HHS Public Access

Author manuscript

Clin Infect Dis. Author manuscript; available in PMC 2019 October 30.

Published in final edited form as:

Clin Infect Dis. 2018 October 30; 67(10): 1535–1542. doi:10.1093/cid/ciy318.

Seroprevalence of Herpes Simplex Virus Types 1 and 2 Among Pregnant Women and Sexually Active, Nonpregnant Women in the United States

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Abstract

Background.—Neonatal herpes is a rare, devastating consequence of herpes simplex virus type 1 (HSV-1) or 2 (HSV-2) infection during pregnancy. The risk of neonatal infection is higher among pregnant women seronegative for HSV-1 or HSV-2 who acquire their first HSV infection near delivery.

Methods.—We estimated HSV-1 and HSV-2 seroprevalence among pregnant women aged 20–39 years in 1999–2014, assessed HSV seroprevalence changes between 1999–2006 and 2007–2014, and compared HSV seroprevalence between pregnant women and sexually active, nonpregnant women aged 20–39 years in 2007–2014 using National Health and Nutrition Examination Survey data.

Results.—Among pregnant women in 1999–2014, HSV-1 seroprevalence was 59.3%, HSV-2 seroprevalence was 21.1%, and HSV seronegativity was 30.6%. Between 1999–2006 and 2007–2014, HSV-1 and HSV-2 seroprevalence among pregnant women remained stable. However, among pregnant women with ≤3 sex partners (approximately 40% of all pregnant women), seronegativity for both HSV-1 and HSV-2 increased from 35.6% to 51.4% ($P < .05$). In 2007–2014, nonpregnant women who were (1) unmarried, (2) living below poverty level, or (3) had ≥4 sex partners were more likely than pregnant women to be seronegative for both HSV-1 and HSV-2 ($P < .05$).

Conclusions.—HSV-1 and HSV-2 seroprevalence among US pregnant women remained stable between 1999 and 2014. However, pregnant women with fewer sex partners were increasingly seronegative for both HSV-1 and HSV-2, indicating an increasing proportion of pregnant women

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Potential conflicts of interest. All authors: No reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

who are vulnerable to primary HSV acquisition in pregnancy, which confers an increased risk of transmitting HSV to their neonates.

Keywords

neonatal herpes; HSV-1; HSV-2; pregnant women; herpes simplex virus

Neonatal herpes is a rare, potentially devastating consequence of herpes simplex virus type 1 (HSV-1) or 2 (HSV-2) infection during pregnancy. While neonatal herpes occurs among infants born to women with longstanding HSV infection, the risk of neonatal infection is higher among pregnant women who are seronegative for HSV-1 or HSV-2 and who acquire their first (primary) HSV infection near delivery [1]. This increased risk likely occurs because of increased viral shedding during primary infections and insufficient time to develop maternal antibodies that protect the infant [2].

Historically, HSV-2 has been the primary cause of neonatal herpes in the United States [3–6]. However, HSV-1, which is typically associated with orolabial lesions, is increasingly being identified as the cause of neonatal herpes in the United States and worldwide, with up to 73% of neonatal herpes cases in some populations caused by HSV-1 [7–9]. This corresponds with an increasing proportion of genital HSV-1 infections, which may be a result of the growing numbers of adolescents lacking HSV-1 antibodies at sexual debut [10–12].

Data regarding HSV infections among pregnant women are limited because infections are frequently asymptomatic and because routine HSV screening in pregnant women is not recommended. Additionally, genital HSV infections are not reportable conditions. We used data from the National Health and Nutrition Examination Survey (NHANES), a series of national surveys that aim to produce nationally representative estimates, to (1) estimate HSV-1 and HSV-2 seroprevalence among pregnant women aged 20–39 years in 1999–2014; (2) assess changes in HSV seroprevalence between 1999–2006 and 2007–2014; and (3) compare HSV seroprevalence between pregnant women and sexually active, nonpregnant women aged 20–39 years in 2007–2014. This updates a previous report describing HSV seroprevalence among pregnant women during 1999–2002 [13].

METHODS

NHANES is a series of cross-sectional national surveys conducted by the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics (NCHS). Detailed NHANES methods have been published previously [14–16]. NHANES has been conducted in 2-year cycles on a continuous basis since 1999 using a multistage, complex sampling scheme to produce nationally representative estimates of the civilian, noninstitutionalized US population. Certain subgroups are oversampled for analytical purposes during specific cycles [16,17]. NHANES survey methodology includes interviews and physical examinations where blood and other specimens are collected for testing. NHANES is approved by the NCHS/CDC Research Ethics Review board. Informed consent was obtained from all participants.

During 1999–2014, all participants aged 14–59 years were interviewed about sexual behavior, female participants aged 12–59 years had pregnancy tests (urine and serum) performed, and persons aged 14–49 years were tested for HSV antibodies using a previously described glycoprotein G–based immunodot assay that has high sensitivity and specificity and discriminates well between type-specific HSV-1 and HSV-2 antibodies but that cannot distinguish genital from oral HSV infections [18, 19]. Indeterminate HSV-1 and HSV-2 results were recoded as negative for analytic purposes. Pregnant women aged 15–39 years were oversampled during 1999–2006. Pregnancy results for females aged <20 years were not included in public use datasets starting in 2007–2008.

Women with a positive laboratory pregnancy test or who self-reported as pregnant were considered pregnant. Women who did not have a positive laboratory pregnancy test, did not self-report as pregnant, and reported ever having vaginal, anal, or oral sex were considered sexually active, nonpregnant. Women with missing HSV-1 or HSV-2 serology results from refusal of or unsuccessful venipuncture or with missing or non-ascertained pregnancy status were excluded from the analysis.

Our analysis used 3 primary approaches. We: (1) estimated overall HSV-1 and HSV-2 seroprevalence among pregnant women aged 20–39 years across the entire 1999–2014 analytic period; (2) compared HSV-1 and HSV-2 seroprevalence among pregnant women aged 20–39 years between 1999–2006 and 2007–2014; and (3) explored differences in HSV-1 and HSV-2 seropositivity between sexually active, nonpregnant women aged 20–39 years and pregnant women aged 20–39 years in 2007–2014. Overall HSV-1 and HSV-2 seroprevalence estimates include pregnant women of all races/ethnicities. However, HSV-1 and HSV-2 seroprevalence stratified by race/ethnicity was only reported for non-Hispanic white, non-Hispanic black, and Mexican American women because sample sizes of other racial/ethnic groups were not sufficient for calculating stable estimates [17]. NHANES' 6 marital status categories (married, widowed, divorced, separated, never married, living with partner) were collapsed into 2 categories (married, other) for analytic purposes. HSV seroprevalence was analyzed among women with ≤3 and ≥4 sex partners to maintain consistency with previous HSV seroprevalence analyses among pregnant women during 1999–2002 and facilitate comparability over time [13].

Statistical analyses were performed in SAS version 9.3 soft-ware (SAS Institute, Cary, North Carolina) to estimate HSV seroprevalences and calculate standard errors while accounting for NHANES' complex survey design. Seroprevalence estimates were weighted to be nationally representative of the noninstitutionalized US civilian population and account for oversampling and interview and examination nonresponse [17]. Standard weights for the NHANES medical examination published by NCHS were used for all analyses. Variances of prevalence estimates were calculated by Taylor series expansion (linearization) method [20, 21] and were used to calculate confidence intervals. We evaluated seroprevalence by age, race/ethnicity, educational level, marital status, poverty index, age at first sex, and number of lifetime sex partners. Prevalence ratios were calculated by dividing weighted seroprevalence estimates within each category. Bivariate statistical associations were examined using the adjusted Wald F test. Prevalence estimates with relative standard error >30% were

considered unstable and should be interpreted with caution. A *P* value of <.05 was considered significant.

RESULTS

HSV-1 and HSV-2 Seroprevalence and Seronegativity Among Pregnant Women Aged 20–39 Years, 1999–2014

In the 1999–2014 NHANES surveys, data were collected for 8124 women aged 20–39 years; 1393 (17.2%) of whom had a positive pregnancy test or reported being pregnant. Serology results for both HSV-1 and HSV-2 were available for 1215 (87.2%) of pregnant women. The majority of pregnant women were aged 20–29 years (60.8%), were non-Hispanic white (64.6%), had more than a high school education (62.7%), were married (65.8%), lived at or above poverty level (78.1%), were aged ≥16 years at first sex (72.8%), and had ≥4 lifetime sex partners (61.0%) (Table 1).

Overall, HSV-1 seroprevalence among pregnant women was 59.3%, HSV-2 seroprevalence was 21.1%, and seronegativity for both HSV-1 and HSV-2 was 30.6% (Table 1). Demographic and behavioral factors among pregnant women who were significantly more likely to be seropositive for HSV-1 included Mexican American and non-Hispanic black race/ethnicity (non-Hispanic white as the referent), having a high school education or less, and living below the poverty level. Characteristics of pregnant women who were significantly more likely to be seropositive for HSV-2 included age 30–39 years (20–29 years as the referent), non-Hispanic black race/ethnicity (non-Hispanic white as the referent), “other” marital status, and ≥4 lifetime sex partners. Non-Hispanic blacks and Mexican Americans were significantly less likely than non-Hispanic whites to be negative for both HSV-1 and HSV-2. Additionally, pregnant women with high school education or less, with “other” marital status, living below the poverty level, with age ≤15 years old at first sex, or with ≥4 lifetime sex partners were less likely to be negative for both HSV-1 and HSV-2.

HSV-1 and HSV-2 Seroprevalence and Seronegativity Among Pregnant Women Aged 20–39 Years, 1999–2006 and 2007–2014

HSV-1 and HSV-2 seroprevalence and HSV seronegativity among pregnant women aged 20–39 years in 1999–2006 and 2007–2014 are presented separately by selected demographic and behavioral factors in Table 2. Between 1999–2006 and 2007–2014, there were no significant differences in age, race/ethnicity, educational level, marital status, poverty index, age at first sex, or number of lifetime sex partners among pregnant women aged 20–39 years. Overall, the HSV-1 and HSV-2 seroprevalence among pregnant women aged 20–39 did not differ between the 2 periods, but some temporal differences were noted among selected subpopulations. While HSV-1 seroprevalence was unchanged over time among pregnant women with ≥4 lifetime sex partners, HSV-1 seropositivity was lower in the later time period among pregnant women with ≤3 lifetime partners (63.5% vs 46.6%, $P = .03$). For HSV-2, non-Hispanic black pregnant women had the overall highest seropositivity in both periods, but there was also a decline in this subgroup from 58.4% in 1999–2006 to 41.6% in 2007–2014, although this difference was not statistically different ($P = .07$).

Additionally, there was a borderline significant decline in HSV-2 seropositivity among pregnant women living below the poverty level between 1999–2006 (31.6%) and 2007–2014 (19.5%) ($P = .05$). Among pregnant women with ≤3 lifetime sex partners, HSV seronegativity increased from 35.6% to 51.4% ($P < .05$).

HSV Seroprevalence Among Pregnant Women and Sexually Active, Nonpregnant Women Aged 20–29 Years, 2007–2014

To determine whether HSV seroprevalence estimates among sexually active, nonpregnant women were similar to HSV seroprevalence among pregnant women, we explored HSV-1 and HSV-2 seroprevalence and seronegativity among pregnant women aged 20–39 years and among sexually active, nonpregnant women aged 20–39 years in 2007–2014 (Table 3). Pregnant and nonpregnant women aged 20–39 differed in several ways. Pregnant women were more likely to be married than nonpregnant women ($P < .01$); pregnant women were younger than nonpregnant women ($P = .05$), and pregnant women were somewhat less likely to be white ($P = .06$), although neither of these differences were statistically significant. Overall, no differences were seen in the estimated seroprevalence of HSV-1 or HSV-2 between pregnant and nonpregnant women. However, when seronegativity for both HSV-1 and HSV-2 was examined, several important differences were identified. Nonpregnant women who were unmarried ($P < .01$) or living below poverty level ($P = .03$) or who had ≥4 lifetime sex partners ($P = .04$) were more likely than pregnant women with the same attributes to be seronegative for both HSV-1 and HSV-2. There were no other significant differences in HSV-1 seroprevalence, HSV-2 seroprevalence, or HSV seronegativity between pregnant women and sexually active, nonpregnant women in 2007–2014.

DISCUSSION

In this nationally representative survey, HSV-1 and HSV-2 sero-prevalence and HSV seronegativity remained largely unchanged among US pregnant women aged 20–39 years between 1999–2006 and 2007–2014. However, the proportion of pregnant women with ≤3 lifetime sex partners who were seronegative for both HSV-1 and HSV-2 increased significantly from 35.6% in 1999–2006 to 51.4% in 2007–2014, suggesting that there is a growing subset of pregnant women with fewer sex partners who are vulnerable to acquiring their first HSV infection during pregnancy, which confers higher risk of transmitting HSV to their neonate.

We expected to see significant declines in HSV-1 seroprevalence among young pregnant women because recent NHANES analyses have demonstrated large decreases in HSV-1 seroprevalence among persons aged 14–29 years between 1999 and 2014 [10, 22]. Whereas HSV-1 seroprevalence among pregnant women aged 20–29 years in NHANES decreased from 61.8% in 1999–2006 to 52.9% in 2007–2014, this decrease was not statistically significant. This discrepancy may be explained by the fact that declines in HSV-1 seroprevalence in other NHANES analyses occurred largely among males and young persons aged 14–19 years, 2 groups that were not included our analysis [10, 22]. Alternatively, this study might have had insufficient statistical power to detect significant differences in HSV-1 prevalence among pregnant women in this age group in NHANES. Of

note, a University of Washington Medical Center study found stable HSV-1 seroprevalence between 1989–1999 and 2000–2010 among pregnant women of all ages who delivered at their facility [23].

While overall HSV-1 seropositivity did not decrease among pregnant women, there was a significant decrease in HSV-1 seropositivity among pregnant women with ≤3 lifetime sex partners between 1999–2006 and 2007–2014. Decreased HSV-1 seropositivity was not observed among pregnant women with ≥4 lifetime sex partners, nor did the proportion of pregnant women with ≤3 lifetime sex partners change significantly across the 2 time periods. The decrease in HSV-1 seroprevalence among pregnant women with ≤3 lifetime sex partners may simply reflect overall declining rates of HSV-1 seroprevalence in the United States, coupled with less risk for nonsexual and sexual transmission. However, the differences in HSV-1 seropositivity between pregnant women with ≤3 lifetime sex partners and ≥4 lifetime sex partners may reflect differences in the number of sexual contacts and/or sexual behaviors given that sexually transmitted HSV-1 infections are increasing as adolescents who lack HSV-1 antibodies at sexual debut become sexually active [10–12]. Further investigation into the sexual transmission of HSV-1 may help elucidate why HSV-1 seroprevalence has decreased among pregnant women with fewer sex partners.

HSV-2 seroprevalence among pregnant women in our analysis was unchanged between 1999–2006 and 2007–2014; non-Hispanic black women had the largest absolute decrease in HSV-2 seroprevalence, although this change was not statistically significant. While our findings contrast with findings from the University of Washington that observed a significant decrease in HSV-2 seroprevalence among pregnant women of all ages from 30.1% in 1989–1999 to 16.3% in 2000–2010, particularly among white pregnant women [23], direct comparison is difficult because the University of Washington analysis included 9 years (1989–1998) not included in our analysis in which well-described decreases in HSV-2 seroprevalence among women of all races/ethnicities occurred in the United States [10, 24].

The increase in the proportion of pregnant women with ≤3 lifetime sex partners who were seronegative for both HSV-1 and HSV-2 is important to note because it could have consequences on rates of neonatal herpes. Women with no serologic evidence of prior HSV infection are at increased risk of acquiring their first HSV infection during pregnancy: studies from 1997 and 2003 found that women seronegative for both HSV-1 and HSV-2 had a nearly 4% chance of acquiring their first HSV-1 or HSV-2 infection during pregnancy [25], women seropositive for HSV-1 but seronegative for HSV-2 had a 2% chance of acquiring their first HSV-2 infection during pregnancy, and women who were seropositive for HSV-2 but seronegative for HSV-1 were protected against acquisition of HSV-1 infection during pregnancy [26]. Furthermore, neonates born to mothers who acquire their first HSV infection during late pregnancy are at much higher risk for HSV transmission compared to neonates born to mothers with recurrent genital HSV infection (57% vs 2%) secondary to lack of protective transplacental maternal HSV antibodies [25]. Finally, the increase in pregnant women who are seronegative for HSV-1, and who consequently are at risk for contracting HSV-1 while pregnant, is of particular concern given that the rate of transmission of HSV from mother to infant is higher when HSV-1 is isolated at delivery compared with HSV-2 (odds ratio, 16.5 [95% confidence interval, 4.1–65]) [25]. While these

studies were conducted when HSV seroprevalences may have been different than current rates, the data suggest that pregnant women with ≤3 lifetime sex partners, who are customarily regarded as low risk for HSV infection and who comprise approximately 40% of all pregnant women in the United States, are increasingly susceptible to acquiring primary HSV-1 or HSV-2 infection during pregnancy and, if infected, are at increased risk for transmitting HSV to their neonate.

Our findings highlight the importance of prevention efforts for HSV-seronegative women because current neonatal herpes prevention strategies, including antiviral suppressive therapy for recurrent outbreaks and delivery of an infant by cesarean section when lesions or prodromal symptoms are present at labor and delivery, are only targeted to pregnant women with known genital herpes infections. Currently, the American College of Obstetricians and Gynecologists and the US Preventive Services Task Force recommend against routine screening of asymptomatic women for HSV during pregnancy [27, 28]. However, a number of strategies have been proposed in the literature to prevent maternal HSV acquisition during pregnancy, though none have been widely tested or recommended routinely and few studies have focused on prevention of maternal HSV-1 acquisition [29–34]. Some strategies that have been suggested in the literature include: (1) screening pregnant women for HSV to identify uninfected women and educate them on strategies to prevent HSV acquisition during pregnancy; (2) screening sex partners for HSV to identify HSV-discordant couples and provide appropriate counseling to minimize risk of HSV transmission to pregnant partners; and (3) having pregnant women abstain from sexual contact during the third trimester with partners known or suspected of having herpes, including vaginal intercourse with partners suspected of having genital herpes and receptive oral sex with partners suspected to have orolabial herpes.

Finally, the prevalence of risk factors or other characteristics among women of child-bearing age in a population are often used to estimate the prevalence among pregnant women. Because pregnancy status was available in NHANES, we determined whether HSV seroprevalence estimates among sexually active, nonpregnant women approximate HSV seroprevalence among pregnant women. Our analysis, using data from 2007–2014, suggest that HSV seroprevalence among pregnant women in the United States may be approximated using data from sexually active, nonpregnant women, but further investigation into this assumption is warranted.

Our analysis has several limitations. First, pregnant women and sexually active nonpregnant women aged 14–19 years were excluded from our analysis because NHANES does not include this information in publicly released datasets. Thus, our analysis does not address the effects of well-described declines in HSV-1 seroprevalence among persons aged 14–19 years on HSV seroprevalence of young pregnant women. Additionally, because these analyses are based on HSV serologic testing, we are unable to distinguish genital HSV infections from oral HSV infections. Finally, pregnant women were no longer oversampled in NHANES starting in 2007, so the small numbers of pregnant women included in NHANES during 2007–2014 did not allow us to investigate HSV seroprevalence trends among women with ≤3 lifetime sex partners by race/ethnicity or other demographic or behavioral characteristics.

Our analysis suggests there is a growing subset of US pregnant women aged 20–39 years who lack antibodies to HSV-1 and HSV-2 and who thus are at risk of acquiring their first HSV infection during pregnancy, which confers higher risk of transmitting HSV to their neonates. Further investigations into new strategies to prevent HSV acquisition in pregnant women and to prevent HSV transmission from mother to neonate are warranted.

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Table 1.

Percentage of US Pregnant Women Who Were Seropositive for Herpes Simplex Virus Type 1 (HSV-1) and 2 (HSV-2) and Who Were Seronegative for Both HSV-1 and HSV-2 by Demographic and Behavioral Factors: National Health and Nutrition Examination Survey, 1999–2014

	Sample Size		HSV-1 Seropositive				HSV-2 Seropositive				HSV-1 and HSV-2 Seronegative			
Characteristic	No.[a]	(%[b])	%[b]	(95% CI)	Prevalence Ratio	(95% CI)	%[b]	(95% CI)	Prevalence Ratio	(95% CI)	%[b]	(95% CI)	Prevalence Ratio	(95% CI)
Total	1215	…	59.3	(54.7–63.9)	…	…	21.1	(17.0–(25.2)	…	…	30.6	(25.8–35.3)	…	…
Age, y														
20–29	792	(60.8)	58.5	(52.5–64.4)	…	…	16.8	(12.9–20.7)	…	…	32.1	(25.9–38.4)	…	…
30–39	423	(39.2)	60.5	(53.1–67.9)	1.0	(.9–1.2)	27.8	(20.0–35.5)	1.7	(1.2–2.3)	28.2	(21.4–34.9)	0.9	(.6–1.2)
Race/ethnicity														
Non-Hispanic white	544	(64.6)	46.2	(39.5–53.0)	…	…	16.2	(10.1–22.3)	…	…	43.0	(36.1–49.9)	…	…
Non-Hispanic black	182	(18.0)	69.5	(61.4–77.6)	1.5	(1.2–1.8)	51.4	(42.9–60.0)	3.2	(2.1–4.7)	11.4	(5.7–17.1)	0.3	(.2–0.4)
Mexican American	331	(17.4)	88.8	(83.7–93.9)	1.9	(1.6–2.3)	16.0	(9.9–22.0)	1.0	(.6–1.6)	7.1	(3.1–11.1)	0.2	(.1–0.3)
Educational level														
High school or less	573	(37.3)	70.9	(64.0–77.9)	1.4	(1.2–1.6)	23.4	(17.4–29.3)	1.2	(.8–1.7)	18.1	(11.1–25.0)	0.5	(.3–0.7)
More than high school	642	(62.7)	52.3	(46.2–58.5)	…	…	19.7	(14.4–25.1)	…	…	38.0	(31.8–44.2)	…	…
Marital status														
Married	770	(65.8)	56.3	(50.3–62.4)	…	…	15.1	(10.3–19.9)	…	…	36.2	(30.1–42.2)	…	…
Other	407	(34.2)	63.7	(57.0–70.4)	1.1	(1.0–1.3)	30.8	(24.9–36.7)	2.0	(1.4–2.9)	21.2	(14.8–27.7)	0.6	(.4–0.8)
Poverty index														
Below poverty level	299	(21.9)	78.2	(71.8–84.5)	1.5	(1.3–1.7)	26.9	(21.1–32.7)	1.4	(1.0–1.9)	10.6	(5.8–15.4)	0.3	(.2–0.5)
At or above poverty level	837	(78.1)	53.2	(47.5–58.9)	…	…	19.3	(14.6–24.1)	…	…	37.1	(31.1–43.0)	…	…
Age at first sex, y														
≤15	310	(27.2)	64.9	(56.3–73.5)	1.1	(1.0–1.4)	24.3	(17.5–31.2)	1.2	(.9–1.8)	22.6	(15.0–30.3)	0.7	(.5–0.9)
≥16	783	(72.8)	56.9	(51.0–62.7)	…	…	19.8	(14.9–24.7)	…	…	34.3	(28.7–40.0))	…	…
Lifetime sex partners, No.														
≤3	506	(39.0)	56.4	(49.3–63.5)	…	…	7.1	(3.9–10.3)	…	…	42.2	(34.9–49.5)	…	…
≥4	580	(61.0)	60.7	(54.7–66.7)	1.1	(.9–1.3)	30.1	(24.0–36.2)	4.3	(2.7–6.8)	23.9	(17.9–29.9)	0.6	(.4–0.8)

Abbreviations: CI, confidence interval; HSV-1, herpes simplex virus type 1; HSV-2, herpes simplex virus type 2.

[a]Unweighted No.

[b] Weighted percentage.

Table 2.

Percentage of US Pregnant Women Who Were Seropositive for Herpes Simplex Virus Type 1 (HSV-1) and 2 (HSV-2) and Who Were Seronegative for Both HSV-1 and HSV-2 by Demographic and Behavioral Factors: National Health and Nutrition Examination Survey, 1999–2006 and 2007–2014

	1999–2006		2007–2014			HSV-1 Seropositive			HSV-2 Seropositive			HSV-1 and HSV-2 Seronegative		
						1999–2006	2007–2014		1999–2006	2007–2014		1999–2006	2007–2014	
Characteristic	**No.[a]**	**(%[b])**	**No.[a]**	**(%[b])**	***P* Value[c]**	**%[b]**	**%[b]**	***P* Value[c]**	**%[b]**	**%[b]**	***P* Value[c]**	**%[b]**	**%[b]**	***P* Value[c]**
Total	999	…	216	…		61.5	55.7	.25	21.6	20.3	.77	28.9	33.2	.42
Age, y					.47									
20–29	657	(62.1)	135	(58.7)		61.8	52.9	.21	17.1	16.3	.86	29.5	36.5	.34
30–39	342	(37.9)	81	(41.3)		61.1	59.7	.85	29.1	25.9	.70	28.0	28.4	.96
Race/ethnicity					.62									
Non-Hispanic white	477	(65.3)	67	(63.2)		46.2	46.2	.99	15.1	18.1[d]	.66	43.9	41.4	.76
Non-Hispanic black	130	(16.6)	52	(20.4)		71.7	66.5	.55	58.4	41.6	.07	9.8[d]	13.6[d]	.53
Mexican American	285	(18.1)	46	(16.3)		90.4	85.6	.40	18.3	11.5[d]	.25	5.8[d]	9.6[d]	.42
Educational level					.64									
High school or less	474	(38.1)	99	(35.9)		72.3	68.6	.64	23.9	22.5	.84	18.9	16.6[d]	.76
More than high school	525	(61.9)	117	(64.1)		54.9	48.5	.34	20.2	19.0	.84	35.1	42.4	.29
Marital status					.41									
Married	657	(67.4)	113	(63.4)		59.6	51.0	.20	14.6	15.9	.81	33.3	40.8	.27
Other	305	(32.6)	102	(36.6)		63.7	63.6	.99	32.9	28.0	.43	22.1	20.2	.78
Poverty index					.85									
Below poverty level	238	(21.7)	61	(22.3)		81.4	73.2	.24	31.6	19.5	.05	8.2	14.4[d]	.27
At or above poverty level	705	(78.3)	132	(77.7)		55.4	49.7	.38	19.6	19.0	.91	35.3	40.0	.48
Age at first sex, y					.84									
≤15	253	(26.8)	57	(27.8)		67.5	60.8	.48	23.7	25.3	.84	23.5	21.2[d]	.77
≥16	651	(73.2)	132	(72.2)		59.1	53.1	.34	21.1	17.6	.51	31.2	39.4	.20
Lifetime sex partners, No.					.24									
≤3	428	(36.7)	78	(42.7)		63.5	46.6	.03	7.3	6.8[d]	.87	35.6	51.4	.05
≥4	470	(63.3)	110	(57.3)		60.5	61.2	.92	30.4	29.7	.91	25.0	22.1	.65

Clin Infect Dis. Author manuscript; available in PMC 2019 October 30.

Abbreviations: HSV-1, herpes simplex virus type 1; HSV-2, herpes simplex virus type 2.

[a] Unweighted No.

[b] Weighted percentage.

[c] *P* values for χ^2 test (<.05 was considered significant).

[d] Relative standard error >30%.

Table 3.

Percentage of US Pregnant Women and Sexually Active, Nonpregnant US Women Who Were Seropositive for Herpes Simplex Virus Type 1 (HSV-1) and 2 (HSV-2) and Who Were Seronegative for Both HSV-1 and HSV-2 by Demographic and Behavioral Factors: National Health and Nutrition Examination Survey, 2007–2014

	Nonpregnant		Pregnant			HSV-1 Seropositive			HSV-2 Seropositive			HSV-1 and HSV-2 Seronegative		
						Nonpregnant	Pregnant		Nonpregnant	Pregnant		Nonpregnant	Pregnant	
Characteristic	**No.[a]**	**(%[b])**	**No.[a]**	**(%[b])**	***P* Value[c]**	**%[b]**	**%[b]**	***P* Value[c]**	**%[b]**	**%[b]**	***P* Value[c]**	**%[b]**	**%[b]**	***P* Value[c]**
Total	2730	…	216	…		55.4	55.7	.95	17.9	20.3	.53	37.3	33.2	.32
Age, y					.05									
20–29	1313	(50.1)	135	(58.7)		47.8	52.9	.42	12.1	16.3	.23	46.6	36.5	.09
30–39	1417	(49.9)	81	(41.3)		63.1	59.7	.58	23.7	25.9	.74	28.1	28.4	.96
Race/ethnicity					.06									
Non-Hispanic white	1141	(72.6)	67	(63.2)		47.8	46.2	.82	13.1	18.1[d]	.41	46.0	41.4	.51
Non-Hispanic black	549	(15.1)	52	(20.4)		61.3	66.5	.49	47.3	41.6	.46	21.0	13.6[d]	.13
Mexican American	449	(12.3)	46	(16.3)		80.5	85.6	.33	11.5	11.5[d]	1.00	16.8	9.6[d]	.15
Educational level					.20									
High school or less	1017	(31.1)	99	(35.9)		70.3	68.6	.82	25.3	22.5	.65	22.6	16.6[d]	.35
More than high school	1713	(68.9)	117	(64.1)		48.7	48.5	.96	14.5	19.0	.33	44.0	42.4	.78
Marital status					<.001									
Married	1112	(44.1)	113	(63.4)		57.1	51.0	.28	13.0	15.9	.52	37.9	40.8	.61
Other	1618	(55.9)	102	(36.6)		54.1	63.6	.12	21.7	28.0	.18	36.9	20.2	<.01
Poverty index					.94									
Below poverty level	742	(22.1)	61	(22.3)		63.3	73.2	.19	24.8	19.5	.33	28.6	14.4[d]	.03
At or above poverty level	1827	(77.9)	132	(77.7)		52.2	49.7	.65	15.7	19.0	.45	40.8	40.0	.89
Age at first sex, y					.68									
≤15	854	(29.6)	57	(27.8)		58.9	60.8	.81	27.3	25.3	.78	29.9	21.2[d]	.24
≥16	1873	(70.4)	132	(72.2)		54.0	53.1	.86	14.0	17.6	.39	40.5	39.4	.84
Lifetime sex partners, No.					.10									

Characteristic	Nonpregnant		Pregnant			HSV-1 Seropositive			HSV-2 Seropositive			HSV-1 and HSV-2 Seronegative		
						Nonpregnant	Pregnant		Nonpregnant	Pregnant		Nonpregnant	Pregnant	
	No.[a]	(%[b])	No.[a]	(%[b])	*P* Value[c]	%[b]	%[b]	*P* Value[c]	%[b]	%[b]	*P* Value[c]	%[b]	%[b]	*P* Value[c]
≤3	1032	(35.5)	78	(42.7)		52.1	46.6	.38	8.3	6.8[d]	.61	44.6	51.4	.30
≥4	1666	(64.5)	110	(57.3)		57.2	61.2	.50	23.1	29.7	.22	33.4	22.1	.04

Abbreviations: HSV-1, herpes simplex virus type 1; HSV-2, herpes simplex virus type 2.

[a] Unweighted No.

[b] Weighted percentage.

[c] *P* values for χ^2 test (<.05 was considered significant).

[d] Relative standard error >30%.