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The prevalence of genital HPV and factors associated with oncogenic HPV among men having sex with men and men having sex with women and men: The *HIM* study

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Abstract

Background—Comparative studies of genital human papillomavirus (HPV) among men having sex with men (MSM), men having sex with women and men (MSWM), and men having sex with women (MSW) have not been conducted; however, such comparisons may be important for planning prevention strategies like vaccination.

Methods—Men, aged 18–70 years, were enrolled in a study of genital HPV in São Paulo, Brazil; Cuernavaca, Mexico; and Tampa, Florida, USA. Men were classified as MSM (n=170), MSWM (n=214) and MSW (n=3326) based on self-reported sexual behavior. Genotyping for HPV was conducted on cells from the penis and scrotum. Prevalence data were adjusted by country. Factors potentially associated with genital HPV were assessed using multivariable Poisson regression.

Results—Genital HPV prevalence was typically higher among MSWM than among MSM or MSW for groups of HPV genotypes including nononcogenic types (51%, 36%, and 42%, respectively), and multiple types (37%, 24%, and 29%, respectively). Age and alcohol consumption in the past month were associated with oncogenic HPV among both MSM and MSWM; however, there were no statistically significant associations between sexual behaviors and genital HPV among MSM or MSWM.

Conclusions—Prevalence of genital HPV may be higher among MSWM than among MSW or MSM. Number of female sex partners was associated with genital HPV among MSW, but number of male anal sex partners was not associated with genital HPV among MSM and MSWM.

Keywords

human papillomavirus; genitals; men; epidemiology; prevalence; sexual orientation; MSM

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INTRODUCTION

Human papillomavirus (HPV) is a common pathogen that infects the skin and mucosal epithelia. In the anogenital region, HPV infections may cause disease such as condylomas or squamous cell carcinomas.¹

While HPV vaccines can prevent infection and disease among both women and men,^{2, 3} vaccine programs have primarily targeted women,⁴ in part, due to a greater burden of disease among women, but also due to limited HPV data for men.⁵

With improved cell sampling techniques,⁶ genital HPV infection among men has been increasingly studied primarily with regard to how genital HPV among men having sex with women increases women's risk for cervical cancer;^{7–12} however, investigations of genital HPV among men may also be important for prevention of male disease, especially among MSM whose incidence of HPV-associated anal cancer may be more than 25 times higher than in heterosexual women or men.¹³ While there is an increasing amount of literature regarding HPV infections of the anal canal among MSM,^{14–16} much less is known about genital infection among MSM.¹⁷

There are also few data regarding the extent of HPV among MSWM. For example, it is not known if prevalence and factors associated with genital HPV differ between MSM and MSWM.

Our objective was to describe genital HPV prevalence in a multinational sample of MSM, MSWM, and MSW and to assess factors associated with genital HPV among MSM and MSWM.

MATERIALS AND METHODS

Study Design

A total of 4074 men from São Paulo, Cuernavaca, and Tampa, were enrolled from June, 2005 to December, 2009 in the *HPV in Men (HIM) Study*. Eligibility criteria included an age of 18–70 years, no history of anal cancer or genital warts, and no current sexually transmitted disease (STD) symptoms or diagnosis including self-reported Human immunodeficiency virus. Data for the current analysis are taken from participants' enrollment visits. Additional details of the study design have been previously described.¹⁸

Men in São Paulo were recruited from the general population through media and oral presentations at sites like universities and companies. In addition, approximately 30% of São Paulo men were recruited from a genitourinary clinic that does HIV/STD testing; however, men presenting with STD-related symptoms or for HIV/STD testing were excluded. In Cuernavaca, men were recruited from a government-funded healthcare system, factories, and the military. Men in Tampa were recruited from a university and the general public. MSM and MSWM were not targeted for recruitment. Participants received a nominal incentive and consented to the study protocol which was approved by human subjects committees in each country.

Procedure

Participants completed a computer-assisted self-interview that elicited information about demographics, substance use, and sexual behaviors. The interview asked the same questions in each country. It was translated and back translated into Spanish and Portuguese from English. After the interview, a study clinician examined the men for STD symptoms, including warts and lesions (men found to have genital warts were retained on study). For

HPV sampling, the clinician used a saline-wetted swab to sweep 360° around the coronal sulcus and glans penis, and if present, a retracted prepuce. A second swab was used to sample the entire surface of the penile shaft while a third was used to sample the scrotum. Finally, the clinician used a separate swab to sample the anal canal. Each swab was placed in a vial of transport media (STM, Qiagen, Germany) and stored at -80°C. First catch urine and blood were collected to test for Chlamydia trachomatis (Chlamydia LCx, Abbott Laboratories, Illinois and COBAS Amplicor CT/NG Test, Roche Diagnostics, England) and Herpes simplex virus-2 antibodies (HerpeSelect 2 ELISA IgG, Focus Diagnostics, California), respectively.

HPV testing

Swabs were combined and analyzed for HPV DNA as described previously.^{18, 19} Briefly, DNA was extracted using the QIAamp Media MDx Kit (Qiagen). The polymerase chain reaction (PCR) consensus primer system (PGMY 09/11) amplified a fragment of the HPV L1 gene.²⁰ Genotyping was conducted for 37 types using the Roche Linear Array: 6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51–56, 58, 59, 61, 62, 64, 66–73, 81–84, IS39, and CP6108.²¹ Accuracy and possible contamination were assessed using negative and positive controls. Of all enrolled men, 2.6% had β -globin negative samples.

Statistical analyses

The prevalence of any HPV, oncogenic, and nononcogenic types was different in the three countries. For example the prevalence of oncogenic HPV among men in São Paulo, Cuernavaca, and Tampa was 34%, 28%, and 29% ($P=0.003$); therefore, prevalence data were adjusted by country using direct standardization with the total sample as the reference.

Men were classified as MSM, MSWM, MSW, and men having no sex based upon answers to 17 questions about lifetime and recent sexual behavior (i.e., the past 3 or 6 months). To classify men, greater weight was given to recent sexual behavior and lifetime sexual behavior with multiple partners in order to account for incidental sexual experimentation common in these three countries.^{22–24} A participant was classified as MSM if he reported any anal or oral sex with men in the past 6 months; or lifetime anal sex with ≥ 3 men. A participant who acknowledged recent sex with only women and who had ≤ 3 lifetime male anal sex partners was classified as MSW. Men who acknowledged recent sex with both men and women or who reported ≥ 3 male and ≥ 3 female partners during the lifetime were classified as MSWM. The final analysis consisted of 170 (4.6%) MSM, 214 (5.8%) MSWM, and 3326 (89.6%) MSW. Excluded were men with β -globin negative samples, men who reported no sex, and men who self-reported HIV. MSM, MSWM, and MSW characteristics were compared using Kruskal-Wallis or Chi square tests.

For analysis of factors associated with HPV, we focused on oncogenic genotypes because of their potential for increased morbidity and mortality. A case was defined as a man infected with ≥ 1 oncogenic genotypes (i.e., type 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, or 68)²⁵ regardless of concurrent infection with nononcogenic genotypes. A non-case was a man negative on both PCR and genotyping tests; thus, for regression analyses, sample size was reduced to 108 MSM, 137 MSWM, and 2078 MSW. Prevalence ratios (PR) and 95% confidence limits (CL) were calculated by bivariate and multivariable Poisson regression using a robust sandwich estimator of the variance.^{26, 27}

Factors chosen for multivariable analysis for MSM and MSWM were significant in bivariate analysis ($P<0.25$) or were derived from the literature. Using directed acyclic graphs,²⁸ potential confounders and intermediary variables were identified. Confounders (age and country of residence) were retained in all multivariable analyses while intermediate

variables (e.g., clinician-diagnosed warts) were excluded.²⁹ For MSM, factors included in multivariable analysis were age, presence of a prepuce, alcohol consumption, lifetime number of male anal sex partners, number of new male anal sex partners in the past 3 months, condom use for anal sex, and a history of partners with STDs. For MSWM, factors included were age, presence of a prepuce, smoking, alcohol consumption, lifetime number of male anal sex partners and female sex partners, number of new male anal sex partners in the past 3 months, number of new female sex partners in the past 6 months, frequency of condom use for vaginal sex and anal sex, and a history of STDs. Alcohol consumption in the past month was derived by multiplying the reported number of days drinking by the average number of drinks each day (reported separately for beer, wine, wine coolers, cocktails, liquor shots, and other alcoholic drinks).

A multivariable analysis was conducted for MSW to allow comparison with MSM and MSWM; however, the large MSW sample size precluded using the same multivariable strategy. Specifically, only factors chosen for MSM or MSWM multivariable analyses were included in MSW analysis (male anal sex variables were excluded). In addition, factors in MSW multivariable analysis were adjusted only by age and country.

For MSM and MSWM multivariable analyses, factors were removed one-by-one until only statistically significant factors remained. A factor was statistically significant if any 95% CIs excluded unity.

A subset of men were asked for details about the frequency of insertive anal sex (MSM=69, MSWM=107, and MSW=2378). These data were analyzed in bivariate but not multivariable analysis.

Data were analyzed using SAS 9.2 (SAS Institute Inc., Cary, North Carolina, USA).

RESULTS

A majority of MSM and MSWM resided in São Paulo (table 1). The median age of MSM, MSWM, and MSW was 29, 33, and 30, respectively ($P=0.002$). Over 80% of MSM reported being single, never married compared with 48% of MSWM and 42% of MSW ($P<0.001$). For MSM, MSWM, and MSW, respectively, study clinicians reported a prepuce in 77%, 75% and 65% of men ($P<0.001$) and anogenital warts in 3%, 6% and 6% of men ($P=0.27$).

Genital HPV Prevalence

For most groups of genital HPV (e.g., nononcogenic and multiple types), prevalence was higher among MSWM than among MSM or MSW. The prevalence of oncogenic HPV was 29.7%, 39.6%, and 30.0%, respectively, for MSM, MSWM, and MSW although confidence limits for MSWM and MSM overlapped (table 2).

Prevalence for the combined group of HPV6/11 was higher among MSM and MSWM than among MSW. The prevalence of α -6 genotypes was higher among MSWM than among MSM or MSW.

The 5 most common genotypes among MSM and MSWM, respectively, were HPV6, 16, 61, 45, and 81 and HPV6, 84, 16, 66, and (tie) CP6108 and 52. The 5 most common types among MSW were HPV62, 84, 16, CP6108, and 51.

Among MSM and MSW, prevalence was higher for men aged 25–34 years compared to men aged 18–24 years; however, among MSWM, prevalence was highest in the youngest men (figure 1).

Factors Associated with Oncogenic HPV

Among MSM, variables statistically significantly associated with oncogenic infection in bivariate analysis were age and alcohol consumption in the past month (table 3). Among MSWM, variables associated with oncogenic infection were age, alcohol consumption, and number of female sex partners in the past 6 months. In bivariate analysis among MSW, a number of factors were associated with oncogenic infection including age, smoking, alcohol consumption, number of female sex partners, and frequency of condom use (table 3).

In multivariable analysis, age was significantly associated with oncogenic HPV among MSM (in comparison to MSM aged 18–24 years: adjusted prevalence ratio (aPR) 2.01, 95% CL, 1.13–3.59 for men aged 25–34 years) while among MSWM HPV was inversely associated with age (in comparison to MSWM aged 18–24 years: aPR 0.74, 95% CL, 0.55–0.99 for men aged 25–34 years; aPR 0.51, 95% CL, 0.35–0.76 for men aged 35–44 years; and aPR 0.54, 95% CL, 0.32–0.90 for men aged 45–70 years). As with MSM, oncogenic HPV was also associated with MSW aged 25–34 years (in comparison to MSW aged 18–24 years: aPR 1.22, 95% CL, 1.08–1.38 for men aged 25–34 years); however, the point estimate among MSM was higher than the estimate among MSW (2.01 and 1.22, respectively).

Alcohol consumption was associated with genital HPV in all three groups of men. Among MSM alcohol consumption was associated most strongly with consumption of 31–60 drinks in the past month (in comparison to 0–30 drinks in the past month: aPR, 1.65, 95% CL, 1.05–2.58). Oncogenic HPV was also associated with MSM who consumed >60 drinks in the past month although it was non-significant. However, among MSWM and MSW, only the highest level of alcohol consumption was significantly associated with genital HPV (in comparison to MSWM who drank 0–30 drinks in the past month: aPR, 1.44, 95% CL, 1.10–1.87 for >60 drinks; and in comparison to MSW who drank 0–30 drinks: aPR, 1.30, 95% CL, 1.17–1.45 for >60 drinks).

Among MSM and MSWM, cigarette smoking, numbers of male anal sex partners and female sex partners, condom use for vaginal and anal sex, and having had a partner with an STD were not associated with oncogenic HPV in multivariable analysis.

CONCLUSIONS

The prevalence of genital HPV was generally comparable among MSW and MSM while prevalence was higher among MSWM; however, there was higher prevalence among MSM and MSWM for the combined group of HPV6/11 genotypes responsible for 90% of genital warts.³⁰ The prevalence of HPV16, responsible for most HPV-associated penile cancers,^{31, 32} was similar among MSM, MSWM, and MSW.

Van der Snoek, et al. observed an HPV prevalence among 241 MSM and MSWM of 15.8% using a PCR test that detected 25 genotypes. HPV6, the most common genotype detected, was present in 5.0% of men.¹⁷ The current study sampled more genital skin and tested for more genotypes; thus, our higher prevalence is not surprising, although we too observed HPV6 to be the most common genotype among MSM and MSWM (9.1% and 11.8%, respectively). These estimates were approximately double the prevalence of genital HPV6/11 among MSW. In our prior study of anal HPV we also observed a large difference in HPV6 prevalence among MSM and MSW (9.1% and 1.6%, respectively).¹⁶ Thus, vaccines targeting HPV6/11 might be especially helpful in preventing anogenital disease among MSWM and MSM. While widespread vaccination among women may eventually lower the prevalence of these types in MSW³³ there was limited evidence for such an effect in the current sample (table 1).

HPV16 was one of the most common types detected among all three groups of men - a frequent finding in prior studies of genital HPV.^{34, 35} Other than HPV16 the most common HPV types found in MSW and MSM did not overlap; thus, a different pool of genotypes among heterosexuals and MSM may help explain the higher proportion of MSWM with multiple HPV types.

We found age and alcohol consumption to be associated with oncogenic HPV among all three groups of men. Alcohol consumption may increase sexual disinhibition and often occurs in settings where it may be easier to find sex partners. In fact, MSWM and MSW who drank >60 drinks in the past month were more likely to report ≥ 2 new female sex partners in the past six months ($P=0.04$ and $P<0.0001$, respectively) compared with men who drank the least. The association was similar for MSWM and MSM with regard to male anal sex partners although non-significant.

In multivariable analysis we did not identify a statistically significant association between sexual behavior and genital HPV among MSM and MSWM, which also reflects the findings of Van der Snoek, et al.¹⁷ This includes number of sex partners, which prior studies among primarily MSW have found to be strongly associated with male genital HPV.^{10, 11, 36, 37} It is likely that the interview did not capture data on all sexual partners since it focused on penetrative sex, and not, for example, number of masturbatory partners. Also, the number of anal sex partners might be expected to have no correlation with genital HPV among men who primarily engage in receptive anal sex.

It also seems plausible that the prevalence of genital HPV among men may be a function not only of the number of sex partners, but also the frequency of sex acts,³⁸ especially insertive sex acts. Among a subset of men, frequency of insertive anal sex was associated with genital HPV (table 3).

A combination of number of sex partners and insertive sex acts may also help explain differing age-specific prevalence. For example, MSM aged 18–24 years had a lower prevalence of genital HPV compared to MSM aged 25–34 years. While the median number of new male anal sex partners (1.0) in the past 3 months was the same in the two age groups, the median number of recent insertive sex acts increased from 2.0 among men aged 18–24 to 5.5 among men aged 25–34. A similar pattern of age-specific prevalence was observed among MSW whose median number of new sex partners (1.0) remained stable across the youngest two age groups while the median number of insertive sex acts (both vaginal and anal) in the past six months increased from 12 to 20. Conversely, MSWM under 25 years of age had a higher prevalence of genital HPV compared to those aged 25–34 years. The younger MSWM had a higher median number of new partners in the past 6 months than the older MSWM (2.0 and 0.0, respectively) while the median number of insertive sex acts in the past six months increased from 6.0 to 10.0 (data not shown).

The present study may have lacked power to identify some statistically significant associations due to sample size (e.g., among MSWM for number of new female sex partners in the past 6 months and among MSM and MSWM for history of a partner with an STD). The relative difference in sample size among the groups may also complicate comparisons. However, a strength of the current study is that MSM, MSWM, and MSW were recruited from the same source populations. In addition, prevalence data were adjusted by residence which provides a more valid basis for comparisons given that a majority of MSM and MSWM were from São Paulo.

Most HPV studies among men have not studied MSM, MSWM and MSW separately.^{10, 16–18, 36} The current study found differences among these groups suggesting

that future studies present stratified results. Since our sample was a self-selected population from mostly urban settings, the results are not necessarily representative of other regions.

Because we weighted more recent sex behavior to classify MSM, MSWM and MSW it is possible that some men were misclassified; however, weighting more recent behavior may be appropriate given that HPV is usually a transient infection. While these behavioral data are self-reports we have found the *HIM Study* interview to be highly reliable with men in the three study sites.³⁹ Even so, we found no statistically significant associations between sexual behavior and genital HPV among MSM and MSWM. Future studies should consider collecting data about non-penetrative sex and possibly non-sexual behaviors to assess factors associated with genital HPV.

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Figure 1. Residence-adjusted genital HPV prevalence by age in 170 men having sex with men (MSW), 214 men having sex with women and men (MSWM), and 3326 men having sex with women (MSW) in the *HPV in Men (HIM) Study*.

Table 1

Descriptive characteristics stratified by men having sex with men (MSM), men having sex with women and men (MSWM), and men having sex with women (MSW) in São Paulo, Cuernavaca, and Tampa

Variable	MSM		MSWM		MSW	
	n	%	n	%	n	%
Age*						
18–24	57	(33.5)	44	(20.6)	998	(30.0)
25–34	61	(35.9)	70	(32.7)	1019	(30.6)
35–44	40	(23.5)	71	(33.2)	879	(26.4)
45–70	12	(7.1)	29	(13.6)	430	(12.9)
<i>Mean; median</i>	30.5;29		34.3;33		32.5;30	
Residence						
São Paulo	116	(68.2)	151	(70.6)	1044	(31.4)
Cuernavaca	21	(12.4)	34	(15.9)	1174	(35.3)
Tampa	33	(19.4)	29	(13.6)	1108	(33.3)
Race†						
White	106	(62.4)	127	(60.5)	1440	(44.0)
Black	33	(19.4)	44	(21.0)	483	(14.8)
Asian/Pacific Islander	1	(0.6)	1	(0.5)	96	(2.9)
American Indian	5	(2.9)	5	(2.4)	62	(1.9)
Mestizo/other	25	(14.7)	33	(15.7)	1193	(36.4)
Ethnicity†						
Hispanic	58	(34.7)	84	(39.6)	1559	(47.2)
Non-Hispanic	109	(65.3)	128	(60.4)	1742	(52.8)
Marital status†						
Single, never married	137	(80.6)	103	(48.4)	1398	(42.1)
Married	8	(4.7)	61	(28.6)	1204	(36.3)
Cohabiting	21	(12.4)	26	(12.2)	418	(12.6)
Divorced/separated/widowed	4	(2.4)	23	(10.8)	299	(9.0)
Years of school†						

Variable	MSM		MSWM		MSW	
	n	%	n	%	n	%
<12	23	(13.6)	47	(22.0)	721	(21.7)
12	35	(20.7)	59	(27.6)	893	(26.9)
13–16	102	(60.4)	93	(43.5)	1496	(45.1)
≥17	9	(5.3)	15	(7.0)	207	(6.2)
Prepuce present	131	(77.1)	160	(74.8)	2160	(64.9)
Cigarette smoking status [†]						
Current smoker	41	(24.1)	65	(30.4)	781	(23.5)
Former smoker	21	(12.4)	45	(21.0)	643	(19.4)
Never smoker	108	(63.5)	104	(48.6)	1896	(57.1)
Alcoholic drinks in past month [†]						
0–30	116	(73.0)	137	(67.2)	2289	(71.8)
31–60	17	(10.7)	26	(12.8)	380	(11.9)
>60	26	(16.4)	41	(20.1)	519	(16.3)
Mean; median	46.5; 9		45.4; 12		42.6; 9	
Lifetime number of male anal sex partners [†]						
0–2	26	(17.0)	37	(18.2)	3307	(100.0)
3–9	42	(27.5)	97	(47.8)	0	(0.0)
10–19	33	(21.6)	25	(12.3)	0	(0.0)
>=20	52	(34.0)	44	(21.7)	0	(0.0)
Mean; median	54.0; 10		32.8; 4		0.1; 0	
Lifetime number of female sex partners [†]						
0–2	157	(100.0)	21	(10.6)	559	(17.8)
3–9	0	(0.0)	79	(39.9)	1235	(39.2)
10–19	0	(0.0)	37	(18.7)	612	(19.4)
>=20	0	(0.0)	61	(30.8)	743	(23.6)
Mean; median	0.5; 0		22.5; 9		19.3; 8	
Number of new male anal sex partners in the past 3 months [†]						
0	67	(42.7)	112	(56.0)	3307	(100.0)

Variable	MSM		MSWM		MSW	
	n	%	n	%	n	%
1	40	(25.5)	43	(21.5)	0	(0.0)
≥2	50	(31.9)	45	(22.5)	0	(0.0)
Mean; median	1.9; 1		1.4; 0		-	
Number of new female sex partners in the past 6 months [†]						
0	164	(100.0)	115	(56.4)	1895	(60.1)
1	0	(0.0)	48	(23.5)	861	(27.3)
≥2	0	(0.0)	41	(20.1)	399	(12.7)
Mean; median	-		1.1; 0		0.7; 0	
Frequency of insertive anal sex in the past 6 months ^{†‡}						
no recent insertive anal sex	20	(29.0)	29	(27.1)	1991	(83.7)
1–5 times	21	(30.4)	44	(41.1)	280	(11.8)
6–10 times	10	(14.5)	13	(12.2)	53	(2.2)
>10 times	18	(26.1)	21	(19.6)	54	(2.3)
Mean; median	10.7; 4		20.9; 3		1.0; 0	
Frequency of condom use for anal sex in the past 6 months [†]						
Always	62	(36.9)	61	(29.5)	240	(7.5)
Sometimes	70	(41.7)	68	(32.9)	203	(6.3)
Never	18	(10.7)	34	(16.4)	431	(13.5)
No anal sex in the past 6 months	18	(10.7)	44	(21.3)	2329	(72.7)
Frequency of condom use for vaginal sex in the past 6 months [†]						
Always	0	(0.0)	40	(18.9)	653	(19.9)
Sometimes	0	(0.0)	75	(35.4)	1133	(34.5)
Never	0	(0.0)	49	(23.1)	1237	(37.6)
No vaginal sex in the past 6 months	149	(90.9)	48	(22.6)	265	(8.1)
Anogenital warts (clinician report)	5	(2.9)	13	(6.1)	196	(5.9)
Herpes simplex virus-2 antibodies	64	(37.7)	87	(40.7)	616	(18.5)
Chlamydia trachomatis	4	(2.4)	4	(1.7)	53	(1.6)
History of a partner with an STD [†]						

Variable	MSM		MSWM		MSW	
	n	%	n	%	n	%
Yes	58	(34.1)	67	(31.3)	497	(15.0)
No	42	(24.7)	51	(23.8)	1623	(48.9)
Don't know	70	(41.2)	96	(44.9)	1200	(36.1)
History of a female sex partner who had HPV vaccination ^{†‡‡}						
Yes	0	(0.0)	4	(2.6)	113	(5.0)
No/Don't know	108	(100.0)	152	(97.4)	2140	(95.0)

* All characteristics differed among the three groups of men ($P \leq 0.01$) except alcoholic drinks in the past month ($P = 0.62$) and clinician-reported anogenital warts ($P = 0.27$).

[†] Because some observations were missing, category entries do not sum to 100%.

[‡] Data collected on a subset of full sample (MSM=72, MSWM=114, MSW=2402).

^{‡‡‡} Data collected on a subset of full sample (MSM=110, MSWM=156, MSW=2378).

Residence-adjusted prevalence* of genital HPV in men having sex with men (MSM), men having sex with women and men (MSWM), and men having sex with women (MSW) in the *HPV in Men (HIM) Study*, São Paulo, Cuernavaca, and Tampa, 2005–2009

Table 2

Variable [†]	MSM (n=170)		MSWM (n=214)		MSW (n=3326)	
	(%)	(95% CL)	(%)	(95% CL)	(%)	(95% CL)
Any HPV [‡]	50.1	(42.5–57.7)	60.3	(53.8–66.9)	53.1	(51.4–54.8)
Oncogenic [‡]	29.7	(22.7–36.8)	39.6	(33.1–46.1)	30.0	(28.4–31.5)
Nononcogenic	36.0	(28.5–43.4)	50.8	(44.1–57.6)	42.1	(40.4–43.8)
Both oncogenic and nononcogenic ^{‡‡}	15.6	(9.8–21.4)	30.1	(24.1–36.1)	19.0	(17.7–20.3)
Only oncogenic [§]	14.1	(8.9–19.3)	9.5	(5.6–13.4)	11.0	(9.9–12.0)
Only nononcogenic/	20.4	(14.0–26.8)	20.8	(14.9–26.7)	23.1	(21.7–24.5)
Only unclassified/	13.9	(8.7–19.1)	10.0	(5.9–14.1)	14.6	(13.4–15.8)
Multiple types	23.8	(16.9–30.6)	37.3	(30.8–43.9)	29.3	(27.8–30.9)
Types 6/11	13.2	(8.5–17.9)	15.1	(10.8–19.5)	7.1	(6.2–7.9)
Types 16/18	12.2	(7.2–17.2)	13.3	(8.7–18.0)	9.6	(8.6–10.6)
Types 6/11/16/18	22.6	(16.4–28.8)	25.7	(20.0–31.3)	15.7	(14.5–16.9)
Species [¶]						
α-9 (7 genotypes)	17.3	(11.4–23.1)	24.9	(19.1–30.7)	16.6	(15.3–17.8)
α-7 (6 genotypes)	19.1	(13.3–25.0)	19.8	(14.7–24.9)	15.3	(14.1–16.5)
α-6 (3 genotypes)	4.4	(0.8–8.0)	18.5	(13.1–23.9)	12.0	(10.9–13.1)
α-5 (5 genotypes)	5.0	(1.4–8.6)	8.0	(4.3–11.8)	8.0	(7.0–8.9)
α-10 (3 genotypes)	13.2	(8.5–17.9)	16.6	(11.8–21.3)	9.3	(8.3–10.3)
α-3 (7 genotypes)	22.2	(15.6–28.8)	33.7	(27.2–40.2)	27.3	(25.8–28.8)
α-9 genotypes						
16	8.5	(4.2–12.8)	10.6	(6.3–14.8)	7.7	(6.8–8.7)
52	6.0	(2.6–9.4)	9.8	(6.0–13.7)	6.1	(5.3–6.9)
α-7 genotypes						
18	3.7	(0.9–6.5)	3.0	(0.8–5.2)	2.2	(1.7–2.7)
45	6.9	(3.7–10.1)	0.2	(0.0–0.9)	1.7	(1.2–2.1)
59	5.6	(2.0–9.2)	9.5	(6.3–12.8)	5.5	(4.8–6.3)

Variable [†]	MSM (n=170)		MSWM (n=214)		MSW (n=3326)	
	(%)	(95% CL)	(%)	(95% CL)	(%)	(95% CL)
<i>α</i> -6 genotypes						
53	2.8	(0.3–5.4)	7.3	(3.3–11.3)	5.8	(5.0–6.6)
66	0.6	(0.0–2.0)	10.2	(6.6–13.9)	5.2	(4.5–6.0)
<i>α</i> -5 genotypes						
51	4.1	(1.1–7.1)	5.3	(2.1–8.6)	6.6	(5.8–7.5)
<i>α</i> -10 genotypes						
6	9.1	(5.0–13.1)	11.8	(7.8–15.8)	6.0	(5.2–6.8)
11	4.4	(1.6–7.2)	3.3	(1.5–5.2)	1.2	(0.9–1.6)
<i>α</i> -3 genotypes						
61	7.9	(3.9–11.9)	3.9	(1.0–6.7)	4.7	(4.0–5.4)
62	3.7	(0.5–6.9)	7.5	(3.4–11.6)	8.4	(7.5–9.3)
81	6.9	(3.0–10.8)	2.7	(0.1–5.2)	2.8	(2.3–3.4)
84	5.4	(2.0–8.8)	11.5	(7.1–15.8)	8.0	(7.1–9.0)
CP6108	3.8	(0.6–7.0)	9.8	(6.4–13.3)	7.4	(6.6–8.3)

* The adjustment for residence used direct standardization with the total sample as the reference population.

[†] Genotypes 26, 31, 33, 35, 39, 40, 42, 54, 55, 56, 58, 64, 67, 68, 69, 70, 71, 72, 73, 82, 83, and IS39 are not shown; each was detected, but the prevalence was <5.0% among MSW, MSWM, and MSM.

[^] Men with 'Any HPV' had ≥1 of 37 types.

[‡] Oncogenic types were 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, and 68.

^{^^} Men with 'Both oncogenic and nononcogenic' had ≥1 oncogenic and ≥1 nononcogenic types.

[§] Men with 'only oncogenic' types were positive only for single or multiple oncogenic types; thus, men harboring both oncogenic and nononcogenic types are excluded.

[/] Men with 'only nononcogenic' types were positive only for single or multiple nononcogenic types; thus, men harboring both nononcogenic and oncogenic types are excluded.

[/] Only unclassified were positive by PCR but negative for all 37 genotypes in the linear array test.

[¶] Only species with multiple genotypes in the linear array test are shown.

CL indicates confidence limit.

Table 3

Factors associated with oncogenic genital HPV in men having sex with men (MSM), men having sex with women and men (MSWM), and men having sex with women (MSW) in the *HIM Study*, São Paulo, Cuernavaca, and Tampa, 2005 – 2009: bivariate analyses

Factor	MSM (n=108) PR (95% CL)	MSWM (n=137) PR (95% CL)	MSW (n=2078) PR (95% CL)
Age			
18–24 years	1.0	1.0	1.0
25–34 years	1.82(1.11–2.98)	0.68(0.50–0.91)	1.22(1.08–1.36)
35–44 years	1.53(0.85–2.76)	0.52(0.36–0.74)	1.08(0.95–1.23)
45–70 years	1.63(0.79–3.35)	0.50(0.30–0.84)	1.11(0.95–1.30)
Residence			
São Paulo	1.63(0.86–3.09)	1.04(0.68–1.58)	1.23(1.11–1.37)
Cuernavaca	1.40(0.62–3.15)	1.10(0.67–1.81)	0.91(0.81–1.02)
Tampa	1.0	1.0	1.0
Prepuce present (clinician report)			
Yes	1.32(0.76–2.29)	1.33(0.91–1.95)	0.97(0.88–1.06)
No	1.0	1.0	1.0
Cigarette smoking status			
Current smoker	1.0	1.0	1.0
Former smoker	1.21(0.63–2.34)	0.98(0.68–1.41)	0.91(0.80–1.04)
Never smoker	1.13(0.70–1.83)	0.78(0.56–1.08)	0.85(0.76–0.94)
Alcoholic drinks in past month			
0–30	1.0	1.0	1.0
31–60	1.59(1.01–2.49)	0.90(0.51–1.61)	0.99(0.85–1.15)
>60	1.19(0.69–2.04)	1.58(1.20–2.07)	1.27(1.14–1.42)
Lifetime number of male anal sex partners			
0–2	1.0	1.0	1.0
3–9	1.92(0.89–4.16)	0.79(0.55–1.14)	ue
10–19	1.64(0.73–3.68)	1.08(0.68–1.70)	ue
>=20	1.20(0.53–2.73)	0.93(0.61–1.42)	ue
Lifetime number of female sex partners			
0–2	1.0	1.0	1.0
3–9	ue	0.93(0.51–1.72)	1.76(1.42–2.18)
10–19	ue	1.09(0.57–2.09)	2.65(2.14–3.27)
>=20	ue	1.29(0.73–2.27)	2.98(2.43–3.66)
Number of new male anal sex partners in past 3 months [*]			
0 men	1.0	1.0	1.0
1 man	0.78(0.45–1.35)	1.12(0.76–1.64)	ue
≥2 men	0.82(0.51–1.32)	1.11(0.76–1.62)	ue
Number of new female sex partners in past 6 months [†]			
0 women	1.0	1.0	1.0

	MSM (n=108)	MSWM (n=137)	MSW (n=2078)
Factor	PR (95% CL)	PR (95% CL)	PR (95% CL)
1 woman	ue	1.15(0.79–1.68)	1.21(1.09–1.35)
≥2 women	ue	1.47(1.06–2.02)	1.55(1.38–1.73)
Frequency of insertive anal sex in the past 6 months [‡]			
no recent insertive anal sex	1.0	1.0	1.0
1–5 times	1.21(0.51–2.91)	1.84(1.02–3.33)	1.36(1.17–1.57)
6–10 times	1.86(0.81–4.27)	2.04(1.07–3.90)	1.45(1.07–1.97)
>10 times	1.44(0.59–3.56)	1.82(0.94–3.50)	1.08(0.73–1.60)
Frequency of condom use for anal sex in past 6 months			
Always	1.0	1.0	1.0
Sometimes	1.23(0.82–1.86)	1.08(0.75–1.54)	0.95(0.78–1.16)
Never	0.96(0.43–2.14)	1.16(0.76–1.77)	0.98(0.83–1.15)
No anal sex past 6 months	0.54(0.16–1.87)	0.73(0.45–1.19)	0.71(0.61–0.81)
Frequency of condom use for vaginal sex in past 6 months [*]			
Always	1.0	1.0	1.0
Sometimes	ue	1.17(0.80–1.70)	1.37(1.20–1.56)
Never	ue	0.82(0.51–1.33)	1.05(0.91–1.20)
No vaginal sex past 6 months	ue	0.91(0.55–1.51)	0.71(0.56–0.92)
History of a partner with an STD			
Yes	1.0	1.0	1.0
No	0.56(0.30–1.03)	0.75(0.48–1.17)	0.69(0.61–0.78)
Don't know	0.92(0.62–1.37)	0.93(0.68–1.28)	0.84(0.75–0.95)

* Data not shown for MSW.

[†] Data not shown for MSM.

[‡] Sample size of subset for bivariate analysis: MSM=44, MSWM=73, MSW=2378.

CL indicates confidence limit; PR, prevalence ratio; ue, unstable estimate due to sparse data. Estimates and 95% CLs are bolded if the CL excludes 1.00.

Table 4

Factors associated with oncogenic genital HPV in men having sex with men (MSM), men having sex with women and men (MSWM), and men having sex with women (MSW) in the *HIM Study*, São Paulo, Cuernavaca, and Tampa, 2005 – 2009: multivariable analyses[§]

	<u>MSM (n=108)</u>	<u>MSWM (n=137)</u>	<u>MSW (n=2078)</u>
Factor	aPR* (95% CL)	aPR[†] (95% CL)	aPR[‡] (95% CL)
Age			
18–24 years	1.0	1.0	1.0
25–34 years	2.01(1.13–3.59)	0.74(0.55–0.99)	1.22(1.08–1.38)
35–44 years	1.75(0.88–3.52)	0.51(0.35–0.76)	1.09(0.95–1.24)
45–70 years	2.03(0.95–4.32)	0.54(0.32–0.90)	1.12(0.95–1.31)
Alcoholic drinks in past month			
0–30	1.0	1.0	1.0
31–60	1.65(1.05–2.58)	0.83(0.48–1.46)	1.00(0.86–1.17)
>60	1.28(0.77–2.11)	1.44(1.10–1.87)	1.30(1.17–1.45)
Cigarette smoking status			
Current smoker	1.0	1.0	1.0
Former smoker	1.08(0.59–2.00)	1.11(0.78–1.58)	0.89(0.78–1.01)
Never smoker	0.93(0.60–1.44)	0.81(0.59–1.12)	0.82(0.74–0.91)
Lifetime number of male anal sex partners			
0–2	1.0	1.0	ue
3–9	1.82(0.87–3.84)	0.78(0.53–1.13)	ue
10–19	1.17(0.52–2.65)	1.00(0.65–1.55)	ue
>=20	0.81(0.35–1.88)	0.94(0.61–1.45)	ue
Lifetime number of female sex partners			
0–2	ue	1.0	1.0
3–9	ue	0.98(0.53–1.81)	1.78(1.44–2.21)
10–19	ue	1.25(0.64–2.45)	2.72(2.19–3.38)
>=20	ue	1.65(0.91–3.02)	3.12(2.52–3.86)
Number of new male anal sex partners in past 3 months			
0	1.0	1.0	ue
1	0.84(0.48–1.47)	0.99(0.67–1.46)	ue
≥2	0.82(0.51–1.33)	1.00(0.69–1.45)	ue
Number of new female sex partners in past 6 months			
0	ue	1.0	1.0
1	ue	1.03(0.71–1.50)	1.23(1.11–1.37)
≥2	ue	1.28(0.93–1.76)	1.52(1.36–1.71)
Frequency of condom use for vaginal sex in past 6 months			
Always	ue	1.0	1.0
Sometimes	ue	1.09(0.77–1.55)	1.38(1.22–1.57)
Never	ue	0.90(0.57–1.42)	1.05(0.91–1.21)
History of a partner with an STD			

	<u>MSM (n=108)</u>	<u>MSWM (n=137)</u>	<u>MSW (n=2078)</u>
Factor	aPR [*] (95% CL)	aPR [†] (95% CL)	aPR [‡] (95% CL)
Yes	1.0	1.0	1.0
No	0.68(0.37–1.27)	0.70(0.45–1.07)	0.73(0.65–0.83)
Don't know	0.96(0.64–1.43)	0.89(0.66–1.20)	0.88(0.78–0.99)

[§] Age and residence were retained in each adjusted model as potential confounders.

^{*} Age and alcoholic drinks in past month remained in the MSM model. Their prevalence ratios are adjusted by each other and residence. Smoking status, lifetime number of male anal sex partners, recent number of male anal sex partners, and history of a partner with an STD are included only for comparison to other models and are adjusted only by age and residence.

[†] Age and alcoholic drinks in past month remained in the MSWM model. Their prevalence ratios are adjusted by each other and by residence. Smoking status, lifetime number of male anal sex partners, lifetime number of female sex partners, number of new male anal sex intercourse partners in past 6 months, number of new female sex partners in past 6 months, frequency of condom use for vaginal sex in past 6 months, and history of a partner with an STD are included only for comparison to other models and are adjusted only by age and residence.

[‡] Variables included in multivariable analysis with MSW come from MSM and MSWM multivariable analysis. Each is adjusted only by age and residence.

CL indicates confidence limit; aPR, adjusted prevalence ratio; ue, unstable estimate due to sparse data. Estimates and 95% CLs are bolded if the CL excludes 1.00.