SHORT REPORT

Prevalence and risk factors of anogenital human papillomavirus infection in a community sample of men who have sex with men in Taiwan: baseline findings from a cohort study

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ABSTRACT

Objectives Men who have sex with men (MSM) are a highly neglected population in the current recommendation of girls-only human papillomavirus (HPV) vaccination programmes in many countries. To better assess the cost effectiveness of HPV vaccination among men requires data on the prevalence of HPV infection in MSM using a community sample, which is still sparse in several regions. We examined the prevalence of and factors associated with anogenital HPV infection among MSM in Taiwan.

Methods MSM 20 years of age and older were recruited from the community and social media in Taiwan in 2015–2016 and screened for HPV infection to detect 37 genotypes. MSM were seen at baseline and were/will be seen at 6, 12, 24 and 36 months. Men completed a questionnaire regarding their sexual experiences. Multivariable regression analyses were conducted to identify associated behavioural risk factors using the baseline data.

Results A total of 253 MSM were recruited; 87 % were below 35 years of age. Diagnosis of HIV was reported in 4% of men; just over 20% had three or more anal sex partners in the past year. The prevalence of any tested HPV type was 29.4% at the anal site and 11% at the penile site. One quarter of MSM were infected with any of the 9-valent vaccine HPV types. Anal HPV detection was associated with having three or more receptive anal sex partners in the past year (adjusted odds ratio (aOR)=2.92, 95% CI 1.29 to 6.61) and having older sex partners (aOR=2.51, 95% CI 1.07 to 5.90).

Conclusions Our data provide the base to calculate the reproductive rate for HPV transmission in a low-risk community sample and cost-effectiveness to include men in HPV vaccination policies. Adding evidence from a community sample adds comprehensiveness for future estimates of disease transmission and vaccine effectiveness.

BACKGROUND

Genital infection with human papillomavirus (HPV) is common among men who have sex with men (MSM)[1] and can lead to anal, penile, oral and pharyngeal cancers, anogenital warts and precancerous lesions.[2] A sample of men aged 18–70 years who were seeking information about sexually transmitted diseases testing—recruited from Brazil, Mexico and the USA—found that genital HPV infection prevalence was 52%–69% and varied by country.[3] Globally, current recommendations of HPV vaccination are mostly for women, yet some countries such as Australia started to provide a nationwide free vaccination programme for boys in early 2013.[4] In most countries, MSM are a highly neglected population in the current recommendation of girls-only vaccination programmes. Sexually active MSM at all ages are subject to continuously high HPV risk; however, they do not benefit from herd protection.[4] Researchers have supported having a vaccination policy targeting MSM.[4] To better assess the cost effectiveness of HPV vaccination among men requires data on the prevalence of HPV infection in MSM using a community sample, which is still sparse in several regions.

Evidence of HPV detection is needed from a non-European or USA region such as Asia, and a community sample is needed to avoid bias towards high-risk behaviour when study participants were recruited from STD clinics. By recruiting a sample from the MSM community, this study intends to avoid a selection bias towards MSM who are at a high risk of acquiring STIs. The goal of this study was to determine the prevalence of type-specific anal and penile HPV infections among MSM recruited from the community. We also identified risk factors associated with anogenital HPV infection in MSM.

METHODS

Participants were recruited between October 2015 and May 2016 from community health centres and on social media. Eligible participants were 20 years of age or older, had ever had sex (including mutual masturbation, oral sex or anal sex) with another man and were willing to give written consent to participate in the study. MSM were seen at baseline and were/will be seen at 6, 12, 24 and 36 months. At each visit, anal and penile swabs were obtained for HPV DNA testing and men completed a questionnaire regarding their sexual experiences. Men were also examined for the presence of anogenital warts by a research nurse. The results from

Table 1 Demographic characteristics and sexual behaviours among men who have sex with men (n=253) and factors associated with anal HPV detection (n=252)

Participant characteristic/ risk factors	Penile	Anal	Anal HPV of any type (n=252)	
	% (no. with HPV/ no. men) or Mean (SD)	% (no. with HPV/ no. men) or Mean (SD)	Crude OR (95% CI)	Adjusted OR (95% CI)
Demographic				
Age at recruitment (years)				
20–24	14.5 (11/76)	34.2 (26/76)	1	
25–29	8.1 (7/86)	27.9 (24/86)	0.74 (0.38 to 1.45)	
30–34	10.3 (6/58)	24.1 (14/58)	0.61 (0.28 to 1.32)	
35–44	17.9 (5/28)	32.1 (9/28)	0.91 (0.36 to 2.29)	
45+ (max 50)	0.0 (0/5)	20.0 (1/5)	0.48 (0.05 to 4.52)	
Education level				
High school graduate or below	7.7 (2/26)	19.2 (5/26)	1	
University graduate or above	11.9 (27/227)	30.4 (69/227)	0.91 (0.56 to 1.49)	
Circumcised				
Yes	10.8 (7/65)	27.7 (18/65)	1.11 (0.59 to 2.07)	
Smoke status				
Non-current smoker	11.9 (26/219)	28.8 (63/219)	1	
Light smoker (<6 cigarettes per day)	10.5 (2/19)	36.8 (7/19)	1.44 (0.54 to 3.84)	
Heavy smoker (≥6 cigarettes per day)	6.7 (1/15)	26.7 (4/15)	0.90 (0.28 to 2.93)	
Recreational drug use in the past year				
Yes	10.0 (3/30)	43.3 (13/30)	2.03 (0.93 to 4.43)	
Sex with males				
No. of insertive anal sex partner in the past year†‡				
0–2	8.9 (14/157)	28.7 (45/157)	1	
≥3	18.2 (8/44)	31.8 (14/44)	1.16 (0.56 to 2.39)	
Missing	13.5 (7/52)	28.9 (15/52)	1.01 (0.50 to 2.02)	
No. of receptive anal sex partner in the past year‡§				
0–2	11.3 (18/159)	22.0 (35/159)	1	1
≥3	10.6 (5/47)	46.8 (22/47)	3.12 (1.57 to 6.18)*	2.92 (1.29 to 6.61)*
Missing	12.8 (6/47)	36.2 (17/47)	2.01 (0.99 to 4.06)	2.04 (0.98 to 4.24)
Time since first insertive/receptive anal sex				
Less than 5 years	9.3 (7/75)	29.3 (22/75)	1	
6–10 years	15.5 (13/84)	26.2 (22/84)	0.85 (0.43 to 1.71)	
10 years+	8.2 (5/61)	31.2 (19/61)	1.09 (0.52 to 2.27)	
Condom use frequency with insertive anal sex partners in the past year†				
No insertive anal sex	4.9 (3/61)	26.2 (16/61)	1.23 (0.55 to 2.77)	
Not always	14.4 (18/125)	34.4 (43/125)	1.82 (0.92 to 3.60)	
Always	11.9 (8/67)	22.4 (15/67)	1	
Condom use frequency with receptive anal sex partners in the past year§				
No receptive anal sex	16.9 (12/71)	21.1 (15/71)	0.71 (0.33 to 1.53)	
Not always	9.2 (10/109)	35.8 (39/109)	1.48 (0.77 to 2.82)	
Always	9.6 (7/73)	27.4 (20/73)	1	
Insertive anal sex with HIV positive partners in the past year†	25.0 (2/8)	62.5 (5/8)	4.25 (0.99 to 18.27)	
Receptive anal sex with HIV positive partners in the past year§	0.0 (0/5)	60.0 (3/5)	3.74 (0.61 to 22.86)	
Age of the majority of sexual partners in the past year				
Insertive anal sex partners†‡				
Partner is older	26.1 (6/23)	47.8 (11/23)	2.52 (0.98 to 6.47)	
Partner is younger	16.2 (6/37)	29.7 (11/37)	1.16 (0.50 to 2.71)	
Around same age	10.0 (9/90)	26.7 (24/90)	1	
Missing	7.8 (8/103)	27.2 (28/103)	1.03 (0.54 to 1.94)	
Receptive anal sex partners‡§				
Partner is older	9.8 (4/41)	46.3 (19/41)	2.59 (1.16 to 5.79)*	2.51 (1.07 to 5.90)*
Partner is younger	7.4 (2/27)	33.3 (9/27)	1.50 (0.58 to 3.89)	1.65 (0.59 to 4.63)
Around same age	9.2 (7/76)	25.0 (19/76)	1	1
Missing	14.7 (16/109)	24.8 (27/109)	0.99 (0.50 to 1.94)	1.33 (0.6 to 2.96)

Continued

Table 1 Continued

Participant characteristic/ risk factors	Penile	Anal	Anal HPV of any type (n=252)	
	% (no. with HPV/ no. men) or Mean (SD)	% (no. with HPV/ no. men) or Mean (SD)	Crude OR (95% CI)	Adjusted OR (95% CI)
HIV testing in lifetime				
Yes	12.4 (28/226)	31.0 (70/226)	2.58 (0.86 to 7.74)	
Sex under influence in the past year				
Alcohol				
Never	10.1 (20/198)	28.3 (56/198)	1	
Seldom	17.0 (8/47)	29.8 (14/47)	1.08 (0.54 to 2.16)	
More than seldom	12.5 (1/8)	50.0 (4/8)	2.54 (0.61 to 10.49)	
Recreational drug				
Never	11.6 (26/224)	28.1 (63/224)	1	1
Seldom	0.0 (0/15)	20.0 (3/15)	0.64 (0.17 to 2.34)	0.48 (0.12 to 1.93)
More than seldom	21.4 (3/14)	57.1 (8/14)	3.41 (1.14 to 10.21)*	2.61 (0.79 to 8.56)
Sex with females in lifetime				
Yes	5.9 (2/34)	26.5 (9/34)	0.85 (0.38 to 1.93)	
HIV/STI history				
HIV	0.0 (0/10)	60.0 (6/10)	3.86 (1.06 to 14.10)*	2.12 (0.49 to 9.11)
Sexually transmitted infection other than HIV	13.6 (8/59)	42.4 (25/59)	2.18 (1.18 to 4.05)*	1.74 (0.89 to 3.41)

*P<0.05.
†Participant's penis in partner's anus.
‡Removed missingness for the denominators.
§Partner's penis in participant's anus.
HPV, human papillomavirus.

the baseline visits are presented in this paper. HPV genotyping was performed by the linear array HPV genotyping test (Roche Molecular Diagnostics, Pleasanton, California, USA) to identify the following 37 genital HPV types. For prevalence, the denominator is the number of men with a specific type of HPV tested at a specific anatomic site, and the numerator is the number of men infected with a specific type of HPV at a specific anatomic site. The study was approved by the Ethics Committee of the National Cheng Kung University Hospital (reference number: A-BR-103–075). HPV screening, sample collection and survey measurement were detailed in online supplementary appendix 1.

RESULTS

Participant characteristics of MSM

As shown in table 1, 253 MSM were recruited from the community. Participants were mostly younger and highly educated: 64% were aged 20–29 years of age. About 2% of MSM had visible anal warts (2.4%) or penile warts (2.0%). Just over 20% had three or more insertive or receptive anal sex partners in the past year. About a third of MSM had less than 5 years of anal sex experience.

HPV DNA detection and genotypes in MSM

One anal sample and three penile samples were invalid and were excluded due to insufficient sample for DNA extraction (table 2A). A third of men had at least one HPV type detected; a higher proportion was detected at the anal site (29.4%) than at the penile site (11.6%; p<0.05). Almost a quarter of men had at least one 9-valent vaccine preventable types detected in the anal canal (table 2B). The proportion of 9-valent types among all types detected at the anal site was 77.0% (57/74) and 72.4% (63/87) at the penile site.

Factors associated with anal and penile HPV DNA detection among MSM

Unadjusted logistic regression showed that anal HPV infection was associated with older partners, lifetime HIV infection, more likely to use recreational drugs during sex in the past year and the number of receptive anal sex partners in the past year (table 1). Penile infection was not significantly associated with any factor tested. In multivariable regression analysis, having three or more receptive anal sex partners in the past year and having sex with older partners remained significant.

DISCUSSION

To our knowledge, this is one of the first studies in Asia and the first study in Taiwan that used a community sample to determine HPV prevalence among MSM. Our study found that in a relatively lower risk of HIV infection sample (4%), anogenital HPV detection can still be as high as one third of the sample.

Only two published studies have been conducted among males regarding HPV prevalence or genotyping in Taiwan; they were conducted among patients who were HIV-positive,[5] who have a much higher prevalence than our community sample. The prevalence of anal or penile HPV infection in our MSM sample was also lower than some of the community samples from other studies in Western countries, which usually ranged 52%–69% and varied by country.[3] It is also lower compared with a recent study that included MSM in China that was also recruited from the community but with extra effort to include more HIV-infected individuals and identified only 26 HPV types.[6] In Qian's study, 68% had at least one HPV type detected out of 671 valid anal samples and 37.8% out of 611 valid genital samples. However, considering the high proportion of HIV-infected individuals in Qian's sample (37.8%), the prevailing HPV detection in our low HIV risk community sample should not be overlooked.

Table 2 Human papillomavirus DNA detection among men who have sex with men (n=253)

	Anal		Penile		Penile/Anal	
	N=252		N=250		N=253	
HPV type	n	%	n	%	n	%
A. HPV DNA positivity, n (%)						
Any type	74	29.4	29	11.6	87	34.4
High-risk types*						
Any high-risk types	52	20.6	17	6.8	62	24.5
16	8	3.2	0	0	8	3.2
18	2	0.8	1	0.4	2	0.8
31	1	0.4	0	0	1	0.4
33	7	2.8	2	0.8	8	3.2
35	3	1.2	0	0	3	1.2
39	6	2.4	2	0.8	8	3.2
45	3	1.2	0	0	3	1.2
51	2	0.8	1	0.4	3	1.2
52	11	4.4	3	1.2	13	5.1
53	1	0.4	0	0	1	0.4
56	8	3.2	1	0.4	9	3.6
58	6	2.4	4	1.6	8	3.2
59	5	2	2	0.8	6	2.4
66	7	2.8	1	0.4	7	2.8
67	1	0.4	0	0	1	0.4
68	7	2.8	3	1.2	10	4
73 (MM9)	1	0.4	1	0.4	2	0.8
Age at recruitment (years)						
20–24	16	21.1	7	9.2	21	27.6
25–29	16	18.6	3	3.5	17	19.8
30–34	11	19	5	8.6	14	24.1
35–44	8	28.9	2	7.1	9	32.1
45+ (max 50)	1	20	0	0	1	20
Low-risk types†						
Any low-risk types	38	15.1	15	6	47	18.6
6	32	12.7	12	4.8	38	15
11	8	3.2	1	0.4	9	3.6
40	1	0.4	1	0.4	2	0.8
42	7	2.8	1	0.4	8	3.2
54	0	0	1	0.4	1	0.4
62	2	0.8	0	0	2	0.8
84 (MM8)	0	0	1	0.4	1	0.4
Age at recruitment (years)						
20–24	15	19.7	6	7.9	18	23.7
25–29	14	16.3	4	4.7	16	18.6
30–34	3	5.2	2	3.5	5	8.6
35–44	5	17.8	3	10.7	7	25
45+ (max 50)	1	20	0	0	1	20
Vaccine-preventable types						
6/11/16/18/31/33/45/52/58	57	22.6	20	8	63	24.9
6/11/16/18	40	15.9	12	4.8	45	17.8
6/11	33	13.1	12	4.8	39	15.4
16/18	10	4	1	0.4	10	4
B. Detection of multiple HPV types						
Any type						
Range						
0	178	70.6	221	88.4	166	65.6
1	37	14.7	23	9.2	43	17
2	23	9.1	3	1.2	26	10.3
3	11	4.4	3	1.2	14	5.5
4+	3	1.2	0	0	4	1.6
4-valent vaccine types						
Range						
0	212	84.1	238	95.2	208	82.2
1	30	11.9	10	4	33	13
2	10	4	2	0.8	12	4.7
9-valent vaccine types						
Range						
0	195	77.4	230	92	190	75.1
1	39	15.5	17	6.8	39	15.4
2	15	6	3	1.2	21	8.3
3	3	1.2	0	0	3	1.2

*High-risk types included type 26, 69, 70 and 82 (MM4), but no one in this sample was detected as such.
†Low-risk types included type 55, 61, 64, 71 (CP8061), 72, 81 (CP8304), 83 (MM7), 82V and 89 but no one in this sample was detected as such.
HPV, human papillomavirus.

Cigarette smoking is an important risk factor to be included in HPV infection studies, yet findings are not consistent; however, unlike previous findings in a sample of young MSM in Australia,[7] cigarette smoking did not show as a significant factor in our sample. There is also a study that found no association between HPV 16 serological markers and smoking.[8] Given the conflicting evidence, more research is needed to demonstrate whether an association exists between HPV infection and smoking.

Unlike the prevalence of HPV for women, HPV prevalence for men is not associated with age. This may be due to the finding that women are more likely to have an immune protective response to HPV seroconversion and that men are less likely to develop protection against reinfection.[9] Our finding of disassortative age-mixing being a risk factor is interesting, given that disassortative age-mixing in sexual partnerships are commonly examined and reported in association with HIV risk, but did not show an independent effect related to HPV detection in the literature.[10] More studies are needed to confirm whether age-mixing is also a risk factor for HPV detection and whether similar mechanisms affecting HIV risk can be applied.

The results of the present study should be interpreted in the context of the following limitations. First, our assessment of HPV is based on cross-sectional data. An investigation of HPV incidence and clearance using multiple HPV assessment data can better understand the HPV epidemiology in Taiwan. Second, although the study is anonymous, we still have a high missing rate for several sensitive questions, such as the number or age of sex partners. Missingness of sensitive sexual practice questions highlights the uniqueness and the difficulty of sample recruitment from the MSM community. Third, selection bias might have occurred because those who were willing to participate a research study with HPV screenings might be those with higher education or health literacy.

Our findings can be used to inform policymakers in countries with low awareness of HPV infection in men regarding HPV vaccine. About one quarter of MSM can be protected against at least one type of HPV infection by 9-valent vaccine that can cover 72% of types detected in our sample. The

majority of infected cases could potentially be prevented by currently available vaccines. Although anogenital HPV infection by itself is not a condition that requires treatment, future studies should evaluate the acceptance and necessity of HPV vaccination among males in Taiwan and, if proven necessary and cost-effective for targeted populations, to further develop plans to encourage vaccinations for cancer prevention. Our results shed light on one of the parameters to estimate the reproductive rate for HPV infection in a relatively lower risk community.

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REFERENCES

1 World Health Organization. *Human papillomavirus vaccines: WHO position paper*, 2014.
2 Centers for Disease Control and Prevention. Atkinson W, Wolfe S, Hamborsky J, eds. *Epidemiology and prevention of vaccine-preventable diseases*. 12th edn. Washington DC: Public Health Foundation, 2012.
3 Giuliano AR, Lee J-H, Fulp W, *et al*. Incidence and clearance of genital human papillomavirus infection in men (HIM): a cohort study. *Lancet* 2011;377:932–40.
4 Cranston RD. *Young gay men and the quadrivalent human papillomavirus vaccine-much to gain and lose*. 2014;209:635–8. http://www.ncbi.nlm.nih.gov/pubmed/24265443 http://jid.oxfordjournals.org/content/209/5/635.full.pdf
5 Cheng SH, Chu FY, Wang CC, *et al*. Screening and risk factors for anal cancer precursors in men infected with HIV in Taiwan. *J Med Virol* 2014;86:193–201.
6 Qian H-Z, Hu Y, Carlucci JG, *et al*. Human immunodeficiency virus status differentially associated with genital and anal human papillomavirus infection among Chinese men who have sex with men. *Sex Transm Dis* 2017;44:656–62.
7 Zou H, Grulich AE, Cornall AM, *et al*. How very young men who have sex with men view vaccination against human papillomavirus. *Vaccine* 2014;32:3936–41.
8 Kelsey KT, Nelson HH, Kim S, *et al*. Human papillomavirus serology and tobacco smoking in a community control group. *BMC Infect Dis* 2015;15:8.
9 Flaherty A, Kim T, Giuliano A, *et al*. Implications for human papillomavirus in penile cancer. *Urol Oncol* 2014;32:53.e1–e8.
10 Zou H, Tabrizi SN, Grulich AE, *et al*. Early acquisition of anogenital human papillomavirus among teenage men who have sex with men. *J Infect Dis* 2014;209:642–51.