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Correlates of Hepatitis C virus infection in homeless men: a latent variable approach

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Abstract

Homeless individuals are at risk for numerous health problems including Hepatitis C virus (HCV). HCV is primarily caused by sharing of equipment associated with injection drug use (IDU). In the current study, we assessed differences among HCV-negative and HCV-positive homeless men residing in Los Angeles ($N = 198$; about 50% HCV positive) on a number of risk factors and behaviors. Findings revealed several significant correlates of HCV-positive status. HCV-positivity was significantly and positively associated with a history of substance use (IDU and non-IDU), recent IDU-related behaviors including equipment sharing, other forms of sharing (e.g., toothbrushes, razors), homelessness severity, tattoos, sexually transmitted diseases, a jail/prison history, and greater age. Lifetime alcohol problems were not associated with HCV. Although associations of HCV with current IDU-related behaviors are not surprising, it is alarming that these behaviors were recent. Those who work among homeless populations should be aware not only of the high likelihood of HCV infection in this population but also of the transmission risk due to continued IDU sharing behaviors. Substance abuse treatment should be implemented to hinder the spread of HCV in this vulnerable population. Also, needle exchange and provision of clean ancillary IDU equipment should be encouraged in areas where homeless people are known to congregate.

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Keywords: Hepatitis C virus; Homelessness; Injection drug use; Needle sharing

1. Introduction

Hepatitis C virus (HCV) infection is the most common chronic bloodborne infection in the United States (Centers for Disease Control and Prevention (CDC), 1998). About 4 million people in the United States have been exposed to HCV and the majority will develop a chronic, active infection (Sylvestre, 2002). One goal of the Healthy People 2010 initiative is to reduce HCV transmission to 1 new case per 100,000 population. 2.4 new cases of HCV per 100,000 were reported in 1996 (U.S. Department of Health and Human Services—USDHHS, 2000). The highest rates of new cases are among nonwhite racial and ethnic groups (Beech et al., 2002; USDHHS, 2000). About 80% of those infected with HCV are chronic carriers (Des Jarlais and Schuchat, 2001) and most infections have not been diagnosed (Hammett, 2003).

Primary prevention of HCV will be accomplished through prevention or treatment of illegal IDU because the majority of HCV transmission occurs from sharing of needles and other injection paraphernalia during IDU (Alter, 1999, 2003; Hagan et al., 2001). Worldwide, 50–95% of injecting drug users have HCV (Stein et al., 2001). As an example, Lorvick et al. (2001) found an HCV seroprevalence of 95% among injection drug users in San Francisco; Samuel et al. (2001) found HCV in 82% of a sample of injecting drug users in New Mexico. Individual studies among IDUs in treatment report similar incidences of HCV. Senti et al. (2003) reported that 83% of the injecting heroin users in their sample were HCV positive. Also, injectors must be caught early: Garfein et al. (1996) found high rates of HCV among injectors who had injected for 1 year or less (76.9%).

1.1. Current study

The current study investigates correlates of HCV among a sample of homeless men inhabiting what is considered the

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“Skid Row” area of downtown Los Angeles. Men who are homeless are considered a potential source of HCV transmission as well as being at risk for HCV. Homeless people are often in poor health, and many suffer from chronic alcoholism and have histories of substance use and abuse (Stein and Gelberg, 1997). Thus, their lifestyles place them at risk of contracting HCV as well as other serious illnesses (Beech et al., 2002). We contrast this group of HCV positive and HCV negative men to assess correlates of HCV infection in this population. Findings that are uncovered will provide health care workers with valuable information identifying behaviors more likely among those who are HCV positive and also indicate areas and topics in which further education should be provided.

1.2. Homeless populations and HCV risk

Homeless men are known to engage in risk behaviors in addition to sharing of needles and other IDU paraphernalia. For instance, due to their poverty and adverse living conditions, they may be more likely to share razors and toothbrushes, behaviors that are not as common in the general population and which have been associated with HCV (Beech et al., 2002). There may also be other forms of sharing related to substance use such as sharing of cocaine straws. We explore whether these behaviors are associated with HCV status in this study.

We also assess whether tattoos, sexually transmitted diseases, alcohol problems, and unsafe sexual behaviors are associated with HCV. We do not expect a causal linkage between these variables; however, if individuals who are HCV positive are more likely to be engaging in these behaviors, they are compromising their own health and the health of others. For instance, heavy alcohol use can accelerate HCV-related liver disease (Stein et al., 2001; USDHHS, 2000).

The possibility of sexual transmission of HCV is controversial (Nyamathi et al., 2002). Haley and Fischer (2001) found no independent association between promiscuous sexual activity and HCV infection. However, data from several studies suggest that HCV in non-injection drug users has been related to sex with multiple partners and STD infections (Hershow et al., 1998; Nakashima et al., 1992). Furthermore, Nyamathi et al. (2002) found HCV in the semen of 36% of a sample of homeless men who were HCV positive.

Tattoos obtained commercially or unprofessionally in prisons are possible risk factors for HCV positivity and have been positively associated with HCV (Aitken et al., 2002; Beech et al., 2002; Haley and Fischer, 2001; Samuel et al., 2001). Haley and Fischer (2001) assessing HCV prevalence in a large sample of medical patients that were not injecting drug users found that tattooing in commercial tattoo parlors might have been responsible for HCV infections. Samuel et al. (2001) found tattooing in prison or jail to be associated with HCV infections although Alter (1999) reported

that case-control studies have found no association between tattooing and HCV.

HCV is prevalent in jails and prisons (Hammett, 2003; Hammett et al., 2002). Hammett et al. (2002) reported that between 29 and 43% of all those infected with HCV in the United States passed through a correctional facility in the year 1997. Aitken et al. (2002) reported an association between HCV exposure and a history of imprisonment in their sample of steroid injectors. We thus examine whether the homeless men in this study have incarceration histories and whether, in this particular nonstandard population, prior incarceration is associated with HCV. The majority of the homeless men in this study had spent time in jail and/or in prison.

Additionally, we assess whether severity of their homelessness, as indicated by the number of times they have been homeless and the number of years of homelessness, is associated with their HCV status. Chronic homelessness has been associated with more substance abuse and poorer health (Stein et al., 2002). Stein et al. (2000) suggested that long and frequent periods of chronic homelessness were debilitating due to inadequate nutrition, general neglect of health during homeless times, and chronically stressful and devastating life circumstances.

2. Methods

2.1. Participants

Assessments were conducted among 198 homeless men residing in the Skid Row area of downtown Los Angeles in 2002 and 2003. These persons were referred from the John Wesley Community Health (JWCH) Medical Clinic by medical care providers aware of the eligibility criteria for the study. Participants in the study were eligible if they were male, between the ages of 18 and 65 years, resided in the Skid Row area, and had been tested for HCV at the JWCH or a nearby clinic. Additionally, flyers describing the study were posted in the medical clinic, which is located in Skid Row. Of the total sample, 104 (52.5%) of the men had verifiable evidence of being HCV positive by laboratory and medical record data, and 94 (47.5%) of the homeless men were classified as HCV negative by laboratory assays. All of the men were tested for HCV infection using standard blood tests (ELISA and RIBA) prior to enrollment in the study. Data from the HCV positive men were used in an unrelated study assessing whether Hepatitis C virus RNA was present in their semen (Nyamathi et al., 2002).

2.2. Procedure

All of the men completed a 15-min questionnaire that assessed demographics and a range of lifetime and current behaviors associated with risk factors for HCV transmission.

Questionnaires were administered by African-American, Latina, and Caucasian nurses and outreach workers extensively trained in working with homeless and drug-addicted individuals. Interviews were conducted in the JWCH Medical Clinic in a private room; the men received US\$ 10 for their participation. The questionnaire was available in both English and Spanish. Informed consent was obtained from all subjects participating in the study. Informed consent materials and the questionnaire were reviewed and approved by the University of California, Los Angeles Medical Institutional Review Board (Nyamathi et al., 2002).

2.3. Measures

Multiple-indicator latent variables were created where possible from the assessment items available. Some items, however, are single-indicator variables and are reported as such below. IDU history was assessed for completeness but not used in the models, as it would have captured too much variance and have been too highly correlated with recent IDU behaviors. We were more interested in current behaviors associated with positive HCV status.

2.3.1. Non-injection substance use history

Three parcels of items represented a history of non-injection substance use which was assessed by the mean of a series of yes/no questions to 14 substances that are typically not injected or were not reported as having been injected (1 = no, 2 = yes). They were categorized as stimulants (e.g., cocaine, amphetamines), hallucinogens (e.g., LSD, marijuana), and depressants (e.g., alcohol, barbiturates). Means were used because there were unequal numbers of items within each subscale (possible range: 1–2).

2.3.2. Recent injection behaviors

Three items represented injection behaviors that were reported for the past 6 months (0 = no, 1 = yes). These included: (i) heroin use frequency on a scale ranging from 1 (never) to 9 (about 4 or more times per day); (ii) a sum of the number of drugs they had injected in the last 6 months excluding heroin to avoid an overlap with item 1, e.g., crack/freebase, speedballs (heroin and cocaine mixed together), street methadone; and (iii) a sum of responses to 2 yes/no questions on needle sharing or works sharing (cookers, cottons).

2.3.3. Non-needle sharing behaviors

Three items encompassed other forms of sharing (1 = no, 2 = yes): (i) sharing of straws for cocaine inhalation, (ii) sharing razors, and (iii) sharing toothbrushes.

2.3.4. Severity of homelessness

Two items were used: (i) number of times homeless, and (ii) the number of years homeless. This measure has been used in prior research and was found to be very useful (Stein et al., 2000, 2002).

2.3.5. Tattoos

One question assessed whether the participant had ever had parts of his body tattooed (1 = no, 2 = yes).

2.3.6. Alcohol problems

Lifetime alcohol problems were assessed with four yes/no items from the CAGE diagnostic screener for alcohol abuse (Ewing, 1984; 1 = no, 2 = yes):

- (1) Have you ever felt the need to cut down on your drinking?
- (2) Have you ever gotten angry when people criticized your drinking?
- (3) Have you ever felt bad or guilty about your drinking?
- (4) Have you ever needed a drink just after you have woken up?

2.3.7. Sexually transmitted diseases (STDs)

A single sum-score item was used to indicate positive STD status within the past 6 months. It was a sum score of whether or not they reported having six possible STDs or STD symptoms during the last 6 months (e.g., penile discharge, sores/ulcers, warts, chlamydia, gonorrhea; 0 = no, 1 = yes).

2.3.8. Risky sexual behaviors

Three items indicated engaging in risky sexual behaviors in the last 6 months: (1) percent of vaginal intercourse without a condom; (2) percent of oral sex without a condom; and (3) number of sexual partners.

2.3.9. Jail/prison

The participants were asked whether they had been in jail, prison, or both (1 = no, 2 = yes). Eighty-three percent of this sample acknowledged that they had been incarcerated.

2.3.10. Demographics

We used age in years as a correlate. Education was not significantly associated with any of the variables in the model and was not included.

2.4. Analyses

The analytic method employed in this study was structural equation modeling (SEM) using latent variables (Bentler, 2004). Latent variables are error-free constructs that represent a more superior order of abstraction than measured variables. The goodness-of-fit of the model was appraised with the Satorra–Bentler χ^2 (S–B χ^2), the robust comparative fit index (RCFI), and the root mean squared error of approximation (RMSEA; Hu and Bentler, 1999). The S–B χ^2 was used because the data were multivariately kurtose (Bentler and Dudgeon, 1996). The RCFI ranges from 0 to 1 and reflects the improvement in fit of a hypothesized model over a model of complete independence among the measured variables, and also adjusts for sample size (Bentler and

Dudgeon, 1996). Values around 0.95 or greater are desirable for the RCFI, and a cutoff value close to or less than 0.06 for the RMSEA is also desirable (Hu and Bentler, 1999).

2.4.1. Confirmatory factor analysis

An initial confirmatory factor analysis (CFA) was performed with each latent construct predicting its hypothesized manifest indicators. The CFA tested the sufficiency of the hypothetical measurement model and measured associations among the latent or manifest variables. All latent constructs and the single-item mediating constructs were correlated without any assumption of causality or precedence among them. All of the associations among the variables in this model were of interest, but we were particularly interested in associations between the variables and whether or not the homeless men were HCV positive. The Lagrange multiplier (LM) test, which suggests additional relationships to add to models to improve the fit, was used to determine whether additional associations were needed (Chou and Bentler, 1990).

2.4.2. Latent variable path analysis

Without any presumption of causality or precedence, we also conducted a supplementary analysis in which all variables in the model predicted HCV status. We did not presume that their HCV-positive status necessarily resulted from their engaging in any of the activities assessed by the questionnaire. Their HCV positive status could have preceded the predictor variable. However, by performing a latent variable path analysis, we could account for significant associations observed in the CFA between the latent variables and HCV status due to overlapping variance among the other latent variables. Only the most powerful predictors of HCV status would remain in the more stringent path analysis, and we could ascertain which predictors were most salient and relevant to their HCV status and explained the most variance in HCV status within this sample of homeless men.

3. Results

3.1. Demographics and other descriptors

The men ranged in age from 18 to 63 years (mean: 43.8 years). Nearly 70% were African-American, about 19% were white, and 11% were Hispanic. They averaged over 12 years of education (range: 4–16 years; median: 12 years). Fifty-nine percent had never been married, less than 3% were currently married; nearly 36% were separated or divorced. Twenty-nine percent were in an intimate relationship with a partner or spouse. Eighty-eight percent were unemployed, and 35% were U.S. veterans. Less than 4% (7) reported that they had sex with other men. The men who were HCV-positive consistently reported more lifetime use of drugs that can be injected than those who were HCV-negative: heroin combined with cocaine (speed-

Table 1

Summary statistics and factor loadings of variables in model ($N = 198$)

Variables (range)	Mean (S.D.)	Factor loadings ^a
HCV positive (0–1)	0.53 (0.50)	–
Non-injection substance use history		
Stimulants (1–2)	1.45 (0.31)	0.73
Hallucinogens (1–2)	1.36 (0.27)	0.72
Depressants (1–2)	1.36 (0.23)	0.65
Recent injection behaviors		
Heroin frequency (1–9)	1.58 (1.77)	0.44
Six-month injection (0–2)	0.09 (0.32)	0.47
Sharing needles (0–2)	0.62 (0.87)	0.66
Non-needle sharing		
Cocaine straws (1–2)	1.38 (0.49)	0.60
Razors (1–2)	1.44 (0.50)	0.48
Toothbrush (1–2)	1.22 (0.41)	0.44
Homelessness severity		
Number of times (0–60)	4.63 (7.14)	0.85
Years homeless (0–23)	4.85 (5.13)	0.66
Tattoo (1–2)	1.41 (0.49)	–
Alcohol problems (1–2)		
Need to cut down	1.62 (0.49)	0.73
Criticism angers them	1.46 (0.50)	0.68
Feel guilty	1.51 (0.50)	0.83
Wake-up drink	1.33 (0.47)	0.60
STDs (0–4)	0.50 (0.61)	–
Risky sexual behaviors—6 months		
Vaginal sex—no condom (%)	0.33 (0.46)	0.45
Oral sex—no condom (%)	0.27 (0.43)	0.51
Number of sex partners (0–40)	1.87 (3.81)	0.62
Jail/prison (1–2)	1.83 (0.38)	–
Age (18–63 years)	43.79 (8.91)	–

^a All factor loadings significant at $P \leq 0.001$.

balls), 43% versus 12%; heroin, 57% versus 22%; street methadone, 14% versus 7%; and methamphetamines (e.g., speed, ice), 31% versus 20%.

3.2. Confirmatory factor analysis

Table 1 reports the factor loadings, means, and standard deviations of the variables in the model. All factor loadings of the measured variables were significant ($P \leq 0.001$). Table 2 reports the correlations among the latent and single-indicator variables in the CFA. Fit indexes for the CFA model were acceptable: S–B $\chi^2(176, N = 198) = 228.62$, RCFI = 0.94, RMSEA = 0.039. For improvement in fit, the LM test provided suggestions for three supplementary associations to be added to the CFA model. These additions appear to be defensible. One was a logical association between the two error residuals of the measured indicators, “sharing cocaine straws” and the use of “stimulants” (which included cocaine). Also, greater age was added as a specific predictor of more years homeless and less injection drug use in the past 6 months.

Table 2
Correlations among all model variables for 198 homeless men

	I	II	III	IV	V	VI	VII	VIII	IX	X
I. HCV positive	–									
II. Non-injection substance use history	0.35***	–								
III. Recent injection behaviors	0.48***	0.49***	–							
IV. Non-needle sharing behaviors	0.17*	0.66***	0.43***	–						
V. Severity of homelessness	0.25**	0.27**	0.20*	0.03	–					
VI. Tattoos	0.16*	0.08	0.20*	–0.09	0.11	–				
VII. Alcohol problems	–0.02	0.25**	0.14	0.25**	0.14	0.18*	–			
VIII. STDs	0.15*	0.31***	0.23**	0.24**	0.05	0.08	0.09	–		
IX. Risky sexual behaviors	–0.15	0.18*	–0.05	0.20*	–0.01	–0.07	0.19*	0.13	–	
X. Jail/prison	0.35***	0.29***	0.26**	0.15	0.12	0.11	0.10	0.04	0.04	–
XI. Age	0.24**	0.13	–0.02	0.05	0.13*	–0.15*	0.07	0.09	–0.12	0.12

Correlations in Column 1 report associations between HCV positivity and the latent variables.

* $P \leq 0.05$.

** $P \leq 0.01$.

*** $P \leq 0.001$.

Of particular interest were associations between HCV status and each latent variable in the model (see Table 2). HCV positive status was significantly associated with a non-injection substance use history, recent injection behaviors, non-needle sharing behaviors, homelessness severity, tattoos, STDs, jail/prison, and greater age.

3.3. Latent variable path analysis

To ascertain which variables were most associated with HCV status, we first assessed a saturated path model in which all nine of the latent variables predicted HCV status. This model explained 38% of the variance in HCV status. We gradually dropped non-significant predictors until only significant independent predictors remained. This trimmed parsimonious model explained 36% of the variance in HCV status using only five predictors. These included recent injection drug use behaviors (regression coefficient (RC) = 0.45, $P \leq 0.001$), homelessness severity (RC = 0.19, $P \leq 0.01$), tattoos (RC = 0.11, $P \leq 0.05$), jail/prison (RC = 0.17, $P \leq 0.01$), and age (RC = 0.22, $P \leq 0.001$). The powerful association between drug history and recent injection drug use accounted for the high initial correlation between HCV positive status and a non-injection drug history. These behaviors often cluster together, especially among the homeless (Beech et al., 2002). Recent injection drug use behaviors was the strongest predictor of HCV status. This model, which also included the significant correlations among the predictors had an acceptable fit: S–B $\chi^2(213, N = 198) = 275.02$, RCFI = 0.94, RMSEA = 0.038.

4. Discussion

Hepatitis C virus is common in areas with a high concentration of homeless people and can be transmitted easily, especially through the sharing of contaminated IDU paraphernalia. Even within this impoverished population that

might be perceived as relatively homogeneous, we found significant correlates of HCV positivity. The association between HCV status and injection drug use and sharing of equipment is certainly not surprising (e.g., Hagan et al., 2001; Sendi et al., 2003; Sylvestre, 2002). Injection drug use is most likely the way in which the injecting drug users initially contracted HCV, and their positive status is quite possibly of long duration (e.g., Garfein et al., 1996). Thus, it is alarming that the injection-related behaviors which included needle and equipment sharing were behaviors performed within the past 6 months. The variable representing recent injection-related behaviors included not only heroin injection and injection of other substances, but also encompassed sharing of needles and works. Thus, many of these men were possibly spreading HCV to others with whom they were associating.

Clearly, homeless men need active counseling and education as well as substance abuse treatment to minimize the spread of HCV to themselves and others. In addition, in sites where needle exchange programs are legal, this practice should be highly encouraged. Moreover, in sites where legal restrictions still exist, advocates for legalization of needle exchange programs should be fully promoting such activities and pursuing legislative changes. Currently in California where this study was conducted, state law requires prescriptions to purchase syringes (Costello, 2004). Additionally, local governments have the option whether to provide needle exchange; currently only 25% of counties have implemented these programs in California (Costello, 2004). However, there are several informal needle exchange programs (NEPs) in the greater Los Angeles area including the impoverished area in which this study was conducted. The city and county of Los Angeles endorse exchanges and financially support them.

Although we found no association between lifetime alcohol problems and HCV status, this result may have been due to a weakness in our using a lifetime measure of alcohol problems rather than more current information. There

also may be a ceiling effect with a lack of variability within this population of homeless men. A substantial number of study participants reported alcohol problems, however, and there was a significant bivariate association between alcohol problems with a history of non-injection forms of illicit drug use. This association highlights the poly-substance use that pervades those who end up homeless, as does the association of HCV with a history of substance use other than IDU (Beech et al., 2002). Alcohol use is especially hazardous among those who are HCV positive, and needs to be discouraged strongly. Alcohol is a hepatotoxin and contraindicated among those who are HCV positive as it may hasten disease progression (Stein et al., 2001; USDHHS, 2000).

Older homeless men were more likely to be HCV positive although in the general population, younger people are more likely to have contracted HCV. This result may be due to the special nature of this sample, which consisted of homeless men who may have had longstanding injection drug habits, which have greatly increased their chances of contracting HCV (Garfein et al., 1996).

The association with greater age may have also contributed to the strong association between homelessness severity and HCV positive status. However, the latent variable path analysis revealed an independent association as well between homelessness severity and HCV. This result supports prior findings that longer periods of homelessness and more episodes of homelessness are associated with poorer health outcomes and greater health risks (e.g., Stein and Gelberg, 1997; Stein et al., 2000, 2002).

Histories of incarceration and tattoos were also independently associated with positive HCV status. We do not know if their tattoos were acquired while they were incarcerated or if they were obtained in a tattoo parlor. This should be explored further, especially because tattoos were more common among younger men in this data set despite the independent relationships between greater age and positive HCV, and more tattoos and positive HCV.

4.1. Limitations

This sample may not be representative of all homeless men living in the Skid Row area of Los Angeles because they were recruited at a health center. Homeless individuals attending and recruited in a health clinic, even if it is free, may differ in some respects from the greater homeless community (Johnson, 1989; Piliavin et al., 1989). However, in a study contrasting homeless clinic attendees with homeless people in the greater community, Stein and Gelberg (1997) found that homeless free clinic attendees reported substance abuse and psychological problems paralleling those of the community homeless sample.

Furthermore, limiting the study to men also lessened the generalizability of our findings. Clearly, a study assessing correlates of HCV among homeless women would be of great benefit. We encourage future research to assess HCV risk among homeless women. The setting of this study in

Los Angeles may also limit its generalizability. In addition, we rely on self-report measures of substance use behaviors, and sexual behaviors. Previous work in this type of sample has indicated that the rapport developed between study participants and the carefully obtained research staff increases the reliability of their responses (Nyamathi et al., 2001).

4.2. Conclusion

It is likely that HCV positive status predated the current injection drug activities that encompass both use of heroin and other injection drugs and sharing of needles and works reported by many HCV-positive homeless individuals. Therefore, in this particular population, those that are HCV positive are likely to be persisting in behaviors that are putting others at risk and that also will be compromising their own health. It is important to know salient correlates of HCV status within an at-risk population to alert health care professionals and outreach workers to those most likely to be carrying this disease.

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