Published in final edited form as:

J Drug Issues. 2009 September ; 39(4): 893–904.

Prevalence and correlates of Hepatitis C among injection drug users: The significance of duration of use, incarceration and race/ethnicity

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Abstract

The study examined associations between Hepatitis C (HCV) seropositivity and a lifetime history of jail or correctional facility incarceration among injection drug users. The sample consisted of 351 injection drug users recruited in inner-city neighborhoods of Baltimore. Multiple logistic regressions were fit to assess associations between HCV seropositivity and a lifetime history of incarceration for the total sample and stratified by race. Analyses demonstrated HCV nearly two times greater for whites than African Americans. In addition, HCV was 2.6 times greater in participants incarcerated in correctional facilities and HCV was 7.4 times greater in participants reporting more than 5 years of injection drug use compared to participants reporting less than 1 year of injection drug use. The study findings suggest that incorporating systematic HCV screening, prevention, and treatment programs within correctional systems represents a vital yet underutilized strategy to reduce HCV transmission in society as a whole.

Keywords

Hepatitis C; HCV prevalence; drug use; incarceration; jail; correctional facility; race; ethnicity; ethnic differences

Introduction

In the United States, estimates of hepatitis C virus (HCV) infection among the general population range between 2.7 million and 3.9 million making HCV the most common blood borne infection among Americans. A number of studies have identified parental, sexual, and other drug-related risk factors associated with HCV infection. Risk factors deemed to be associated with HCV infection include: injection drug use, sexual contact, tattooing and ear piercing, intranasal cocaine use, organ transplantation, and occupational exposure to blood among health care workers (Alter and Mast 1994; Centers for Disease Control and Prevention 1991; Holsen et al., 1993; Murphy et al., 2000; Nowicki et al., 1994; Ruiz et al., 1999; Villano et al., 1997).

Not surprisingly, recent studies have identified heightened HCV seropositivity among incarcerated populations presumably, as risk behaviors associated with transmission are also associated with incarceration (Macalino et al., 2005; Macalino et al., 2004; Solomon et al.,

2004). Epidemiologic studies estimate HCV prevalence among inmates in the United States to be between 16% and 41% (Macalino, et al. 2005; Macalino, et al. 2004; Reindollar 1999; Solomon, et al. 2004; Vlahov et al., 1993). Additionally, more-than 7 million inmates of U.S. jails and correctional facilities are released annually (Hammett et al., 2002). When considered in light of the substantial numbers of inmates who are returned to society each year, many of whom are likely to be infected with HCV, the social and economic costs associated with the continued absence of systematic HCV screening, prevention, and treatment efforts in correctional settings is evident.

While there is a growing base of research describing heightened HCV prevalence among incarcerated populations, few studies have examined associations between HCV infection and incarceration among drug using populations. For example, extant research has not evaluated the extent to which differing levels of incarceration, such as short-term jail stays versus longer-term incarceration in correctional facilities and prisons, are associated with variations in HCV prevalence. Such information may help to improve efforts to develop and implement infectious disease prevention and treatment programs within correctional systems. A related gap in the literature concerns racial/ethnic differences in HCV prevalence. General population studies have shown HCV prevalence among African Americans to be higher than that of whites (Fleckenstein 2004; Pyrsopoulos and Jeffers 2007; Rawls and Vega 2005). However, three studies conducted with inmates in Texas (Baillargeon et al., 2003), Maryland (Solomon, et al. 2004), and California (Ruiz, et al. 1999), each found HCV prevalence to be highest among whites.

This study initially examined associations between HCV prevalence, racial/ethnic status, and incarceration history among injection drug users. Secondly, we sought to examine whether relationships HCV infection and incarceration history would differ between African American and white injection drug users.

Methods

The present study sample was collected as part of the United States (U.S.) site of the NEURO-HIV Epidemiologic Study, an epidemiological examination of neuropsychological, social, and behavioral risk factors of HIV, and hepatitis A, B, and C among injection and non-injection drug users with sites in the U.S., South Africa, and Russia. To be eligible for the study, participants had to report using injection or non-injection drugs during the previous 6 months, and be aged 15-50 years. Non-injection drug users were not included in the present study, because HCV seroprevalence in this population was low. Additionally, because we sought to examine associations between HCV seropositivity and incarceration status stratified by race/ethnicity, the present study sample was limited to African American and white participants and did not include subjects of Hispanic, Asian, Native American, or mixed race ethnicities (N = 18). The resulting study sample of 351 injection drug users was comprised of African American (N = 136; 38.8%) and white (N = 215; 61.2%) participants with 60.4% (N = 212) of the sample being male. Further summarizations of sample characteristics are in Table 1.

Full approval of the study protocol by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board in 2001 has since received annual reviews and approval. Expert clinicians who underwent extensive training, including formal course work in HIV epidemiology and prevention, seminars on psycho-diagnostic and neuropsychological assessment, and weekly team meetings and supervision, conducted all participant interviews and counseling sessions.

Participant Sample Selection

Enrollment included multiple recruitment strategies: street outreach, advertisements in local newspapers, outreach at local needle exchange sites, as well as referrals from enrolled participants, and social service agencies. Informed consent obtained at the outset of the baseline assessment also addressed permission for follow-up contacts. Participant incentives included \$45 for the baseline assessment, \$10 for locator visits, and \$55 for follow-up assessments.

Data Collection

The baseline assessment was comprised of a standardized face-to-face HIV-Risk Behavior Interview, a battery of neuropsychological tests focusing mainly on executive functions, attention, and general intellectual functioning, a blood draw, and urine sample collection. Tests of HIV, hepatitis A, hepatitis B, and hepatitis C used blood samples drawn by expert phlebotomists. Urinalysis tested for recent use of cannabinoids, opiates, cocaine, amphetamine, methamphetamine, methadone, PCP, barbiturates, benzodiazepines, tricyclic antidepressants, MDMA, and oxycodone. Risk-reduction counseling provided to participants was pertinent to HIV/AIDS, viral hepatitis, and other STDs as well as referral information to community-based drug treatment and social services.

Measures

The HIV-Risk Behavior Interview was originally adapted from a similar interview used for the REACH study. The interview consisted of questions on demographics and medical, educational, and neurodevelopment histories, including STDs, and detailed behavioral information about drug use, sexual practices, social networks, and community violence (Strathdee and Sherman 2003). Demographic variables collected via self-report included gender, age, education and race. Participants self-reported their race/ethnicity and were categorized as African American; Asian or Pacific Islander; Hispanic or Latino; Native American; white; or multiple racial backgrounds.

Derived categories of educational level included participants who had some high school, a general equivalency degree (GED), a high school diploma, or some college experience with participants having no high school education as the referent group. The interview obtained data on lifetime incarceration status, distinguishing between jail incarceration and incarceration in correctional facilities or prisons. Typically, the length of a jail stay in Maryland during the study period was between one and 30 days, while the length of stay in a correctional facility or prison was typically for a period of months or longer. Further variables of interest included duration of injection drug use, which was also collected via self-report. Participants were grouped into 3 categories of injection drug use duration: less than 1 year of use, 1-5 years and greater than 5 years of injection drug use (Galeazzi et al., 1995; Garfein et al., 1996; Hagan et al., 2007).

HCV Antibody Testing

Tests of blood specimens used Ortho-Clinical Diagnostics Inc. HCV Version 3.0 ELISA Test System, an enzyme-linked immunosorbent assay for the detection of antibodies to hepatitis C Virus (Anti-HCV) in human serum and plasma samples. The Ortho® HCV V 3.0 ELISA Test System used recombinant antigens provided by Chiron Corporation.

Statistical Methods

Statistical analysis included the sample of 351 injection drug users who reported African American or white racial/ethnic status. Initially, the association between HCV seropositivity, sociodemographic, injection drug duration and incarceration status variables was evaluated using the total sample. Use of descriptive statistics identified proportions of the sample that

tested positive for HCV across the levels of each sociodemographic and incarceration status variable. Analyses of associations included comparisons of participants reporting a lifetime history of jail incarceration only, participants reporting a history of correctional facility/prison incarceration and participants reporting no history of incarceration using simple logistic regressions to compute unadjusted odds ratios.

Multiple logistic regression models were subsequently fit to assess associations between HCV seropositivity, race/ethnic status, and incarceration status with adjustment for gender, age, education and duration of injection drug use. Further, a race/ethnicity stratified analysis examined simple and multiple associations between HCV seropositivity and incarceration status for African American and white participants, separately. All statistical analyses were computed using SAS version 9.1 (SAS 9.1 2002-2003).

Results

Eighteen percent (N = 64) of participants reported no lifetime history of any incarceration, 49% (N = 172) reported jail incarceration only in their lifetime, and 33% (N = 115) reported correctional facility incarceration in their lifetime. Among the 115 participants reporting correctional facility incarceration in their lifetime, 92% (N = 106) also reported a history of jail incarceration. All participants reported injection drug use with 55% (N=192) of the sample reporting greater-than 5 years of use. Seventy-six percent of participants reported that heroin by itself was their drug of choice while 9% reported speedball and 6% reported cocaine by itself as their drug of choice. Ninety seven percent of participants reported injecting heroin in their lifetime, 78% reported injecting heroin in the past 6 months. Seventy three percent of participants reported injecting speedball in their lifetime, 49% reported injecting speedball in the past 6 months. Seventy three percent of participants reported injecting cocaine in their lifetime, with 49% reported injecting cocaine in the past 6 months. Approximately one-quarter (N=90; 26%) of participants reported graduating high school with most (40%) participants reporting having some high school education.

Table 1 summarizes the distributions of incarceration and demographic variables and their associations with HCV prevalence. The unadjusted results indicate that when compared against drug users having no high school education, graduating from high school [odds ratio (OR)=0.3, 95% CI=0.1, 0.9] and having some college experience (OR = 0.2, 95% CI = 0.1-0.6) produced a protective effect against HCV infection. Without adjustment, the prevalence of HCV was significantly greater among injection drug users with a history of correctional facility incarceration (83%) (OR = 2.9, 95% CI = 1.5-5.9) when compared to drug users with no lifetime incarceration (61%). Also without adjustment, duration of injection drug use was highly associated with HCV status. Specifically, participants reporting one-to-five years of injection drug use were twice as likely to test positive for HCV (OR = 2.2; 95% CI= 1.2, 4.3) compared to participants reporting less than 1 year of injection drug use. The odds of HCV were greater for participants reporting greater than 5 years of injection drug use (OR=7.6, 95% CI= 4.1, 14.3).

Adjusting for gender, age, education, lifetime incarceration status and injection drug duration, whites were twice as likely to test positive for HCV when compared to African Americans [adjusted odds ratio (AOR) = 2.0, 95% CI = 1.0-3.9]. The significance of the association between a correctional facility stay and HCV infection was maintained with adjustment (AOR = 2.6, 95% CI = 1.2, 6.1). Additionally, when compared against drug users having no high school education, having some college experience (AOR = 0.3, 95% CI = 0.1-1.0) produced an independent protective effect against HCV infection.

Analysis Stratified by Race/Ethnicity

Only duration of injection drug use remained statistically significant among African Americans after adjusting for all other covariates in the multiple logistic regression model. Compared to African American participants who reported less than 1 year of drug use, participants who reported greater than 5 years of injection drug use were about 13 times more likely to test positive for HCV (AOR = 13.3; 95% CI= 4.5, 39.5) adjusting for gender, age, education, and lifetime incarceration.

Though not identical, the pattern of results among Caucasian participants was similar to that of the entire sample (Table 2). Namely, when compared against Caucasians having no high school education, having some college exhibited significantly lower HCV infection prevalence. Correctional facility stay and longer duration of injection drug use in both the unadjusted and adjusted models were associated with higher HCV prevalence. In adjusted models, injectors with a history of correction facility stay were nearly 15 times more likely to test positive for HCV when compared to injectors with no history of incarceration (AOR = 14.7; 95% CI= 2.9, 79.5). Drug users with five-or-more years of injection were nearly five times more likely to test positive for HCV when compared to drug users with less-than one year of injection drug use (AOR=4.6, 95% CI=1.8, 12.0).

Discussion

Our study found an overall prevalence of HCV infection of 69.2% among a population of injection drug users residing in Baltimore city. Notably, significant variations were found in HCV prevalence when duration of injection drug use, incarceration status and racial/ethnic status were taken into account. Approximately, 65% of African American injection drug users with no history of incarceration were seropositive for HCV. Sixty-three percent of African American injection drug users with a history of jail incarceration only tested positive for HCV. Seventy-two percent of African American injection drug users with a history of correctional facility incarceration tested positive for HCV. Among white injection drug users, 96% with a history of correctional facility incarceration tested positive for HCV. Sixty-four percent of white injectors with a history of jail stay only, and 59% of white injection drug users with no lifetime history of incarceration tested positive for HCV.

Consistent with previous research with drug using and incarcerated populations, whites in our study were significantly more likely than African Americans to test positive for hepatitis C when controlling for potentially influential covariates such as duration of injection drug use (Baillargeon, et al. 2003; Ruiz, et al. 1999; Solomon, et al. 2004). Our study findings are also consistent with a large base of research documenting high rates of HCV among incarcerated populations (Macalino, et al. 2005). The overall rates of HCV prevalence associated with various levels of incarceration found in our study are higher than rates of HCV found in extant studies of general populations of incarcerated adults where rates of HCV prevalence ranged from 16% to 41% (Macalino, et al. 2005; Macalino, et al. 2004; Reindollar 1999; Solomon, et al. 2004; Vlahov, et al. 1993).

Previous studies examining HCV prevalence among inmate populations also have not differentiated between levels of incarceration. As anticipated, HCV prevalence among injection drug users with a history of correctional facility incarceration was significantly higher than drug users with no history of incarceration for whites but not African Americans. For both whites and African Americans, HCV prevalence among drug users with a history of jail incarceration was similar to those with no incarceration history.

Given research conducted in the general population that has shown African Americans to be at greater risk to contract HCV than whites, the higher prevalence of HCV among incarcerated

whites than among incarcerated African Americans is noteworthy. The differing base rates of incarceration among African Americans and whites in the United States could be a possible explanation for this finding. It is well documented that the U.S. incarcerates a higher proportion of its citizens at a rate 5-8 times that of other industrialized nations (Harrison PM 2003; Thomas and Sampson 2005). The rate of incarceration in the United States has increased by more-than 200% during the past 20 years attributable mainly to a growth in the prosecution of drug-related offenses (Macalino, et al. 2005). Further, while African Americans comprise 12.3% of the population, they comprise 43.7% of incarcerated individuals (Bonczar and Beck 1997; Braithwaite and Arriola 2003). Equally alarming is the one-in-eight rate of incarceration among African American males aged 25-29 years (Bonczar and Beck 1997). To the extent that incarceration is less likely for whites than African Americans for drug-related offenses, whites who serve sentences may have higher levels of drug use, infectious disease and pathology than incarcerated African Americans. The stratified findings also have relevance to the prevention of HCV among African American and white populations of drug users. Consistent with extant studies, longer duration of injection drug use was associated with HCV prevalence among African Americans and whites (Hagan, et al. 2007).

Consideration of several limitations of this study is now considered. Notably, despite being of comparable size to several studies of adult injection drug users, the sample was relatively small particularly with respect the stratified analysis for some variables. Additionally, sufficient representation of ethnic/racial groups other than African American and white in the study sample did not allow for generalization to other ethnicity groups. Further, the cross sectional data utilized in the present study limits the capacity to infer causal relationships. Future studies will need to evaluate the present study findings in light of incidence data that provide a more precise measure of the nature of an epidemic. Despite these important limitations, the present study design and sampling method provide contributions to the HCV literature particularly with respect to insights into possible foci of prevention programs targeting African American and white drug users.

Correctional systems throughout the United States do not incorporate systematic HCV screening or prevention programs for inmates (Braithwaite and Arriola 2003; Hammett, et al. 2002). A growing base of empirical research strongly suggests that the absence of such programming represents a lost opportunity to improve public health within society as a whole as well as among inmates and those released from incarceration. When an estimated 30% to 90% of drug users with a history of incarceration are seropositive for HCV, the utility of providing systematic screening and prevention efforts within jails and correctional facilities is clear. The significance of such programming for the prevention of subsequent HCV transmission in the general population is necessary when considered in light of the estimated 7 million inmates released from jails or correctional institutions annually.

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TABLE 1
Associations of HCV infection among injection drug users, Baltimore, 2001-2004

Variable	N (%) or Mean (SD)	HCV Positive (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender				
Male	212 (60.4)	69.3	1.0	1.0
Female	139 (39.6)	69.1	1.0 (0.6, 1.7)	1.4 (0.8, 2.4)
Age	32.0 (7.3)	NA	1.1 (1.0, 1.3) [†]	1.0 (0.8, 1.2) [†]
Ethnicity				
African American	136 (38.7)	67.7	1.0	1.0
Caucasian	215 (61.3)	70.2	1.2 (0.7, 1.9)	2.0 (1.0, 3.9) [*]
Education				
No high school	37 (10.5)	83.8	1.0	1.0
Some high school	140 (39.9)	73.6	0.5 (0.2, 1.4)	0.7 (0.3, 2.0)
GED	37 (10.5)	78.4	0.7 (0.2, 2.3)	1.0 (0.3, 3.6)
High school graduate	90 (25.7)	61.1	0.3 (0.1, 0.9) [*]	0.5 (0.2, 1.5)
Some College	47 (13.4)	53.2	0.2 (0.1, 0.6) ^{**}	0.3 (0.1, 1.0) [*]
Lifetime Incarceration				
No Incarceration	64 (18.2)	61.0	1.0	1.0
Jail only	172 (49.0)	63.4	1.2 (0.6, 2.1)	1.2 (0.6, 2.3)
Correctional facility	115 (32.8)	82.6	2.9 (1.5, 5.9) ^{**}	2.6 (1.2, 6.1) [*]
Injection Drug Status				
< 1 Year of Injection	70 (19.9)	40.0	1.0	1.0
1-5 Years of Injection	89 (25.4)	60.7	2.2 (1.2, 4.3) [*]	2.0 (1.0, 3.9)
>5 Years of Injection	192 (54.7)	83.9	7.6 (4.1, 14.3) ^{**}	7.4 (3.7, 14.8) ^{**}

AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

[†] Age was divided by 5 for the logistic regression analysis; therefore, odds ratios are interpreted for 5 year increments

^{*} $p < .05$,

^{**} $p < .01$

TABLE 2
Associations of HCV infection among injection drug users by ethnicity, Baltimore, 2001-2004

Variable	African American (N=136)			Caucasian (N=215)		
	N (%) or Mean (sd)	HCV + (%)	OR (95% CI)	HCV + (%)	OR (95% CI)	AOR (95% CI)
Gender						
Male	69 (50.7)	65.2	1.0	71.3	1.0	1.0
Female	67 (49.3)	70.2	1.3 (0.6, 2.6)	68.1	0.9 (0.5, 1.8)	1.6 (0.8, 3.4)
Age	36.6 (5.4)	NA	1.3 (0.9, 1.8) [†]	NA	1.2 (1.0, 1.5) [†]	1.0 (0.7, 1.3) [†]
Education						
No high school	10 (7.3)	90.0	1.0	81.5	1.0	1.0
Some high school	50 (36.8)	68.0	0.2 (0.1, 2.0)	76.7	0.7 (0.2, 2.2)	1.3 (0.4, 4.4)
GED	13 (9.6)	69.2	0.3 (0.1, 2.7)	83.3	1.1 (0.3, 4.8)	2.1 (0.4, 10.2)
High school graduate	44 (32.4)	65.9	0.2 (0.1, 1.9)	56.5	0.3 (0.1, 1.1)	0.6 (0.2, 2.3)
Some College	19 (13.9)	57.9	0.2 (0.1, 1.5)	50.0	0.2 (0.1, 0.8) [*]	0.4 (0.1, 1.5)
Lifetime Incarceration						
No Incarceration	20 (14.7)	65.0	1.0	59.1	1.0	1.0
Jail only	51 (37.5)	62.8	0.9 (0.3, 2.7)	63.6	1.3 (0.6, 2.7)	1.4 (0.6, 3.2)
Correctional facility	65 (47.8)	72.3	1.4 (0.5, 4.1)	96.0	15.6 (3.3, 72.6) ^{**}	14.7 (2.7, 79.5) ^{**}
Injection Duration						
< 1 Year of Injection	26 (19.1)	26.9	1.0	47.7	1.0	1.0
1-5 Years of Injection	19 (14.0)	47.4	2.4 (0.7, 8.5)	64.3	1.8 (0.8, 4.0)	2.1 (0.9, 4.9)
> 5 Years of Injection	91 (66.9)	83.5	13.8 (4.9, 38.5) ^{**}	84.2	5.6 (2.5, 12.9) ^{**}	4.6 (1.8, 12.0) ^{**}

AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

[†] Age was divided by 5 for the logistic regression analysis; therefore, odds ratios are interpreted for 5 year increments

^{*} $p < .05$,

^{**} $p < .01$