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ORIGINAL PAPER

# The Impact of Chronic Hepatitis C on Health-Related Quality of Life in Homeless and Marginally Housed Individuals with HIV

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**Abstract** Although infection with Hepatitis C Virus (HCV) and Human Immunodeficiency Virus (HIV) frequently co-exist, there has been little research to determine the effects of HIV/HCV co-infection on health-related quality of life (HRQOL). We performed a cross-sectional analysis of baseline data from 216 participants enrolled in a community based study of HIV-infected homeless and marginally housed individuals, using multivariable linear regression analysis to determine if co-infection with HCV was independently associated with lower short-form 36 (SF-36) questionnaire scores. We found that individuals with HCV had significantly lower mean SF-36 scores in the domains of physical functioning, bodily pain, social functioning and role limitation due to emotional health, and that HIV/HCV co-infection was independently associated with a lower physical component score but not a lower mental component score after controlling for numerous covariates. These results suggest that co-infection with HCV may have an adverse effect on HRQOL among homeless and marginally housed individuals with HIV.

**Keywords** Hepatitis C · HIV · Quality of Life · Homelessness

**Abbreviations**

| | |
|---|---|
| HCV | Hepatitis C virus |
| HRQOL | Health-related quality of life |
| HIV | Human immunodeficiency virus |
| SF-36 | Short form 36 |
| PCS | Physical component scale |
| MCS | Mental component scale |
| HAART | Highly active anti-retroviral therapy |
| HMH | Homeless/marginally housed |

## Introduction

Hepatitis C virus (HCV) and Human Immunodeficiency Virus (HIV) are major public health issues of the twenty-first century (Alter et al., 1999; Sulkowski & Thomas, 2003). Because of overlapping risk factors, HIV/HCV co-infection is common: approximately 30% of all individuals with HIV and 50–70% of HIV-positive injection drug users are also infected with HCV (Fleming, Craven, Thorton, Tumility, & Nunes,

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2003). Homeless individuals have high rates of both diseases (Cheung, Hanson, Maganti, Keeffe, & Matsui, 2002; Culhane, Gullub, kuhn, & Shpaner, 2001; Nyamathi et al., 2002; Robertson et al., 2004).

Health-related quality of life (HRQOL) is increasingly recognized as an important measurement of overall function in patients with HIV and HCV as the goals of care have shifted from simple survival to patient-centered outcomes. There are numerous measurement instruments that have been applied to quantify HRQOL, one of the most common being the short form-36 (SF-36). The SF-36 health survey is a self-reported generic measure of health status that includes physical, emotional, and social components to provide a comprehensive measurement of health status (Wu, Hays, Kelly, Malitz, & Bozzette, 1997).

Prior studies indicate that individuals with chronic HCV infection have diminished HRQOL even in the absence of significant liver disease, and that improvements in HRQOL can be achieved through successful treatment of HCV (Bayliss et al., 1998; Cordoba et al., 2003a, b; Foster, Goldin, & Thomas, 1998; Gallegos-Orozco et al., 2003; Hunt et al., 1997; Kramer et al., 2002; McHutchison et al., 2001). A recent systematic review of the effects of HCV on HRQOL found that HCV was associated with worse HRQOL across all SF-36 subscales, but had the strongest effect in the domains of vitality, general health, physical function and social function (Spiegel et al., 2005). Likewise, symptomatic HIV infection and AIDS also have been associated with reduced HRQOL (Call et al., 2000; Gill et al., 2002; Hays et al., 2000).

There is little research to determine if HCV affects HRQOL in patients who are already infected with HIV. As patients who are co-infected with HIV/HCV increasingly become eligible for HCV treatment, understanding the impact of HCV on HRQOL in these patients is an important component of weighing the risks and benefits of treatment. Although prior studies among patients infected with HCV alone support an association between HCV and HRQOL, two previously published studies examining the effects of co-infection did not find that infection with HCV further diminished HRQOL compared to patients with HIV alone (Fleming et al., 2003; Kanwal et al., 2005). However, those studies were conducted on patients seen in specialty clinics who were receiving care for their HIV, and may not be representative of other subpopulations, such as homeless and marginally housed individuals with HIV.

The objective of this study was to determine how infection with HCV impacts HRQOL among homeless and marginally housed individuals with HIV. Based on prior literature, we hypothesized that individuals with HIV and HIV/HCV would have mean SF-36 scores lower than norms for the general U.S. population, and that there would be further decrements seen in patients who were co-infected with HCV/HIV compared with those who had HIV alone.

## Method

### Participants and Procedures

This was a cross-sectional study of participants enrolled in the ''Research in Access to Care in the Homeless'' (REACH) cohort who agreed to undergo HCV testing of baseline stored blood samples. The REACH study is an ongoing community-based study of HIV-infected homeless and marginally house adults living in San Francisco that was established in 1996. The cohort is a systematic sample of individuals drawn from homeless shelters, free-lunch programs, and select residential hotels who tested positive for HIV. Details on sampling methods and recruitment have been published previously (Hall, Charlebois, Hahn, Moss, & Bangsberg, 2004; Riley et al., 2003; Robertson et al., 2004). Initial screening of 4,682 individuals identified 386 who were HIV-positive, of which 330 agreed to participate. Individuals who agreed to participate underwent a detailed interview that included the SF-36 questionnaire. Subsequently 249 of the initial cohort were contacted and agreed to HCV testing. Of the 81 who were not tested the various reasons included: having died (43), having relocated (16), being lost to follow-up (15), withdrawing participation (5), and being incarcerated (2). Our sample further consisted of 216 individuals who had no missing results for HCV testing and the SF-36 questionnaire.

### Measures

The main outcome measurement was HRQOL as described by the SF-36. This instrument has been found to be reliable and valid in homeless and marginally housed populations (Riley et al., 2003). The survey instrument consists of 36 items that measure the following eight scales: general health perceptions (GH), physical functioning (PF), role limitation because of physical health (RP), role limitation because of emotional health (RE), social functioning (SF), bodily pain (BP), vitality (VT), and mental health (MH). Scores were calculated for each subscale by converting summated item responses to a scale from 0 to 100 (Ware, Kosinski, & Gandek, 2004). Physical and

mental component scores (PCS and MCS) were constructed based on results from the eight subscales (Ware et al., 1995), and were also scaled 0 to 100 with higher scores being indicative of better health status.

The primary predictor of interest was chronic HCV infection as determined by serologic and viral load testing. Participants were tested for HCV antibody using an enzyme immunoassay (EIA; Hepatitis C Enzyme Immunoassay 2.0, Abbott Laboratories, Emeryville, CA), and positive EIA results were followed up by testing with a polymerase chain reaction (PCR) assay to detect HCV RNA viral load (Amplicor Monitor Hepatitis C Virus Test, version 2.0 Roche Molecular Systems, Inc., Branchburg, N.J.). Participants who were EIA positive and had detectable HCV RNA were considered HCV positive. Patients who were EIA positive but HCV RNA negative were assumed to have cleared their infection or to have had a false positive EIA, and were considered HCV negative for the purposes of this study.

Additional covariates included directly measured baseline CD-$4^+$ T-cell count and log of HIV viral load, as well as the following self-reported baseline questionnaire information: age, gender, race, receipt of highly-active anti-retroviral therapy (HAART), co-morbidities (self-reported history of heart disease, high blood pressure, diabetes, emphysema or asthma), insurance status (having Medicaid/Medicare, Veterans Administration benefits or other health insurance), disability status, having a primary care provider and current (defined as within 30 days) use of injection drugs, crack cocaine and alcohol use (any amount).

### Data Analyses

Descriptive statistics comparing participants with and without chronic hepatitis C were calculated using chi-square analysis for categorical data, Student's *t*-test assuming unequal variance for continuous data. Statistically significant differences in mean SF-36 subscale results between individuals with and without HCV were tested using the student's *t*-test. Multivariable linear regression was used to assess the relationship between HCV and component summary scores (PCS and MCS), adjusting for other variables. Full models were constructed using all the covariates used in the descriptive statistics. We then selected covariates for the final model based on the strength of statistical association with the outcome and their ability to confound the estimate for HCV. Covariates were evaluated in a step-wise backward fashion and were dropped if: (a) the *P*-value for the strength of the association was >0.2; and (b) inclusion of the covariate in the model did not cause a substantial (i.e. >10%) change in the beta-coefficient estimate for HCV (Vittinghoff, Glidden, Shiboski, & Mcculloch, 2005). Prior to model fitting, collinearity with HCV was assessed using a correlation matrix and by analyzing two-by-two tables between HCV and dichotomous variables. The final models were checked for model assumptions and fit. A *P*-value $<0.05$ was considered significant for all hypothesis testing.

## Results

Among the 216 study participants, 17% were female and the median age was 41. The majority of participants were non-white: 43% were black, 7% were Hispanic, 1% were Asian, 3% were Native American, 1% were Hawaiian, Filipino or Pacific Islander and 4% were other. For the analysis, we chose to analyze the data using a dichotomous variable for non-white race, which collapsed all the categories of participants who did not respond as being white. The HCV antibody test was positive in 142 (66%) of participants, among whom 120 (84%) were found to have detectable virus. Therefore the prevalence of chronic HCV in our sample was 56%.

Comparing patients with HIV alone to those co-infected with HIV/HCV, there were no significant differences in age, race, gender, CD4 count, log viral load, receipt of HAART therapy, presence of co-morbidities, insurance or disability status or having a primary care provider (Table 1). However, unadjusted differences were seen in drug-use behaviors: patients with HCV were more likely to be currently using injection drugs and crack cocaine (chi-square *P*-value $<0.05$). In our exploration of collinearity between HCV and the self-reported drug use variables (current injection drug use, current crack cocaine use and current alcohol use) we found that Pearson's correlation coefficient values were low ( $<0.25$). Additionally, when we constructed two-by-two tables of HCV status and each drug use variable, we found that cells with discordant results (i.e. current IDU/HCV negative and no current IDU/HCV positive) contained >30% of the total observations, suggesting that HCV and drug use are not strictly collinear in this population.

Mean SF-36 subscale scores were consistently lower in both HIV-infected and HIV/HCV co-infected individuals compared with the U.S. population norms (Fig. 1) (Ware et al., 2004). Scores were lower in all domains for individuals co-infected with HIV/HCV compared with HIV alone, although the effect was

**Table 1** Sample characteristics by Hepatitis C status

| | HCV Negative ($N$ = 74) % or Mean ($SD$) | HCV Positive ($N$ = 142) % or Mean ($SD$) | Test statistic[a] ($df$, $N$) |
|---|---|---|---|
| Female | 15 | 19 | 0.57 (1, 213) |
| Non-white | 53 | 63 | 2.29 (1, 216) |
| Age | 40 (±9.5) | 42 (±7.8) | –1.73 (213, 215) |
| Current HAART Therapy | 24 | 16 | 2.25 (1, 216) |
| CD4 Count <200 | 24 | 23 | 0.06 (1, 216) |
| Current IDU | 24 | 45 | 9.95 (1, 213)** |
| Current Crack Use | 24 | 39 | 4.83 (1, 213)* |
| Current Alcohol Use | 60 | 58 | 0.05 (1, 198) |
| Comorbid Medical Conditions | 26 | 33 | 1.15 (1, 215) |
| Drug Treatment in Past Year | 25 | 40 | 5.61 (1, 215)* |
| Insured | 57 | 55 | 0.15 (1, 215) |
| On Disability | 56 | 63 | 1.02 (1, 215) |
| Regular Healthcare Provider | 84 | 80 | 0.69 (1, 216) |
| Homeless in the Past Year | 41 | 42 | 0.02 (1, 216) |

[a]Student's $t$-test for age and natural log of viral load only; all others represent a Chi-square test statistic

*$P \leq 0.05$, **$P \leq 0.01$

statistically significant only for physical functioning, social function, role limitation-emotional, and bodily pain (Table 2).

In the analysis of component summary scores, participants with HCV were found to have PCS that were on average more than three points lower than participants who did not have HCV (adjusted final model β = –3.73, 95% CI: –6.45 to –1.01); (Table 3). Being female, having additional medical co-morbidities and a higher HIV viral load were highly associated with lower PCS in the multivariate models. Participants who were infected with HCV did not appear to have significantly lower MCS (adjusted final model β = –2.07, 95% CI:–5.53 to 1.40); (Table 4). Younger age, not being on HAART, having co-morbidities and being insured were significantly associated with lower MCS in the multivariable analysis.

## Discussion

In this study of 216 homeless and marginally housed individuals with HIV, we found that participants who were co-infected with HIV/HCV had significantly lower mean SF-36 scores in the domains of physical functioning, bodily pain, social functioning and role-emotional. In addition, we found that having HCV infection was associated with a mean summary score for physical health that was more than three points lower.

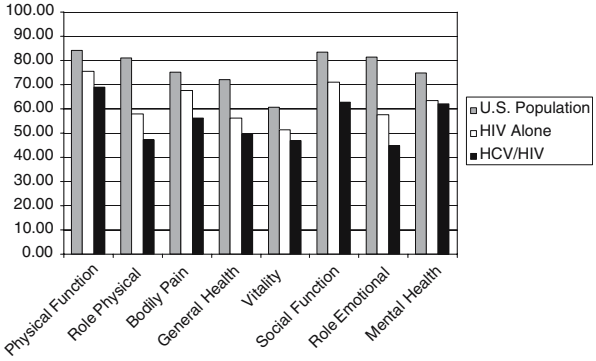


**Fig. 1** Mean SF–36 subscale scores of cohort compared to US population norms (Adapted from Ware et al., 2004)

Although statistically significant differences in HRQOL measures were observed among HIV infected and HIV/HCV co-infected participants, the clinical significance of these results should be evaluated. Previous authors have suggested that 3- to 5-point difference in SF-36 scores may represent a minimum clinically important difference, with a difference of 10 points showing a moderate difference (Samsa et al., 1999). In our study the significant differences in mean subscale scores ranged between 7 and 13 points, suggesting clinically significant effects of HCV on HRQOL. An alternate way to evaluate clinical significance is to compare effect size (calculated as the difference in mean scores between two groups and divided by the standard deviation from group 1). It has been suggested that a value of <0.2 represents a small clinical effect, 0.5 a moderate effect, and >0.8 a large effect (Hays & Woolley, 2000). The effect size observed for the domains that had significantly different means ranged from 0.3–0.5, with the largest effect size seen in the domain of bodily pain. These results support the hypothesis that there are modest differences in HRQOL among homeless and marginally housed individuals with HIV who are co-infected with HCV compared to HIV alone.

Our findings differ from prior studies that have not found additional decrements in perceived health-related quality of life among co-infected HCV/HIV patients compared with patients who have HIV alone (Fleming et al., 2003; Kanwal et al., 2005). One

**Table 2** Mean SF-36 scores by HCV status

| SF-36 Category | HIV Alone (*SD*) | HIV/HCV (*SD*) | Test statistic* | *P*-value |
|---|---|---|---|---|
| Sub-scale | | | | |
| Physical Functioning | 76 (22) | 69 (25) | 2.00 | 0.05 |
| Role Limitations-Physical | 58 (42) | 47 (43) | 1.85 | 0.07 |
| Bodily Pain | 68 (25) | 56 (28) | 3.14 | <0.01 |
| General Health | 56 (24) | 50 (27) | 1.83 | 0.07 |
| Vitality | 51 (23) | 47 (25) | 1.37 | 0.17 |
| Social Function | 71 (27) | 63 (29) | 2.15 | 0.03 |
| Role Limitations-Emotional | 58 (44) | 45 (43) | 2.19 | 0.03 |
| Mental Health | 63 (22) | 62 (24) | 0.46 | 0.65 |
| Summary score | | | | |
| Physical Component | 46 (9) | 42 (12) | 2.65 | <0.01 |
| Mental Component | 43 (12) | 41 (13) | 1.18 | 0.24 |

*Test statistic is Student's *t*-test; $df = 214$ and $N = 216$ for all comparisons

possible explanation for the divergent findings could be that the participants in our sample differed in severity of liver disease related to their HCV. Prior research on this cohort has revealed that the minority of patients had received care for their HCV: only 28% reported referral to a gastroenterologist and less than 4% reported ever having been treated (Hall et al., 2004). Furthermore, behaviors that are risk factors for disease progression such as drinking alcohol and smoking may have been higher in our cohort, also leading to more severe chronic liver disease.

While our study is concordant with prior literature on HCV mono-infected patients that show that HCV is associated with lower HRQOL, the specific ways in which health status was affected in this population differed from previous studies. A recently published systematic analysis (Spiegel et al., 2005) reported that the impact of HCV on HRQOL was seen across all subscales as well as the component summary scores (MCS and PCS). However, we did not see an effect of HCV infection on the mental health subscale, nor was HCV significantly associated with the MCS in the unadjusted or adjusted analysis. This may be somewhat surprising given that there has been prior research suggesting an association between HCV and depression and neurocognitive deficits (Cordoba et al., 2003a, b; Fontana et al., 2002; Forton, Taylor-Robinson, & Thomas, 2003; Hilsabeck, Hassanein, Carlson, Ziegler, & Perry, 2003; Kramer et al., 2002; Rowan, Tabasi, Abdul-Latif, Kunik, & El-serag, 2004). One possibility is that our sample was underpowered to show an association (there was a nonsignificant trend between HCV infection and MCS). Another possibility is that this population of homeless and marginally housed

**Table 3** Association between HCV infection and Physical Component Score (PCS)

| Predictors | Unadjusted β coefficient (95% CI) | *P*-value | Full Model | | Final Model* | |
|---|---|---|---|---|---|---|
| | | | Adjusted β coefficient (95% CI) | *P*-value | Adjusted β coefficient (95% CI) | *P*-value |
| HCV Infection | –3.75 (–6.54 to –0.96) | <0.01 | –3.04 (–5.98 to –0.11) | 0.04 | –3.73 (–6.45 to –1.01) | <0.01 |
| Age | –0.06 (–0.22 to 0.11) | 0.48 | –0.03 (–0.21 to 0.14) | 0.71 | — | |
| Female | –7.03 (–10.71 to –3.35) | <0.01 | –6.36 (–10.15 to –2.57) | <0.01 | –6.59 (–10.17 to –3.01) | <0.01 |
| Non-white race | 0.90 (–1.96 to 3.77) | 0.54 | 2.02 (–0.93 to 4.98) | 0.18 | 2.14 (–0.59 to 4.87) | 0.12 |
| HAART | 0.54 (–3.03 to 4.10) | 0.77 | –3.48 ( –7.43 to 0.46) | 0.08 | –3.41 (–7.12 to 0.30) | 0.07 |
| Low CD4 count | –4.09 (–7.34 to –0.79) | 0.02 | –1.05 ( –4.44 to 2.33) | 0.54 | — | |
| Log HIV viral load | –0.61 (–1.00 to –0.23) | <0.01 | –0.77 (–1.21 to –0.33) | <0.01 | –0.81 (–1.21 to –0.40) | <0.01 |
| Current IDU | –3.04 (–5.96 to –0.11) | 0.04 | –1.04 (–4.15 to 2.07) | 0.51 | — | |
| Current crack cocaine | –2.35 (–5.37 to 0.67) | 0.13 | –1.11 (–4.35 to 2.12) | 0.50 | — | |
| Current alcohol | –1.56 (–4.50 to 1.39) | 0.30 | –1.83 ( –4.84 to 1.17) | 0.23 | –2.01 ( –4.76 to 0.74) | 0.07 |
| Co-morbidities | –4.54 (–7.58 to –1.51) | <0.01 | –4.66 (–7.86 to –1.46) | <0.01 | –4.73 ( –7.68 to –1.79) | <0.01 |
| Drug treatment in the past year | –2.61 (–5.59 to 0.37) | 0.09 | –0.73 (–3.79 to 2.34) | 0.64 | — | |
| Insured | –1.78 (–4.62 to 1.06) | 0.22 | 0.66 ( –2.74 to 4.06) | 0.70 | — | |
| Disability | –3.06 (–5.92 to –0.20) | 0.04 | –0.89 (–4.56 to 2.79) | 0.63 | — | |
| Regular healthcare provider | –2.18 (–5.83 to 1.48) | 0.24 | –2.04 (–5.90 to 1.83) | 0.30 | –2.52 (–6.00 to 0.97) | 0.16 |
| Homeless in the past year | –0.89 (–3.75 to 1.98) | 0.54 | 0.62 ( –2.45 to 3.68) | 0.69 | — | |

*Includes covariates if they are significant at a $P < 0.2$ level, or if inclusion of the covariate in the model changes the estimate of the beta-coefficient for HCV ≥10%

**Table 4** Association between HCV infection and Mental Component Score (MCS)

| Predictors | Unadjusted β coefficient (95% CI) | *P*-value | Full Model | | Final Model* | |
|---|---|---|---|---|---|---|
| | | | Adjusted β coefficient (95% CI) | *P*-value | Adjusted β coefficient (95% CI) | *P*-value |
| HCV Infection | –2.03 (–5.43 to 1.37) | 0.241 | –2.31 (–6.01 to 1.39) | 0.22 | –2.07 (–5.53 to 1.40) | 0.24 |
| Age | 0.28 (0.09 to 0.48) | <0.01 | 0.36 (0.14 to 0.59) | <0.01 | 0.35 (0.15 to 0.56) | <0.01 |
| Female | –1.25 (–5.82 to 3.32) | 0.59 | 0.57 (–4.22 to 5.35) | 0.82 | — | |
| Non-white race | 3.60 (0.19 to 7.01) | 0.04 | 3.06 (–0.67 to 6.78) | 0.11 | 3.35 (–0.14 to 6.83) | 0.06 |
| HAART | 5.48 (1.26 to 9.70) | .01 | 6.07 (1.10 to 11.05) | 0.02 | 6.43 (1.71 to 11.16) | <0.01 |
| Low CD4 count | 0.66 (–3.36 to 4.68) | 0.74 | 1.40 (–2.88 to 5.67) | 0.52 | — | |
| Log HIV viral load | 0.01 (–0.46 to 0.48) | 0.97 | 0.31 (–0.24 to 0.87) | 0.27 | 0.38 (–0.13 to 0.89) | 0.15 |
| Current IDU | –1.53 (–5.09 to 2.03) | 0.40 | 0.16 (–3.76 to 4.09) | 0.94 | — | |
| Current crack cocaine | 0.62 (–3.04 to 4.28) | 0.74 | 0.59 (–3.49 to 4.68) | 0.77 | — | |
| Current alcohol | 0.35 (–3.28 to 3.97) | 0.85 | 0.06 (–3.73 to 3.84) | 0.98 | 0.40 (–3.05 to 3.84) | 0.82 |
| Co-morbidities | –1.91 (–5.62 to 1.80) | 0.31 | –4.39 (–8.43 to –0.35) | 0.03 | –3.85 (–7.64 to –0.05) | 0.05 |
| Drug treatment in the past year | –3.69 (–7.26 to –0.13) | 0.04 | –3.27 (–7.14 to 0.6) | 0.10 | –2.58 (–6.18 to 1.02) | 0.16 |
| Insured | –2.45 (–5.86 to 0.96) | 0.16 | –4.49 (–8.78 to –0.2) | 0.04 | –3.88 (–7.41 to –0.35) | 0.03 |
| Disability | –1.55 (–5.01 to 1.91) | 0.38 | 1.19 (–3.44 to 5.83) | 0.61 | — | |
| Regular healthcare provider | 1.09 (–3.32 to 5.49) | 0.63 | 0.54 (–4.34 to 5.41) | 0.83 | — | |
| Homeless in the past year | –1.36 (–4.80 to 2.08) | 0.44 | 1.08 (–2.79 to 4.95) | 0.58 | — | |

*Includes covariates if they are significant at a $P < 0.2$ level, or if inclusion of the covariate in the model changes the estimate of the beta-coefficient for HCV ≥10%

individuals with HIV already have such substantially diminished mental health so that additional co-infection with HCV does not cause further decrements in their mental health status. However, it is also conceivable that HCV infection has less impact on mental health status through its biological effects alone than does the awareness of having hepatitis that occurs through diagnosis. This has been referred to in prior literature as the ''labeling effect'' (Cordoba et al., 2003a, b).

To address the question of whether awareness would differ from actual infection, we conducted an additional analysis using awareness of having hepatitis C as a predictor. We used data from 138 participants who had information on self-reported hepatitis C status (i.e. responded *yes* to the question ''Have you ever been told you had hepatitis C?''), which was collected an average of 8.5 days after the SF-36 data were collected (standard deviation 7.6 days). In this analysis, individuals who were told that they had hepatitis C had a mean MCS nearly five points lower (adjusted β = –4.92; 95% CI: –9.71 to –0.13). In contrast, being aware of having hepatitis did not appear to be strongly associated with a lower mean PCS after adjustment for confounders (adjusted β = –2.72; 95% CI: –6.52 to 1.09). Our findings lend support to the hypothesis that awareness of infection is a stronger predictor for mental HRQOL than actual HCV infection. Conversely, it appeared that the physical HRQOL was significantly associated with actual infection rather than with awareness of infection.

Our findings have implications for testing, treatment and management of homeless and marginally housed individuals with HIV who are co-infected with HCV. Research is accumulating to suggest that treating co-infected patients for HCV is relatively safe and efficacious (Carrat et al., 2004; Chung et al., 2004; Laguno et al., 2004; Torriani et al., 2004). As clinicians weigh the potential risks and benefits of treatment for HCV in this patient population, the impact that HCV has on patients' self-reported HRQOL should enter into consideration. Studies are needed to determine if treatment of HCV in co-infected patients results in improvements in reported HRQOL, as has been reported in mono-infected patients. Finally, additional research is needed to see if the decrements in HRQOL that we observed among co-infected participants are associated with different patterns of health-services utilization and adherence.

There are a number of potential limitations to this study. As mentioned previously, there were no data available on extent of liver disease, making it impossible to determine if lower SF-36 scores in patients with HCV were due to more advanced liver disease. However, prior research on patients with HCV suggests that the effects of HCV on HRQOL are independent of histologic and biochemical indices, although decompensated cirrhosis clearly affects HRQOL (Foster et al., 1998). Another limitation of the study is its cross-sectional design that precludes conclusions about causality between HCV and HRQOL. Additionally, by collapsing all non-white ethnicities into one category,

we may have been concealing potential ethnic differences. However, the small numbers of non-white/non-black participants did not allow us to perform analyses using finer categorization. Finally, the analysis that used an awareness of HCV as a predictor could only be performed on a subset of individuals who were asked the question ''Have you ever been told you have hepatitis C?'' on a questionnaire. However, this occurred as a result of study logistics rather than participant non-response, minimizing the potential for non-response bias.

This study also has important strengths. It is unique in that it was conducted among a population of homeless or marginally housed individuals, a group that is disproportionately affected by HIV and HCV, but not traditionally included within HRQOL research on those diseases. This study also collected detailed clinical information on drug use behaviors and other potential confounding variables, making it possible to ascertain the independent effects of HCV.

In summary, among a cohort of homeless or marginally housed individuals with HIV, co-infection with HCV was associated with lower SF-36 scores in the domains of physical functioning, social function, role limitation-emotional, and bodily pain. Based on component summary scores, being infected with HCV was associated with poorer physical health status, but not mental health status; however, being aware of having hepatitis was associated with poorer mental health status. When considering the burden of disease for patients co-infected with HIV and HCV, the impact of HCV on HRQOL should be taken into account. Further research is needed to confirm these findings, and determine whether treatment can result in improvements in HRQOL among patients co-infected with HCV and HIV.

## References


Alter, M. J., Kruszon-Moran, D., Nainan, O. V., McQuillan, G. M., Gao, F., Moyer, L. A., et al. (1999). The prevalence of hepatitis C virus infection in the United States, 1988 through 1994. *New England Journal of Medicine, 341*, 556–562.

Bayliss, M. S., Gandek, B., Bungay, K. M., Sugano, D., Hsu, M. A., & Ware, J. E. Jr. (1998). A questionnaire to assess the generic and disease-specific health outcomes of patients with chronic hepatitis C. *Quality of Life Research, 7*, 39–55.

Call, S. A., Klapow, J. C., Stewart, K. E., Westfall, A. O., Mallinger, A. P., DeMasi, R., et al. (2000). Health-related quality of life and virologic outcomes in an HIV clinic. *Quality of Life Research, 9*, 977–985.

Carrat, F., Bani-Sadr, F., Pol, S., Rosenthal, E., Lunel-Fabiani, F., Benzekri, A., et al. (2004). Pegylated interferon alfa-2b vs standard interferon alfa-2b, plus ribavirin, for chronic hepatitis C in HIV-infected patients: A randomized controlled trial. *Journal of the American Medical Association, 292*, 2839–2848.

Cheung, R. C., Hanson, A. K., Maganti, K., Keeffe, E. B., & Matsui, S. M. (2002). Viral hepatitis and other infectious diseases in a homeless population. *Journal of Clinical Gastroenterology, 34*, 476–480.

Chung, R. T., Andersen, J., Volberding, P., Robbins, G. K., Liu, T., Sherman, K. E., et al. (2004). Peginterferon Alfa-2a plus ribavirin versus interferon alfa-2a plus ribavirin for chronic hepatitis C in HIV-coinfected persons. *New England Journal of Medicine, 351*, 451–459.

Cordoba, J., Flavia, M., Jacas, C., Sauleda, S., Esteban, J. I., Vargas, V., et al. (2003a). Quality of life and cognitive function in hepatitis C at different stages of liver disease. *Journal of Hepatology, 39*, 231–238.

Cordoba, J., Reyes, J., Esteban, J. I., & Hernandez, J. M. (2003b). Labeling may be an important cause of reduced quality of life in chronic hepatitis C. *American Journal of Gastroenterology, 98*, 226–227.

Culhane, D. P., Gollub, E., Kuhn, R., & Shpaner, M. (2001). The co-occurrence of AIDS and homelessness: Results from the integration of administrative databases for AIDS surveillance and public shelter utilisation in Philadelphia. *Journal of Epidemiology and Community Health, 55*, 515–520.

Fleming, C. A., Craven, D. E., Thornton, D., Tumilty, S., & Nunes, D. (2003). Hepatitis C virus and human immunodeficiency virus coinfection in an urban population: Low eligibility for interferon treatment. *Clinical Infectious Diseases, 36*, 97–100.

Fontana, R. J., Hussain, K. B., Schwartz, S. M., Moyer, C. A., Su, G. L., & Lok, A. S. (2002). Emotional distress in chronic hepatitis C patients not receiving antiviral therapy. *Journal of Hepatology, 36*, 401–407.

Forton, D. M., Taylor-Robinson, S. D., & Thomas, H. C. (2003). Cerebral dysfunction in chronic hepatitis C infection. *Journal of Viral Hepatitis, 10*, 81–86.

Foster, G. R., Goldin, R. D., & Thomas, H. C. (1998). Chronic hepatitis C virus infection causes a significant reduction in quality of life in the absence of cirrhosis. *Hepatology, 27*, 209–212.

Gallegos-Orozco, J. F., Fuentes, A. P., Gerardo Argueta, J., Perez-Pruna, C., Hinojosa-Becerril, C., Sixtos-Alonso, M. S., et al. (2003). Health-related quality of life and depression in patients with chronic hepatitis C. *Archivesof Medical Research, 34*, 124–129.

Gill, C. J., Griffith, J. L., Jacobson, D., Skinner, S., Gorbach, S. L., & Wilson, I. B. (2002). Relationship of HIV viral loads, CD4 counts, and HAART use to health-related quality of life. *Journal of Acquired Immune Deficiency Syndrome, 30*, 485–492.

Hall, C. S., Charlebois, E. D., Hahn, J. A., Moss, A. R., & Bangsberg, D. R. (2004). Hepatitis C virus infection in San Francisco's HIV-infected urban poor. *Journal of General Internal Medicine, 19*, 357–365.

Hays, R. D., Cunningham, W. E., Sherbourne, C. D., Wilson, I. B., Wu, A. W., Cleary, P. D., et al. (2000). Health-related quality of life in patients with human immunodeficiency virus infection in the United States: Results from the HIV Cost and Services Utilization Study. *American Journal of Medicine, 108*, 714–722.

Hays, R. D., & Woolley, J. M. (2000). The concept of clinically meaningful difference in health-related quality-of-life research. How meaningful is it? *Pharmacoeconomics, 18*, 419–423.

Hilsabeck, R. C., Hassanein, T. I., Carlson, M. D., Ziegler, E. A., & Perry, W. (2003). Cognitive functioning and psychiatric symptomatology in patients with chronic hepatitis C. *Journal- International Neuropsychological Society, 9*, 847–854.

Hunt, C. M., Dominitz, J. A., Bute, B. P., Waters, B., Blasi, U., & Williams, D. M. (1997). Effect of interferon-alpha treatment of chronic hepatitis C on health-related quality of life. *Digestive Diseases and Sciences, 42*, 2482–2486.

Kanwal, F., Gralnek, I. M., Hays, R. D., Dulai, G. S., Spiegel, B. M., Bozzette, S., et al. (2005). Impact of chronic viral hepatitis on health-related quality of life in HIV: Results from a nationally representative sample. *American Journal of Gastroenterology, 100*, 1984–1994.

Kramer, L., Bauer, E., Funk, G., Hofer, H., Jessner, W., Steindl-Munda, P., et al. (2002). Subclinical impairment of brain function in chronic hepatitis C infection. *Journal of Hepatology, 37*, 349–354.

Laguno, M., Murillas, J., Blanco, J. L., Martinez, E., Miquel, R., Sanchez-Tapias, J. M., et al. (2004). Peginterferon alfa-2b plus ribavirin compared with interferon alfa-2b plus ribavirin for treatment of HIV/HCV co-infected patients. *AIDS, 18*, F27–F36.

McHutchison, J. G., Ware, J. E. Jr., Bayliss, M. S., Pianko, S., Albrecht, J. K., Cort, S., et al. (2001). The effects of interferon alpha-2b in combination with ribavirin on health related quality of life and work productivity. *Journal of Hepatology, 34*, 140–147.

Nyamathi, A. M., Dixon, E. L., Robbins, W., Smith, C., Wiley, D., Leake, B., et al. (2002). Risk factors for hepatitis C virus infection among homeless adults. *Journal of General Internal Medicine, 17*, 134–143.

Riley, E. D., Bangsberg, D. R., Perry, S., Clark, R. A., Moss, A. R., & Wu, A. W. (2003). Reliability and validity of the SF-36 in HIV-infected homeless and marginally housed individuals. *Quality of Life Research, 12*, 1051–1058.

Robertson, M. J., Clark, R. A., Charlebois, E. D., Tulsky, J., Long, H. L., Bangsberg, D. R., et al. (2004). HIV seroprevalence among homeless and marginally housed adults in San Francisco. *American Journal of Public Health*, *94*, 1207–1217.

Rowan, P. J., Tabasi, S., Abdul-Latif, M., Kunik, M. E., & El-Serag, H. B. (2004). Psychosocial factors are the most common contraindications for antiviral therapy at initial evaluation in veterans with chronic hepatitis C. *Journal of Clinical Gastroenterology, 38*, 530–534.

Samsa, G., Edelman, D., Rothman, M. L., Williams, G. R., Lipscomb, J., & Matchar, D. (1999). Determining clinically important differences in health status measures: A general approach with illustration to the Health Utilities Index Mark II. *Pharmacoeconomics, 15*, 141–155.

Spiegel, B. M., Younossi, Z. M., Hays, R. D., Revicki, D., Robbins, S., & Kanwal, F. (2005). Impact of hepatitis C on health related quality of life: A systematic review and quantitative assessment. *Hepatology, 41*, 790–800.

Sulkowski, M. S., & Thomas, D. L. (2003). Hepatitis C in the HIV-Infected Person. *Annals of Internal Medicine, 138*, 197–207.

Torriani, F. J., Rodriguez-Torres, M., Rockstroh, J. K., Lissen, E., Gonzalez-Garcia, J., Lazzarin, A., et al. (2004). Peginterferon Alfa-2a plus ribavirin for chronic hepatitis C virus infection in HIV-infected patients. *New England Journal of Medicine, 351*, 438–450.

Vittinghoff, E., Glidden, D. V., Shiboski, S. C., & McCulloch, C. E. (2005). *Regression Methods in Biostatistics*. New York, NY: Springer (p. 94).

Ware, J. E. Jr., Kosinski, M., Bayliss, M. S., McHorney, C. A., Rogers, W. H., & Raczek, A. (1995). Comparison of methods for the scoring and statistical analysis of SF-36 health profile and summary measures: summary of results from the Medical Outcomes Study. *Medical Care, 33*, AS264–AS279.

Ware, J. E. Jr., Kosinski, M., & Gandek, B. (2004). *SF-36 Health Survey Manual & Interpretation Guide*. QualityMetric Incorporated, Lincoln, RI.

Wu, A. W., Hays, R. D., Kelly, S., Malitz, F., & Bozzette, S. A. (1997). Applications of the Medical Outcomes Study health-related quality of life measures in HIV/AIDS. *Quality of Life Reserch, 6*, 531–554.