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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., 2003). 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. Sendi 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...
Samuel et al. (2001) reported that case-control studies have found no association between tattooing and HCV. HCV is prevalent in jails and prisons (Hammitt, 2003; Hammitt et al., 2002). Hammitt 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 (Nymath 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 (cook, cots).

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 $\chi^2$ (S–B $\chi^2$), the robust comparative fit index (RCFI), and the root mean squared error of approximation (RMSEA; Hu and Bentler, 1999). The S–B $\chi^2$ 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).
were HCV-negative: heroin combined with cocaine (speed, ice), 31% versus 20%; and methamphetamine (e.g., speed, ice), 43% versus 12%; heroin, 57% versus 22%; street methadone, 14% versus 7%; and methamphetamine (e.g., speed, ice), 31% versus 20%.

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.

2.5. 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; nearly 36% were separated or divorced. Twenty-nine percent were in an intimate relationship with a partner or spouse. Eighty-eight percent rated or divorced. Twenty-nine percent were in an intimate relationship with a partner or spouse. Eighty-eight percent

<table>
<thead>
<tr>
<th>Variables (range)</th>
<th>Mean (S.D.)</th>
<th>Factor loadings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCV positive (0–1)</td>
<td>0.53 (0.50)</td>
<td>–</td>
</tr>
<tr>
<td>Non-injection substance use history</td>
<td>1.45 (0.31)</td>
<td>0.73</td>
</tr>
<tr>
<td>Stimulants (1–2)</td>
<td>1.36 (0.27)</td>
<td>0.72</td>
</tr>
<tr>
<td>Depressants (1–2)</td>
<td>1.36 (0.23)</td>
<td>0.65</td>
</tr>
<tr>
<td>Recent injection behaviors</td>
<td>1.58 (1.77)</td>
<td>0.44</td>
</tr>
<tr>
<td>Heroin frequency (1–9)</td>
<td>0.09 (0.32)</td>
<td>0.47</td>
</tr>
<tr>
<td>Six-month injection (0–2)</td>
<td>0.62 (0.87)</td>
<td>0.66</td>
</tr>
<tr>
<td>Non-injection sharing</td>
<td>1.38 (0.49)</td>
<td>0.60</td>
</tr>
<tr>
<td>Cocaine straws (1–2)</td>
<td>1.44 (0.50)</td>
<td>0.48</td>
</tr>
<tr>
<td>Toothbrush (1–2)</td>
<td>1.22 (0.41)</td>
<td>0.44</td>
</tr>
<tr>
<td>Homelessness severity</td>
<td>4.63 (7.14)</td>
<td>0.85</td>
</tr>
<tr>
<td>Number of times (0–60)</td>
<td>4.85 (5.13)</td>
<td>0.66</td>
</tr>
<tr>
<td>Years homeless (0–23)</td>
<td>4.14 (0.49)</td>
<td>–</td>
</tr>
<tr>
<td>Alcohol problems (1–2)</td>
<td>1.62 (0.49)</td>
<td>0.73</td>
</tr>
<tr>
<td>Need to cut down</td>
<td>1.46 (0.59)</td>
<td>0.68</td>
</tr>
<tr>
<td>Feel guilty</td>
<td>1.5 (0.58)</td>
<td>0.83</td>
</tr>
<tr>
<td>Wake-up drink</td>
<td>1.5 (0.47)</td>
<td>0.60</td>
</tr>
<tr>
<td>STIs (0–4)</td>
<td>0.50 (0.61)</td>
<td>–</td>
</tr>
<tr>
<td>Risky sexual behaviors—6 months</td>
<td>0.33 (0.46)</td>
<td>0.45</td>
</tr>
<tr>
<td>Vaginal sex—no condom (%)</td>
<td>0.27 (0.43)</td>
<td>0.51</td>
</tr>
<tr>
<td>Oral sex—no condom (%)</td>
<td>1.87 (3.81)</td>
<td>0.62</td>
</tr>
<tr>
<td>Number of sex partners (0–40)</td>
<td>1.83 (0.38)</td>
<td>–</td>
</tr>
<tr>
<td>Age (18–63 years)</td>
<td>43.79 (8.91)</td>
<td>–</td>
</tr>
</tbody>
</table>

* All factor loadings significant at P ≤ 0.001

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 ≤ 0.001). 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 ≤ 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.
less (Beech et al., 2002). Recent injection drug use behaviors often cluster together, especially among the home-
positive status and a non-injection drug history. These be-
use accounted for the high initial correlation between HCV
association between drug history and recent injection drug
predictors had an acceptable fit: S–B
which also included the significant correlations among the
iors was the strongest predictor of HCV status. This model,
This model explained 38% of the variance in HCV status.
This trimmed model explained 36% of the variance in HCV
status, we first assessed a saturated path model in
3.3. Latent variable path analysis
To ascertain which variables were most associated with
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 behavior-
or, non-needle sharing behaviors, homelessness severity,
tattoos, STDs, jail/prison, and greater age.
Of particular interest were associations between HCV
status and each latent variable in the model (see Table 2).
Table 2
Correlations among all model variables for 198 homeless men

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>0.35***</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>III</td>
<td>0.46***</td>
<td>0.49***</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>0.17*</td>
<td>0.66***</td>
<td>0.43***</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>0.25*</td>
<td>0.27**</td>
<td>0.20*</td>
<td>0.03</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>0.16*</td>
<td>0.08</td>
<td>0.20*</td>
<td>0.09</td>
<td>0.11</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>0.02</td>
<td>0.25**</td>
<td>0.14</td>
<td>0.25**</td>
<td>0.14</td>
<td>0.18*</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>0.15</td>
<td>0.31***</td>
<td>0.23***</td>
<td>0.24**</td>
<td>0.05</td>
<td>0.08</td>
<td>0.09</td>
<td></td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>0.18*</td>
<td>0.18*</td>
<td>0.05</td>
<td>0.20*</td>
<td>0.01</td>
<td>0.07</td>
<td>0.19*</td>
<td>0.13</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>X</td>
<td>0.38***</td>
<td>0.29***</td>
<td>0.26**</td>
<td>0.15</td>
<td>0.12</td>
<td>0.11</td>
<td>0.10</td>
<td>0.04</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>XI</td>
<td>0.24**</td>
<td>0.13</td>
<td>0.02</td>
<td>0.05</td>
<td>0.11*</td>
<td>0.15*</td>
<td>0.07</td>
<td>0.09</td>
<td>0.12</td>
<td>0.12</td>
</tr>
</tbody>
</table>

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 

4. Discussion
Hepatitis C virus is common in areas with a high concen-
tration of homeless people and can be transmitted easily,
especially through the sharing of contaminated IDU para-
phernalia. 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 shar-
ing 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., Garfen et al., 1996).
Thus, it is alarming that the injection-related behaviors
which included needle and equipment sharing were be-
haviors 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 ed-
ucation 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 legaliza-
tion of needle exchange programs should be fully promot-
ing such activities and pursuing legislative changes. Cur-
rently 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 nee-
dle 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 al-
cohol problems and HCV status, this result may have been
due to a weakness in our using a lifetime measure of alco-
hol problems rather than more current information. There
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.

Acknowledgements

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