.0	
Drug abuse/dependence (lifetime)		
Yes	3.0 (1.3–6.8)	.015
No	1.0	

^aIncludes drug users who deny ever injecting drugs as well as non-drug users

^bIncludes sharing ink and/or sharing needles or other sharp objects