Hepatitis A Seroprevalence and Risk Factors Among Homeless Adults in San Francisco: Should Homelessness Be Included in the Risk-Based Strategy for Vaccination?

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SYNOPSIS

Objectives. Homeless adults have an increased risk of infectious diseases due to sexual and drug-related behaviors and substandard living conditions. We investigated the prevalence and risk factors for presence of hepatitis A virus (HAV) antibodies among homeless and marginally housed adults.

Methods. We analyzed serologic and questionnaire data from a study of marginally housed and homeless adults in San Francisco from April 1999 to March 2000. We tested seroprevalance for total antibodies to HAV (anti-HAV) and analyzed data using Chi-square tests and logistic regression.

Results. Of the 1,138 adults in the study, 52% were anti-HAV positive. The anti-HAV prevalence in this study population was 58% higher than the expected prevalence based on age-specific prevalence rates from the general population. Number of years of homelessness (≤1, 2–4, and ≥5 years) was associated with anti-HAV prevalence (46%, 50%, and 61%, respectively, $p<0.001$). We found other differences in anti-HAV prevalence ($p<0.05$) for ever having injected drugs (63% vs. 42% for non-injectors), being foreign-born (75% vs. 51% among U.S.-born), race/ethnicity (72%, 53%, and 45% for Hispanic, white, and black people, respectively), and increasing age (38%, 49%, and 62% among those aged <35, 35–45, and >45 years, respectively). These variables all remained significant in a multivariate model.

Conclusions. We found overall anti-HAV prevalence elevated in this San Francisco homeless population compared with the general U.S. population. These data show that anti-HAV was associated with homelessness independent of other known risk factors, such as being foreign-born, race/ethnicity, and injection drug use. This increase indicates an excess risk of HAV infection and the potential need to offer hepatitis A vaccination as part of homeless services.

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Since the introduction of hepatitis A vaccine, reported cases of hepatitis A infection have decreased by 80% compared with years prior to vaccine introduction.[1,2] Vaccine recommendations were made in 1996 and included universal routine vaccination of children in high prevalence states and vaccination of adults with increased risk of infection. Further recommendations in 2006 included vaccination of all children and maintained recommendations to vaccinate adults at risk.[3] Adults who are at risk for hepatitis A virus (HAV) infection, and who are recommended to be vaccinated, include household or sexual contacts of infected people, people who travel to high HAV-prevalent countries, non-injection drug users and injection drug users (IDUs), and men who have sex with men (MSM). Although the majority of vaccinations have occurred among children, herd immunity is likely to have played a role in preventing hepatitis A among adults. However, adults remain at risk and, in 2005, the highest rates of acute hepatitis A were among adults, particularly among males aged 20–34 years.[2]

Little is known about HAV prevalence among homeless populations in the U.S., and no seroprevalence studies among homeless in the U.S. have been reported. Homelessness has been linked to HAV outbreaks in the U.S.;[4–6] however, these data alone have not established homelessness as an independent risk factor for HAV infection, as many homeless people have other known HAV risk factors, namely sexual and drug-related risk factors.[7,8]

Hepatitis A causes fever, tiredness, loss of appetite, nausea, abdominal discomfort, and jaundice, usually lasting six to eight weeks, although 10% to 15% of symptomatic people have prolonged or relapsing disease for up to six months. Among older children and adults, infection is typically symptomatic, with jaundice occurring in more than 70% of patients. In people with chronic liver disease, including liver disease related to hepatitis C virus infection, HAV co-infection can cause fulminant hepatitis.[9] Because HAV is transmitted by ingesting viral particles shed in the stool of infected people, we hypothesized that homelessness is a risk factor for HAV infection because homelessness may present challenges to maintaining good hygiene.

The purpose of this study was to estimate HAV prevalence and risk factors in an adult homeless population. Because an effective and safe vaccine is available, understanding HAV prevalence could provide helpful information for guiding prevention activities.

METHODS

We analyzed serologic and questionnaire data on marginally housed and homeless adults who were recruited for a 12-month period beginning in April 1999 as part of the Research in Access to Care in the Homeless study.[10] In brief, a sampling strategy of probability proportional to size within each venue was used to survey English-speaking adults in five overnight shelters, six midday free-meal programs, and 28 low-income residential hotels (i.e., costing less than $400 per month). Comprehensive interviews took place near each sampling site. Unique study identification codes were used instead of collecting names and personal identifiers.

There were no significant gender or racial/ethnic differences between participants and nonparticipants. Participants from shelter and meal programs received a $20 cash incentive and those from hotels received $25. While other study waves occurred from 1990 to 2003, as described in Hahn et al.,[11] this was the only study wave for which screening blood specimens were stored.

Informed consent allowed for the option of future testing of sera; these samples had been stored in San Francisco and were sent for testing of total antibodies to HAV (anti-HAV) to the Hepatitis Reference Laboratory at the Centers for Disease Control and Prevention (CDC) in May 2005. Anti-HAV tests were conducted using a commercially available enzyme immunoassay (HAVAB-EIA, Abbott Laboratories, Abbott Park, Illinois). This study was approved by the University of California San Francisco Human Subjects Review Board and determined to not involve human subjects at CDC, as samples were not linked to any identifiers.

We calculated proportions and exact 95% confidence intervals (CIs) and conducted logistic regression using SAS® version 9.1.[12] Multivariate logistic regression included all significant univariate variables. We used indirect standardization to estimate the study population's expected anti-HAV prevalence rate by applying the study population's age distribution to the age-specific prevalence rates from the National Health and Nutrition Examination Survey (NHANES), 1999–2000.

RESULTS

Of the 1,426 participants from the original study, 1,138 (80%) were tested for anti-HAV and 52% were anti-HAV-positive (Table 1). Number of years of being homeless (≤1, 2–4, and ≥5 years) was associated with anti-HAV prevalence (46%, 50%, and 61%, respectively, $p<0.001$). We analyzed other variables related to homelessness, such as number of nights in the last year spent in a shelter, on the street, or in a private home, but they were not significant. Other variables found to be associated with increased anti-HAV

prevalence ($p<0.05$) included drug use (53%, 37%, and 63% anti-HAV prevalence for never used drugs, ever used drugs but never injected, and ever used injection drugs, respectively), being born in another country (75% vs. 51% among U.S.-born), race/ethnicity (72%, 53%, and 45% for Hispanic, white, and black people, respectively), and increasing age (38%, 49%, and 62% for those aged <35, 35–45, and >45 years, respectively). Gender, sex-related behaviors (MSM or number of sex partners in the last 12 months), and incarceration were not associated with anti-HAV risk (Table 1). We analyzed specific sex-related behaviors, such as anal sex in the last three months or ever, and specific non-injection drug-related behaviors such as smoking or snorting, and found them to be not significant (data not shown).

Table 1. Prevalence of HAV infection among homeless adults in San Francisco, 1999–2000

Characteristic	N *(percent[a])*	*Prevalence of HAV infection (95% CI)*
Overall	1,138 (100)	52 (49, 55)
Gender		
Male	850 (75)	54 (51, 57)
Female	288 (25)	46 (40, 52)
Age (in years)		
<35	72 (6)	38 (26, 49)
35–45	766 (67)	49 (46, 53)
>45	260 (23)	62 (56, 68)
Race/ethnicity		
White	476 (42)	53 (48, 57)
Black	472 (41)	45 (41, 50)
Hispanic	69 (7)	72 (62, 83)
Other	119 (10)	61 (53, 70)
Education		
Did not complete high school	343 (30)	60 (54, 65)
Completed high school	795 (70)	49 (45, 52)
Origin		
U.S.-born	856 (91)	51 (48, 54)
Foreign-born	87 (9)	75 (66, 84)
Cumulative years homeless		
≤1	444 (46)	46 (42, 51)
2–4	262 (27)	50 (44, 56)
≥5	267 (27)	61 (55, 66)
Sexual behavior		
<3 sex partners in last 12 months	928 (82)	51 (48, 54)
≥3 sex partners in last 12 months	210 (18)	56 (49, 62)
MSM[b]	208 (25)	55 (48, 62)
Not MSM	637 (75)	54 (50, 58)
Drug use		
Never used drugs	173 (15)	53 (46, 61)
Ever used drugs, never injected	420 (37)	37 (33, 42)
Ever injected drugs	545 (48)	63 (59, 67)
Incarcerations		
Ever incarcerated	326 (29)	53 (48, 59)
Never incarcerated	812 (71)	51 (48, 55)

[a]Percent among nonmissing responses

[b]Among men; MSM was defined as men reporting gay, mostly gay, or bisexual behavior; men reporting mostly straight behavior were not considered MSM.

HAV = hepatitis A virus

CI = confidence interval

MSM = men who have sex with men

Multivariate logistic regression analysis showed that all variables remained significant except completion of high school. We observed significant associations with prevalence of anti-HAV when comparing those aged >45 years with those aged <35 years (odds ratio [OR] = 4.4, 95% CI 2.2, 8.5), Hispanic vs. white race/ethnicity (OR=3.7, 95% CI 1.6, 8.3), foreign-born vs. U.S.-born (OR=2.4, 95% CI 1.3, 4.6), ≥5 vs. ≤1 cumulative years homeless (OR=1.7, 95% CI 1.2, 2.4), and ever injected drugs vs. never used drugs (OR=2.0, 95% CI 1.2, 3.2) (Table 2).

In calculating the expected anti-HAV prevalence for this study population, we excluded five study participants aged 18–19 years because anti-HAV estimates for these ages were not available from the NHANES, 1999–2000 study. An additional 40 participants with missing values for age were also excluded. The age-adjusted expected anti-HAV prevalence for this study population was 33%.

DISCUSSION

Overall anti-HAV seroprevalence in this adult homeless population in San Francisco was 52%. Older age is an important predictor of anti-HAV, and this was an older population with only 6% of people younger than 35 years of age. However, the observed anti-HAV prevalence in our sample was 58% higher than the expected prevalence based on age-specific prevalence rates from the NHANES, 1999–2000 study. This was the first study to report anti-HAV seroprevalence among homeless people in the U.S. and report an association between cumulative years of homelessness and anti-HAV after controlling for known risk factors.

The primary objective of this study was to investigate the hypothesis of homelessness as an independent risk factor for HAV infection, given the challenges in maintaining hygiene among homeless adults. Multiple outbreaks have reported inclusion of both homeless people and IDUs, making it important to be able to control for simultaneous risks.[5,6,13] This study found that when simultaneously modeling multiple potential risk

factors, both duration of homelessness and injection drug use remained significant. It is possible that this analysis may not completely control for confounding if underreporting of drug use occurred.

Two other anti-HAV seroprevalence studies among homeless people conducted in Australia and Canada found similarly high anti-HAV prevalence of 48% and 53%, respectively.[14,15] Like the present study, these two studies found older age to be a major predictor of anti-HAV. Although no seroprevalence studies among homeless people have been reported in the U.S., seroprevalence estimates from the NHANES III study, which does not include homeless people, found socioeconomic factors to be associated with increased anti-HAV prevalence, including being below the poverty-level index and being above a crowding index.[16]

The finding that foreign-born people had an increased risk of anti-HAV was expected, as the anti-HAV prevalence rates are much higher in other countries compared with the U.S.[3] The higher anti-HAV prevalence found among Hispanic people compared with other race/ethnicities is consistent with national findings of higher anti-HAV prevalence from Mexican Americans who participated in the NHANES III study. Because HAV is endemic in Mexico as well as Central and South America, the increased prevalence among Hispanic people has been attributed to an increased opportunity for introducing HAV in the community or HAV circulation in the community.[16]

Similar to findings from other studies, being an MSM, having multiple sex partners, and engaging in non-injection drug use were not associated with higher anti-HAV seroprevalence.[3,17,18] Even though studies do not indicate that these risk groups have an elevated anti-HAV seroprevalence, they are recommended for vaccination based on the frequency of outbreaks occurring in these populations. It was unexpected to observe an increase in anti-HAV prevalence among people who reported never using drugs compared with the non-injection drug use group; however, this was not significantly different in multivariate analysis.

Limitations

This study had several limitations. No laboratory tests exist to distinguish natural immunity from vaccine-induced immunity; therefore, we were unable to make this distinction. Specimen collection for this study began in 1999, and national rates of acute HAV infection among adults have been declining since vaccine introduction in 1996. However, it is not known if a similar decline has occurred among homeless people. Despite this uncertainty, this study identified risk factors for anti-HAV prevalence with important policy implications.

CONCLUSIONS

This study found an elevated prevalence of anti-HAV compared with the general population. Although a large number of homeless people have sexual or drug-related risk factors for anti-HAV, this study indicates that homelessness may be an independent risk factor. Despite the high prevalence, almost half of the study participants were susceptible to HAV infection. CDC's Advisory Committee on Immunization Practices does not specifically recommend that homeless people receive hepatitis A vaccine; however, recommendations do exist for largely overlapping risks such as sexual and drug-related risk behaviors.[3]

Table 2. Crude and adjusted odds ratios for HAV infection as an outcome among homeless adults in San Francisco, 1999–2000

Factor	*Crude OR (95% CI)*	*Adjusted OR (95% CI)*[a]
Gender		
Female	Ref.	Ref.
Male	1.3 (1.0, 1.8)	1.1 (0.8, 1.5)
Age (in years)		
<35	Ref.	Ref.
35–45	1.6 (1.0, 2.7)	2.5 (1.4, 4.6)
>45	2.7 (1.5, 4.8)	4.4 (2.2, 8.5)
Race/ethnicity		
White	Ref.	Ref.
Black	0.7 (0.6, 0.9)	0.9 (0.6, 1.2)
Hispanic	2.3 (1.3, 4.2)	3.7 (1.6, 8.3)
Other	1.1 (1.0, 1.3)	1.5 (0.9, 2.4)
Education		
Did not complete high school	Ref.	Ref.
Completed high school	0.6 (0.5, 0.8)	0.7 (0.5, 0.9)
Origin		
U.S.-born	Ref.	Ref.
Foreign-born	2.8 (1.7, 4.8)	2.4 (1.3, 4.6)
Cumulative years homeless		
≤1	Ref.	Ref.
2–4	1.2 (0.9, 1.6)	1.2 (0.9, 1.8)
≥5	1.8 (1.3, 2.5)	1.7 (1.2, 2.4)
Drug use		
Never used drugs	Ref.	Ref.
Ever used drugs, never injected	0.5 (0.4, 0.8)	0.7 (0.4, 1.2)
Ever injected drugs	1.5 (1.0, 2.1)	2.0 (1.2, 3.2)

[a]Adjusted using multivariate logistic regression including all variables in table

HAV = hepatitis A virus

OR = odds ratio

CI = confidence interval

Ref. = reference group

MSM = men who have sex with men

Future consideration should be given to the cost-effectiveness and impact of including younger homeless people as a risk group for hepatitis A vaccination. Studies on the cost-effectiveness and impact of various strategies, such as vaccinating homeless people based on age or duration of homelessness, could be used to guide these considerations.

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