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Anal human papillomavirus prevalence and risk factors among men who have sex with men in Vietnam

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ABSTRACT

Objectives: Men who have sex with men (MSM) are at risk of human papillomavirus (HPV)-related cancers, while published data are scarce. This study determined HPV prevalence and risk factors in MSM in Vietnam to inform HPV prevention strategies in this key population.

Methods: A cross-sectional study of 799 MSM aged 16-50 years was conducted in Vietnam in 2017-2018. Information was collected on risk behaviours, and knowledge of HPV and anal cancer; rectal swabs were taken to detect anal HPV infection. An in-house polymerase chain reaction and Genoflow HPV array test kit were used for HPV detection and genotyping.

Results: The median age of the study participants was 25 years (range 18-52). Overall prevalence of any HPV and HPV16/18 infection was 32.3% and 11.0%, respectively. A higher prevalence of high-risk HPV infection to all 14 types tested was found in Ho Chi Minh City (30.9%) than in Hanoi (18.4%). High-risk HPV infection was associated with inconsistent condom use and history of engaging in sex under the influence of drugs (adjusted odds ratio (aOR), 2.27; 95% CI, 1.48-10.67), as well as having multiple sexual partners (aOR, 1.01; 95% CI, 1.00–1.02).

Conclusions: High-risk anal HPV infections in Vietnamese MSM were significantly associated with risky sexual behaviours. A targeted HPV vaccination strategy would have substantial benefit for MSM in Vietnam.

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Introduction

Human papillomavirus (HPV) infection is the most common sexually transmitted infection globally, affecting both men and women (Crosbie et al., 2013). Although the majority of HPV infections are asymptomatic and transient (Dunne et al., 2006), persistent HPV infections can lead to a range of diseases from benign anogenital warts (90% caused by HPV6/11) to life-threatening diseases such as anogenital and some oropharyngeal cancers (>70% caused by HPV16/18) (Daling et al., 2004; Frisch et al., 1999; Garland et al., 2009; Hoots et al., 2009; Parkin and Bray, 2006; Vaccarella et al., 2010).

As with cervical cancer, most anal cancers are squamous cell carcinomas, and 90% of them are caused by HPV infection, particularly with HPV16 (Daling et al., 2004; Frisch et al., 1999; Hillman et al., 2014; Parkin and Bray, 2006). Anal cancer incidence and mortality have risen sharply over the last decade (Deshmukh et al., 2020; Nelson et al., 2013). Most cases have been recorded in high-income countries, while data are scarce in low-income and middle-income countries (Islami et al., 2016). The age standardized rate of anal cancer in Vietnam is 0.3 per 100,000 males per year (http://hpvcentre.net/statistics/reports.VNM.pdf). Compared with heterosexual men and women, MSM are at increased risk of HPV infection and HPV-associated diseases, such as anogenital warts and anal cancer, due to risky sexual behaviours such as practicing anal intercourse and having multiple sexual partners (Daling et al., 2004; Daling et al., 1982; Grulich et al., 2012; Machalek et al., 2012; Nyitray et al., 2016; Palefsky et al., 2011). Furthermore, they are often not targeted by HPV vaccination and, unlike heterosexual men, MSM are unlikely to benefit from herd effects from girls-only HPV vaccination (Ali et al., 2013).

There are currently three licensed prophylactic HPV vaccines (Cervarix®, bivalent - 2vHPV; Gardasil®, quadrivalent - 4vHPV; and Gardasil®9, nonavalent - 9vHPV) that protect against HPV16/18 infections. Both the 4vHPV and 9vHPV protect against 90% of anogenital warts cases. The 9vHPV protects against an additional five high-risk HPV types: HPV31/33/45/52 and 58. These three vaccines will likely protect against anal cancers caused by these HPV types, although only 4vHPV and 9vHPV are currently licensed for the prevention of anal cancer. The 4vHPV has demonstrated 50.3% and 77.5% efficacy against anal intraepithelial neoplasia, the precursor of anal cancer, in young men who were previously infected with HPV and those who were HPV-naïve, respectively (Palefsky et al., 2011).

In Vietnam, little is known about the epidemiology and prevalence of HPV among MSM. There are currently no HPV prevention programs for MSM and men who have sex with women because the HPV vaccine is yet to be recommended for males in Vietnam. Access to HPV screening and testing in the MSM population remains limited, unless they present with symptoms of sexually transmitted infections. This cross-sectional study was conducted to determine the demographic, behavioural patterns and HPV prevalence among MSM in two of the largest cities in Vietnam – Hanoi and Ho Chi Minh City (HCMC) – to inform HPV prevention strategies for MSM in Vietnam.

Methods

Ethics approval

The study was reviewed and approved by the ethics review boards of the National Institute of Hygiene and Epidemiology (NIHE), Vietnam (IRB-VN01057-13/2017) and London School of Hygiene & Tropical Medicine, UK (reference number: 14207).

Study design and population

This community-based, cross-sectional study was conducted in Hanoi and HCMC between December 2017 and February 2018. Men aged 16-50 years who reported a history of having anal sex with men in the last month prior to their first study visit were recruited. The respondent-driven sampling (RDS) method was used to recruit this "hard-to-reach" study population of participants. The RDS sampling process began with the recruitment of "seed" members among the MSM population. First, seeds were selected through discussions with peer educators and staff of outreach programmes. Study-participated seeds were then asked to randomly recruit a maximum of three other members of their population from their network to the study by distributing invitation coupons to introduce subsequent participants. Thereafter, each MSM recruited and enrolled in the study received up to three recruitment coupons used to recruit their peers into the study. Each coupon was uniquely coded to link recruiters with those recruited. If the recruitment chains "dried up", new seeds were selected based on the inclusion criteria. In Hanoi, 399 MSM were recruited through three seeds and five waves of the RDS recruitment process, while in HCMC, 400 MSM were recruited through 15 seeds and six waves (Appendix 1). All participants provided written informed consent to answer the questionnaire and to have anal swabs taken. Individuals were allowed to participate in this study only once. No participants withdrew from the study after providing consent.

Data collection

Participants completed a face-to-face interview with study nurse/staff on questionnaires related to the demographics, sexual behaviour, knowledge of HPV and associated diseases, as well as their willingness to be vaccinated. An anal swab specimen was collected from each participant by a trained medical professional. The swab was placed in a tube containing 1 ml of specimen transport media (Qiagen, Germany). On the same day, the samples were sent for processing at the laboratories in the National Institute of Hygiene and Epidemiology (NIHE) in Hanoi or Pasteur Institute in HCMC. In the laboratory, the swabs were vortexed in the transport media, aliquoted and stored at -30 °C until further analysis.

HPV detection and genotyping test

HPV detection and genotyping were performed using a two-step method. First, nucleic acid extraction was performed using Cador pathogen 96 Qiacube HT kit (Qiagen, Hilden, Germany) on the automated platform, followed by amplification with PGMY9/11 by polymerase chain reaction (PCR) to detect HPV-DNA; HLA was used as the internal control (Human papillomavirus laboratory manual, 2010). HPV-DNA-positive samples by PCR were subjected to genotyping by Genoflow HPV array test kit (Diagcor, Hongkong), which detected 33 HPV types (14 high-risk types, 3 probable high-risk types and 16 low-risk types): (i) high-risk and probable high-risk types: 16, 18, 31, 33, 35, 39, 45, 51, 52, 53, 56, 58, 59, 66, 68,

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73, 82; and (ii) low-risk types: 6, 11, 40, 42, 43, 44, 54, 55, 57, 61, 70, 71, 72, 81, 26/84 (Clifford et al., 2005; Walboomers et al., 1999). The kit was authorised for in-vitro diagnostic usage and qualified by the World Health Organization (WHO) HPV LabNet for high-risk HPV detection and genotyping.

The human leukocyte antigen (HLA) and beta-globulin genes were used as internal controls for the PGMY9/11 PCR assay and Genoflow kit, respectively. Samples negative for HLA gene were considered invalid. For each laboratory, external quality assurance was performed on a panel of 40 previously tested samples prior to screening test by HPV LabNet at the Western Pacific WHO reference laboratory, Melbourne, Australia. There was ~90% agreement between labs for all samples, and some discordant/missed results were found for certain tested hrHPV genotypes: 4/20 for HPV16, 1/12 for HPV18, 1/4 for HPV31, 2/12 for HPV39, 2/7 for HPV45, 3/9 for HPV56, 2/17 for HPV58, and 3/16 for HPV 66.

Statistical analyses

The overall and type-specific prevalence of anal HPV infection from Hanoi and HCMC were calculated. In these analyses, HPV genotypes were classified based on IARCs classification. The RDS-adjustment methods (Gile and Handcock, 2010) were used to estimate 95% confidence intervals (CI) of HPV infection (Clopper and Pearson, 1934). Between-city differences were evaluated using Chi-square test or Fisher's exact test for categorical variables and Student's *t*-test or Mann-Whitney U test for continuous variables, where appropriate. Logistic regression was performed to determine participants' sociodemographics and sexual behaviours that were associated with high-risk anal HPV infection at the time of screening. Variables with a significance level of $p < 0.10$ in the bivariate analyses were included in the multivariable model. Nested models were compared using the likelihood ratio test. Data analyses were performed in R version 3.6.3 (Team, 2018).

Results

Participant characteristics

From December 2017 to February 2018, a total of 799 MSM with the median age of 25 years (range: 18-52) from Hanoi and HCMC completed the questionnaires. Participants' sociodemographic, behavioural, and clinical characteristics are presented in Table 1. Overall, the age of sexual debut, duration of sexual activity, and number of sex partners in the last 12 months were similar for MSM between both cities (Table 1). Conversely, a higher proportion of MSM from Hanoi (58.9%) attained at least college education compared with MSM from HCMC (26.0%), while more risky behaviours such as drug use, sex under drug influence (chemsex), group sex, and inconsistent condom use were more generally observed for MSM from HCMC than from Hanoi. Generally, the proportions of MSM had good knowledge of HPV, preventative measures and anal cancer in Hanoi were higher than in HCMC (at 5.0%, 25.3% and 21.8% in Hanoi compared with 0%, 0.8% and 1.3% in HCMC, respectively). All MSM participating in this study did not get vaccinated for reasons such as: don't know HPV vaccine (86.98%), don't know where to get vaccine (14.5%) and other reasons (4.0%) (Table 1).

HPV prevalence

Of the 799 MSM who were screened, HPV DNA was detected in 238 (29.8%). The RDS-adjusted prevalence of any HPV, any high-risk HPV and HPV-16/18 infections among all subjects were 32.3% (95% CI: 28.4–36.1%), 24.5% (95% CI: 21.1–27.9%) and 11.0% (95% CI: 8.5–13.4%), respectively. Prevalence of high-risk HPV was almost two-fold higher in HCMC (RDS-adjusted prevalence, 30.9; 95% CI: 25.6–36.2%) than in Hanoi (RDS-adjusted prevalence, 18.4; 95% CI: 15.2–21.5%). The most common HPV types among MSM in HCMC and Hanoi were HPV52 and HPV39, respectively, followed by HPV66/68, HPV18 and HPV16 in both cities. Figure 1 depicts the prevalence of the individual high-risk and low-risk HPV genotypes in MSM in Hanoi and HCMC, as well as the prevalence of vaccine-preventable HPV types. Overall, the prevalence of vaccine-preventable HPV infection was 10.5% (95% CI: 5.8–15.2%) for the 2vHPV genotypes, 17.0% (95% CI: 11.5–22.5%) for the 4vHPV and 20.9% (95% CI: 14.9–26.9%) for the 9vHPV. Almost a quarter (23.0%) of the MSM aged < 25 years were infected with a vaccine-preventable genotype (Figure 2).

Risk factors

The unadjusted and adjusted association between high-risk anal HPV infection and demographic and behavioural characteristics of the participants are summarised in Table 2. In Hanoi, MSM who reported inconsistent condom use with a regular partner and sex workers were associated with a two-fold (aOR, 2.03; 95% CI, 1.14–3.60) and four-fold (aOR, 4.22; 95% CI, 0.46–38.76) higher prevalence of high-risk HPV infection, respectively. In HCMC, higher prevalence's of high-risk HPV infection were found in MSM who, in the last year, had engaged in chemsex (aOR, 2.27; 95% CI, 1.48–10.67) or had multiple sex partners (aOR, 1.01; 95% CI, 1.00–1.02, for every additional partner). Interestingly, older MSM in Hanoi, but not HCMC, were associated with a lower prevalence of high-risk HPV infection (aOR, 0.88; 95% CI, 0.77–1.03). Prevalence and risk factors for high-risk anal HPV infection among MSM differed across the two cities (Figure 2). Unlike in HCMC, infection with a high-risk HPV genotype among MSM in Hanoi appeared to attenuate with the number of years of being sexually active (Figure 2).

Discussion

In this largest community-based HPV prevalence survey of MSM in both northern and southern Vietnam, it was found that one in three MSM had detectable anal HPV, and among them, one in four harboured at least one high-risk HPV genotype. In the current cohort, the high-risk HPV genotypes were significantly associated with risky sexual behaviours such as inconsistent condom use, having multiple sexual partners and chemsex.

The prevalence of high-risk anal HPV infection observed in this survey of MSM was comparable with the prevalence rates previously reported in Vietnam (Le et al., 2019; Vu et al., 2013), although it did find higher high-risk anal HPV infections in HCMC than in Hanoi. Higher HPV prevalence was also observed in a previous study of male sex workers where the prevalence was highest in Ho Chi Minh City (59%), followed by Hanoi (19%) and Nha Trang (6%) (Vu et al., 2013). Compared to the other countries in Asia, such as Thailand (30) and China (28), lower HPV prevalence was observed. This observation could be attributed to the study design and study population, as well as small sample sizes that may overestimate or underestimate the HPV prevalence in the community. In other studies, higher prevalence rates were often found in studies performed in sexual health clinics (Chow et al., 2019; Milošević et al., 2010; ; Supindham et al., 2015) since selection criteria in these clinic-based recruitments are usually biased toward higher-risk men.

Persistent infection with high-risk anal HPV genotypes is a real risk for anal cancer (Hoots et al., 2009; Lin et al., 2018; Machalek et al., 2012). Compared to heterosexual men and women, MSM are disproportionately more likely to have an anal HPV infection, which is related a precursors to anal cancer. Previous stud-

Table 1
Sociodemographic, behavioural characteristics, and HPV prevalence of participants (n = 799).

Characteristics	Hanoi (n = 399)	HCMC (n = 400)	Total (n = 799)
Demographics			
Age (years)			
mean (SD)	25.8 (5.6)	29.4 (9)	27.6 (7.7)
median (range)	24 (19-48)	26 (18-52)	25 (18-52)
Attained college education and above, n (%)	235 (58.9)	104 (26)	339 (42.4)
Marital status, n (%)			
never married	355 (89)	365 (91.2)	720 (90.1)
married	7 (1.8)	4 (1)	11 (1.4)
ever married (separated, divorced, widowed)	37 (9.2)	31 (7.8)	68 (8.5)
Living arrangements			
alone	133 (33.3)	108 (27)	241 (30.2)
with female partner	9 (2.3)	4 (1)	13 (1.6)
with male partner	20 (5.0)	50 (12.5)	70 (8.8)
with friends	168 (42.1)	37 (9.2)	205 (25.7)
others	69 (17.3)	201 (50.2)	270 (33.8)
Behaviours			
Ever smoked	96 (24.1)	150 (37.5)	246 (30.8)
Ever consumed alcohol	285 (71.5)	273 (68.2)	558 (69.8)
Ever consumed drugs	20 (5)	48 (12)	68 (8.5)
Ever engaged in chemsex[§]	7 (1.8)	16 (4)	23 (2.9)
Ever had in-group sex	29 (7.3)	55 (13.8)	84 (10.5)
Inconsistent condom use with regular sex partner	214 (53.6)	242 (60.5)	456 (57.1)
Inconsistent condom use with casual sex partner	2 (0.5)	77 (19.2)	79 (9.9)
Inconsistent condom use with sex worker	6 (1.5)	22 (5.5)	28 (3.5)
Ever had sex with both male and female partners	94 (23.6)	79 (19.8)	173 (21.7)
Age of sex debut, in years, median (range)	18 (12-34)	18 (11-47)	18 (11-47)
Duration of sexual activity, in years, median (range)	7 (2-28)	8.2 (2-35)	8 (2-35)
Number of sex partners in the last 12 months, median (range)	2 (1-12)	2 (1-240)	2 (1-240)
HPV prevalence			
Any HPV infection	106 (26.6)	132 (33)	238 (29.8)
Any high-risk HPV infection[†]	76 (19)	116 (29)	192 (24)
HPV 16/18 infection	36 (9)	49 (12.2)	85 (10.6)
HPV vaccine			
Got HPV vaccine	0 (0)	0 (0)	0 (0)
Reasons not to get vaccinated			
don't know	305 (76.44)	390 (97.50)	695 (86.98)
unnecessary	10 (2.51)	5 (1.25)	15 (1.88)
worry about side effects	3 (0.75)	0 (0)	3 (0.38)
expensive vaccine price	7 (1.75)	2 (0.50)	9 (1.13)
don't know where to get vaccine	115 (28.82)	1 (0.25)	116 (14.52)
inconvenient location	5 (1.25)	0 (0)	5 (0.63)
fear of being stigmatized	12 (3.01)	0 (0)	12 (1.50)
don't provide to male	6 (1.50)	3 (0.75)	9 (1.13)
others	4 (1.00)	2 (0.50)	6 (0.75)

HCMC, Ho Chi Minh City; SD, standard deviation
[†] High-risk HPV types: 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66/68
[§] Chemsex: intentional sex under the influence of psychoactive drugs

ies have found that high-risk sexual behaviours such as engaging in sex work, receptive anal intercourse, inconsistent condom use, and high number of sexual partners are the strongest risk factors for anal HPV infection (Colon-Lopez et al., 2014; Dunne E. F. et al., 2006; Muller et al., 2016; Nyitray et al., 2011; Tian et al., 2017; Zou et al., 2014). Similarly, the current study found that inconsistent condom use, having multiple sexual partners and chemsex significantly increased the risk of high-risk HPV infections, although this differed between HCMC and Hanoi, which might explain the higher prevalence of any and high-risk HPV infections among MSM in HCMC than in Hanoi.

The two most prevalent high-risk HPV in each city were HPV52 or HPV39 for HCMC and Hanoi, respectively, and HPV66/68. These HPV types are not included in the 2vHPV or 4vHPV, and only HPV52 is in the 9vHPV. Despite these, the proportion of anal cancers attributed to these HPV types in Vietnam is unclear, and more studies are needed to address this research gap to inform HPV prevention strategies. An interesting observation observed in Hanoi but not HCMC is that the high-risk HPV genotype appears to attenuate with the number of years of being sexually active, suggesting the possibility of natural immunity or latent infection.

Based on studies conducted in 2015, there are more than 52,000 and 30,000 MSM in HCMC and in Hanoi, respectively (Safarnejad et al., 2017; Son et al., 2019). This large population of MSM in two of the largest cities in Vietnam are at risk of anal cancers as well as other HPV-associated diseases such as oropharyngeal cancers and anogenital warts. HPV vaccination is the best way to prevent HPV infections and HPV-associated diseases. The introduction of girls-only HPV vaccination would confer protection for heterosexual men only if the coverage were high. However, MSM are unlikely to benefit from herd effects of a girls-only vaccination programme. Evidence emerging from epidemiological and modelling studies has led to the introduction of targeted MSM HPV vaccination programmes in the United Kingdom and Australia (Datta et al., 2019; Zhang et al., 2017). Therefore, a targeted HPV vaccination strategy for MSM in Vietnam could have substantial benefits. Future work investigating the willingness to receive HPV vaccination is crucial to the feasibility of HPV vaccination strategies for MSM in Vietnam.

This study had some limitations, including that the participant identification was based on RDS recruitment and may not have represented individuals outside the participants' networks. The

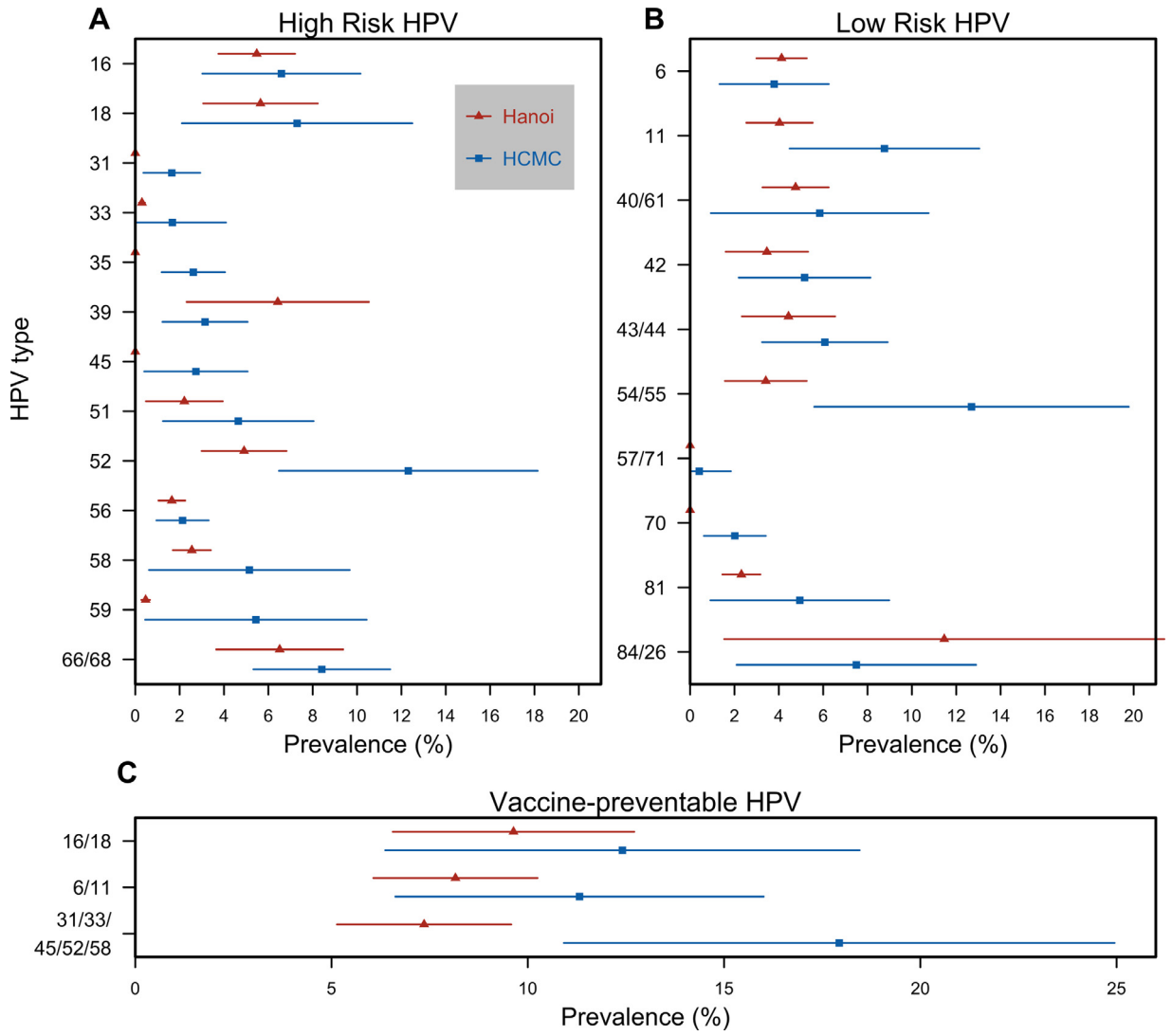


Figure 1. Prevalence of high-risk and low-risk HPV types among MSM in Hanoi and HCMC after adjusting for respondent-driven sampling, 2017–2018. Respondent-driven sampling method was used to estimate 95% CI of HPV infection for north Vietnam, Hanoi (in red) and south Vietnam, HCMC (in blue). The high-risk HPV types included 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66/68 and the low-risk HPV types included 6, 11, 34, 40, 42, 43, 44, 62, 84, 89, 61, 54, 83, 81, 55.

study focused on the age range 16-50 years, which is considered to be the sexually active period of MSM in Vietnam, thus might have affected the generalizability of the results for the MSM population. In addition, it was unable to capture information on persistent HPV infection, which is an appropriate surrogate for anogenital precancers or cancers (Daling et al., 2004; Frisch et al., 1999; Parkin and Bray, 2006). Other limitations included the study findings on sexual activity – in last sex act, the past month, the past 12 months – that were subject to recall bias. In addition, human immunodeficiency virus (HIV) infection status of the study participants, a major risk factor for HPV infection, was not collected, so there was no correlation with HPV prevalence (Clifford et al., 2006; Orlando et al., 2008; Palefsky and Holly, 2003). The national HIV surveillance, however, reported HIV prevalence of 10.9% among MSM in Hanoi (Hanoi Medical University-National HIV/AIDS conference, 2018) and 13.6% among MSM in HCMC (Nguyen et al., 2021). Nevertheless, this study did identify risk factors associated with anal HPV infection among MSM in Hanoi and HCMC.

In conclusion, this study identified several sociodemographic and behavioural factors associated with the prevalence of incident anal HPV infection, as well as the HPV genotypes circulating among MSM in the two largest cities of Vietnam. The findings have significant implications for the prevention of anal cancer among MSM in Vietnam and Asia in general. The study highlights the need for better education on safe sex practices and HPV disease awareness in men. The study also suggests that MSM should be considered for future HPV vaccination programs; it is already available for MSM in the UK, Canada and Australia.

Author contributions

KM and NVT conceptualised the study. KM, NVT, HPT, NAT and SG contributed to study design. LAT and QDP were involved in data collection. KP, MJ, MB, KB, PDN, TVN and NVT contributed to statistical analysis and made the figures. VC and TDLH performed laboratory testing. KP and LAT conducted the literature review. KP, ZQT, LAT wrote the initial draft. All authors contributed equally to data interpretation, critically reviewed the manuscript and approved the final version.

Ethics approval

The study was reviewed and approved by the ethics review boards of the National Institute of Hygiene and Epidemiology

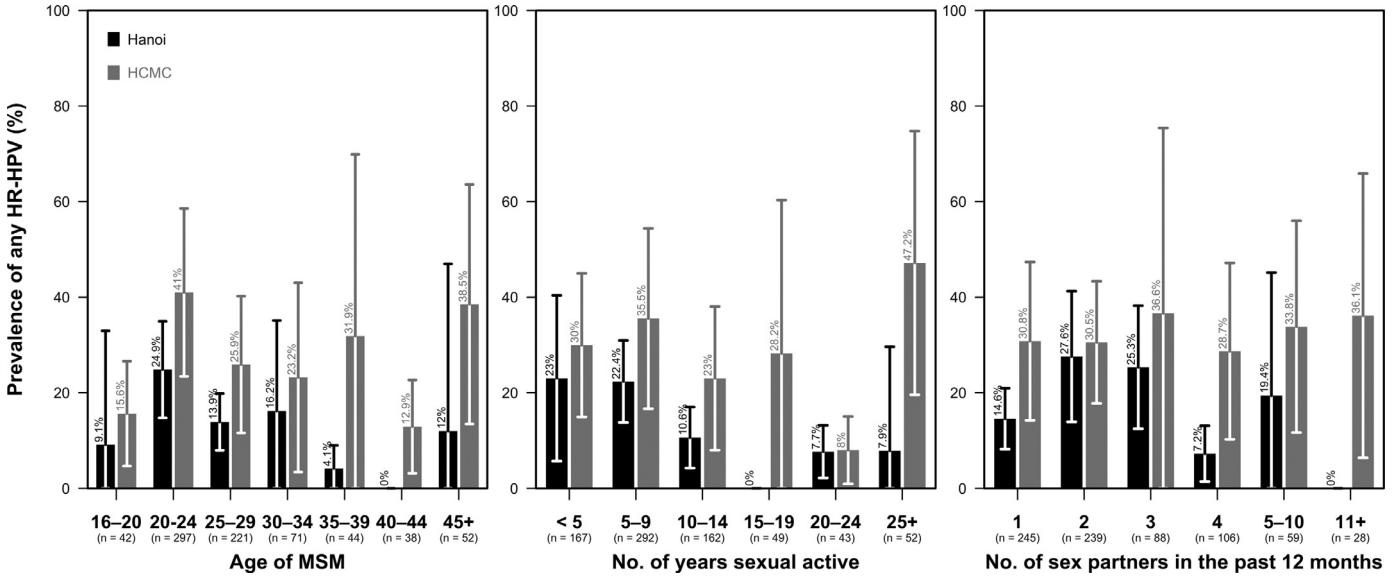
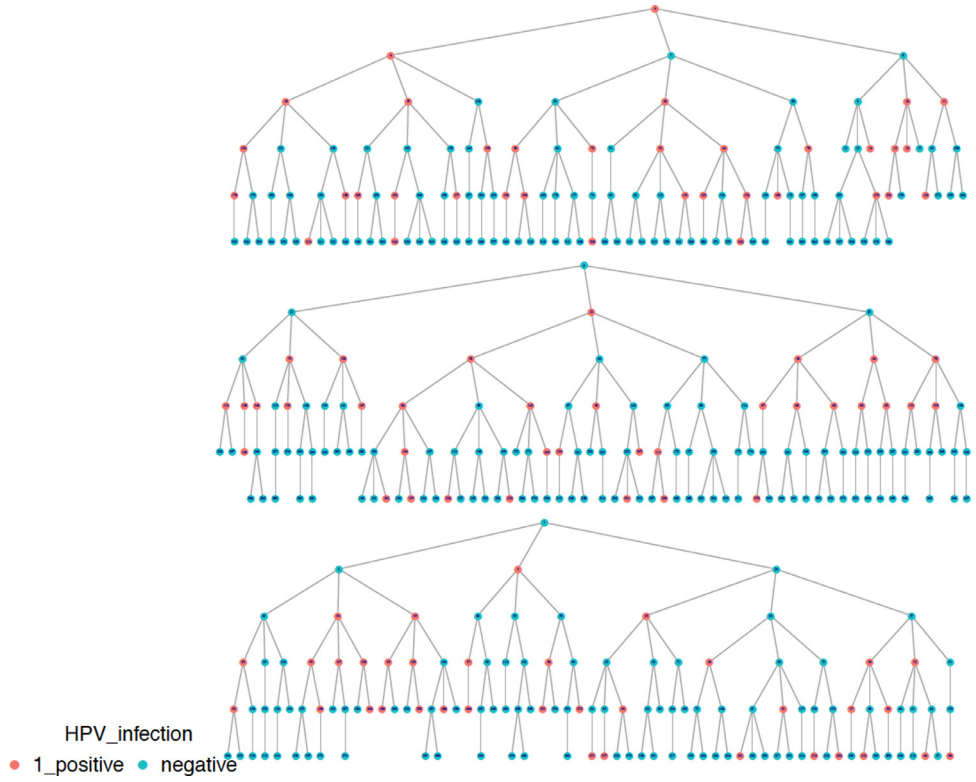


Figure 2. Correlates of high-risk anal HPV infection among MSM in Hanoi and HCMC, 2017–2018.
Respondent-driven sampling method was used to estimate prevalence and their 95% CI of HPV infection for north Vietnam, Hanoi (in black) and south Vietnam, HCMC (in grey) and how it correlates to age, number of years since sexual debut, and number of sex partners in the past 12 months. The numbers of respondent in each bin are presented in parentheses. The high-risk HPV types included 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66/68.

Table 2
Correlations of factors associated with high-risk HPV infection.

	Hanoi (n = 399)						HCMC[§] (n = 400)					
	Any high-risk HPV[†]				Bivariate analysis	Multivariate analysis	Any high-risk HPV[†]				Bivariate analysis	Multivariate analysis
Variables	N	n	%	*P*	OR (95% CI)*	OR (95% CI)*	N	n	%	*P*	OR (95% CI)*	OR (95% CI)*
Age, in years					0.91 (0.85-0.96)	0.88 (0.77-1.03)					0.97 (0.95-1.00)	0.94 (0.87-1.02)
Attained college education and above	235	44	18.7	1	0.95 (0.57-1.58)	0.90 (0.51-1.58)	104	40	38.5	0.02	1.81 (1.12-2.92)	1.87 (1.06-3.30)
Marital status												
never married	355	73	20.6	0.04	1		365	110	30.1	0.06	1	
married	7	1	14.3		0.64 (0.08-5.45)		4	2	50		2.32 (0.32-16.75)	
ever married (i.e. separated, divorced, widowed)	37	2	5.4		0.22 (0.05-0.95)		31	4	12.9		0.34 (0.11-1.01)	
Living arrangements												
alone	133	20	15	0.66	1		108	34	31.5	0.72	1	
with female partner	9	2	22.2		1.61 (0.31-8.40)		4	2	50		2.18 (0.28-16.34)	
with male partner	20	3	15		1 (0.27-3.73)		50	13	26		0.76 (0.36-1.62)	
with friends	168	36	21.4		1.54 (0.84-2.82)		37	12	32.4		1.04 (0.47-2.33)	
others (parents, siblings)	69	15	21.7		1.57 (0.74-3.31)		201	55	27.4		0.82 (0.49-1.37)	
Ever smoked	96	17	17.7	0.67	0.89 (0.49-1.62)	1.12 (0.54-2.32)	150	31	20.7	0.01	0.51 (0.31-0.82)	0.58 (0.31-1.08)
Ever consumed alcohol	285	59	20.7	0.21	1.49 (0.82-2.69)	1.72 (0.90-3.28)	273	73	26.7	0.18	0.71 (0.45-1.13)	0.72 (0.42-1.21)
Ever consumed drugs	20	1	5	0.14	0.21 (0.03-1.63)		48	16	33.3	0.59	1.26 (0.66-2.40)	
Ever engaged in chemsex	7	0	0	0.35			16	8	50	0.11	2.56 (0.93-7.02)	2.27 (1.48-10.67)
Ever had in-group sex	29	5	17.2	0.87	0.88 (0.32-2.38)		55	20	36.4	0.26	1.48 (0.81-2.70)	
Inconsistent condom use with regular sex partner	214	50	23.4	0.02	1.86 (1.10-3.15)	2.03 (1.14-3.60)	242	66	27.3	0.41	0.81 (0.52-1.26)	0.85 (0.50-1.47)
Inconsistent condom use with casual sex partner	2	0	0	1			77	19	24.7	0.43	0.76 (0.43-1.35)	
Inconsistent condom use with sex worker	6	3	50	0.11	4.38 (0.85-22.37)	4.22 (0.46-38.76)	22	5	22.7	0.67	0.71 (0.25-1.97)	0.73 (0.15-3.61)
Ever had sex with both male and female partners	94	19	20.2	1	1.10 (0.62-1.97)		79	21	26.6	0.7	0.86 (0.49-1.50)	
Duration of sexual activity, in years, median (range)					0.90 (0.84-0.96)						0.98 (0.96-1.01)	
Number of sex partners in the last 12 months, median (range)					1.01 (0.85-1.21)	1.08 (0.88-1.32)					1.01 (1.00-1.02)	1.01 (1-1.02)

OR, odds ratio, and its 95% confidence interval (CI) are presented in the brackets
[†] High-risk HPV types: 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66/68
[§] HCMC: Ho Chi Minh City



The dot represents 1 person. Each dot can branched to up to 3 dots.

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Declaration of Competing Interest

The authors have declared no competing interest.

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Appendix 1. Recruitment chart for MSM.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2021.09.016.

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