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Authors

Nyamathi, AM
Dixon, EL
Wiley, D
[et al.](#)

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Hepatitis C Virus Infection Among Homeless Men Referred From a Community Clinic

Adeline M. Nyamathi
Elizabeth L. Dixon
Dorothy Wiley
Ashley Christiani
Ann Lowe
University of California, Los Angeles

In this study of factors related to Hepatitis C virus (HCV) infection in 104 homeless HCV-infected men and 94 uninfected homeless men, findings reveal that homeless men with HCV infection are older and more likely to be cocaine injectors than those not infected. Moreover, the sharing of needles, use of injected cocaine during the past 6 months, previous incarceration, veteran status, fair or poor health, and having multiple tattoos are also associated with HCV infection. Reports of having completed the HBV vaccination series, weekly marijuana use, and snorting cocaine or methamphetamine are negatively associated with HCV infection. Among men not reporting lifetime injection drug use, factors such as sharing toothbrushes, having multiple tattoos, being in fair or poor health, and past incarceration are associated with HCV infection. These findings may need to be considered when making screening decisions and counseling homeless male patients about HCV.

Keywords: *hepatitis C; hepatitis C risk factors; homeless men; hepatitis C transmission; factors associated with HCV*

Hepatitis C Virus (HCV) infection is the most common chronic bloodborne infection in the United States, with at least 4 million Americans believed to be infected. California statistics suggest that HCV is at epidemic proportions, with an estimated 640,000 infected residents (American

Authors' Note: Dr. Adeline Nyamathi was responsible for making executive decisions to refine the prevention program and implement the study. She worked closely with the research team to coordinate the nurses and outreach workers in executing the program. In addition, she coordi-

Liver Foundation, 2004). Acute HCV is symptomatic in only 20% to 30% of cases, resulting in a large reservoir of uninformed HCV-infected persons. Approximately 60% to 85% of HCV-infected persons develop chronic hepatitis, of which 10% to 20% progress to cirrhosis (Centers for Disease Control and Prevention [CDC], 1998; Estrada, 2002; National Institutes of Health, 2002). HCV-related liver disease is the most frequent indication for liver transplantation among adults and is the identified cause of death in at least 10,000 to 12,000 Americans each year. With no vaccine available to prevent or limit the spread of this infection, HCV is clearly a significant health hazard.

Modes of HCV–Infection Transmission

HCV infection is primarily transmitted through parenteral modes. Although injection drug use (IDU) accounts for at least 60% of all chronic and new HCV infections annually (National Institute on Drug Abuse, 2000), research is advancing theories regarding additional risk factors, some of which are controversial. These disputed HCV factors include the use of noninjection drugs, including inhaled crack and methamphetamine (Fuller et al., 2004; Koblin, Factor, Wu, & Vlahov, 2003; Rosenblum, Nuttbrock, McQuiston, Magura, & Joseph, 2001; Tortu, Neaigus, McMahon, & Hagen, 2001), the use of other gateway-type drugs such as marijuana or alcohol (Nyamathi, Dixon, et al., 2002; Rosman et al., 1996), sharing drug preparation equipment (Hagan et al., 2001), tattooing (Haley & Fischer, 2001, 2003; Silverman et al., 2000), and sexual transmission (Estrada, 2002; Hershow, Kalish, Sha, Till, & Cohen, 1998; Leruez-Ville, Kunstmann, De Almeida, Rouzioux, & Chaix, 2000; Marincovich et al., 2003). Homeless persons are particularly at risk for HCV, with prevalence rates ranging from 17% to 45%

nated the efforts of the statistical support staff in setting up the database and conducting the data analysis. Finally, she was responsible for interpretation of study findings and dissemination of the research results. Dr. Elizabeth Dixon is project director for the Center for Vulnerable Populations Research in the School of Nursing. She assisted in the presentation of the background section and refinement of the discussion section for this article. Dr. Dorothy Wiley is a professor in the School of Nursing and was the coprincipal investigator of this study. She provided technical assistance and final critique of the article. Dr. Ashley Christiani is the medical director for the UCLA School of Nursing Health Center at the Union Rescue Mission. She assisted with the prevalence data and assisted in the discussion of findings for this article. Ann Lowe is an experienced nurse practitioner and doctoral student at the UCLA School of Nursing. She provided assistance with development of the tables for this article.

Please address correspondence to Dr. Adeline Nyamathi, School of Nursing, University of California, Los Angeles, Rm. 2-250, Factor Building, Los Angeles, CA 90095-1702; e-mail: anyamath@sonnet.ucla.edu.

(Desai, Rosenheck, & Agnello, 2003; Hagan et al., 2001; Nyamathi, Dixon, et al., 2002). Despite the well-known modes of HCV transmission, many questions remain regarding other possible routes of transmission. Health care providers serving homeless patients have had little guidance on whether to screen for HCV based solely on CDC (1998) recommendations, such as history of IDU and transfusions or transplant prior to 1992, and whether they should limit their counseling efforts to the use of injection drugs and sharing needles in this high-risk population.

Predictors of HCV among Homeless Populations

Persons who are homeless are known to engage in IDU behaviors at a rate far greater than the general population (Estrada, 2002). Among homeless persons with severe mental illness and substance abuse disorder, HCV was found to be 30% (Klinkenberg et al., 2003). As a result of dire poverty, homeless persons often resort to sharing razors and toothbrushes, and among cocaine users, the sharing of straws; behaviors that have been associated with HCV (Beech, Myers, Beech, & Kernick, 2003). Sharing of straws for nasal inhalation or hot crack pipes that abrade mucosa is likewise a controversial source of HCV infection (Koblin et al., 2003). A history of incarceration and military service, commonly reported among homeless persons, has likewise been associated with HCV infection (Desai et al., 2003).

In terms of sexual transmission, HCV is thought to be inefficiently spread sexually in long-term spouses of patients with chronic HCV (CDC, 1998). The possibility of sexual transmission of HCV remains arguable particularly in light of findings by Klinkenberg and colleagues (2003) who found that a lifetime history of having a sexually transmitted disease and a history of exchanging sex for money or drugs was associated with being HCV seropositive. These sexually related characteristics and behaviors are commonly reported by homeless persons.

Purpose

The purpose of this study is to examine presumed risk factors (i.e., IDU) and more controversial factors (i.e., sharing of drug paraphernalia, incarceration or military service, and hygienic and sexual practices) associated with HCV infection among homeless men referred from a community clinic in the skid row area of downtown Los Angeles, California. The intent of this study is to further elucidate potential risk factors for HCV infection and guide clinical decision making regarding HCV screening and counseling in homeless populations.

Design

This study consists of a case control study in which half of the sample was to be composed of HCV seronegative homeless adults whereas the other half was HCV seropositive. Test results were based on HCV serology.

Sample and Setting

The sample consisted of 198 homeless men referred from the John Wesley Community Health (JWCH) Medical Clinic in the skid row area of Los Angeles. Participant referrals came from medical care providers at the community clinic who were aware of the eligibility criteria for the study by means of posted flyers. Participants in the study were eligible if they were male, between the ages of 18 and 65, resided in the skid row area, and had been tested for HCV at the JWCH or a nearby clinic. All homeless patients at the clinic who presented with elevated liver function tests were assessed for HCV infection. One hundred and four of these men had verifiable evidence of being HCV positive by blood test and medical record data, whereas another 94 homeless men had similar evidence of being HCV negative. The HCV positive men had participated in a previous study in which semen specimens were collected for analysis of HCV Ribonucleic Acid (Nyamathi, Robbins, et al., 2002). All men completed a 15-min questionnaire detailing potential demographic, biologic, and behavioral risk factors for HCV transmission. Of the men who met the eligibility criteria, none declined participation in the study.

A total of 198 homeless male patients comprised the sample; of which approximately half of the sample (54%) was HCV positive. The majority of the sample was African American (70%) and to a lesser extent White (19%) or Latino (11%); more than half (59%) had never married. Approximately one third were veterans and about one half had served time in prison; a greater number (83%) had been in jail during their lifetime. Less than 7% had HIV (Table 1).

Method

Procedures

Data were collected between 2002 and 2003 to examine predictors of HCV infection among homeless male clinic patients. Research staff consisted of African American and Latino nurses and outreach workers exten-

sively trained in working with homeless and drug-addicted individuals. The sample was recruited using flyers posted in the community clinic. These flyers were made known to the medical care providers in the clinic setting. Interested participants were informed of the study and were required to read and sign a written informed consent document. Appointments were made for interviews to be conducted in the JWCH Medical Clinic area in a private room. The questionnaire was available in both English and Spanish. Participants received \$10 for their time. The study was approved by the institutional review board.

Measures

Sociodemographic characteristics. Information was collected through a structured questionnaire that included age, ethnicity, race, education, veteran status, relationship status (i.e., single, married, etc.), history of incarceration, perceived health status, and hepatitis B virus (HBV) vaccine history.

Drug-related risk behaviors. Drug and alcohol use were measured by the revised Texas Christian University (TCU) Drug History form (Simpson & Chatham, 1995). This questionnaire has been tested with men and women with a history of drug addiction, prostitution, and homelessness. The TCU Drug History elicits information about lifetime use of 16 drugs and records the frequency of use during the past 6 months. It also provides information about IDU during the past 6 months. Drugs assessed include heroin, other opiates, cocaine, crack, methamphetamine and other amphetamines, inhalants, marijuana and hashish, hallucinogens, tranquilizers, barbiturates, other sedatives, designer drugs, and alcohol and nicotine. Test-retest reliability for daily narcotic use and abstinence is in the acceptable range of .63 to .71 (Anglin et al., 1996).

The CAGE¹ questionnaire was used to identify individuals experiencing problems with alcohol. The CAGE is a sensitive and rapid screener for persons with a high likelihood of lifetime alcohol dependence or abuse. Four yes or no questions were asked using the acronym *CAGE*. Using two or three positive responses as criteria yielded a correlation coefficient of .89 (Mayfield, McLeod, & Hall, 1974).

For the analyses in this article, indicators of daily use of noninjection drugs and alcohol during the past 6 months were created. Such consistent use of a substance is generally considered problematic (Anglin & Hser, 1990; Longshore, Hsieh, & Anglin, 1993), particularly in homeless populations. For injection drugs, any use in the past 6 months could represent greater risk of HCV infection and was therefore used for analyses.

Other risk behaviors. Other behavioral risk factors assessed included the history of sharing needles and syringes (works), sharing straws in cocaine use, tattooing, piercing, and sharing personal hygiene implements such as toothbrushes and razors.

Sexually related risk factors. Participants' sexual behaviors were assessed by a 13-item Sexual Activity Questionnaire developed by Temoshok (1986). This instrument measures types and frequency of sexual activity, particularly as they relate to protected and unprotected activity during lifetime and the past 6 months. Sexual risk behaviors included trading sex for money, partner shooting drugs, and unprotected sex. Additional risk factors included lifetime sexually transmitted diseases. Partners, length of current relationships, and lifetime number of male and female sexual partners were also assessed.

HCV serostatus and HBV vaccination. Men were tested for HCV infection using standard blood tests (ELISA and RIBA) prior to enrollment in the study. Participants eligible for enrollment were provided proof of HCV-infection status by their referring physician. HBV vaccine status (receipt of the three vaccine series) was reported by each participant.

Analysis of Data

Differences in categorical sociodemographic and behavioral characteristics between those who did and did not have evidence of HCV antibodies were examined with chi-square and Fisher's exact tests. Differences in continuous variables between the two groups were assessed with independent sample *t* tests. To identify independent factors associated with HCV antibodies, stepwise backward and forward logistic regression analyses were conducted using variables in Tables 1 and 2 that were associated with HCV infection at the .10 level. The *p* value for retention was also set at .10. Both stepwise algorithms led to the same core model. Variables not included in the core model were added to the model one at a time to estimate their effects, controlling for factors related to the core model. Because noninjection drug use factors were of particular interest, the same set of analyses was also run on participants with no reported history of injection drug use. Interactions between race (African American versus Other) and risky behaviors were examined but were not found to be important.

Table 1
Associations Between Key Characteristics
and HCV Infection (*n* = 198)

Sociodemographic factors	HCV Positive (<i>n</i> = 104)			HCV Negative (<i>n</i> = 94)			Total Sample (<i>n</i> = 198)		
	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>	%
Age*** (years)	46.0	7.3		41.3	9.8		43.8	8.9	
Education (years)	12.2	1.9		12.3	1.6		12.2	1.8	
Ethnicity***									
African American			60.2			80.9			70.1
White			21.4			16.0			18.8
Latino			18.5			3.2			11.2
Never married			54.8			63.8			59.1
Veteran**			44.2			25.5			35.4
Prison***			62.5			40.3			52.0
Jail**			95.2			69.9			83.3
Poor or fair health status***			37.5			16.0			27.3
HIV Positive*			10.6			2.1			6.6

Note: HCV = Hepatitis C virus.

* $p < .05$. ** $p < .01$. *** $p < .001$; chi-square and *t* tests for men with and without HCV infection.

Results

Sociodemographic Factors

Table 1 also depicts associations between key sociodemographic characteristics and HCV infection. Compared to homeless persons found to be HCV negative, those who were HCV positive were more likely to be older and Latino. HCV-positive men were more likely than HCV-negative men to report a history of having been incarcerated, of serving in the military, and of being in fair or poor health. HCV-positive men were also more likely to test positive for HIV. No associations were found between HCV infection and education or marital status.

Nonsexual Risk Behaviors

HCV-infected homeless men were more likely than their uninfected counterparts to have injected cocaine or heroin in the past 6 months and more likely to have shared needles in their lifetime (Table 2). Recent use of marijuana and other noninjection drugs was negatively associated with HCV infection. Men who tested negative for HCV were also more than twice as

Table 2
Association Between HCV Infection and Selected
Substance Use and Behavioral Characteristics

	HCV Positive (<i>n</i> = 104) %	HCV Negative (<i>n</i> = 94) %	Total Sample (<i>n</i> = 198) %	<i>p</i> value
Recent drug-related risk factors:				
IDU in the past 6 months	20.2	3.2	12.1	.001
Inject cocaine in the past 6 months	43.3	5.3	25.3	.001
Inject heroin in the past 6 months	54.8	18.1	37.4	.001
Ever shared needles	55.8	11.7	34.9	.001
Weekly marijuana use in the past 6 months	12.5	28.7	20.2	.005
Non-IDU past 6 months	59.6	76.6	67.7	.010
Other lifetime behaviors:				
HBV vaccine completion	21.2	46.8	33.3	.001
Ever shared toothbrushes	26.9	16.0	21.7	.062
Ever shared razors	51.9	35.1	43.9	.017
Tattoos (≥2)	34.6	18.1	26.8	.009
Ever snorted cocaine or meth	40.6	57.5	59.1	.655
Ever shared straws	37.5	38.3	37.9	.910
Trade sex for money	41.4	37.2	39.4	.554
Sexually transmitted disease history	47.1	39.4	43.4	.272
Drug using partners	42.3	25.5	34.3	.013

Note: HCV = Hepatitis C virus; IDU = injection drug use.

likely as those who tested positive to report that they had completed the HBV vaccine series (47% versus 21%, respectively). Other factors that were positively associated with HCV infection included sharing razors and receiving multiple tattoos. Snorting and sharing straws were not related to HCV-infection status in unadjusted analyses.

When unadjusted analyses were conducted with a subsample of non-IDUs (data not shown), significant associations were found between HCV positivity and sharing toothbrushes, being in poor or fair health, having been incarcerated, and having multiple tattoos. Similar to the overall sample findings, HBV vaccination was negatively associated with HCV infection.

Sexually Related Factors

No associations were found between HCV infection and trading sex for money or drugs or having had a sexually transmitted disease. Compared to homeless men who were HCV negative, those who tested positive were more likely to report having a partner who used drugs.

Table 3
Logistic Regression Analysis of Factors Predicting
Detection of HCV in Homeless Men in the Total
Sample and Among Noninjection Drug Users

Variable	Adjusted Odds Ratio	95% Confidence Interval	<i>p</i>
HCV positive total sample (<i>n</i> = 197)			
Age	1.06	1.27 to 10.37	.035
Ever shared needles	3.89	1.29 to 11.73	.016
Injected cocaine in the past 6 months	8.62	2.16 to 34.52	.002
Jail or prison history	10.81	2.78 to 41.97	.001
HBV vaccine completion	0.30	0.12 to 0.74	.009
Veteran	2.91	1.16 to 7.32	.023
Poor or fair health	2.99	1.18 to 7.60	.022
Two or more tattoos	3.64	1.27 to 10.37	.016
Ever snorted cocaine or meth	0.33	0.14 to 0.81	.015
Weekly marijuana use in the past 6 months	0.18	0.06 to 0.51	.004
Lifetime male partners	3.93	0.88 to 17.51	.073
HCV positive, no history of IDU (<i>n</i> = 102)			
Ever shared toothbrushes	6.10	1.63 to 22.77	.007
Jail or prison history	5.71	1.42 to 22.90	.011
HBV vaccine completion	0.29	0.10 to 0.88	.028
Poor or fair health	3.81	1.26 to 14.97	.018
Two or more tattoos	4.51	1.36 to 14.97	.014

Note: HCV = Hepatitis C virus; HBV = Hepatitis B virus; IDU = injection drug use.

Factors Associated with HCV Positivity in Multivariate Analysis

Logistic regression analysis revealed that the adjusted odds of HCV infection were about three to four times greater among homeless men reporting a history of sharing of injection equipment, military service, fair or poor health, and receipt of two or more tattoos (Table 3) than for those not reporting these factors. The likelihood of being HCV positive increased to 8 and 10 times, respectively, for homeless adults reporting recent injection of cocaine or incarceration compared to homeless men not reporting these characteristics. Those who used marijuana weekly, snorted cocaine or methamphetamine, and reported receiving the hepatitis B vaccine series were less likely to be HCV positive compared to homeless men not reporting these characteristics.

When multivariable analyses were run on men who did not report a lifetime history of IDU (Table 3), similar noninjection drug use factors were

found to be associated with HCV infection. The odds ratio (OR) of HCV infection ranged from 3.8 (those reporting poor or fair health) to 6.1 (those sharing toothbrushes). HBV vaccine completion remained negatively correlated with an OR approximating that in the model for the total sample.

Discussion

This study examined a high-risk sample of homeless men known to be HCV positive and HCV negative. Exploratory analyses were performed to determine which individual characteristics or behaviors were associated with HCV infection in the overall sample and in a subsample of men with no reported history of IDU. The use of specific drugs was also examined in relation to HCV infection.

Among the total sample, multiple demographic and health history factors, including older age, Latino ethnicity, veteran status, report of poor or fair health, previous imprisonment, and HIV-positive status distinguished the HCV-infected homeless men from the noninfected homeless men in unadjusted analyses. Older age likely reflects an accumulation of HCV risks through time. The other factors, with the exception of completing the HBV vaccine, were found to be associated with HCV infection. These findings may well reflect personal and/or social environmental HCV risks that disproportionately affect lower income people and the homeless.

As anticipated and substantiated by a vast body of research on HCV risk factors (CDC, 1998), a history of sharing injection equipment and recent use of specific drugs by injection proved to be strongly related to HCV infection. The fact that having a drug-using partner was significantly related to being HCV positive may reflect cross-infection as a result of sharing drug equipment. A controversial but less likely explanation is that of sexual transmission as a recent finding of HCV Ribonucleic Acid in the semen of 36% of HCV-infected homeless men supports the biological possibility of sexual transmission of HCV (Nyamathi, Robbins, et al., 2002).

In the logistic regression model using the entire sample, HBV vaccination, weekly marijuana use, and snorting of cocaine or methamphetamine were inversely related to HCV infection. The inverse relationship between weekly marijuana use and HCV infection may represent drug preferences or lower severity of drug use history. Considering the composition of this sample, which included a substantial number of IDUs, preferences for noninjection drugs, as opposed to injectable drugs, may diminish the risk for HCV transmission and subsequent infection. Individuals who snort drugs appear to be at a lower risk of HCV infection than are cocaine injectors and

IDUs who share injection equipment (Fuller et al., 2004). Using structural equation modeling, the finding of no association between HCV seropositivity and alcohol problems among this sample may reflect the fact that when the majority of the sample report alcohol problems, a ceiling effect may obscure variability among the sample (Stein & Nyamathi, 2004).

In men not reporting lifetime IDU, the factors strongly associated with HCV infection were sharing toothbrushes and having been in jail or prison. Although sharing toothbrushes has been identified as a potential HCV transmission route, our finding is notable because research supporting this assertion is lacking in the scientific literature. Because sharing of personal items may be a common behavior among homeless populations with limited resources and dental and gum disease is prevalent in this group, the risk of oral transmucosal transmission of HCV may be higher than previously thought.

With respect to an association found between history of incarceration and HCV infection among non-IDUs, the question arises whether HCV infection occurred before, during, or after incarceration and how incarceration really relates to HCV positivity. Studies by Macalino and colleagues (2004) and Vlahov, Nelson, Quinn, and Kendig (1993) demonstrate that although HCV prevalence rates are high following intake into the correctional system (23% and 38%, respectively), HCV seroconversion during incarceration is low (0.4 and 1.1 per 100 person years, respectively). A history of serving time in jail or prison is likely most reflective of the high-risk behavioral histories of individuals involved with the correctional system. Regardless of the location of HCV transmission, an individual's history of imprisonment would be a worthwhile item to include in HCV screening tools and would inform provider decision making regarding HCV counseling and testing.

Tattooing may be an underestimated HCV risk factor, both in the homeless and in the general population; yet controversy exists related to the strength of such an association (Silverman et al., 2000). Haley and Fischer (2001) found evidence of a strong relationship between receipt of a commercially applied tattoo and HCV infection in a sample of 626 adults who were previously unaware of their HCV serologic status. The conditions under which the men in this sample received their tattoos were not explored (i.e., commercial tattoo parlors versus application by a nonprofessional). Their tattoos were applied under less than optimal conditions and/or by an individual not adhering to sterile technique, thus facilitating HCV transmission.

In the statistical model for non-IDUs, HBV vaccination was found to be negatively associated with HCV infection. This finding may reflect the participants' personal values regarding preventive care and/or availability of resources. Individuals who complete the series of HBV vaccines (which

requires three injections during at least 6 months) may value preventive care and, thus, may take more precautionary measures to avoid HCV infection. This finding may also demonstrate the success of either street outreach by community health workers in the area or of general hepatitis health education, which was presumably provided at the time the HBV vaccine was being administered. National Institute of Health Consensus Development Conferences on the management of HCV dating back to 1997 have recommended that hepatitis A and B vaccines be given to all persons at risk for HCV, and the findings in this study may signal successful dissemination of this recommendation to medical providers (National Institutes of Health, 2002).

The limitations of this study include the self-report nature of the data and the possibility that the factors found to be associated with HCV infection are confounded by unreported IDU. The sample size also prevents an analysis of potentially important combinations of risk factors such as receiving tattoos and injecting cocaine while in prison. Geographical characteristics of the sample and the nature of sample recruitment (known HCV positive or negative) from clinic settings also limit the ability to make definitive conclusions or to generalize findings to other populations of homeless men.

Note

1. CAGE is short for Cutting down on drinking, Annoyed by criticism, Guilty about drinking, Eye-opener in the morning.

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Adeline M. Nyamathi, ANP, PhD, FAAN, is a professor at the University of California, Los Angeles.

Elizabeth L. Dixon, RN, MSN/MPH, PhD, is Project Director at the University of California, Los Angeles.

Dorothy Wiley, PhD, RN, is a professor at the University of California, Los Angeles.

Ashley Christiani, MD, is Medical Director at the University of California, Los Angeles.

Ann Lowe, RN, is a nurse practitioner at the University of California, Los Angeles.