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High Rates of Herpes Simplex Virus Type 2 Infection in Homeless Women: Informing Public Health Strategies

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Abstract

Background: Homeless and unstably housed women living in an urban setting are at risk for sexually transmitted diseases, yet the seroprevalence and correlates of herpes simplex virus type 2 (HSV-2) specific to impoverished women are poorly understood.

Materials and Methods: Between April and October 2010, we conducted a cross-sectional analysis of socio-demographic, structural, and behavioral factors associated with prevalent HSV-2 infection (recent and historical infections) within a community-recruited cohort of homeless and unstably housed women. Logistic regression modeling was used to identify independent sociobehavioral correlates of HSV-2 infection.

Results: Among 213 women (114 HIV positive and 99 HIV negative), the median age was 49, 48% were African American, and 63% had completed high school. HSV-2 seroprevalence was 88%, and only 17% of infected women were aware of their infection. In adjusted analysis, odds of HSV-2 infection were significantly higher for those reporting at-risk drinking (adjusted odds ratio [AOR]=7.04; 95% confidence interval [CI]=1.59, 67.91), heterosexual orientation (AOR=4.56; 95% CI=1.81, 11.69), and for those who were HIV positive (AOR=3.64; 95% CI=1.43, 10.30). Odds of HSV-2 infection decreased as current income increased (AOR for each \$500 monthly increase=0.90; 95% CI=0.78, 0.997).

Conclusions: There is an extremely high seroprevalence of HSV-2 infection among homeless and unstably housed women, and most are unaware of their HSV-2 status. Screening all unstably housed women for HSV-2 infection, with additional counseling for sexual risk and alcohol use, may lead to the identification of more infections and be a first step in reducing additional disease transmission.

Introduction

THE SEROPREVALENCE OF herpes simplex virus type-2 (HSV-2) is 21%–24% among women in the United States (US).¹ In contrast to symptomatic HSV-2 infections, which clinically warn of transmission risk, most women become infected during intermittent periods of asymptomatic viral shedding from their sexual partners² and are unaware of their infection.^{3,4} Sex without a condom and with an HSV-2 infected partner contributes to the transmission of HSV-2.⁵ HSV-2 infection increases the risk of acquiring HIV and other sexually transmitted diseases (STDs) and may contribute to disease progression among HIV-infected women.^{2,6}

HSV-2 infection has consistently been associated with social determinants of health, including older age,⁷ female

gender,^{8,9} African American and Latina race/ethnicity,^{7,10} a lower level of education,⁸ and low income.^{7,10} It is also associated with behaviors related to both social determinants of health and mental health such as sex work,^{7,11} drug use,^{7,12} and mental illness.¹³ While female sex and circumstances surrounding poverty are consistently linked to HSV-2 infection, few studies have evaluated correlates of HSV-2 that are unique to impoverished women, such as housing instability. In addition, few have conducted studies exclusively among impoverished women, which would allow for a more thorough understanding of unique challenges this population faces. As a result of the complexities where biological and unique behavioral factors both influence health, there have been calls for a paradigm shift in epidemiology, which “take into account the causes of disease at multiple levels, reciprocal relations,

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and interrelation between causes that characterize [the outcome].¹⁴ Housing instability has been described as the result of complex social histories that commonly include mental illness, victimization,¹⁵ and substance abuse.¹⁶ These factors tie into theoretical frameworks of homelessness and have been shown to have independent associations with HSV-2 infection. As a result of the above, further investigation of unstably housed and homeless women could assist public health officials and healthcare providers in developing targeted screening strategies for HSV-2.

Current guidelines of the Centers for Disease Control and Prevention (CDC) recommend HSV-2 screening in people with genital ulcers, HIV-infected persons, and men who have sex with men.¹⁷ Additional guidelines developed by the California Department of Public Health (CDPH) recommend HSV-2 screening for select people who are at risk for STD/HIV acquisition (*i.e.*, those with a current STD, recent STD, or high-risk behaviors) and motivated to change risk behavior, HIV-infected persons, and those who are in or are considering a partnership with an HSV-2 infected person.¹⁸ In this study, we sought to determine the seroprevalence and correlates of HSV-2 infection in a high-risk sample of homeless and unstably housed women to inform current HSV-2 screening guidelines.

Materials and Methods

Between April and October 2010, we conducted a cross-sectional STD study within “Shelter, Health and Drug Outcomes among Women” (SHADOW), a cohort study designed to evaluate health and health services use of homeless and unstably housed women living in San Francisco. Women were recruited from all free meal programs serving over 100 meals per day, homeless shelters, and low-cost single room occupancy hotels selected with probability proportionate to the number of residents. This methodology was based on those originally developed by Burman and Koegel and was used to recruit individuals who reflect the larger population of San Francisco homeless persons.¹⁸ Women who were present at these venues on recruitment days were invited to participate in screening activities for potential study participation. Inclusion criteria included biological female sex, age greater than 18, and a history of housing instability (slept in a public place, a shelter, or stayed with other people because she had no other place to sleep [“couch-surfed”] in the past 6 months). HIV testing took place at screening. Antibody to HIV was detected with an HIV type 1/2 enzyme immunoassay (OraSure), and repeatedly, reactive samples were tested with an HIV type 1 Western blot (Quest Diagnostics). HIV-infected women were oversampled on additional recruitment days to ensure statistical power for HIV-specific analyses. Participants underwent a behavioral interview, which was administered using a combination of interviewer-administered questionnaires and Audio Computer Assisted Self-Interview (ACASI) for socially sensitive questions, and phlebotomy to obtain serum samples.

HSV-2 testing and cross-sectional data presented in this study represent results from a single visit. The outcome of interest was HSV-2 infection; testing for HSV-2 antibodies was performed using the HerpeSelect 2 IgG (Quest Diagnostics). Participants were paid \$35 for completing the interview and phlebotomy. All study procedures were approved by the Institutional Review Board at the University of California, San Francisco.

Independent variables obtained through study interviews were selected based on correlates of sexually transmitted infections and general health found in previous studies of impoverished women. Data were self-reported and referred to the prior 6 months. Variables included age, race/ethnicity, income, sexual orientation (prefers to have sex with men [heterosexual] or women/both [homosexual/bisexual]), incarceration (any jail or prison time),¹⁹ sex exchange (for money, drugs, a place to sleep, *etc.*),²⁰ proportion of time spent sleeping in a homeless shelter, and proportion of time spent sleeping in a public place.²⁰ Substance use variables included at-risk alcohol use (>1 drink/day for women),²¹ heroin use, and cocaine use. Individuals were also screened for depression, manic episodes, PTSD, and schizophrenia using the computerized Diagnostic Interview Schedule-IV, based on DSM-IV criteria.^{22,23} Vaginal sex without a condom, physical assault, intimate partner violence, and number of sexual partners were assumed to be in the causal pathway between study factors and HSV-2 infection, thus, they were not included as potential correlates to avoid over adjustment. Analyses were considered by HIV status to assess effect modification of other study factors.

One-way frequency tables and measures of central tendency were generated to characterize the sample population. Bivariate analyses were performed using logistic regression with Firth’s penalized likelihood correction to handle partial or complete separation due to the small sample size. As recommended by

TABLE 1. DEMOGRAPHICS OF HOMELESS AND UNSTABLY HOUSED WOMEN LIVING IN SAN FRANCISCO (N=213)

	<i>Population prevalence, n (%)</i>
Race	—
African American	102 (47.9)
White	58 (27.2)
Mixed	30 (14.1)
Other	23 (10.8)
Age, median (IQR)	49 (43–54)
Monthly income, median (IQR)	950 (800–1,100)
% Time slept in public	—
0	175 (82.2)
1–25	30 (14.1)
26–100	8 (3.8)
% Time slept in a shelter	—
0	186 (87.3)
1–25	16 (7.5)
26–100	11 (5.2)
Heterosexual orientation	167 (78.4)
Exchanged sex (6 months)	22 (10.3)
Recent incarceration (6 months)	23 (10.8)
At-risk drinking (>1/day)	47 (22.1)
Cocaine use (6 months)	105 (49.3)
Heroin use (6 months)	27 (12.7)
Schizophrenia diagnosis ^a	24 (11.7)
PTSD diagnosis ^a	86 (42.6)
Manic episode diagnosis ^a	47 (23.4)
Depression diagnosis ^a	112 (55.9)
HIV ^b	114 (53.5%)

^aDiagnosed by the Diagnostic Interview Survey.

^bBy design, half of the population was recruited on the basis of HIV infection.

IQR, interquartile range.

Hosmer and Lemeshow, independent variables with a bivariate *p*-value of 0.25 or less were included into the initial backwards elimination model for multivariate analysis, and variables were eliminated according to the highest *p*-value²⁴ to obtain the most parsimonious model. Missing data were minimal (<5%) and listwise deletion was used.

Results

A total of 300 women were enrolled in the SHADOW study population. Interview and HSV-2 testing data existed for 213 participants (114 HIV positive and 99 HIV negative) and were included in the current analysis. There were no significant differences in sociodemographic characteristics pertaining to race/ethnicity, age, income, or other variables of interest between the initial study sample and those included in this analysis.

Nearly half (48%) of the study participants were African American and the median age of participants was 49 years. At baseline, the median monthly income was \$929 and 18% of participants had slept on the street or in a public place in the prior 6 months. Half of the participants (49%) reported recent cocaine use, 56% screened positive for depression, and 12% screened positive for schizophrenia (Table 1).

Among the 213 tested participants, 88% were HSV-2 seropositive, of which only 17% had received a prior diagnosis. In unadjusted analysis, HSV-2 infection was significantly

associated with at-risk alcohol use, heterosexual orientation, HIV infection, and income status (Table 2). In adjusted analysis, these factors maintained their significant associations. HSV-2 infection was significantly higher among persons reporting at-risk alcohol use (adjusted odds ratio [AOR]=7.04, 95% confidence interval [CI]=1.59, 67.91), heterosexual orientation (AOR=4.56, 95% CI=1.81, 11.69), and HIV infection (AOR=3.64, 95% CI=1.43, 10.30). Women reporting higher incomes had lower odds of HSV-2 infection (AOR for each \$500 monthly increase=0.90, 95% CI=0.78, 0.997). Factors that did not reach levels of significance in this population included race, age, time homeless, sex exchange, incarceration, drug use, and mental health diagnoses (schizophrenia, PTSD, manic episodes, and depression).

Restricted analysis of HSV-2 infections by HIV status resulted in only minor changes to significant variables, suggesting modest effect modification by HIV status. Among HIV-infected women, the unadjusted odds of HSV-2 infection were lower among persons who were recently incarcerated and used heroin; however, associations did not reach levels of significance after adjusting for sexual orientation (Table 3). In addition, while the unadjusted odds of HSV-2 infection were over 3.5-fold higher for both HIV-infected and uninfected participants who self-reported at-risk drinking, only the estimate for HIV-uninfected individuals was statistically significant.

TABLE 2. ASSOCIATIONS BETWEEN HSV-2 INFECTION AND STUDY FACTORS (6 MONTHS) AMONG HOMELESS AND UNSTABLY HOUSED WOMEN LIVING IN SAN FRANCISCO (N=213)

	Unadjusted OR (95% CI)	Adjusted ^a OR (95% CI) Final Model
Race		
African American	—	
White	0.52 (0.21, 1.33)	
Mixed	1.29 (0.35, 7.00)	
Other	0.66 (0.19, 2.82)	
Age (per 10 years)	1.33 (0.83, 2.12)	
Monthly income (per \$500)	0.91 (0.76, 0.9998)	0.90 (0.78, 0.997)
% Time slept in public		
0	—	
1–25	0.54 (0.20, 1.68)	
26–100	0.31 (0.07, 1.76)	
% Time slept in a shelter		
0	—	
1–25	0.79 (0.22, 4.21)	
26–100	0.96 (0.21, 9.16)	
Heterosexual orientation	4.14 (1.75, 9.80)	4.56 (1.81, 11.69)
Exchanged sex (6 months)	1.14 (0.33, 5.95)	
Recent incarceration (6 months)	0.55 (0.19, 1.89)	
At-risk drinking (>1/day)	5.33 (1.32, 48.64)	7.04 (1.59, 67.91)
Cocaine use (6 months)	1.06 (0.46, 2.43)	
Heroin use (6 months)	0.39 (0.15, 1.11)	
Schizophrenia diagnosis ^b	2.10 (.50, 19.47)	
PTSD diagnosis ^b	1.06 (0.44, 2.64)	
Manic episode diagnosis ^b	0.76 (0.30, 2.15)	
Depression diagnosis ^b	0.49 (0.18, 1.24)	
HIV ^c	3.25 (1.38, 8.45)	3.64 (1.43, 10.30)

^aFinal model only includes variables significant after adjustment.

^bDiagnosed by the Diagnostic Interview Survey.

^cBy design, half of the population was recruited on the basis of HIV infection.

Bold values are statistically significant 95% CI, which does not include 1.

CI, confidence interval; HSV-2, herpes simplex virus type 2; OR, odds ratio.

TABLE 3. ASSOCIATIONS BETWEEN HSV-2 INFECTION BY HIV STATUS

	HIV+ (n=114) unadjusted OR (95% CI)	HIV+ (n=114) adjusted ^a OR (95% CI) Final Model	HIV- (n=99) unadjusted OR (95% CI)	HIV- (n=99) adjusted ^a OR (95% CI) Final Model
Race				
African American	—		—	—
White	0.32 (0.05, 1.76)		0.73 (0.24, 2.26)	
Mixed	0.49 (0.06, 5.59)		1.94 (0.38, 19.52)	
Other	0.31 (0.04, 3.63)		0.98 (0.22, 5.78)	
Age (per 10 years)	1.54 (0.64, 3.49)		1.28 (0.72, 2.25)	
Monthly income (per \$500)	0.88 (0.66, 0.98)		0.94 (0.72, 1.36)	
% Time slept in public				
0	—		—	
1–25	0.22 (0.04, 1.40)		0.92 (0.27, 3.89)	
26–100	0.15 (0.02, 1.67)		0.37 (0.05, 4.25)	
% Time slept in a shelter				
0	—		—	
1–25	0.19 (0.03, 1.21)		3.32 (0.36, 440.85)	
26–100	0.40 (0.03, 56.19)		1.28 (0.25, 12.68)	
Heterosexual orientation	6.22 (1.40, 30.01)	6.22 (1.40, 30.01)	3.21 (1.10, 9.28)	3.59 (1.17, 11.25)
Exchanged sex (6 months)	0.37 (0.07, 3.85)		2.10 (0.45, 20.17)	
Recent incarceration (6 months)	0.18 (0.04, 0.90)		1.00 (0.19, 10.08)	
At-risk drinking (>1/day)	4.88 (0.56, 640.85)		3.89 (0.88, 36.71)	4.99 (1.05, 49.98)
Cocaine use (6 months)	0.82 (0.18, 3.54)		1.09 (0.40, 3.05)	
Heroin use (6 months)	0.17 (0.04, 0.83)		0.58 (0.16, 2.54)	
Schizophrenia diagnosis ^b	1.47 (0.15, 197.39)		1.87 (0.40, 18.14)	
PTSD diagnosis ^b	2.02 (0.36, 20.72)		0.96 (0.34, 2.73)	
Manic episode diagnosis ^b	0.24 (0.04, 1.29)		1.09 (0.33, 4.60)	
Depression diagnosis ^b	0.34 (0.03, 1.92)		0.68 (0.21, 2.01)	

^aFinal model only includes variables significant after adjustment.

^bDiagnosed by the Diagnostic Interview Survey.

Bold values are statistically significant 95% CI, which does not include 1.

Discussion

Compared to infection rates of 21%–24% among women from the general US population, this study found an extremely high seroprevalence (88%) of HSV-2 infection among homeless and unstably housed women. Infection was significantly higher among HIV-infected individuals and the vast majority of all infected individuals (83%) were unaware of their infection before study participation, which is similar to prior studies.^{3,4} Under current CDC guidelines, being HIV infected or a man who has sex with men are risk factors and reasons to test for HSV-2.¹⁷ Recent estimates among all sexually active men who have sex with men living in a large metropolitan area indicate that the seroprevalence of HSV-2 infection is 24.5%.²⁵ Homeless and unstably housed women are not currently included as a high-risk population in national guidelines, yet the seroprevalence of HSV-2 infection is more than three times higher. Data presented in this study indicate that revising current guidelines to include women who experience housing instability in screening strategies would target a population with an especially high seroprevalence of infections.

Because most HSV-2 transmission occurs during asymptomatic viral shedding,² and because such a high proportion of homeless and unstably housed study participants were seropositive, screening all women who experience housing instability is an approach that could lead to improved health

and reductions in disease transmission. Over one-quarter of the participants were of reproductive age, and screening this subpopulation of women has additional relevance since mother-to-child HSV-2 transmission is associated with very high neonatal morbidity and mortality.²⁶ If screened before or during pregnancy, antiviral therapy against HSV-2 infections can reduce vertical transmission and clinical sequelae.²⁷ The benefits of treatment of HSV-2 extend to women in general; antiviral therapy has been shown to decrease symptoms related to genital ulcers and reduce the transmission of HSV-2 to uninfected partners, regardless of symptoms and genital ulcers.^{2,5} In addition, people who know their HSV-2 status can benefit from behavioral interventions (*i.e.*, condoms, counseling, and abstinence), which have an independent role in reducing HSV-2 and/or HIV transmission.^{5,28}

Based on prior research linking social determinants of health to HSV-2 infection, we restricted the population of the study to low-income women with disproportionately high rates of housing instability. Within this high-risk population, results were consistent with national samples that point to female heterosexual orientation as a risk factor for prevalent HSV-2 infection.^{29,30} They are also similar to prior studies linking alcohol consumption to risky sexual intentions,³¹ risky sexual behaviors,^{32–35} HSV-2 infection,^{9,36} and other STDs,³³ an association especially important among HIV-negative individuals in this analysis (Table 2). Thus, in

addition to screening for HSV-2 infection among all women experiencing housing instability, additional sexual risk and alcohol counseling may assist in tailoring services and interventions aimed at reducing HSV-2 in impoverished women.

Results should be considered in the context of several potential limitations. First, our study had a small sample size. While using techniques specifically designed to recruit a study sample that reflects the larger population of homeless and unstably housed women in San Francisco minimized the possibility of a biased sample, data were obtained from a single geographical location and may not be representative of homeless women in other areas. However, prior research regarding impoverished adults from different geographic areas has been similar on a variety of social, behavioral, health, and health services-related observations,^{37–39} increasing the likelihood that results reported in this study may be generalizable to impoverished women in other areas. Second, the study design was also cross-sectional and assessed the previous 6 months, so causation cannot be inferred from the results, especially because HSV-2 was probably acquired before this study. This limitation inherent with cross-sectional data may have also contributed to the lack of significant associations between HSV-2 and other factors, including drug use and sex exchange. While ACASI interviews were used to minimize socially desirable responses, self-reported substance use, sexual orientation, and sexual behaviors may still be affected by social desirability bias and misreporting. In this case, at-risk alcohol consumption and homosexual orientation may have been underreported; however, this would have biased results toward the null. Thus, effects are at least as strong as those reported in this study.

In this study, 88% of participants were seropositive for HSV-2 infection suggesting that homeless and unstably housed women are at disproportionately high risk for negative health outcomes. Pending replication of study results in geographically diverse locations, findings reported in this study suggest that augmenting current guidelines for HSV-2 testing among women by including housing instability and at-risk alcohol use as triggers for HSV-2 testing may be an effective strategy to identify, treat, and reduce HSV-2 infections in this high-risk population.

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Author Disclosure Statement

No competing financial interests exist.

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