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Prevalence and Risk Factors Associated With Herpes Simplex Virus-2 Infection in a Contemporary Cohort of HIV-Infected Persons in the United States

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Abstract

Background—We compared the herpes simplex virus type 2 (HSV-2) seroprevalence in a contemporary HIV cohort with the general US population and determined risk factors for HSV-2 infection among HIV-infected persons.

Methods—The Study to Understand the Natural History of HIV and AIDS in the Era of Effective Therapy (SUN) Study is a prospective observational cohort of 700 HIV-infected adults enrolled in 4 US cities between 2004 and 2006. At baseline, participants completed a behavioral risk questionnaire and provided specimens for HSV-2 serology. We calculated HSV-2 seroprevalence, standardized by age, gender, and race among HIV-infected persons compared with the general US adult population, using data from the National Health and Nutrition Examination Survey from 2003 to 2006. We examined risk factors associated with HSV-2 infection among HIV-infected persons using multivariate logistic regression.

Results—Among 660 (94%) SUN participants with adequate specimens for HSV-2 serologic testing, 548 (83%) were 20 to 49 years old (median age, 39 years; 77% male; 59% non-Hispanic white; median CD4 count, 470 cells/mm^3; 74% with HIV RNA viral loads <400 copies/mL). HSV-2 seroprevalence was significantly higher among HIV-infected adults (59.7%, 95% confidence interval: 55.8-63.6) compared with the general US population (19.2%, 95% confidence interval: 17.5-21.1). In multivariate analysis, we found that older age, female gender, black non-Hispanic race/ethnicity, being currently unemployed, high-risk anal HPV infection, and longer duration since HIV diagnosis were associated with significantly higher odds of HSV-2 infection.

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Conclusion—HSV-2 seroprevalence is 3 times as high among HIV-infected adults as in the general US population. Clinicians should be aware that increased risk for HSV-2 infection was distributed broadly among HIV-infected persons and not limited to those with high-risk sexual behaviors.

Herpes simplex virus type 2 (HSV-2) is the primary cause of genital herpes, one of the most common sexually transmitted infections (STI).[1] As many as 95% of HSV-2 seropositive individuals shed HSV-2 asymptomatically, facilitating the transmission of genital herpes.[2] Recent seroprevalence studies indicate that approximately 17% of US adults aged 14 to 49 years are chronically infected with HSV-2, showing a marked 19% decline from 1988 to 1994.[1] However, given that HSV-2 and HIV-1 share routes of transmission, the seroprevalence of HSV-2 among HIV-infected persons is high, ranging from 50% to 90%, with the highest HIV/HSV-2 coinfection rates among heterosexuals in sub-Saharan Africa and men who have sex with men (MSM) in the Americas.[3-6]

Although it is difficult to determine the temporal order of these 2 infections, several studies have illustrated that infection with either HSV-2 or HIV alone markedly increases the risk of acquisition of the other virus.[1,7] In addition, genital ulcerations caused by HSV-2 infection increase the risk of transmitting and acquiring HIV infection by almost 3-fold.[8,9] Furthermore, HIV-infected persons have more frequent and severe genital herpes recurrences and are more likely to shed HSV-2 asymptomatically than HIV-uninfected persons. [10–13] Although lower CD4 cell counts correspond with increased frequency of HSV-2 shedding, even persons with CD4+ cell counts >400 cells/mm^3 intermittently shed HSV-2.[11–13]

HIV-infected persons can benefit from HSV-2 suppressive therapy, which decreases the frequency and severity of HSV-2 recurrences and shedding, modestly decreases HIV viral load in the blood and genital secretions, and reduces the risk of HIV-1 disease progression.[14,15] Unfortunately, many persons are unaware of HSV-2 infection because primary HSV-2 infection is often asymptomatic.[16] Given the clinical implications regarding HIV transmission risk and the availability of effective HSV-2 suppressive therapies, HSV-2 infection is an important coinfection to identify. However, there are limited data to inform clinicians of specific factors associated with HSV-2 serostatus among HIV-infected persons.

This analysis was designed to determine the seroprevalence of and risk factors for HSV-2 among a contemporary cohort of HIV-infected adults compared with the general US population. Specifically, our objectives were to determine HSV-2 seroprevalence among HIV-infected and HIV-unin-fected populations for persons aged 20 to 49 years and to describe the demographic characteristics of each population. In addition, we determined risk factors associated with HSV-2 seroprevalence among a larger group of HIV-infected persons aged 20 to 69 years.

Methods

Study Population

The Study to Understand the Natural History of HIV and AIDS in the Era of Effective Therapy—The Study to Understand the Natural History of HIV and AIDS in the

Era of Effective Therapy (SUN) is a prospective, observational cohort study that enrolled 700 HIV-infected adults between 2004 and 2006. Enrollees have been followed at 7 HIV specialty care clinics in 4 US cities: Denver, CO; Minneapolis, MN; Providence, RI; and St. Louis, MO. The goals of the SUN Study are as follows: (1) to monitor the incidence of metabolic and other medical complications related to the treatment of HIV infection and attendant prolonged survival; (2) to identify risk factors associated with the development of these metabolic and other medical complications; (3) to monitor the contribution of these complications and other conditions to the morbidity and mortality of HIV-infected individuals; and (4) to evaluate the efficacy of a structured program of prevention activities, which are integrated into the routine medical care of HIV patients to reduce HIV transmission. All enrollees have provided written informed consent to participate and to provide data for the study. The protocol was approved and has been annually renewed by the institutional review boards of the Centers for Disease Control and Prevention and of all participating institutions.

The SUN Study design and methods have been previously described.[17] Briefly, at enrollment and each 6-monthly study visit, biologic specimens are collected and stored for future use. In addition, participants complete an audio computer-assisted self-interview that collects an array of clinical, social, and behavioral data, including information on substance use and high-risk sexual behaviors.

All participants had their HSV-2 serostatus determined at study entry (i.e., baseline) by Quest Diagnostics (Baltimore, MD). The assay used for detection of HSV type 2 IgG antibody was the FDA-approved type-specific, glycoprotein G-based (gG-2) product, HerpeSelect (Focus Diagnostics, Cypress, CA). This enzyme immunoassay uses a spectrophotometer to measure the color change associated with the presence of HSV-2 antibodies which is quantified by an optical density. The index value is calculated by dividing the specimen optical density by the mean of the cutoff calibration absorbance values. Index values for samples that read above the absorbance limit of the spectrophotometer as >1.0 are positive and >5.0 are strongly positive.

National Health and Nutrition Examination Survey—National Health and Nutrition Examination Survey (NHANES) is a series of cross-sectional studies ongoing since 1999 designed to assess the health and nutritional status of adults and children in the United States by combining interviews and physical examinations. NHANES is conducted by the National Center for Health Statistics, a component of the Centers for Disease Control and Prevention, which has the responsibility of producing health statistics for the nation. Each survey examines a nationally representative sample of approximately 5000 persons from 15 counties across the United States. The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination consists of medical, dental, and physiological measurements, along with laboratory tests administered by trained medical personnel. NHANES data and materials are collected in 2-year cycles. For this analysis, we used data from the NHANES 2003-2004 and 2005-2006 cycles to describe HSV-2 seroprevalence in the general US population.

In both cycles, eligible persons aged 14 to 49 years were tested for HSV-2 antibodies to establish seropositivity using an immunodot assay. Positive samples were confirmed by a monoclonal antibody inhibition assay using a viral glycoprotein specific for HSV-2 (gG-2). In this assay, enzyme immunoassay plates are coated with a limited quantity of gG-2 antigens. The amount of type-specific human antibodies is inversely proportional to the final optical density. The mean optical density obtained in the 3 negative control sera minus 3 standard deviations determines the cutoff value for positive reaction. Human samples that generate optical densities less than the cutoff value are considered reactive. Further explanation of NHANES laboratory methodology has been previously described.[18] In addition to HSV-2 results, we used demographic information from NHANES surveys for our analysis.

Statistical Analysis

Among SUN participants, we calculated the overall prevalence of HSV-2 infection adjusted for age, race, and gender to the US population, as well as age-adjusted (categorized by 10-year intervals) prevalence, stratified by race (non-Hispanic white, non-Hispanic black, Hispanic) and gender (male, female). We estimated the same prevalence rates of HSV-2 infection in the US adult population, aged 20 to 49 years, using sample design variables and sample weights to account for the complex sampling scheme used for NHANES 2003-2006.[19] To compare the prevalence of HSV-2 infection among HIV-infected persons in the SUN Study with that in the general population, we calculated rate ratios (RRs) for the entire observation period (2003-2006). Analyses were conducted using SAS version 9.1 (SAS, Cary, NC) and SAS-callable SUDAAN (RTI International, Research Triangle Park, NC). Confidence intervals (CIs) were calculated using OpenEpi (Emory University, Atlanta, GA), when appropriate.[20]

Univariate analyses of associations between HSV-2 infection and potential risk factors were performed for all SUN Study participants, as well as MSM, men who have sex with women, and women, separately, using either Mantel-Haenszel χ^2 or Fisher exact test for categorical variables and the Student t test for continuous variables. Variables included (1) demographic and socioeconomic status: age, gender, race, marital status, education, and employment status; (2) sexual risk behaviors: HIV infection risk classified as being an MSM; number of partners in the past 6 months; unprotected vaginal, anal, and oral sex; and STI status; (3) HIV-related information: time since HIV diagnosis, CD4 + cell count, HIV viral load, and antiretroviral treatment; and (4) substance abuse: recreational drug use, use of male enhancement drugs, alcohol use, and tobacco smoking history. Factors with a P value ≤0.10 by univariate analysis were included in the multivariate logistic regression models. Associations were assessed using adjusted odds ratios, 95% CIs, and corresponding P values. Associations with P values <0.05 were considered significant. All analyses were conducted using SAS version 9.1 (Cary, NC).

Results

Prevalence of HSV-2 Infection

The Study to Understand the Natural History of HIV and AIDS in the Era of Effective Therapy—Among the 660 SUN participants with evaluable specimens for HSV-2 serology, 548 (83%) persons aged 20 to 49 years were included in the HSV-2 prevalence estimate for comparison with NHANES. Characteristics of these SUN participants were as follows: median age, 39 years; 77% male; 59% non-Hispanic white; median CD4+ cell count, 470 cells/mm^3; 95% on combination antiretroviral therapy; and 74% with HIV RNA viral loads <400 copies/mL. Age-, race-, and gender-adjusted prevalence of HSV-2 infection was 59.7% (95% CI: 55.8– 63.6). HSV-2 prevalence was significantly higher among women (81.3%, 95% CI: 73.8–87.3) than men (53.6%, 95% CI: 48.8–58.3) and significantly higher among non-Hispanic blacks (77.1%, 95% CI: 70.0–83.1) than non-Hispanic whites (52.3%, 95% CI: 46.9–57.7). HSV-2 prevalence was similar among MSM (54.1%, 95% CI: 48.6-59.5) and men who have sex with women (51.3%, 95% CI: 39.7-62.8).

National Health and Nutrition Examination Survey—Persons aged 20 to 49 years surveyed for the 2003-2006 NHANES cycles who met the HSV-2 testing criteria represented approximately 115 million US adults (median age, 34 years; 49% male; 67% non-Hispanic white; 0.53% HIV-infected). Overall HSV-2 prevalence was 19.2% (95% CI: 17.5– 21.1). HSV-2 prevalence was significantly higher among women (24.8%, 95% CI: 22.5-27.2) than men (13.5%, 95% CI: 11.6-15.6) and significantly higher among non-Hispanic blacks (47.5%, 95% CI: 43.8-51.1) than non-Hispanic whites (14.7%, 95% CI: 13.0-16.6).

SUN and NHANES Comparisons—The prevalence of HSV-2 infection was >3 times as high among HIV-infected persons as among adults in the general US population (RR = 3.1, 95% CI: 2.7-3.7); a similar trend was observed among men (RR = 3.5, 95% CI: 2.7-4.4) and women (RR = 3.3, 95% CI: 2.7-3.8) when examined separately. Among HIV-infected non-Hispanic white men, Hispanic men, and non-Hispanic black men compared with the same groups in the general US population, the RRs were 4.0 (95% CI: 2.8-5.5), 5.4 (95% CI: 2.9-9.9), and 1.6 (95% CI: 1.2-2.1), respectively (Fig. 1A). Among the HIV-infected women, the RRs for non-Hispanic white women, Hispanic women, and non-Hispanic black women were 4.0 (95% CI: 2.9-5.1), 2.7 (95% CI: 1.6-4.5), and 1.6 (95% CI: 1.3-1.8), respectively, compared with the same groups in the general US population (Fig. 1B).

Factors Associated With HSV-2 Infection Among HIV-Infected Persons

Among the 660 SUN participants, the median age was 41 years, 78% were male, 60% were non-Hispanic white, the median CD4 cell count was 469 cells/mm^3, and 74% had an HIV RNA viral load <400 copies/mL (Table 1). By multivariate analyses, factors independently associated with HSV-2 infection included older age, female gender, non-Hispanic black race/ethnicity, current unemployment, infection with high-risk anal HPV, and duration since HIV diagnosis >2.3 years (lowest quartile) (Table 2). In the multivariate analysis limited to women (n = 148), factors independently associated with HSV-2 infection included older age, non-Hispanic black race/ethnicity, and current unemployment (Table 3). In the multivariate

analysis limited to MSM (n = 415), factors independently associated with HSV-2 infection included older age, non-Hispanic black race/ethnicity, and history of injection drug use (Table 4).

Discussion

This is the first study to compare HSV-2 seroprevalence among a contemporary cohort of HIV-infected adults in the United States with adults in the general US population; these results highlight the striking differences in HSV-2 seroprevalence, which is 3 times as high among HIV-infected adults. Nevertheless, the trends in HSV-2 seroprevalence in both populations were similar and consistent with those already reported in the literature.[1,4,21]

HSV-2 is a lifelong incurable infection; therefore, an increase in HSV-2 seroprevalence with increasing age is anticipated and is consistent with previous reports.[1,4,21] The women in our HIV cohort had a particularly high risk of HSV-2 infection compared with men. Women are at greater risk of HSV-2 infection[1,4,21] because of higher efficiency of HSV-2 transmission from men to women as compared with that from women to men,[22,23] and anatomical differences of the female genital tract, including the lack of an intact stratum corneum and large surface area, which is susceptible to abrasions.[24] With regard to race, our results were similar to other studies that found that nonwhites have an increased risk of HSV-2 infection.[1,4,21] This disparity may be due to several factors, such as variation in HSV-2 assay performance among certain populations,[25] higher prevalence of poverty, lower socioeconomic status, limited access to health care, differences in sex behaviors and health-related behaviors, and illicit drug use.[26]

By multivariate analysis, independent factors associated with HSV-2 infection were older age, female gender, non-Hispanic black race, being unemployed, infection with a high-risk anal HPV type, and longer duration since HIV diagnosis. Because HPV, HSV-2, and HIV infections are all chronic viral STIs, which share transmission routes and risk behaviors,[27] the association of high-risk HPV infection with HSV-2 infection among HIV-infected persons is biologically plausible, and underscores the need to screen for multiple viral STIs when a patient presents with any one of them. Furthermore, the association of longer duration of HIV infection with HSV-2 infection is not surprising because HIV-infected people live longer, and are able to maintain sexually active lives while on highly active antiretroviral therapy. Anogential herpes was one of the first opportunistic infections described among persons with AIDS, and persistent herpetic ulceration is an AIDS-defining illness, demonstrating that coinfection with these 2 sexually transmitted viruses has been recognized since the beginning of the epidemic.[28]

Surveillance data from 2006 indicate that nearly half (48.1%) of all HIV-infected persons in the United States are MSM.[29] Although MSM are a principal risk group for HIV infection in the United States, we found no significant association between HSV-2 infection and being an MSM as opposed to other risk groups, consistent with a recent Canadian study.[4] In our multivariate analysis limited to MSM, we found that older age, non-Hispanic black race, and any history of injection drug use were independently associated with HSV-2 infection. Because HSV-2 is primarily transmitted through sexual activities, the association with

injection drug use is an unexpected, but not novel, finding. At least 1 other study has reported this finding, specifically with cocaine use.[1] MSM who inject drugs likely engage in multiple risk behaviors for HIV infection because these illicit substances potentially enhance sexual pleasure. Also, intoxication and consequent disinhibition leads to risky behavior, for example, unprotected sex or sex with multiple partners.[30] Furthermore, injection drug users may be more likely to change their drug injection behavior (e.g., seek treatment or use clean syringes) than practice sexual risk reduction to avoid spreading HIV, which may explain this association.[31]

Our study is subject to limitations. Compared with the US population of HIV-infected adults, the population from which SUN Study participants were recruited was older, with a greater proportion of whites and of persons exposed to HIV through homosexual or bisexual activity.[32] Participants in the SUN Study receive continuous care and have well-controlled HIV infection through highly active antiretroviral therapy; consequently, these individuals generally maintain good health. In addition, the SUN Study did not enroll persons with a current opportunistic infection or persons who are not in care. As a result, the SUN Study data may not be generalizable to the entire HIV-infected population of the United States. Finally, we did not exclude HIV-infected persons from the general US population data (NHANES). However, the percentage of HIV-infected people in the NHANES cohort was <1%. Because this number is small, the overall analysis is not likely to have been significantly affected by their inclusion.

In conclusion, HSV-2 seroprevalence was 3 times as high among HIV-infected adults compared with the general US population. However, risk factors for HSV-2 infection—older age, female gender, and non-Hispanic black race—were similar among HIV-infected persons and the general US population. HSV-2 seroprevalence remains high among HIV-infected individuals because the same behaviors confer risk for both HSV-2 and HIV infection. Interestingly, as a principal risk group for HIV infection, MSM from our HIV-infected cohort were not disproportionately likely to be HSV-2 coinfected. Nor were high-risk sexual behaviors among our HIV-infected cohort significantly associated with HSV-2 infection. The failure to observe these associations is a reflection of the extremely high HIV-HSV-2 coinfection rates among all participants in the study. Clinicians should be aware that the risk for HSV-2 infection is broadly distributed among HIV-infected adults, including MSM, and does not necessarily concentrate among persons who report high-risk sexual behaviors. Emerging data suggest that HSV suppression can reduce risk of HIV-1 disease progression, which not only benefits coinfected individuals but also may reduce HIV transmission in the community. Acyclovir is an effective, inexpensive, and widely available drug. A recent meta-analysis showed that HSV treatment may result in a clinically meaningful decrease in HIV viral load, which is more pronounced among persons on antiretroviral therapy who as a result have a lower risk of AIDS progression and death.[33] Therefore, routine screening of HIV-infected patients for HSV-2 infection in HIV clinics requires serious consideration.

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The investigation followed the guidelines of the US Department of Health and Human Services regarding protection of human subjects. The study protocol was approved and renewed annually by each participating institutions' ethical review board. All study participants provided written, informed consent.

The findings and conclusions from this review are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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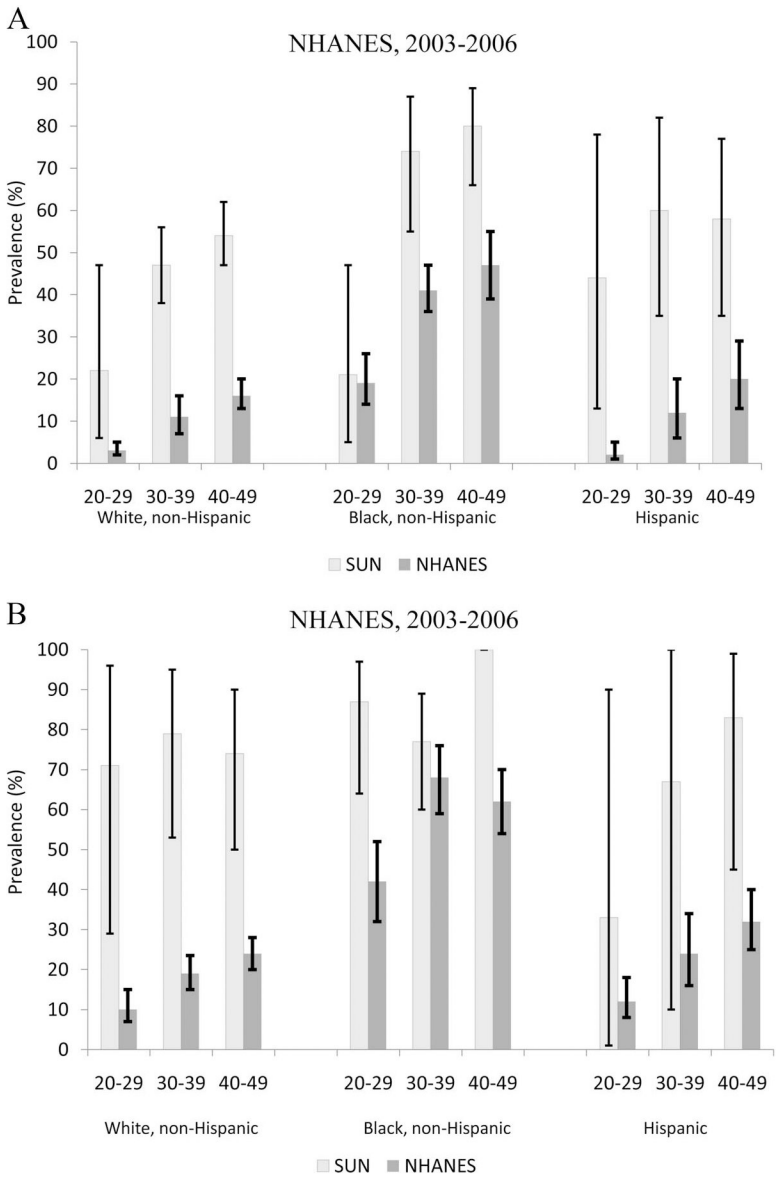

Figure 1.

A, HSV-2 seroprevalence among men, by age and race, SUN versus NHANES, 2003–2006. B, HSV-2 seroprevalence among women, by age and race, SUN versus NHANES, 2003–2006.

Table 1
Characteristics of SUN Study Participants, 2004–2006

Characteristic	All Participants N = 660n (%)	Men Who HaveSex With Menn = 415n (%)	Women n = 148n (%)	Men Who HaveSex With Womenn = 97n (%)
HSV-2 infected	408 (62)	235 (57)	122 (82)	51 (53)
Median age (IQR)	41 (35–47)	42 (36–47)	39 (32–45)	42 (37–48)
Male gender	512 (78)	415 (100)	0 (0)	97 (100)
Currently married/living with partner (n = 588)	390 (66)	236 (66)	109 (75)	45 (52)
Race/ethnicity				
White, non-Hispanic	393 (60)	316 (76)	44 (30)	33 (34)
Black, non-Hispanic	190 (29)	60 (14)	84 (57)	46 (47)
Hispanic	62 (9)	34 (8)	14 (9)	14 (14)
Other	15 (2)	5 (1)	6 (4)	4 (4)
High school graduate (n = 616)	539 (87)	362 (94)	108 (75)	69 (81)
Employed full time (n = 654)	310 (47)	238 (58)	38 (26)	34 (35)
Sexual activity in last 6 mo				
None	177 (27)	78 (19)	57 (39)	42 (43)
1 partner	253 (38)	133 (32)	75 (51)	45 (46)
2–3 partners	109 (17)	90 (22)	11 (7)	8 (8)
4 or more partners	120 (18)	113 (27)	5 (3)	2 (2)
Unprotected vaginal or anal sex	208 (32)	162 (39)	34 (23)	12 (12)
CD4 cell count (cells/mm^3)				
Median baseline (IQR)	469 (333–678)	482 (345–692)	458 (335–691)	442 (288–572)
Median nadir (IQR)	205 (90–320)	213 (100–339)	212 (102–312)	138 (56–284)
HIV History				
Median years since HIV diagnosis				
AIDS diagnosis	154 (23)	90 (22)	33 (22)	31 (32)
Median viral load (log_{10}, IQR) (n = 656)	Und (Und–2.70)	Und (Und–Und)	Und (Und–3.19)	Und (Und–Und)
HIV viral load >400 copies/mL	486 (74)	314 (76)	99 (67)	73 (76)
Current combination antiretroviral therapy	520 (79)	330 (80)	109 (74)	81 (84)
Ever drug use				
Marijuana	480 (73)	328 (79)	93 (63)	59 (61)
Cocaine	323 (49)	211 (51)	69 (47)	43 (44)
Injection drug use	90 (14)	44 (11)	23 (16)	23 (24)
Inhaled nitrites	318 (48)	300 (72)	6 (4)	12 (12)
Erectile dysfunction drugs *	177 (35)	157 (38)	N/A	20 (21)
Current drug use (in last 6 mo)				
Marijuana	212 (32)	148 (36)	36 (24)	28 (29)
Cocaine	85 (13)	42 (10)	27 (18)	16 (16)
Injection drug use	14 (2)	7 (2)	5 (3)	2 (2)

Characteristic	All Participants N = 660n (%)	Men Who HaveSex With Menn = 415n (%)	Women n = 148n (%)	Men Who HaveSex With Womenn = 97n (%)
Inhaled nitrites	126 (19)	123 (30)	2 (1)	1 (1)
Erectile dysfunction drugs *	84 (16)	73 (18)	N/A	11 (11)
Current smoking	291 (44)	172 (41)	75 (51)	44 (45)
Alcohol consumption in past 30 d	457 (69)	324 (78)	77 (52)	56 (58)
Cervical HPV (n = 142)				
Any HPV	123 (87)	N/A	123 (87)	N/A
High-risk HPV	96 (68)	N/A	96 (68)	N/A
Low-risk HPV	81 (57)	N/A	81 (57)	N/A
Anal HPV (n = 643)				
Any HPV	571 (89)	382 (95)	132 (90)	57 (59)
High-risk HPV	527 (82)	354 (88)	122 (84)	51 (53)
Low-risk HPV	486 (76)	339 (85)	108 (74)	39 (41)

* Men only.

HSV indicates herpes simplex virus; IQR, interquartile range; Und, undetermined; HIV, human immunodeficiency virus; AIDS, acquired immunodeficiency syndrome; HPV, human papillomavirus.

Table 2

Logistic Regression Analysis of Factors Associated With HSV-2 Prevalence Among SUN Study Participants

Characteristic	Univariate Analysis (N = 660) OR (95% CI)	*P*	Multivariate Analysis (n = 632) adjusted OR (95% CI)	*P*
Age (yr)				
20–29	Ref			
30–39	1.74 (1.01, 3.02)	0.048	2.54 (1.35, 4.88)	0.004
40–49	2.27 (1.33, 3.90)	0.003	2.95 (1.57, 5.63)	<0.001
50 +	2.93 (1.58, 5.53)	<0.001	3.87 (1.89, 8.12)	<0.001
Gender, female	3.71 (2.38, 5.97)	<0.001	3.04 (1.82, 5.25)	<0.001
Black, non-Hispanic	3.08 (2.10, 4.61)	<0.001	2.53 (1.61, 4.05)	<0.001
Current unemployment	2.83 (2.09, 4.16)	<0.001	1.98 (1.36, 2.91)	<0.001
High-risk anal HPV infection	1.41 (0.93, 2.11)	0.100	1.69 (1.07, 2.67)	0.025
Duration since HIV diagnosis >2.3 yr (lower quartile)	2.08 (1.45, 2.99)	<0.001	1.54 (1.03, 2.30)	0.033
Current cocaine use (in previous 6 mo)	2.06 (1.24, 3.54)	0.006	NS	
History of opportunistic infection	1.67 (1.14, 2.49)	0.009	NS	
Current marijuana use (in previous6mo)	1.35 (0.96, 1.90)	0.088	NS	

OR indicates odds ratio; NS, nonsignificant.

Table 3

Logistic Regression Analysis of Factors Associated With HSV-2 Prevalence Among Women in the SUN Study

Characteristic	Univariate Analysis (n = 148) OR (95% CI)	*P*	Multivariate Analysis (n = 147) adjOR (95% CI)	*P*
Age >32 yr (lower quartile)	3.16 (1.30, 7.70)	0.011	3.58 (1.37, 9.58)	0.010
Black, non-Hispanic	2.47 (1.05, 6.06)	0.042	3.00 (1.19, 8.10)	0.023
Current unemployment	4.13 (1.72, 10.5)	0.002	4.42 (1.76, 11.9)	0.002
Cervical HPV infection	4.86 (1.66, 14.0)	0.003	NS	
High-risk anal HPV infection	3.09 (1.11, 8.23)	0.026	NS	
Health very good/excellent	0.39 (0.16, 0.92)	0.032	NS	
History of opportunistic infection	4.09 (1.12, 26.3)	0.066	NS	
Current cocaine use in previous 6 mo	6.77 (1.33, 123)	0.067	NS	
Current smoking	2.23 (0.94, 5.59)	0.076	NS	

OR indicates odds ratio; adjOR, adjusted odds ratio; HPV, human papillomavirus; NS, nonsignificant.

Table 4

Logistic Regression Analysis of Factors Associated With HSV-2 Prevalence Among MSM in the SUN Study

Characteristic	Univariate Analysis (n = 415) OR (95% CI)	*P*	Multivariate Analysis (n = 415) adjOR (95% CI)	*P*
Age (yr)				
20–29	Ref		Ref	
30–39	2.78 (1.24, 6.72)	0.017	3.62 (1.54, 9.22)	0.004
40–49	4.57 (2.08, 10.9)	<0.001	5.76 (2.51, 14.4)	<0.001
50 +	6.04 (2.51, 15.6)	<0.001	7.96 (3.17, 21.6)	<0.001
Black, non-Hispanic	2.15 (1.20, 4.00)	0.012	2.90 (1.54, 5.77)	0.001
Current unemployment	2.18 (1.40, 3.43)	<0.001	NS	
Duration since HIV diagnosis >2.3 yr (lower quartile)	2.04 (1.30, 3.22)	0.002	NS	
History of opportunistic infection	1.71 (1.06, 2.82)	0.031	NS	
Nadir CD4 <50 cells/mm^3	1.85 (1.06, 3.32)	0.035	NS	
History of injection drug use	2.88 (1.43, 6.30)	0.005	3.57 (1.72, 8.06)	0.001
History of inhaled nitrites use	1.48 (0.96, 2.29)	0.073	NS	
Current marijuana use (in previous 6 mo)	1.42 (0.95, 2.15)	0.091	NS	

OR indicates odds ratio; adjOR, adjusted odds ratio; NS, nonsignificant.