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Differences in Prevalence Between Sexes and Concordance With Genital Human Papillomavirus Infection, NHANES 2011 to 2014

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Abstract

Background: The burden of human papillomavirus (HPV) positive oropharyngeal squamous cell carcinoma (OPSCC) is disproportionately high among men, yet empirical evidence regarding the differential prevalence of oral HPV infection by gender is limited. Concordance of oral and genital HPV infection among men is unknown.

Objective: To determine the prevalence of oral HPV infection, and concordance of oral and genital HPV infection among US men and women.

Design: Nationally representative survey.

Setting: Civilian noninstitutionalized population.

Participants: Participants aged 18–69 years from the National Health and Nutritional Examination Survey (2011–2014).

Measurements: Oral rinse, penile swab, and vaginal swab specimens were evaluated using polymerase chain reaction followed by type-specific hybridization.

Results: The overall prevalence of oral HPV among men and women was 11.5% (equating to 11 million men nationwide) and 3.2% (3.2 million), respectively. High-risk oral HPV (HR-HPV) prevalence was higher among men (7.3%) than in women (1.4%). Oral HPV-16 was 6-times more common in men (1.8%) than in women (0.3%), i.e., 1.7 million men compared with 0.27 million women. Among men and women who reported having same gender sex partners, prevalence of HR-HPV infection was 12.7% and 3.6%, respectively. Particularly, among men who reported having 2 same gender oral sex partners, prevalence was 22.2%. Oral HPV prevalence among men with concurrent genital HPV infection was 4-fold greater (19.3%) compared to men without genital HPV infection (4.4%). Gender and lifetime number of oral sex partners were associated with overall HPV, HR-HPV, concordant overall HPV, and concordant HR-HPV infection.

Limitations: Sexual behaviors were self-reported.

Conclusion: Oral HPV infection is common among US men. Our findings provide several policy implications to guide future OPSCC prevention efforts to combat this disease.

INTRODUCTION

Human papillomavirus (HPV) infection causes cancer at several anatomic sites, including oropharyngeal, anal and penile cancers among men, and oropharyngeal, anal, cervical, vaginal and vulvar cancers among women (1). Between the years 2008 and 2012, an average 38,793 HPV-related cancers were diagnosed annually in the United States (US)—23,000 (59%) among women and 15,793 (41%) among men (2). The most common of these cancers was oropharyngeal squamous cell cancer (OPSCC) (3,100 cases among women and 12,638 cases among men) (2).

The incidence of HPV-related OPSCC among women remained generally plateaued (statistically insignificant increase of 0.57% per year) from 2002 to 2012 (3). In contrast, the incidence of OPSCC (7.8 per 100,000) among men has increased dramatically (2.89% per year) and has already surpassed the incidence of cervical cancer among women (7.4 per 100,000) (3). The increase in annual incidence was particularly high among 50–59-year-old men—7.75% from 2002–2004 and 2.44% from 2004–2010 (3). It is projected that these trends in the incidence will continue and will not reverse until after 2060, making OPSCC a significant public health concern (4, 5).

Recent evidence shows that prophylactic HPV vaccination appears to provide protection against infection with vaccine-covered oral HPV subtypes (6), and thus holds promise for reversing the rising incidence of OPSCC among men in the long term; however, the low uptake rate of the vaccine among boys remains a concern (7–9). Furthermore, the great majority of individuals at risk for OPSCC are older than 26 years (4) and do not qualify for HPV vaccination or might have already exposed to HPV. For this reason, epidemiological studies on oral HPV infection are needed to guide the design and development of alternative OPSCC prevention strategies targeted towards high-risk individuals. It is also crucial to examine the relationship between HPV infections occurring at different anatomic sites to understand HPV transmission dynamics. Therefore, our objective was twofold: 1) to estimate the population-based prevalence and risk factors of oral HPV infection by gender and sexual orientation and 2) to characterize the concordance of oral and genital HPV infection from the National Health and Nutrition Examination Survey (NHANES).

METHODS

Survey Design and Population

The NHANES is conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) to monitor the health and nutritional status of the US population. Participants in the NHANES 2011–2014 are non-institutionalized US civilians who are identified using a stratified, multistage probability sampling technique. Participants 18–69-year-old undergo physical examination in a mobile examination center (MEC) followed by a household interview. Hispanic individuals, African Americans, low-income individuals, and individuals aged ≥ 60 years are oversampled to allow sufficient sizes for subgroup analysis.

The medical examinations conducted in the MEC include medical, dental, and physiological measurements, and laboratory tests administered by highly trained medical personnel. The household interview component consists of standardized questionnaires on demographics, socioeconomic status, diet, and sexual behavior, administered through a personal or phone interview.

Demographic and Behavioral Data

The NHANES collected demographic data using a standard demographic questionnaire administered in-home by trained interviewers using a Computer-Assisted Personal Interviewing system. Data on cigarette, alcohol, and marijuana use was collected during the

MEC self-interview. Demographic data included age during the time of interview, gender, race, marital status, and income. Income to poverty ratio was calculated by dividing income by the poverty guidelines by the Department of Health and Human Services (HHS) specific to the survey year. Use of birth control pills and hormones use was self-reported by female participants.

Self-reported sexual behavior data, for example, ever having had sex (vaginal, anal, or oral), sexual orientation, ever having had a same gender sexual partner, number of oral sex partners during the past 12 months, age at first oral sex, barrier use during oral sex in the past 12 months, was collected at the MEC using standardized questionnaire. History of herpes/warts and HPV infection was also self-reported. HIV positivity was based on human immunodeficiency virus (HIV) antibody test results.

Specimen Collection and Laboratory Methods

Oral rinse specimens were collected by a dental hygienist in to a sterile collection cup. Each individual was asked to swish a 10 ml sample of a mouthwash or a sterile solution in their mouth and then expectorate the sample in the sterile cup. The sample was later transferred from the collection cup to a 14 ml Falcon snap cap tube by the MEC laboratory technologist and shipped to laboratory for testing. Detailed quality control steps can be found on the NHANES website in the MEC laboratory procedure manual (10).

Samples were then purified at the laboratory according to the Puregene DNA purification kit protocol (11). β globin-positive samples were considered evaluable. Using a polymerase-chain-reaction assay, the purified DNA sample was analyzed for detection of 37 HPV types including HR types (HPV-16, -18, -26, -31, -33, -35, -39, -45, -51, -52, -53, -56, -58, -59, -66, -68, -73, and -82) and low-risk (LR) (HPV-6, -11, -40, -42, -54, -55, -61, -62, -64, -67, -69, -70, -71, -72, -81, -82 IS39 subtype, -83, -84, and -89 (cp6108)) (12).

Concordance of oral and genital HPV

Concurrent *overall* genital and oral HPV infection was defined as having an infection in both the genital and oral regions without regard to type. Concurrent *HR* genital and oral HPV infection was defined as having an infection of any HR type in both the genital and oral regions. Similarly, concurrent type-specific infection was defined as having an infection of a specific HPV type (e.g., HPV-16) in genital-oral regions. Details of specimen collection and laboratory methods for genital HPV detection among men and women can be found on the NHANES website and previously published studies (13, 14).

Statistical Analysis

We estimated the prevalence of overall, HR, and LR, and type-specific oral HPV, and prevalence by demographic and sexual behaviors for males and females among 18–69-year-old adults using NHANES 2011–2014. Concordance of genital and oral HPV infection was estimated among 18–59-year-old adults using NHANES 2013–2014. Survey design-adjusted Wald *F* test was used for bivariate analyses and the Cochran-Armitage test was performed to detect trends in prevalence. Prevalence estimates with a relative standard error of >30% or

based on 10 positive cases are noted; these are considered unstable and should be interpreted with caution. Associations between overall and HR oral HPV prevalence and risk factors and predicted probabilities (PPs) were evaluated using logistic regression models. Variables in logistic regression models were selected based on bivariate associations. Statistical significance was tested at $P < 0.05$. All analyses were performed using SAS® 9.4 software (SAS Institute, Inc, Cary, NC). For population estimates, we used SAS PROC SURVEY procedures, which included weight, cluster, and strata statements, to incorporate sampling weights.

Role of the funding source

The funders had no role in study design, conduct, or reporting of the results.

RESULTS

Analyses of overall and high-risk oral HPV infection included 4,493 male and 4,641 female participants (Figure 1 of the Supplement).

Prevalence of oral HPV infection among men and women

The prevalence of overall oral HPV infection among men and women was 11.5% (95% CI, 9.8%–13.1%) and 3.2% (95% CI, 2.7%–3.8%), respectively, which equates to 11 million men and 3.2 million women nationwide. Similarly, the prevalence of HR-HPV infections was higher among men (7.3%; 95% CI, 6.0%–8.6%; 7 million) compared to women (1.4%; 95% CI, 1.0%–1.8%; 1.4 million) ($P < 0.001$). The type-specific prevalence of HR and LR-HPV infection is shown in Figures 1a and 1b, respectively. Notably, the prevalence of HPV-16, the most common HPV type, was 6-fold higher among men (1.8%; 95% CI, 1.3%–2.2%; 1.7 million) compared to women (0.3%; 95% CI, 0.1%–0.5%; 0.27 million) ($P < 0.001$). Prevalence of all HR and LR HPV types was consistently higher among men compared to women. Age-specific prevalence of vaccine-covered 9-valent, 4-valent, 2-valent, and HPV-16 subtype(s) among men and women are reported in Figure 2 of the Supplement.

Prevalence of overall and HR oral HPV infection by demographic and sexual characteristics

Prevalence of oral HPV infection by demographic characteristics is presented in Table 1. Overall prevalence of HPV infection among men followed a bimodal pattern with prevalence peaks at age 35–39 (12.2%; 95% CI, 8.9%–15.7%) and 50–54 (15.4%; 95% CI, 10.2%–20.5%). There was no significant difference by age in the prevalence of HR-HPV infection in men and overall and HR-HPV infection in women. Non-Hispanic Black men had highest prevalence overall (15.8%) and HR (8.8%) oral HPV infection followed by White (11.7% overall and 7.8% HR) and Hispanic (9.9% overall and 5.5% HR) men.

Prevalence of overall and HR oral HPV infection was significantly associated with cigarette and marijuana use among men and women (Table 1). Prevalence of overall oral HPV infection was highest (23.6% overall and 15.0% HR) among men who smoked more than 20 cigarettes a day and was lowest (8.3% overall and 5.4% HR) among never or former

smokers. The prevalence was highest among men who were former marijuana users (13.4% overall and 9.4% HR). Among women, the highest prevalence of oral HPV infection was among current marijuana users (7.9% overall and 3.0% HR).

We found no significant difference in the prevalence of overall and HR-HPV infection by receipt of HPV vaccine (Table 1). However, among HPV vaccine eligible individuals who were reportedly vaccinated, we found that the prevalence of 4-valent types was significantly lower when compared with unvaccinated individuals (0.18% vs 1.47%; $p<0.001$) (Figure 3 of the Supplement). Similarly, the difference remained statistically significant among men (0.41% vs 1.97%; $p=0.019$).

Prevalence of oral HPV infection was significantly associated with sexual and behavioral characteristics among men and women (Table 2). Prevalence of HR-HPV infection was 8-, 10-, and 4-fold higher among men who reported having more than 16 lifetime (any, oral, or vaginal) sex partners, respectively, when compared with men with 0–1 lifetime sex partners. Similarly, the prevalence among women who reported such behavior was 7-, 3-, and 6-fold higher when compared with women with 0–1 lifetime any, oral, or vaginal sex partners. When restricted to number of sex partners in the past 12 months, oral HPV prevalence (both overall and HR) was highest among men with 2 or more any and oral sex partners. Results were similar for women but not statistically significant.

Among men and women who reported having same gender sex partners, prevalence of HR-HPV infection was 12.7% and 3.6%, respectively; while among men and women who did not report this behavior the prevalence of HR-HPV infection was 6.8% and 1.2%, respectively. In particular, the prevalence of HR-HPV infection was highest (22.2%) among men who reported having 2 or more lifetime number of same gender oral sex partners. There was no statistically significant difference in prevalence by lifetime number of anal sex partners among men who reported having same gender sex partners.

Prevalence of Oral HPV Infection Concurrent with Genital HPV Infection

Figure 2 illustrates the prevalence oral HPV infection with and without concurrent genital HPV infection among men and women (overall and by age and race). The prevalence of overall (Figure 2a) and HR (Figure 2b) oral HPV infections among men with concurrent genital overall or HR-HPV infection was 19.3% and 13.7%, respectively; whereas, the prevalence among men without such infections was 4.4% and 3.9%. Similarly, the prevalence of overall (5.1%) and HR (3.2%) oral HPV infection was almost 3-fold higher among women with concurrent genital HPV infection when compared with women without such infections (2.1% overall and 1.1% HR). We also present vaccine-covered 9-valent, 4-valent, 2-valent, and HPV-16 oral infection prevalence among men and women with or without genital HPV infection in Figure 4 of the Supplement.

When stratified by age (Figures 2c and 2d), the prevalence of oral HPV infection increased with age among men with or without concurrent genital HPV infection ($p<0.001$ for trend). When stratified by race (Figures 2e and 2f), we found no significant difference in the oral HPV infection prevalence irrespective of the presence or absence of genital HPV infection. Among both men and women, when stratified by lifetime number of sexual partners, we

found that irrespective of presence or absence of concurrent genital HPV infection, prevalence of oral HPV infection increased with number of (any, oral, or vaginal) sexual partners (Figures 3a-3f). We further report prevalence among men and women with genital HPV infection by age and lifetime number of sexual partners in Figures 5 and 6 of the Supplement.

Factors associated with oral HPV infection among men and women

Results of the logistic regression models examining the risk factors for overall and HR oral HPV infection and PPs are presented in Table 3. Likelihood of overall oral HPV infection was higher for males (odds ratio (OR) = 3.49; 95% CI, 2.77–4.41) compared with females; PP=0.10 for males and PP=0.02 for females. Increase in the likelihood of overall oral infection was positively associated with increasing cigarette use and lifetime number of oral sex partners compared with never or former cigarette use and 0–1 oral sex partners, respectively.

The odds of HR oral HPV infection was significantly higher among males (OR=4.95; 95% CI, 3.56–7.30) compared with females; PP=0.06 for males vs PP=0.01 for females. Also, participants who reportedly were former marijuana users had higher likelihood of HR oral HPV infection compared with participants who never used marijuana (OR=1.80, 95% CI, 1.20–2.69; PP=0.05 vs 0.02). Results for likelihood of HR infection by lifetime number of oral sex partners were similar to that observed for overall oral HPV infection. The odds for HR oral HPV infection increased with increasing number of lifetime sex partners compared with 0–1 lifetime oral sex partners. Results for ethnicity and lifetime number of vaginal sex partners were not statistically significant for both overall and HR oral HPV models.

DISCUSSION

Prevalence of oral high-risk HPV infection is substantially higher among US men than women. We found that 7.3% of men and 1.4% of women in the general population have high-risk oral HPV infection, which equates to 7 million men and 1.4 million women, respectively. Particularly, the prevalence of HPV-16, an oncogenic HPV type that is known to contribute to increased risk of OPSCC, is seven times higher among men than women, equating to 1.7 million men and 0.27 million women with HPV-16 infection.

When characterized by age, we found that the prevalence of oral HR-HPV infection both among men and women peaked at 50–54 years of age. A large multi-country cohort study—the HPV infection in men (HIM) study—found that acquisition of HR oral HPV infection was constant across the age (15). Therefore, the peaking of prevalence among older participants observed in our study might be a result of increased duration of infection at older ages in addition to increased acquisition (15, 16). We found that oncogenic HPV-16 was most prevalent among men 50–69 years of age. Data from HIM study indicate that the high prevalence of HPV-16 among older men might be attributed to longer persistence of infection (17). The study reported that the prevalent oral HPV-16 infection persisted longer than newly acquired infections and the persistence of incident HPV-16 infection increased significantly with age (17). Given the incidence of OPSCC is highest among this age group of men (4), it is crucial to explore whether persistent HPV-16 infection plays a role in the

observed excess prevalence of oral HPV-16 infection, particularly because persistent infection might be driving the OPSCC carcinogenesis among older men.

We found that the prevalence of oral HPV infection was high among men with concurrent genital HPV infection. This finding is particularly important given the recently reported high prevalence (45.2%; 95% CI, 41.3%–49.3%) of genital HPV infection among US men (13). To our knowledge, only one study from rural China studied oral-genital HPV concordance and found that the prevalence of oral HPV infection was higher among men with concurrent genital HPV infection (11.4%) compared to uninfected men (5.7%) (18). Steinau et al studied oral and anal (another anatomic site) concordance among MSM and found that participants were more likely to have any oral HPV if they also had any anal HPV (Relative Risk, 1.16; 95% CI, 1.05–1.28) (19).

Consistent association between sexual behaviors (e.g., lifetime number of sex partners) and high prevalence of oral HPV infection among adults with genital HPV infection observed in our study implies that the transmission via genital-oral sex is possibly occurring among these individuals (20–22). It is also likely that oral HPV infection is acquired via autoinoculation from genital HPV infection, or vice versa, through fingers in the same individual (23). It is crucial to study HPV transmission dynamics further because it is likely that the bidirectional transmission between genital and oral HPV might be promoting other HPV-related malignancies in a same individual or contributing towards the increased risk of second primary HPV-related cancers among men (24). Finally, the observed discrepancy between oral-genital HPV concordance rates among men and women might have occurred due to possible difference in the size of HPV sampling area and circumcision status of their male partners (25).

Difference in the burden of oral oncogenic infection and OPSCC among men and women is partially explained by the strength of association between sexual behaviors and HPV infection among men (26), and as observed in our study, higher prevalence of HPV-16 infection among men. It is also possible that seroconversion rates after genital HPV infection are lower among men than women, leading to greater protection against subsequent oral infection among women (1, 27). Our findings indicate that association between HPV infections at oral and genital sites might also be contributing to this heterogeneity by sex. Like cervical cancer, the incidence of OPSCC among women is decreasing in the US (5). Attributed to increased prevention efforts, e.g., screening, and given the positive association between genital and oral HR-HPV, the decline in the incidence of OPSCC among women might be mirroring the decline in the incidence of cervical cancer (28). Likewise, OPSCC incidence trends paralleled increased rates of genital warts and genital herpes among men (29). Studies also attributed these incidence trends to a birth cohort effect predicting that the relative incidence of OPSCC among men will continue to increase for at least 30 more years (28, 30).

We examined several risk factors for oral HPV infection. We found that smoking is associated with a higher likelihood of overall oral HPV infection. The exact mechanism of action for this association is unknown; however, one rationale might be that smoking may induce proinflammatory and immunosuppressive effects, increasing risk of HPV incidence

and persistence at oropharynx (31, 32). We found that there was no significant association between prevalence of oral HPV infection and lifetime number of vaginal sex partners. On the contrary, the likelihood of oral HPV infection significantly increased with increasing number of lifetime oral sex partners. This finding is consistent with a previous study which showed that individuals with a high number of oral sex partners have higher odds of oral HPV infection (33).

Similar to Hirth et al (6), our findings suggest that HPV vaccination prevents oral vaccine-covered HPV subtypes infection among vaccine-eligible individuals. The AIDS Clinical Trials Group protocol A5298, a randomized double-blind trial of quadrivalent HPV vaccination in HIV-infected adults over age 27, found that HPV vaccination reduced the risk of persistent oral infection with vaccine types [HR=0.12 (95% CI, 0.02–0.98)], but the number of events was low—1 event among vaccine recipients as compared to 8 events among placebo recipients (34). Further research is needed to understand whether HPV vaccination protects against oral HPV infection across all age groups among the general population of men, and whether the incidence of HPV-related OPSCC is lower among individuals who received HPV vaccine. Future decision analyses are also needed to estimate value of vaccinating mid-adult-men to reduce the expanding epidemic of HPV-associated OPSCC.

The primary limitation of our study was insufficient sample sizes to determine certain associations, e.g., prevalence of 4-valent types by HPV vaccination dose(s). However, the use of two NHANES panels allowed sufficient sample size to report the most comprehensive data on oral HR-HPV prevalence and genital-oral HPV concordance among men and women available to date. Concordance of oral-genital HPV infection was studied using only one NHANES panel (2013–2014). There are known caveats on the stability of the prevalence estimated using one cycle of NHANES data; therefore, it is necessary to interpret our findings cautiously. There are certain inherent limitations associated with NHANES data. Self-reported behaviors, for example, sexual behaviors, are likely to be underreported due to social desirability and recall bias. However, self-report is the only way to obtain this data and is considered a standard practice. Finally, comparison of our estimates with other non-NHANES studies should be performed with caution as other studies might have used alternative methods (e.g., scraping) for sample collection.

Conclusion

Our study provides the latest national estimates of oral HPV infection prevalence among men and women in the United States. Overall prevalence of oral HPV infection was high among US men. Almost 2 million men had oncogenic HPV-16 infection. The overall oral HPV infection prevalence was particularly high among men who have had large number (>16) of lifetime oral sexual partners (29.8%), men who reported having sex with men (18.2%), and men with concurrent genital HPV infection (19.3%). Future research needs to be prioritized to improve targeted prevention and advances in screening/early detection procedures to combat oropharyngeal cancer among these high-risk individuals.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Type-specific prevalence of oral HPV infection among men and women, NHANES 2011–2014.

(A) The weighted prevalence (and 95% CI) of high-risk type-specific oral HPV infection among men and women. (B) The weighted prevalence (and 95% CI) of Low-risk type-specific oral HPV infection among men and women.

Figure 2. Prevalence by age and race of overall and high-risk oral HPV infection among individuals with or without concurrent genital HPV infection, NHANES 2013–2014.

Prevalence of (A) overall and (B) high-risk oral HPV infection among men and women with or without concurrent genital HPV infection. Prevalence of (C) overall and (D) high-risk oral HPV infection by age among men and women with or without concurrent genital HPV infection. Prevalence of (E) overall and (F) high-risk oral HPV infection by race among men and women with or without concurrent genital HPV infection.

* P -value for trend

Figure 3. Prevalence by sexual behavior of overall and high-risk oral HPV infection among individuals with or without concurrent genital HPV infection, NHANES 2013–2014.

Prevalence of (A) overall and (B) high-risk oral HPV infection by lifetime number of any sex partners among men and women with or without concurrent genital HPV infection. Prevalence of (C) overall and (D) high-risk oral HPV infection by lifetime number of oral sex partners among men and women with or without concurrent genital HPV infection. Prevalence of (E) overall and (F) high-risk oral HPV infection by lifetime number of vaginal sex partners among men and women with or without concurrent genital HPV infection.

* *P*-value for trend

Table 1.

Prevalence of overall and high-risk oral human papillomavirus (HPV) infection by demographic characteristics among men and women, NHANES 2011-2014.

Characteristics	Men				Women			
	Overall oral HPV		High-risk oral HPV		Overall oral HPV		High-risk oral HPV	
	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)
Age *								
18-26	947 (75)	6.8 (4.5-9.1)	947 (52)	5.0 (3.0-7.1)	944 (40)	4.1 (2.8-5.3)	944 (17)	1.6 (0.6-2.6)
27-34	716 (82)	10.6 (7.8-13.4)	716 (55)	7.0 (4.5-9.6)	678 (18)	2.3 (1.0-3.6)	678 (10)	1.2 (0.4-2.0)
35-39	414 (54)	12.2 (8.8-15.7)	414 (27)	5.9 (2.9-8.9)	445 (10)	2.0 (0.8-3.3)	445 (5)	0.9 (0.0-2.0)
40-44	418 (41)	11.0 (7.2-14.8)	418 (28)	7.9 (4.3-11.4)	477 (16)	3.5 (1.2-5.9)	477 (9)	1.9 (0.2-3.6)
45-49	396 (56)	13.1 (8.7-17.5)	396 (34)	8.4 (4.8-12.0)	431 (17)	2.8 (0.9-4.8)	431 (6)	0.8 (0.1-1.6)
50-54	412 (61)	15.4 (10.2-20.5)	412 (36)	9.9 (5.4-14.3)	457 (23)	3.8 (1.3-6.4)	457 (11)	2.3 (0.0-4.6)
55-59	378 (54)	14.6 (9.5-19.6)	378 (28)	8.9 (5.0-12.7)	392 (17)	3.3 (0.9-5.8)	392 (9)	1.5 (0.0-3.1)
60-64	471 (70)	13.4 (8.5-18.4)	471 (36)	7.0 (3.8-10.2)	480 (22)	4.1 (1.4-6.8)	480 (11)	1.5 (0.1-2.8)
65-69	341 (43)	11.5 (6.8-16.2)	341 (26)	8.0 (4.1-12.0)	337 (15)	2.7 (0.9-4.6)	337 (6)	0.5 (0.1-1.0)
<i>p-value</i>		0.007		0.132		0.47		0.189
Marital status †								
Never married	1052 (118)	11.4 (7.6-15.2)	1052 (74)	8.0 (4.5-11.4)	953 (38)	4.3 (2.9-5.7)	953 (13)	1.5 (0.4-2.7)
Married/living with partner	2567 (293)	10.9 (8.8-12.9)	2567 (183)	7.0 (5.4-8.5)	2418 (74)	2.5 (1.8-3.2)	2418 (37)	1.1 (0.6-1.6)
Widowed/separate/divorced	572 (111)	18.5 (13.6-23.3)	572 (57)	9.9 (6.6-13.2)	960 (52)	4.6 (3.1-6.1)	960 (26)	2.2 (1.1-3.2)
<i>p-value</i>		0.028		0.33		0.014		0.21
Race/ethnicity *								
Non-Hispanic White	1655 (210)	11.7 (9.6-13.8)	1655 (139)	7.8 (6.1-9.5)	1653 (59)	2.9 (2.2-3.7)	1653 (27)	1.2 (0.7-1.8)
Non-Hispanic Black	1081 (169)	15.8 (13.2-18.3)	1081 (95)	8.8 (7.0-10.5)	1155 (51)	4.5 (3.1-6.0)	1155 (21)	1.9 (1.1-2.7)
Hispanic	1009 (112)	9.9 (7.8-12.0)	1009 (60)	5.5 (3.8-7.3)	1070 (51)	4.0 (2.6-5.5)	1070 (27)	1.9 (1.1-2.8)
Other	748 (45)	7.0 (4.4-9.6)	748 (28)	4.6 (2.5-6.7)	763 (17)	2.3 (0.9-3.6)	763 (9)	1.0 (0.4-1.7)
<i>p-value</i>		<0.001		0.008		0.023		0.077
Education ‡								
Less than High School	1024 (137)	11.7 (9.5-14.0)	1024 (76)	6.8 (5.5-8.2)	930 (47)	4.7 (2.9-6.4)	930 (21)	2.5 (1.1-3.9)

Characteristics	Men						Women					
	Overall oral HPV			High-risk oral HPV			Overall oral HPV			High-risk oral HPV		
	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)
HS degree/GED	1054 (146)	14.5 (11.0-18.1)	1054 (76)	7.5 (5.0-10.1)	960 (42)	4.0 (2.8-5.1)	960 (22)	1.7 (0.7-2.6)				
Some college	1235 (155)	12.0 (9.2-14.8)	1235 (110)	9.6 (6.9-12.3)	1484 (61)	3.7 (2.6-4.8)	1484 (27)	1.6 (0.8-2.4)				
College graduate/higher	1075 (95)	9.0 (6.4-11.7)	1075 (58)	5.4 (3.6-7.2)	1168 (22)	1.6 (0.5-2.6)	1168 (10)	0.5 (0.1-0.8)				
<i>p-value</i>	0.115			0.105			0.002			0.006		
Income to poverty ratio ^{*,†}												
IPR < 1.0	1346 (182)	13.0 (10.4-15.5)	1346 (101)	6.5 (5.2-7.8)	1523 (81)	5.2 (4.4-6.0)	1523 (36)	2.0 (1.1-2.8)				
1.0 ≤ IPR < 2.0	1051 (131)	12.0 (9.4-14.6)	1051 (76)	7.2 (5.0-9.4)	1032 (46)	4.2 (2.4-6.1)	1032 (18)	1.5 (0.5-2.6)				
2.0 ≤ IPR < 3.0	543 (60)	12.0 (7.6-16.3)	543 (41)	9.7 (6.0-13.4)	550 (19)	2.8 (1.1-4.5)	550 (12)	1.8 (0.3-3.3)				
3.0 < IPR	1553 (163)	10.5 (8.2-12.7)	1553 (104)	7.0 (5.3-8.6)	1536 (32)	1.9 (0.9-2.8)	1536 (18)	0.9 (0.4-1.5)				
<i>p-value</i>	0.48			0.27			<0.001			0.25		
Cigarette Use ^{‡,§}												
Never/former smoker	2235 (203)	8.3 (6.9-9.6)	2235 (123)	5.4 (4.2-6.5)	3049 (82)	2.1 (1.4-2.7)	3041 (38)	0.7 (0.4-1.0)				
<10 cigarettes/day	549 (79)	13.5 (9.8-17.2)	549 (44)	9.2 (5.5-12.9)	394 (24)	5.1 (2.5-7.8)	394 (11)	2.4 (0.6-4.1)				
11-20 cigarettes/day	337 (64)	19.4 (12.9-25.9)	337 (39)	10.2 (5.1-15.4)	222 (15)	4.7 (1.6-7.8)	222 (6)	1.9 (0.3-3.6)				
>20 cigarettes/day	93 (25)	23.6 (12.4-34.8)	93 (15)	15.0 (3.8-26.2)	33 (2)	7.0 (0-17.9)	33 (2)	7.0 (0-17.9)				
<i>p-value</i>	0.003			0.011			0.048			0.101		
Alcohol use in past 12 months (number of drinks/week) [‡]												
0	611 (86)	13.3 (9.3-17.3)	611 (55)	10.4 (6.3-14.5)	578 (23)	3.3 (1.4-5.2)	578 (12)	2.2 (0.3-4.0)				
<1-7	734 (77)	8.8 (6.5-11.0)	734 (48)	4.8 (3.1-6.6)	1161 (42)	2.9 (1.6-4.2)	1161 (17)	1.0 (0.3-1.6)				
8-14	800 (100)	11.4 (7.5-15.4)	800 (58)	6.9 (3.9-9.9)	845 (36)	3.5 (2.2-4.9)	845 (17)	1.2 (0.7-1.7)				
>14	1650 (206)	12.7 (10.0-15.4)	1650 (122)	8.1 (6.0-10.3)	762 (39)	4.6 (2.8-6.4)	762 (22)	2.7 (1.3-4.2)				
<i>p-value</i>	0.161			0.013			0.58			0.162		
Marijuana use ^{‡,}												
Never users	1344 (105)	6.6 (4.7-8.4)	1344 (57)	3.2 (2.1-4.4)	1768 (45)	2.2 (1.3-3.0)	1768 (19)	0.9 (0.5-1.3)				
Former users	1400 (187)	13.4 (11.1-15.7)	1400 (122)	9.4 (7.5-11.2)	1214 (45)	2.9 (1.5-4.3)	1214 (25)	1.8 (0.8-2.8)				
Current users	654 (91)	13.1 (9.4-16.8)	654 (58)	8.9 (5.4-12.5)	396 (34)	7.9 (4.2-11.5)	396 (16)	3.0 (1.6-4.4)				
<i>p-value</i>	<0.001			<0.001			0.015			0.032		
Birth control pills use ^{‡,}	NA	NA	NA	NA	NA	NA	NA	NA				

Characteristics	Men				Women			
	Overall oral HPV		High-risk oral HPV		Overall oral HPV		High-risk oral HPV	
	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)
Yes					2970 (123)	3.5 (2.7-4.2)	2970 (58)	1.5 (1.0-2.0)
No					1255 (39)	2.5 (1.3-3.8)	1255 (18)	1.1 (0.4-2.0)
<i>p-value</i>						0.24		0.41
Hormone use ^{†,¶, **}								
Yes	NA	NA	NA	NA	564 (26)	3.7 (2.0-5.5)	564 (16)	1.6 (0.4-2.8)
No					3359 (123)	3.2 (2.4-3.9)	3359 (53)	1.4 (0.9-1.9)
<i>p-value</i>						0.57		0.69
HPV vaccination ^{‡, //}								
Received vaccine	135 (18)	10.3 (4.8-15.8)	135 (12)	7.7 (2.0-13.4)	498 (22)	3.8 (2.1-5.5)	498 (11)	1.5 (0.3-2.6)
Did not receive vaccine	3299 (381)	11.5 (9.5-13.5)	3299 (235)	7.3 (5.7-8.9)	3177 (114)	3.1 (2.2-4.0)	3177 (55)	1.5 (1.0-2.0)
<i>p-value</i>		0.69		0.89		0.54		0.94

Abbreviations: CI, Confidence Interval; HPV, human papillomavirus; GED, general equivalency diploma; IPR, Income to poverty ratio; HIV, Human immunodeficiency virus

^{*} Prevalence estimates based on valid non-missing Oral HPV results of Male (N=4,493) and Female (N=4,641) participants aged 18-69 years.

[‡] Sample size not equal to total sample size due to missing data

[¶] Income to poverty ratio was calculated by dividing income by the poverty guidelines by the Department of Health and Human Services (HHS) specific to the survey year.

[§] Ever use of cigarettes was defined for individuals aged 18 and 19 years as ever having tried cigarettes and for those aged 20-69 years as lifetime use of ≥ 100 cigarettes. A current smoker was defined as someone who had smoked a cigarette in the prior 30 days. A former smoker was defined as an ever user who had not smoked a cigarette in the prior 30 days.

^{//} Analyses restricted to participants 18-59 years of age

^{¶¶} Data restricted to female participants only.

^{**} Hormone use data was available for females 20-69 years

Table 2.

Prevalence of overall and high-risk oral human papillomavirus (HPV) infection by sexual and behavioral characteristics among men and women, NHANES 2011-2014.

Characteristics	Men			Women		
	Overall oral HPV N (N with infection)	Prevalence, % (95% CI)	High-risk oral HPV N (N with infection)	Overall oral HPV N (N with infection)	Prevalence, % (95% CI)	High-risk oral HPV N (N with infection)
Ever had sex ^{*, †}						
Yes	3896 (474)	11.6 (9.7-13.4)	3896 (290)	3917 (156)	3.3 (2.7-4.0)	3917 (74)
No	254 (14)	3.2 (1.2-5.3)	254 (3)	217 (4)	1.5 (0.3-6)	217 (1)
<i>p-value</i>		<0.001			0.129	<0.001
Ever had oral sex ^{*, ‡}						
Yes	3210 (425)	12.1 (10.2-14.0)	3210 (261)	3092 (133)	3.6 (2.8-4.3)	3092 (64)
No	923 (63)	6.9 (3.9-9.8)	923 (33)	1037 (28)	1.9 (1.0-2.8)	1037 (12)
<i>p-value</i>		0.004			0.007	0.142
Ever had vaginal sex ^{*, §}						
Yes	3778 (457)	11.5 (9.7-13.3)	3778 (278)	3875 (156)	3.3 (2.7-4.0)	3875 (74)
No	374 (32)	6.8 (3.0-10.6)	374 (16)	264 (4)	1.3 (0.3-3.0)	264 (1)
<i>p-value</i>		0.026			0.046	<0.001
Ever had anal sex ^{*,}						
Yes	1587 (238)	14.5 (12.1-16.9)	1587 (152)	1357 (62)	4.0 (2.8-5.1)	1357 (34)
No	2554 (251)	9.0 (7.1-10.9)	2554 (142)	2768 (99)	2.9 (2.2-3.5)	2768 (42)
<i>p-value</i>		<0.001			0.068	0.102
Lifetime number of sex partners (Any) ^{*, ¶}						
0-1	754 (39)	3.6 (1.7-5.4)	754 (17)	961 (19)	1.2 (0.5-2.0)	961 (7)
2-5	1017 (941)	7.1 (4.8-9.3)	1017 (46)	1681 (52)	2.2 (1.6-2.8)	1681 (22)
6-10	850 (111)	10.8 (7.2-14.4)	850 (71)	850 (49)	4.8 (3.1-6.5)	850 (22)
11-15	394 (50)	14.0 (9.0-18.9)	394 (30)	257 (15)	5.4 (1.6-9.2)	257 (8)
16	1087 (208)	20.1 (16.8-23.5)	1087 (125)	362 (24)	5.6 (2.5-8.7)	362 (16)
<i>p-value</i>		<0.001			0.002	0.023
Lifetime number of sex partners (Oral) ^{*, **}						

Characteristics	Men						Women					
	Overall oral HPV			High-risk oral HPV			Overall oral HPV			High-risk oral HPV		
	N (N with infection)	Prevalence, % (95% CI)		N (N with infection)	Prevalence, % (95% CI)		N (N with infection)	Prevalence, % (95% CI)		N (N with infection)	Prevalence, % (95% CI)	
0-1	1457 (85)	4.7 (3.2-6.3)		1457 (41)	2.1 (1.2-3.0)		1788 (43)	1.7 (1.2-2.3)		1788 (20)	0.9 (0.5-1.3)	
2-5	1262 (132)	8.4 (6.2-10.6)		1262 (80)	5.5 (3.9-7.0)		1426 (58)	3.0 (1.9-4.1)		1426 (27)	1.4 (0.7-2.1)	
6-10	413 (61)	13.5 (9.1-18.0)		413 (36)	7.7 (4.8-10.6)		274 (18)	5.5 (2.2-8.8)		274 (8)	2.3 (0.3-4.4)	
11-15	162 (32)	21.0 (10.9-31.1)		162 (22)	14.6 (5.3-24.0)		71 (5)	3.9 (0-14.4)		71 (4)	2.7 (0.0-5.6)	
16	307 (93)	29.8 (21.6-37.9)		307 (64)	21.8 (14.9-28.8)		112 (9)	7.2 (1.6-12.9)		112 (4)	2.5 (0.0-5.3)	
p-value	<0.001			<0.001			0.042			0.182		
Lifetime number of sex partners (Vaginal) ^{*,††}												
0-1	820 (60)	5.6 (3.3-7.8)		820 (31)	3.1 (1.4-4.8)		952 (21)	1.8 (0.7-2.9)		952 (7)	0.6 (0.0-1.2)	
2-5	885 (63)	6.0 (3.8-8.1)		885 (39)	4.0 (1.9-6.0)		1256 (38)	2.3 (1.4-3.1)		1256 (15)	0.8 (0.5-1.2)	
6-10	630 (78)	11.1 (7.7-14.5)		630 (51)	7.3 (4.3-10.4)		702 (34)	3.8 (2.3-5.3)		702 (20)	2.1 (1.1-3.1)	
11-15	321 (40)	15.1 (9.6-20.7)		321 (23)	7.1 (3.1-11.2)		208 (11)	4.5 (0.8-8.2)		208 (5)	1.8 (0.0-3.7)	
16	760 (151)	20.7 (17.2-24.2)		760 (95)	14.8 (11.7-17.9)		291 (18)	5.7 (1.8-9.6)		291 (11)	3.5 (0.7-6.3)	
p-value	<0.001			<0.001			0.074			0.074		
Number of sex partners during the past 12 months (Any) [*]												
0	276 (17)	5.2 (1.4-9.0)		276 (6)	3.2 (0.0-6.9)		255 (9)	3.9 (0.1-7.7)		255 (3)	2.0 (0.0-5.2)	
1	79 (10)	10.5 (1.7-19.4)		79 (6)	4.3 (0.0-9.1)		158 (10)	4.0 (1.0-7.1)		158 (6)	1.9 (0.0-3.9)	
2	788 (119)	14.8 (11.2-18.4)		788 (73)	9.8 (6.8-12.8)		512 (35)	6.9 (3.2-10.6)		512 (20)	3.3 (1.4-5.2)	
p-value	<0.001			0.003			0.47			0.62		
Number of sex partners during the past 12 months (Oral) [*]												
0	917 (59)	6.4 (3.6-9.2)		917 (31)	3.6 (1.7-5.4)		1059 (32)	2.4 (1.3-3.6)		1059 (14)	1.3 (0.3-2.3)	
1	25 (3)	8.2 (0-19.6)		25 (2)	6.8 (0.0-17.8)		325 (17)	4.4 (1.6-7.1)		325 (3)	0.4 (0.0-1.0)	
2	469 (91)	18.3 (13.0-23.5)		469 (55)	12.4 (8.2-16.6)		325 (21)	6.7 (2.5-10.9)		325 (9)	1.9 (0.2-3.5)	
p-value	<0.001			0.001			0.057			0.133		
Number of sex partners during the past 12 months (Vaginal) [*]												
0	615 (49)	7.8 (4.7-10.8)		615 (30)	5.8 (2.9-8.7)		718 (23)	2.3 (1.0-3.6)		718 (8)	1.0 (0.0-2.0)	
1	1929 (216)	11.1 (8.8-13.5)		1929 (131)	7.1 (5.3-8.9)		2159 (71)	2.9 (1.9-3.9)		2159 (33)	1.4 (0.8-2.0)	
2	765 (106)	12.6 (9.8-15.3)		765 (65)	8.2 (5.4-8.9)		485 (30)	6.1 (2.6-9.7)		485 (18)	2.9 (1.1-4.7)	
p-value	0.023			0.45			0.140			0.21		

Characteristics	Men				Women			
	Overall oral HPV N (N with infection	Prevalence, % (95% CI)	N (N with infection	High-risk oral HPV Prevalence, % (95% CI)	Overall oral HPV N (N with infection	Prevalence, % (95% CI)	N (N with infection	High-risk oral HPV Prevalence, % (95% CI)
Age had first any sex*								
< 18 years	2416 (354)	14.6 (12.0-17.1)	2416 (210)	9.2 (7.1-11.4)	2162 (108)	4.6 (3.5-5.6)	2162 (52)	2.0 (1.2-2.8)
18 years	1480 (120)	6.8 (5.3-8.4)	1480 (80)	4.6 (3.4-5.8)	1755 (48)	1.8 (1.2-2.3)	1755 (22)	0.8 (0.4-1.2)
<i>p-value</i>		<0.001		<0.001		<0.001		0.011
Age had first oral sex*								
< 18 years	3160 (415)	12.0 (10.1-13.9)	3160 (255)	7.8 (6.3-9.3)	1335 (64)	3.8 (2.6-4.9)	1335 (37)	1.9 (0.8-3.1)
18 years	50 (10)	16.2 (4.2-28.2)	50 (6)	11.0 (1.0-20.9)	1757 (69)	3.4 (2.2-4.6)	1757 (27)	1.2 (0.7-1.8)
<i>p-value</i>		0.50		0.52		0.69		0.30
Time since last oral sex*								
Never had oral sex	923 (63)	6.9 (3.9-9.8)	923 (33)	4.0 (2.0-5.9)	1037 (28)	1.9 (1.0-2.8)	1037 (12)	0.9 (0.2-1.6)
<12 months	781 (113)	13.6 (10.5-16.6)	781 (75)	9.6 (6.7-12.4)	724 (33)	3.6 (2.0-5.1)	724 (20)	2.1 (0.9-3.3)
12-24 months	210 (33)	18.6 (11.5-25.8)	210 (18)	11.4 (5.6-17.2)	210 (5)	2.4 (0.5-2)	210 (0)	NR
>24 months	89 (13)	11.6 (3.3-20.0)	89 (9)	7.5 (0.8-14.2)	88 (3)	2.3 (0.1-4.5)	88 (2)	2.1 (0.4-2)
<i>p-value</i>		0.002		0.0002		0.177		NA
Used barrier during oral sex during past 12 months*								
Never/ Rarely	1807 (247)	13.0 (10.7-15.3)	1807 (155)	8.5 (6.7-10.3)	1744 (64)	2.9 (2.0-3.8)	1744 (36)	1.5 (0.9-2.1)
Usually/Always	275 (30)	9.7 (5.2-14.2)	275 (18)	6.9 (2.8-11.0)	193 (14)	8.1 (2.8-13.4)	193 (6)	3.0 (0.6-5.4)
<i>p-value</i>		0.115		0.38		0.072		0.23
History of Herpes/Warts*								
Yes	137 (22)	15.5 (6.3-24.8)	137 (16)	12.0 (2.2-21.7)	310 (12)	4.1 (0.7-7.5)	310 (2)	0.8 (0.2-3)
No	3031 (351)	11.2 (9.3-13.1)	3031 (217)	7.2 (5.7-8.7)	2880 (106)	3.0 (2.3-3.7)	2880 (55)	1.5 (1.1-2.0)
<i>p-value</i>		0.34		0.34		0.47		0.38
History of Chlamydia/Gonorrhea ^{††}								
Yes	29 (12)	28.0 (5.7-50.3)	29 (8)	20.7 (0.2-41.1)	73 (4)	3.8 (0.0-7.9)	73 (1)	1.1 (0.0-3.4)
No	3139 (362)	11.3 (9.4-13.2)	3139 (226)	7.4 (5.9-8.9)	3118 (115)	3.1 (2.3-3.9)	3118 (56)	1.4 (1.0-1.9)
<i>p-value</i>		0.113		0.196		0.72		0.79
History of HPV ^{§§}								
Yes		NA		NA	287 (12)	4.3 (1.1-7.5)	287 (9)	2.7 (0.5-5.0)

Characteristics	Men				Women			
	Overall oral HPV		High-risk oral HPV		Overall oral HPV		High-risk oral HPV	
	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)	N (N with infection)	Prevalence, % (95% CI)
No					2906 (107)	3.0 (2.1-3.9)	2906 (48)	1.3 (0.9-1.7)
<i>p-value</i>						0.43		0.23
HIV status ^{***}								
HIV-positive	28 (9)	29.7 (6.0-53.4)	28 (7)	24.8 (2.9-46.7)	8 (0)	NR	8 (0)	NR
HIV-negative	3412 (380)	10.9 (9.3-12.5)	3412 (231)	7.0 (5.7-8.3)	3582 (128)	3.1 (2.4-3.8)	3582 (60)	1.4 (1.0-1.9)
<i>p-value</i>		0.105		0.110		NR		NR
Self-reported sexual orientation [*]								
Heterosexual	3211 (356)	10.8 (9.0-12.5)	3211 (217)	6.9 (5.5-8.2)	3035 (101)	2.9 (2.0-3.7)	3035 (46)	1.3 (0.8-1.7)
Homosexual/Bisexual	119 (21)	17.1 (7.5-26.7)	119 (16)	13.9 (5.7-22.1)	207 (16)	6.3 (3.1-9.5)	207 (8)	3.2 (1.0-5.5)
<i>p-value</i>		0.157		0.073		0.043		0.097
Ever had any sex with partner of same gender ^{*,†††}								
Yes	212 (38)	18.2 (10.8-25.6)	212 (25)	12.7 (7.0-18.4)	374 (31)	6.6 (3.6-9.7)	374 (17)	3.6 (1.4-5.9)
No	3934 (451)	10.8 (9.1-12.4)	3934 (269)	6.8 (5.5-8.1)	3762 (130)	2.9 (2.3-3.5)	3762 (59)	1.2 (0.8-1.6)
<i>p-value</i>		0.045		0.041		0.020		0.043
Lifetime number of same gender oral sex partners [*]								
0	3934 (451)	10.7 (9.1-12.4)	3934 (269)	6.8 (5.5-8.1)	3762 (130)	2.9 (2.3-3.5)	3762 (59)	1.2 (0.8-1.6)
1	134 (14)	8.3 (3.3-13.2)	134 (8)	5.1 (0.2-9.9)	310 (24)	6.8 (3.3-10.2)	310 (14)	3.9 (1.2-6.6)
2	75 (22)	30.3 (15.2-45.5)	75 (16)	22.2 (9.6-34.8)	44 (5)	6.9 (2.3-11.5)	44 (1)	1.6 (0.0-5.0)
<i>p-value</i>		0.029		0.038		0.026		0.146
Number of same gender oral sex partners during the past 12 months ^{††}								
0	4018 (463)	10.8 (9.2-12.4)	4018 (277)	12.1 (2.3-21.8)	3816 (136)	3.1 (2.4-3.7)	3816 (61)	1.3 (0.9-1.7)
1	91 (16)	15.6 (4.3-26.9)	19 (12)	6.9 (5.5-8.2)	112 (10)	8.6 (2.5-14.8)	112 (3)	3.3 (0.0-7.4)
<i>p-value</i>		0.37		0.28		0.080		0.36
Lifetime number of same gender anal sex partners ^{†††}								
0	3934 (451)	10.8 (9.1-12.4)	3934 (269)	6.8 (5.5-8.1)	NA	NA	NA	NA
1	90 (14)	12.7 (3.6-21.9)	90 (8)	6.5 (0.8-12.2)				
2	65 (16)	26.1 (12.4-39.8)	65 (12)	19.9 (8.2-31.7)				
<i>p-value</i>		0.108		0.083				

Characteristics	Men			Women		
	Overall oral HPV	Prevalence, % (95% CI)	N (N with infection)	Overall oral HPV	Prevalence, % (95% CI)	N (N with infection)
High-risk oral HPV						
Prevalence, % (95% CI)						
High-risk oral HPV						
Prevalence, % (95% CI)						
Number of same gender anal sex partners during the past 12 months^{†††}						
0	3994 (462)	10.9 (9.3-12.6)	3994 (276)	6.9 (5.6-8.3)	NA	NA
1	75 (15)	15.7 (4.1-27.4)	75 (12)	14.2 (3.2-25.1)	NA	NA
<i>p-value</i>	0.39			0.193		

Abbreviations: HPV, human papillomavirus

* Prevalence estimates based on valid non-missing Oral HPV results for participants aged 18-69 years who responded to the audio, computer-assisted self-interview

[†] If a male answered "yes" to having had any of the following types of sex: Ever had vaginal sex with a woman, Ever performed oral sex on a woman, Ever had anal sex with a woman, or Ever had any sex with a man; anal, oral; he was coded as "yes". Similarly for women.

^{††} Men were asked 'Have you ever performed oral sex on a woman? This means putting your mouth on a woman's vagina or genitals.' Females were asked 'Have you ever performed oral sex on a man? This means putting your mouth on a man's penis or genitals.'

^{†††} Men were asked 'Have you ever had vaginal sex, also called sexual intercourse, with a woman? This means your penis in a woman's vagina.' Females were asked 'Have you ever had vaginal sex, also called sexual intercourse, with a man? This means a man's penis in your vagina.'

^{††††} Men were asked 'Have you ever had anal sex with a woman? Anal sex means contact between your penis and a woman's anus or butt.' Females were asked 'Have you ever had anal sex? This means contact between a man's penis and your anus or butt.'

^{†††††} Men were asked 'In your lifetime, with how many women have you had any kind of sex?'; Females were asked 'In your lifetime, with how many men have you had any kind of sex?'

^{**} Men and Women were asked 'In your lifetime, on how many women have you performed oral sex?' and 'In your lifetime, on how many men have you performed oral sex?'

^{†††} Males were asked 'In your lifetime, with how many women have you had vaginal sex?'; Females were asked 'In your lifetime, with how many men have you had vaginal sex?'

^{††††} Restricted to participants aged 18-59 years

^{§§} Restricted to female participants 18-59 years

^{***} Restricted to participants 18-59 years with valid non-missing human immunodeficiency virus (HIV) antibody test results

^{†††††} Men were asked 'Have you ever had any kind of sex with a man, including oral or anal?'. Females were asked 'Have you ever had any kind of sex with a woman? By sex, we mean sexual contact with another woman's vagina or genitals.'

^{††††††} Restricted to male participants 18-59 years

Table 3.

Factors associated with overall and high-risk oral human papillomavirus (HPV) infection, NHANES 2011-2014.

Risk Factor	Overall oral HPV		High-risk oral HPV	
	Odds Ratio (95% Confidence interval)	Predicted Probability (95% Confidence interval)	Odds Ratio (95% Confidence interval)	Predicted Probability (95% Confidence interval)
Gender				
Males	3.49 (2.77-4.41)	0.10 (0.10-0.11)	4.95 (3.36-7.30)	0.06 (0.06-0.07)
Females	Ref	0.02 (0.02-0.03)	Ref	0.01 (0.01-0.01)
Ethnicity				
Black	1.32 (0.88-1.96)	0.09 (0.09-0.10)	1.41 (0.87-2.26)	0.05 (0.05-0.05)
White	0.58 (0.38-0.88)	0.06 (0.05-0.06)	0.78 (0.50-1.22)	0.04 (0.03-0.04)
Other	0.65 (0.39-1.07)	0.04 (0.04-0.05)	0.80 (0.42-1.52)	0.03 (0.02-0.03)
Mexican/Hispanic	Ref	0.06 (0.06-0.07)	Ref	0.03 (0.03-0.03)
Cigarette use				
Never/Former	Ref	0.05 (0.04-0.05)	Ref	0.03 (0.03-0.03)
<10/Day	1.60 (1.12-2.30)	0.10 (0.10-0.11)	1.63 (0.97-2.74)	0.07 (0.06-0.07)
11-20/Day	1.82 (1.17-2.85)	0.12 (0.10-0.14)	1.29 (0.67-2.47)	0.06 (0.05-0.08)
>20/Day	1.99 (1.09-3.65)	0.14 (0.12-0.17)	2.16 (0.99-4.72)	0.11 (0.09-0.13)
Marijuana use				
Never	Ref	0.04 (0.04-0.04)	Ref	0.02 (0.02-0.02)
Current	1.03 (0.72-1.49)	0.10 (0.09-0.11)	1.42 (0.86-2.36)	0.06 (0.06-0.07)
Former	1.08 (0.77-1.51)	0.08 (0.07-0.08)	1.80 (1.20-2.69)	0.05 (0.05-0.06)
Lifetime number of vaginal sex partners				
0-1	Ref	0.03 (0.03-0.03)	Ref	0.02 (0.02-0.02)
2-5	0.81 (0.45-1.45)	0.04 (0.03-0.04)	0.72 (0.31-1.66)	0.02 (0.02-0.02)
6-10	1.26 (0.77-2.07)	0.07 (0.07-0.08)	1.29 (0.64-2.57)	0.05 (0.04-0.05)
11-15	1.42 (0.92-2.21)	0.12 (0.10-0.13)	0.77 (0.34-1.76)	0.05 (0.04-0.06)
16	0.99 (0.67-1.47)	0.14 (0.13-0.15)	0.90 (0.57-1.43)	0.10 (0.09-0.10)
Lifetime number of oral sex partners				
0-1	Ref	0.03 (0.02-0.03)	Ref	0.01 (0.01-0.01)
2-5	1.98 (1.30-3.02)	0.06 (0.05-0.06)	2.24 (1.22-4.12)	0.03 (0.03-0.03)
6-10	2.46 (1.49-4.06)	0.09 (0.08-0.10)	2.57 (1.36-4.87)	0.05 (0.04-0.05)
11-15	4.91 (2.90-8.30)	0.18 (0.16-0.19)	6.6 (3.09-14.09)	0.12 (0.11-0.13)
16	6.45 (3.38-12.31)	0.21 (0.19-0.23)	7.33 (3.29-16.36)	0.14 (0.13-0.15)

Abbreviations: HPV, human papillomavirus Models simultaneously adjusted for variables in the table and for age as a linear term