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Racial/Ethnic Disparities in Undiagnosed Infection With Herpes Simplex Virus Type 2

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Abstract

Background—Herpes simplex virus type 2 (HSV-2) is a common sexually transmitted infection (STI) that is the main cause of genital herpes. Studies have found racial/ethnic disparities in HSV-2 prevalence, but there have been few studies of racial/ethnic differences in the proportion of infections that go without a genital herpes diagnosis.

Methods—Data from 1396 HSV-2-seropositive participants of the National Health and Nutrition Examination Survey 1999–2004 were used to examine racial/ethnic differences in the odds of reporting being diagnosed previously with genital herpes.

Results—The proportion of participants who reported not being diagnosed previously with genital herpes was 85.5%. In adjusted analysis, non-Hispanic blacks had twice the odds of reporting being undiagnosed as non-Hispanic whites (adjusted odds ratio = 2.0, 95% CI = 1.37, 2.87). Being undiagnosed was also significantly associated with less than high school education, no prior STI history or HIV test, no current health insurance, and residence in the Midwest and South.

Conclusions—The low proportion of genital herpes diagnosis among non-Hispanic blacks with HSV-2 is not accounted for by other socio-demographic factors or health insurance. Combined with the high prevalence of HSV-2, the low proportion of diagnosis in this population is more likely to contribute to ongoing HSV-2 transmission than among non-Hispanic whites or Mexican Americans. More research is needed to assess the role that lack of diagnosis plays in ongoing HSV-2 transmission, and whether targeted HSV-2 screening, counseling and treatment could be part of a more effective prevention strategy for non-Hispanic blacks.

Non-Hispanic blacks experience a disproportionate burden of sexually transmitted infections (STI), even among those who report few sexual partners.¹ To reduce racial/ethnic disparities in STI incidence and prevalence, there is a need for research to understand potential underlying mechanisms.^{2–4} Herpes simplex virus type 2 (HSV-2) is one of the most common STI in the United States and is the main cause of genital herpes. HSV-2 is most prevalent among non-Hispanic blacks (40.3%) compared with the members of other US

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racial/ethnic groups (13.7% among non-Hispanic whites and 11.9% among Mexican Americans).⁵ Although most HSV-2-infected people do not recognize symptoms, HSV-2 can cause serious morbidity, including a severe primary infection in some people, recurrent painful lesions, psychological distress associated with sexual relationships and social stigma, and neonatal herpes in newborns of infected mothers. Infected individuals can transmit the virus to their sex partners through viral shedding even if they have no symptoms.⁶ In addition, HSV-2 infection has been found to be associated with increased risk for HIV acquisition.^{7,8} Antiviral suppressive therapy is about 50% effective in reducing HSV-2 transmission, and patients diagnosed with genital herpes may also receive counseling to reduce their risk of transmission by informing their sexual partners and using condoms.^{9,10} Infrequent diagnosis has been recognized as a central problem for HSV-2 control.¹¹

Studies have found high proportions of participants with HSV-2 reporting not being diagnosed previously with genital herpes, ranging from 84.0% to 90.1%.^{5,12–15} These results have been attributed to the infrequent recognition of symptoms, and the lack of widespread testing in the general population.^{5,13} A study of data from the National Health and Nutrition Examination Survey (NHANES) 1999–2004 data collection period found that 85.7% of HSV-2-seropositive participants reported not being diagnosed with genital herpes, which was an improvement compared with the 90.1% found in 1988–1994.⁵ Several factors have been found to be associated with the lack of genital herpes diagnosis among individuals with HSV-2 including black race/ethnicity, female gender, older age, less formal education, lack of information about genital herpes, not having a usual place for health care, coinfection with herpes simplex virus type 1 (HSV-1) or gonorrhea, not having had a recent STI diagnosis, and for men, being uncircumcised.^{12,15,16} In addition, the likelihood of diagnosis may be reduced in poor urban or rural areas because of a deficit of adequate STI care providers,^{17,18} especially for blacks,¹⁹ and may vary by geographic region.²⁰

This study analyzed data from NHANES 1999–2004 to replicate and extend previous findings regarding the extent of racial/ethnic differences in the proportion of individuals infected with HSV-2, but not diagnosed with genital herpes, and to identify other characteristics independently associated with the lack of genital herpes diagnosis.

METHODS

Data

Cross-sectional data from NHANES collection waves between 1999 and 2004 were combined for the analysis. To provide a representative sample of the US population, and to facilitate comparative research NHANES participants were sampled using stratified multistage clustered design with some demographic groups, including non-Hispanic blacks, over-sampled. The data were collected at both an in-home interview and at mobile examination centers for biologic assessments and for surveys of data considered sensitive, including sexual behavior. The overall interview response rate during this period was 82%. Informed written consent was obtained from all participants or their parents or guardians. Race/ethnicity was coded using self-reports, and is categorized as Mexican American, non-Hispanic black, non-Hispanic white, and mixed or other, including non-Mexican American Hispanics. Data regarding sexual behavior, prior diagnoses with STI, and prior HIV testing were collected using audio computer-assisted self-interview methods. For participants aged 14 to 49 purified glycoproteins (gG-1 of HSV-1) and (gG-2 of HSV-2) were used as antigens to detect type-specific antibodies for HSV-1 and HSV-2 in blood specimens using solid-phase enzymatic immunodot assays.²¹ For participants aged 18 or older prior diagnosis with genital herpes was ascertained by asking participants: “Has a doctor or other health care professional ever told you that you had genital herpes?” Thus, the coding by reported prior genital herpes diagnosis could only be accomplished for participants aged 18 to 49

who responded conclusively to the question; participants who responded “don’t know” were not included. Data on symptoms of genital herpes were not collected. For comparability with previous research and to reflect the focus of the analysis on the lack of diagnosis, the dependent variable was coded to indicate reporting not being diagnosed previously with genital herpes compared to the reference group of participants who reported being diagnosed.

We considered for inclusion in the analysis all participant characteristics available in NHANES that were previously shown to be associated with the lack of genital herpes diagnosis, or were hypothesized to be related to the severity of symptoms or healthcare access. The number of sexual partners participants reported having in their lifetimes was categorized for comparability with previous research; the categories were defined to avoid small numbers. HIV testing was performed using a combination of the Synthetic Peptide Enzyme Immunoassay (Bio-Rad Laboratories, Hercules, CA), and the Cambridge Biotech HIV-1 Western Blot Kit (Calypse Biomedical Corporation, Rockville, MD). HIV test results were provided to participants, along with results of other STI tests, using a password-protected call in system.²² Comprehensive lifetime STI history data were not collected. Prior STI history was ascertained by self-reports of ever having received a diagnosis of genital warts, or having received a diagnosis of gonorrhea or Chlamydia in the last 12 months. These measures were combined into a single indicator with a value of 1 if the participant positively endorsed any of the 3 items. Poverty is measured as the family income of the participant indexed to the poverty level, as defined by the US Census Bureau.²³ Because the focus of the analysis was on racial/ethnic differences, race/ethnicity interaction terms were also evaluated. NHANES data were matched by county of residence with data from the US Census 2000 through a special arrangement with the National Center for Health Statistics (Centers for Disease Control and Prevention, Hyattsville, MD). To assess potential geographic and contextual effects that may be related to differences in healthcare access or HSV-2 screening practices, 3 variables from the Census were included in the analysis: an indicator for Region (Northeast, South, Midwest, and West), residence in a metropolitan statistical area, and the county poverty rate. The county poverty rate was categorized into tertiles to facilitate comparisons.

Analysis

Data were analyzed with SUDAAN software (Research Triangle Institute, Research Triangle Park, NC) using guidelines provided by NHANES.²⁴ SUDAAN provides parameter estimates and standard errors that are adjusted for complex sampling and shared variance within geographic units using a Taylor series linearization expansion method.²⁵ Sample prevalences, means, and standard error values were adjusted for the unequal probability of selection, nonresponse, and poststratification. Prevalence estimates for undiagnosed HSV-2 infection were age-adjusted to the year 2000 US standard population for age categories 18 to 29, 30 to 39, and 40 to 49.²⁶

Associations with reporting being undiagnosed were assessed using weighted logistic regressions. Although the outcome was common, and the odds ratios should not be interpreted as prevalence ratios, logistic regressions were used because procedures for weighting and adjustment for sampling were not available with other methods. Significance of the logistic regressions was evaluated using Satterthwaite adjusted F-statistics. Multivariable logistic regression models were developed using partial likelihood ratio tests of nested models and assessing changes in parameter estimates.^{27,28} All variables in Table 1 were included in an initial multivariable model. Variables were retained if their inclusion significantly improved the model fit, or changed the parameter estimates of racial/ethnic indicators by 10% or more. There was little evidence of multicollinearity except between education and poverty index variables. Education was retained because it was more strongly

associated with the outcome. The multivariable model shown contains only those variables that remained in the best-fitting model.

RESULTS

Among the 1396 HSV-2-seropositive participants, the proportion reporting not being diagnosed with genital herpes was 85.5% (95% CI = 83.13%, 87.61%). Table 1 displays the proportion undiagnosed by individual and geographic-contextual characteristics, and bivariate logistic regression results. In bivariate analysis, the odds of reporting being undiagnosed differed significantly by race/ethnicity, with non-Hispanic black and Mexican American participants more likely to have been undiagnosed than non-Hispanic whites. Participants born outside the United States had significantly greater odds of reporting being undiagnosed. The odds of reporting being undiagnosed also differed by education, with participants who did not graduate high school or have a high school equivalent degree more likely to have been undiagnosed than those who had more than a high school education. Uncircumcised men had greater odds of reporting being undiagnosed than circumcised men. The odds of reporting being undiagnosed did not differ significantly overall by lifetime number of sexual partners category, although participants with 3 or fewer lifetime partners were more likely to be undiagnosed than participants with more than 20 lifetime partners. Participants who were infected with HSV-1, those who had not received a prior diagnosis with genital warts or recent diagnosis with Chlamydia or gonorrhea, those who had never been tested for HIV infection, those who were not currently covered by health insurance, and those who resided in counties with the highest poverty rate were significantly more likely to be undiagnosed. All 33 HIV/HSV-2-coinfected participants reported not being diagnosed with genital herpes. Because none of the coinfecting participants reported being diagnosed with genital herpes, coinfection was not included in logistic regression models.

Initially, separate multivariable logistic regression models were developed for men and women, to accommodate circumcision status as a potential covariate for men. However, circumcision status was not independently associated with reporting being undiagnosed among men, and models for men and women were similar. Therefore, a multivariable model using the combined sample of men and women was developed, including gender interaction terms.

Multivariable model results for the combined sample are also shown in Table 1. Adjusting for other factors, race/ethnicity remained a significant predictor of reporting being undiagnosed; non-Hispanic black participants had twice the odds of being undiagnosed as non-Hispanic whites (adjusted odds ratio [AOR] = 2.0, 95% CI = 1.37, 2.87). Mexican Americans and those of mixed or other race/ethnicity were not significantly more likely to be undiagnosed than non-Hispanic whites in multivariable analysis. The association with education level remained significant; participants who did not graduate high school or have a high school equivalent degree had almost 3 times the odds of being undiagnosed than those who had more than a high school education (AOR = 2.7, 95% CI = 1.32, 5.59). Participants who had not received a prior diagnosis with genital warts or recent diagnosis with chlamydia or gonorrhea, those who had never been tested for HIV infection, and those who were not covered by health insurance each had about twice the odds of being undiagnosed (AOR = 2.3, 95% CI = 1.26, 4.03; AOR = 1.8, 95% CI = 1.10, 2.95; AOR = 2.0, 95% CI = 1.07, 3.59, respectively). Participants who resided in the Midwest or the South each had almost twice the odds of being undiagnosed as those who resided in the Northeast (AOR = 1.9, 95% CI = 1.17, 3.02; AOR = 1.8, 95% CI = 1.10, 2.96, respectively). The odds of reporting being undiagnosed were not significantly different between participants who resided in the West compared to those who resided in the Northeast. Other

models that included other variables, or interactions with gender or race/ethnicity did not provide a better fit.

DISCUSSION

Results of this study confirm, in national data, that the low proportion of genital herpes diagnosis among non-Hispanic blacks with HSV-2 infection is not accounted for by other factors.^{12,15} There are several possible reasons for this finding, including differences in healthcare seeking behavior in response to symptoms, healthcare quality, or screening practices, and these mechanisms should be investigated.^{12,15,29} Combined with the high prevalence of HSV-2, the low proportion of diagnosis in this population is more likely to contribute to ongoing HSV-2 transmission than among non-Hispanic whites or Mexican Americans.

Several other participant characteristics were associated with the lack of diagnosis. Participants who were not covered by health insurance may have been less likely to seek healthcare in response to symptoms. Preexisting HSV-1 infection is known to reduce the severity of subsequently acquired HSV-2 infection, and thus HSV-1/HSV-2 coinfecting participants may have been less symptomatic, contributing to the significant bivariate effect and the trend in multivariable analysis. The weakening of this association in multivariable analysis is similar to findings from another recent population-based survey.¹⁵ The greater odds of reporting being undiagnosed seen among participants who had never been tested for HIV infection, and those who had not received a prior diagnosis with genital warts, or recent diagnosis with chlamydia or gonorrhea may reflect the practice of simultaneous HSV-2 testing conducted when patients present for comprehensive STI screening or reproductive health care,^{30,31} or they may indicate that people who are tested for HIV/STI are more likely to seek or have access to healthcare for genital symptoms. The greater likelihood of reporting being undiagnosed seen among participants residing in the South and Midwest may have resulted from many factors, including differences in the number of available STI care providers, HSV-2 screening practices, or concerns about privacy and stigma.^{32,33} Although family income and county poverty level were not strongly associated with reporting being undiagnosed, the significant effect of education may indicate an association with socioeconomic status. Because the number of participants who tested positive for HIV in this study was small, the finding that all HSV-2/HIV coinfecting participants reported not being diagnosed previously with genital herpes should be interpreted with caution.

Although the results generally replicate previous findings, there were some exceptions. The lack of a significant gender difference is consistent with a previous population-based study in New York City, and contrasts with findings from a clinic-based study, possibly reflecting differences in selection processes.^{12,15} Bivariate associations with place of birth, circumcision status, and county poverty rate were accounted for by other variables in the multivariable model. The proportion of participants reporting being undiagnosed with genital herpes differs slightly from that reported in these data previously because of age adjustment in this study.⁵

Several limitations should be acknowledged. Data on symptoms were not collected, thus we could not determine whether differences in diagnosis across groups were because of differences in screening, healthcare seeking behaviors in response to symptoms, or failure of healthcare providers to recognize symptoms. Many participants may have had no symptoms or such mild symptoms that they did not seek care. In addition, the proportion of infections without a diagnosis may have been inflated because of denial, or possibly to imperfect recall among asymptomatic participants who received a positive screening test result. The lack of more comprehensive information regarding STI history in NHANES is also a limitation.

Counseling to increase disclosure of infection to sex partners, and increase consistent condom use with uninfected partners and suppressive therapy, when medically appropriate, are optimal yet imperfect prevention strategies.^{10,34} The proportion of those with asymptomatic infections who would accept and adhere to suppressive therapy, primarily to prevent transmission to others, is unknown.³⁵ A recent study of sexual behavior following HSV-2 testing found that, although participants who tested positive significantly increased their condom use, their frequency of condom use did not differ significantly from those who tested negative.³⁶ This may reflect the inadequacy of standard posttest counseling to promote behavior change. Other strategies, such as clinic- or community-based education programs to help people recognize symptoms of primary genital herpes infections, may also be beneficial for prevention.³⁷ Mathematical modeling suggests that screening monogamous heterosexual couples for unrecognized HSV-2 infection, and following standard treatment guidelines for those found to be infected, can decrease the incidence of HSV-2.³⁸ The cost-effectiveness of such screening increases with HSV-2 prevalence.

Persistent racial/ethnic disparities in HSV-2 prevalence suggest that new prevention research directions are needed.^{2,39} Although national data have shown a decline in HSV-2 prevalence in recent years, the decline has not been equal across racial/ethnic groups. Between 1988–1994 and 1999–2004, Mexican Americans experienced a 39.8% decline in unadjusted HSV-2 prevalence, and non-Hispanic whites a 21.2% decline, but non-Hispanic blacks experienced only a 3.9% decline.⁵ Research that includes data on symptoms could clarify the extent to which racial/ethnic differences in diagnosis may be due to differences in healthcare seeking, or healthcare access or effectiveness. Such research could be used to more fully explore the costs and benefits of targeted screening to improve prevention, and reduce racial/ethnic disparities in HSV-2 prevalence.

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TABLE 1

Prevalence of Self-Reported Lack of Genital Herpes Diagnosis Among Herpes Simplex Virus Type 2 (HSV-2) Antibody-Positive Participants, Aged 18–49, by Selected Characteristics

Characteristic	Sample Size (N = 1396)	Undiagnosed HSV-2 Prevalence* (%, 95% CI)	Unadjusted Odds Ratio (95% CI)	<i>p</i> †	Adjusted Odds Ratio‡ (95% CI)	<i>p</i> †
Data collection wave				0.502		
1999–2000	432	86.4 (83.02, 89.26)	1.0			
2001–2002	531	86.1 (80.21, 90.42)	0.9 (0.5, 1.4)			
2003–2004	433	83.4 (79.43, 86.65)	0.7 (0.4, 1.3)			
Gender				0.295		
Men	457	87.9 (83.53, 91.18)	1.0			
Women	939	84.5 (81.04, 87.45)	0.8 (0.48, 1.26)			
Age group (yr)				0.827		
18–29	375	85.0 (79.86, 88.94)	1.0			
30–39	487	85.1 (81.36, 88.23)	1.0 (0.63, 1.63)			
40–49	534	86.5 (81.52, 90.28)	1.1 (0.68, 1.88)			
Racial/ethnic group				<0.001		0.007
Non-Hispanic white	433	80.5 (75.57, 84.61)	1.0		1.0	
Non-Hispanic Black	627	91.5 (88.28, 93.87)	2.6 (1.69, 3.89)		2.0 (1.37, 2.87)	
Mexican American	223	92.7 (87.92, 95.71)	2.8 (1.61, 5.02)		1.7 (0.78, 3.88)	
Mixed or other	113	89.5 (80.75, 94.51)	1.9 (0.92, 4.07)		1.5 (0.65, 3.31)	
Place of birth				0.014		
US	1156	84.5 (81.96, 86.77)	1.0			
Outside US	238	93.1 (87.12, 96.44)	2.4 (1.21, 4.60)			
Education				<0.001		0.029
More than high school grad.	626	81.8 (78.85, 84.49)	1.0		1.0	
High school grad. or equivalent	328	85.4 (78.90, 90.19)	1.6 (0.97, 2.48)		1.5 (0.85, 2.57)	
Did not graduate high school	442	94.0 (89.66, 96.54)	3.9 (2.17, 7.16)		2.7 (1.32, 5.59)	
Poverty index§						
At or above poverty level	974	84.3 (81.63, 86.58)	1.0			
Below poverty level	332	89.1 (83.70, 92.85)	1.5 (0.92, 2.39)			
Circumcision status (men only)				0.026		
Yes	304	86.4 (81.36, 90.30)	1.0			
No	132	93.6 (86.66, 97.04)	2.5 (1.13, 5.51)			
HSV-1 serostatus				<0.001		0.068
Negative	460	80.5 (76.71, 83.82)	1.0		1.0	
Positive	931	89.0 (85.81, 91.47)	1.9 (1.39, 2.72)		1.5 (0.97, 2.21)	
Lifetime number of sexual partners				0.082		0.281
≥21	263	81.9 (76.15, 86.49)	1.0		1.0	
11–20	250	80.9 (72.58, 87.15)	0.9 (0.55, 1.53)		0.8 (0.47, 1.32)	
4–10	608	87.3 (82.79, 90.73)	1.4 (0.87, 2.40)		1.2 (0.65, 2.03)	

Characteristic	Sample Size (N = 1396)	Undiagnosed HSV-2 Prevalence* (%, 95% CI)	Unadjusted Odds Ratio (95% CI)	<i>P</i> [†]	Adjusted Odds Ratio [‡] (95% CI)	<i>P</i> [†]
3 or fewer	275	90.3 (84.83, 93.96)	2.1 (1.15, 3.98)		1.7 (0.89, 3.09)	
Prior diagnosis with genital warts/recent diagnosis with gonorrhea or chlamydia				<0.001		0.008
Yes	148	68.1 (59.07, 75.93)	1.0		1.0	
No	1248	87.7 (84.84, 90.10)	3.0 (1.92, 4.75)		2.3 (1.26, 4.03)	
HIV test history				0.017		0.021
Tested Previously	537	89.9 (86.04, 92.76)	1.0		1.0	
Never tested	849	82.9 (79.14, 86.10)	1.9 (1.12, 3.03)		1.8 (1.10, 2.95)	
Health insurance status				0.016		0.030
Currently covered	1001	83.8 (80.35, 86.66)	1.0		1.0	
Not currently covered	390	90.9 (86.06, 94.20)	2.2 (1.17, 4.03)		2.0 (1.07, 3.59)	
Has usual place for health care				0.657		0.142
At least one usual place	1149	86.0 (83.18, 88.34)	1.0		1.0	
No usual place	247	83.4 (74.48, 89.62)	0.9 (0.47, 1.63)		0.6 (0.34, 1.18)	
Region				0.051		0.027
Northeast	202	83.9 (77.75, 88.56)	1.0		1.0	
Midwest	260	85.7 (78.15, 90.95)	1.5 (0.91, 2.53)		1.9 (1.17, 3.02)	
South	665	88.2 (84.82, 90.84)	1.6 (0.96, 2.57)		1.8 (1.10, 2.96)	
West	269	77.7 (69.22, 84.40)	0.8 (0.46, 1.49)		1.1 (0.51, 2.18)	
Residence in an MSA [¶]				0.146		
In an MSA	1211	85.2 (82.61, 87.52)	1.0			
Outside of an MSA	185	87.2 (81.83, 91.19)	1.4 (0.88, 2.23)			
County poverty rate ^{//}				0.044		
5%–10%	394	82.2 (76.91, 86.55)	1.0			
11%–13%	423	85.1 (79.24, 89.46)	1.4 (0.78, 2.39)			
14%–25%	579	89.1 (86.00, 91.53)	2.0 (1.27, 3.20)			

* Undiagnosed HSV-2 Prevalence refers to the weighted percentage of participants with HSV-2 antibodies who reported never being diagnosed with genital herpes. Prevalence estimates were age-adjusted to the Year 2000 US standard population.

[†] *P* values are for Satterthwaite adjusted F-statistics.

[‡] Odds ratios are adjusted for the other variables in the column. Variables that are not included in this column were excluded from the final multivariable model because they did not significantly improve the model.

[§] Poverty index refers to family income relative to the poverty level for a family of a given size, as defined by the US Census Bureau.

[¶] Residence in MSA refers to residence in a Metropolitan Statistical Area, as defined by the US Census Bureau.

^{//} County poverty rate refers to the percentage of residents of the county where the participant resided who were living below the poverty level as defined by the US Census Bureau, and is categorized using tertiles.

CI indicates confidence interval.