ORIGINAL ARTICLE

Prevalence and sociodemographic correlates of cervicovaginal human papillomavirus (HPV) carriage in a cross-sectional, multiethnic, community-based female Asian population

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ABSTRACT

Objectives Cervical cancer is a largely preventable disease, and the strategic implementation of a cervical cancer prevention programme is partly dependent on the impact of human papillomavirus (HPV) infection interpreted within the context of the country's sociodemographic attributes. The objective of this study is to determine the prevalence of cervicovaginal HPV infection among a healthy, community-based, multiethnic Malaysian population. The HPV prevalence was subsequently correlated to the individual's sociodemographics and sexual/reproductive history. Of significance, the observed prevalence captured was in a birth cohort not included in the national school-based HPV vaccination programme.

Methods This was a cross-sectional study where 1293 healthy women aged between 18 and 60 years were recruited via convenience sampling from five community-based clinics in Selangor, Malaysia. Cervicovaginal self-samples were obtained and DNA was extracted for HPV detection and genotyping. A comprehensive questionnaire was administered to determine the sociodemographics and behavioural patterns of participants.

Results The median age at enrolment was 37 years old (IQR: 30–47). In total, 86/1190 (7.2%) of the samples collected were positive for HPV infection, with the highest HPV prevalence (11.9%) detected in the subgroup of 18–24 years old. The top three most prevalent HPV genotypes were HPV 16, 52 and 58. The independent risk factors associated with higher rates of HPV infection included Indian ethnicity, widowed status and women with partners who are away from home for long periods and/or has another sexual partner.

Conclusions The overall prevalence of HPV infection in this Malaysian multiethnic population was 7.2%, with 6.5% being high-risk genotypes. The top three most common high-risk HPV types were HPV 16, 52 and 58. This information is important for the planning of primary (HPV vaccination) and secondary (screening) cervical cancer prevention programmes in Malaysia.

INTRODUCTION

Cervical cancer is the second most common female cancer in Malaysia, with 2145 new cases (15.6 per 100 000 woman) and 645 deaths (4.7 per 100 000) reported annually.[1 2] In 2010, a government-funded, national school-based human papillomavirus (HPV) vaccination programme was initiated in Malaysia. The uptake of all three doses of the vaccine among all 13-year-old school-going girls was reported to exceed 90%.[3]

The 2014 WHO comprehensive cervical cancer control guide considers monitoring and evaluation to be essential components of cervical cancer prevention and control programmes.[4] The primary aim of this study was to determine the prevalence of HPV infection among healthy community-based Malaysian women, while the secondary aims were to identify sociodemographic and behavioural patterns associated with HPV infection. This was important for at least two reasons. First, the impact of a national HPV immunisation strategy on cervical cancer will not be evident for 20–30 years, and thus surrogate markers such as prevalent infection allow for early assessment of vaccine effectiveness on a population level. Second, with the success of the national HPV vaccination programme, current evidence suggests that monitoring the population with primary HPV testing in the future will be more accurate and informative than continuing primary cytology as currently exists.[5 6] Thus, population-based HPV prevalence data, as determined by this study, will serve to facilitate strategic implementation of effective cervical cancer prevention programmes.

METHODS

Participants

This was a cross-sectional study where 1293 healthy women were recruited via convenience sampling from five community-based clinics from 2013 to 2015. The clinics were located in Selangor, the most populous Malaysian state with a high level of urbanisation. The ethnic composition of Selangor is 67.4% Malays, 24.5% Chinese and 7.3% Indians, reflecting the population of Malaysia as a whole.[5] Healthy study participants were recruited, predominantly among women who were accompanying family members requiring medical attention or

during their visits for primary care services (such as routine check-up, repeat prescriptions). None of the women recruited were attending for cervical screening. Participants between the ages of 18 and 60 years who agreed to perform self-sampling and answer a questionnaire were recruited for the study. The exclusion criteria were pregnancy, menstruation, acute illness or never having been sexually active. Written informed consent was obtained from all participants.

Cervicovaginal sample and data collection

Cervicovaginal self-samples were obtained using a brush ('Just for Me' self-sampler, courtesy of Preventive Oncology International, Hong Kong). Instructions were provided to the participants verbally or in a diagram. Briefly, participants were instructed to gently push the brush to the top of the vagina with one leg on a chair. The brush is turned a few times to the left and then the right before removal. After withdrawal, the brush is smeared rigorously on to the Preventive Oncology International FTA card provided with the kit and the card is then sealed in an envelope. The FTA card is a solid media specimen transport card that lyses the cells, stabilises the DNA and renders the sample non-infectious, thereby eliminating exposure and transportation difficulties.[6] Each participant responded to two sets of questions on separate forms administered by a trained study staff member in private. The first questionnaire included detailed sociodemographic data, reproductive and contraceptive history, sexual behaviour, and cervical cancer screening history. The second questionnaire included questions on pre and post cervicovaginal self-sampling to assess acceptability specific to the study participants.[7]

HPV DNA detection and genotyping

DNA was eluted from the FTA cards for HPV detection and genotyping using the BGISEQ-100 (Beijing Gemone Institute (BGI)-assembled Ion Proton Sequencer from Life Technologies, South San Francisco, California, USA) as previously described.[8] Briefly, a pool of primers coded with specific sample index for multiplexed PCR was designed to amplify 16 HPV genotypes (14 HR-HPV: 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68; and 2 low-risk HPV: 6, 11) and β-globin (HBB) gene. Subsequently, the amplicons from both HPV and human HBB DNA were pooled into a library from up to 96 samples. This is followed by magnetic bead purification, end repair reaction and adapter ligation. Several adapter-indexed libraries were pooled into one sequencing DNA library using Ion Chef and then detected in one sequencing Ion chip for the 16 HPV genotypes. The sequences were mapped with the sample index and adapter sequences of the library and the reads per sample were re-grouped. The detected HPV sequence was aligned with a BGI-curated standard references HPV database from the National Center for Biotechnology Information (NCBI) by using the HPV typing software (China Food and Drug Administration (CFDA) registration number: 022702129, registered under Beijing Genome Institute). If the HPV type reads were over a threshold set for each HPV type, the sample was classified as HPV-positive for the corresponding type, otherwise HPV-negative.

Statistical analysis

Demographic and sexual behaviour information such as age, number of pregnancies, age at sex debut and number of sexual partner was recorded as continuous data. Marital status, ethnicity, highest attained education level, household income, parity, use of hormonal contraception, HPV vaccination status and partner's behaviour were recorded and analysed categorically. Partners who did not spend more than 1 week away from home per month were classified as 'stay at home', while those who did were categorised as 'stay away'. Positive HPV infection was defined by detection of any HPV DNA genotypes. Age-specific HPV prevalence estimates (with 95% CIs) for each of the HPV outcomes were described using percentage. Association between variables and HPV infection was evaluated using a X^2 test or Fisher exact test when cell counts were less than 5. Variables with P value ≤0.1 in the univariable analysis were included into multivariable analyses to determine potential risk factor of HPV infections. The independent association with HPV infection was estimated with prevalence ratios (PR) (with 95% CIs) using a Poisson regression model with robust variance estimation. A two-tailed P value of <0.05 was considered as statistically significant. All analyses were performed using Statistical Package for Social Science (SPSS) V.20.

RESULTS

Study participants

There were 1293 healthy women who consented to be enrolled into this study. Thirty-seven subjects were excluded due to incomplete data/information (n=1256 available for analysis). The main ethnic groups were Malays (n=599, 50.3%), followed by Chinese (n=272, 22.9%) and Indians (n=294, 24.7%). The median age at enrolment was 37 years old (IQR: 30–47). In this study, 88.5% (1053/1190) of women were married, 88% (1047/1190) completed secondary or tertiary education, 93.8% (1116/1190) never smoked tobacco and 64.8% (771/1190) reported to have ever had at least one Pap smear. In terms of reproductive and sexual behaviours, 80.7% (960/1190) reported one lifetime sexual partner and 68.7% (817/1190) had never used any hormonal contraceptives (tables 1 and 2).

Prevalence of HPV infection and genotype distribution

Of the 1256 samples sent for HPV detection and genotyping, 66 (5%) could not be tested because of undetectable/inadequate DNA, resulting in 1190 samples yielding HPV DNA for sequencing. The overall prevalence of any HPV genotype infection was 7.2% (86/1190), whereas the prevalence of high-risk (HR) HPV infection was 6.5%. The highest HPV prevalence was observed in the youngest group of the study population, followed by two peaks in the middle-aged women (31–40 years old) and the older group (51–60 years old). Most of the HPV-positive individuals (75/86, 87.2%) possessed a single HPV genotype. Out of the 14 HR-HPV genotypes that were tested, HPV 16 topped the list at 18.6% (16/86) of positive cases, followed by HPV 52 and HPV 58 at 14% (12/86) and 12.8% (11/86), respectively. The HPV genotypes detected in the different cohorts are detailed in table 3.

Correlates of prevalent HPV infection

The associations between HPV infection and sociobehavioural characteristics are shown in table 1, with the multivariable results using Poisson regression shown in table 4. HPV prevalence did not vary by age in the univariate analysis (P=0.40), but declined with age after adjustment for ethnicity, marital status, partner's behaviour and history of Pap screening. This pattern was maintained even when the analysis was restricted to HR-HPV types. There was a significant difference in HPV prevalence among the ethnic groups (P≤0.01), with higher prevalence of HPV infection among Indian women (adjusted PR=2.16, 95%CI 1.12 to

Table 1 HPV prevalence based on demographic characteristics

Variables	n (%)	HPV prevalence (%)	P value
Age category			
18–24	76 (6.4)	11.84	0.398*
25–30	239 (20.1)	6.28	
31–40	374 (31.4)	8.02	
41–50	296 (24.9)	5.74	
51–60	205 (17.2)	7.32	
Ethnicity			
Malay	599 (50.3)	5.51	<0.006*
Chinese	272 (22.9)	5.88	
Indian	294 (24.7)	11.90	
Others	25 (2.1)	8.00	
Marital status			
Single/not married	49 (4.1)	8.16	<0.002†
Married	1053 (88.5)	6.36	
Divorced	42 (3.5)	11.90	
Widowed	46 (3.9)	21.74	
Education			
None	16 (1.3)	12.50	0.386*
Primary	127 (10.7)	10.24	
Secondary	688 (57.8)	6.10	
Tertiary	308 (25.9)	8.12	
Postgraduates	51 (4.3)	7.84	
Employment			
Full-time	638 (53.6)	7.84	0.66*
Part-time	84 (7.1)	8.33	
Temporarily unemployed/ students	37 (3.1)	10.81	
Retired/disabled	18 (1.5)	5.56	
Work from home/housewives	411 (34.5)	5.84	
Missing	2 (0.2)	0	
Household income (Malaysian Ringgit)			
<1000	180 (15.1)	8.89	0.42*
1000–2000	343 (28.8)	6.12	
2001–5000	499 (41.9)	7.41	
5001–10 000	138 (11.6)	7.24	
>10 000	28 (2.4)	7.14	
Missing	2 (0.2)	0	
Current cigarette use			
No	1116 (93.8)	6.99	0.332†
Yes	69 (5.8)	10.14	
Missing	5 (0.4)	20.00	
Current alcohol consumption			
No	1073 (90.2)	6.99	0.436*
Yes	110 (9.2)	9.09	
Missing	7 (0.6)	14.29	
Pap smear (ever had one)			
No	409 (34.4)	9.78	0.031*
Yes	771 (64.8)	5.71	
Don't know	8 (0.7)	12.50	
Missing	2 (0.1)	50.00	
Last Pap test results			
Normal	711 (59.7)	5.77	0.0015†
Abnormal	31 (2.6)	0	
Don't recall	9 (0.8)	0	
Never got results	20 (1.7)	15.00	
Never had pap	409 (34.4)	9.78	
Missing	10 (0.8)	20.00	
Number of pregnancy			
0	129 (10.8)	10.08	0.426*
1	169 (14.2)	8.28	
2	208 (17.5)	9.13	
3	252 (21.2)	6.35	
4	169 (14.2)	5.33	
5+	261 (21.9)	5.75	
Missing	2 (0.2)	0	
Hormone contraceptive used ever			
No	817 (68.7)	7.22	0.903*
Yes	365 (30.6)	6.85	
Missing	8 (0.7)	25.00	
Current IUD used			
No	1133 (95.2)	7.24	0.769†
Yes	47 (4.0)	4.26	
Missing	10 (0.8)	20.00	
HPV vaccination status			
No	1118 (94.0)	7.07	0.763†
Yes	43 (3.6)	4.65	
Missing	29 (2.4)	17.24	

Missing data were not included in the analysis.
*P value generated using χ^2 test.
†P value generated using Fisher exact test.
HPV, human papillomavirus; IUD, intra-uterine device.

4.17). Widowed women also had a higher prevalence of HPV infection compared with married women in multivariable analysis (adjusted PR=2.48, 95%CI 1.04 to 5.90). Higher HPV prevalence was reported in the group of women (P=0.03) who never had a Pap test done, but it was not found to be a significant risk factor in the multivariable analysis (adjusted PR for women who had Pap test done=0.67, 95%CI 0.43 to 1.05). Having a circumcised partner showed a lower HPV prevalence in the univariate analysis (P≤0.01) but was not found to be a significant risk factor after adjustment for age, ethnicity, marital status, partner's behaviour and history of Pap screening (adjusted PR=1.06, 95%CI 0.55 to 2.04). Women whose partners possessed markers of high-risk behaviour such as 'stays at home but has other partner' (adjusted PR=2.25, 95%CI 1.19 to 4.25), 'stays away but no reported other partner' (adjusted PR=2.45, 95%CI 1.28 to 4.70) and 'stays away and has other partner' (adjusted PR=3.19, 95%CI 1.50 to 6.80) were also at a higher risk of HPV infection. Women's sexual behaviour such as number of lifetime sexual partners, age of sexual debut and having new partner in the last 12 months were not associated with prevalent HPV infection. History of hormonal contraceptive pills used and parity were also not associated with HPV infections.

DISCUSSION

To date, this is the largest community-based HPV prevalence survey among healthy Malaysian women, which also investigated the sociobehavioural characteristics of the study participants. The overall prevalence of clinically relevant HPV infection was 7.2%, with the highest prevalence demonstrated in the youngest age group (11.9%). The top five most prevalent HPV genotypes were HPV 16, 52, 58, 51 and 68. The independent risk factors associated with significantly higher rates of HPV infection included ethnic Indian ethnicity, widowed status and among

Table 2 Sexual behavioural factors among study participants

Variables	n (%)	HPV prevalence (%)	P value
Age of sexual debut			
<18 years old	98 (8.2)	11.2	0.316*
18–25 years old	766 (64.4)	7.20	
26–30 years old	251 (21.1)	4.80	
31–40 years old	42 (3.5)	7.10	
>40 years old	2 (0.2)	0	
Missing	31 (2.6)	16.13	
Lifetime sex partner			
1	960 (80.7)	6.98	0.587†
2	109 (9.2)	6.42	
3+	66 (5.5)	10.61	
Don't know/refused to answer	32 (2.7)	9.38	
Missing	23 (1.9)	8.70	
New partner in the last 12 months			
No	1145 (96.2)	6.90	0.514*
Yes	4 (0.3)	25.00	
Decline to respond	2 (0.2)	0	
N/A	22 (1.9)	9.09	
Missing	17 (1.4)	23.53	
Current sex partner			
No	128 (10.7)	14.84	<0.008†
Yes	1038 (87.2)	6.26	
Declined to answer	3 (0.3)	0	
Missing	21 (1.8)	9.52	
Partner's circumcision status			
No	375 (31.5)	7.73	<0.009*
Yes	640 (53.8)	5.47	
Don't know/declined to answer	22 (1.8)	4.55	
N/A	128 (10.8)	14.84	
Missing	25 (2.1)	8.00	
Partner's behaviours			
Stays at home and no partner	769 (64.6)	4.68	<0.000*
Stays at home but have other partner	108 (9.1)	10.19	
Stays away but no partner	101 (8.5)	10.89	
Stays away and has other partner	51 (4.3)	13.73	
No current partner	149 (12.5)	14.09	
Missing	12 (1.0)	0	

Missing data were not included in the analysis.
*P value generated using χ^2 test.
†P value generated using Fisher exact test.
N/A, not available.

women who reports having partners who are away from home for long periods and/or has another sexual partner.

The overall HPV prevalence (7.2%) reported in our study was in the lower distribution of global estimates. In a recent meta-analysis involving 32 studies from 224 320 asymptomatic women, the pooled HPV prevalence was 11% among women who attended cervical cancer screening clinics, while it was 10% among urban and rural women.[9] High HPV prevalence rates have been reported in the USA (26.8%), Australia (38.7%), Japan (22.5%) and China (26%),[10–13] while lower rates have been observed in South-East Asia: Thailand (15.1%), Indonesia (11.6%) and Singapore (9.3%).[14–16] The prevalence of HR-HPV (6.5%) was comparable to the studies reported in South-East Asia countries like Singapore (5.05%), Thailand (5.4%) and Vietnam (7.6%).[16–18] As a caveat to these global prevalence comparisons, we note that the genotype spectrum (number of types) in this study, compared with the literature, included all significant high-risk types but not the full range of low-risk types. The age-specific HPV prevalence pattern followed the global general pattern where the youngest age group (<25 years old) had the highest HPV infection rate.[10 12 16 19] Although prevalence spikes were also observed in women aged 31–40 and 51–60 in our study, the risk of HPV infection showed a general decline with increasing age following adjustment for ethnicity and other factors (online supplementary figure 1). The second HR-HPV peak among perimenopausal women has been previously reported in an Asian population.[20]

The most common HPV genotypes (HPV 16, 52, 58 and 51) reported in our study were similar to many recent studies reported in the Asian population.[13 14 16 19 21] This is particularly important since HPV genotypes 16, 52 and 58 were also found to be the most prevalent genotypes detected in invasive cervical cancer cases in Malaysia and Asia.[21–23] This has implications for the local public health and cancer control programmes particularly in the light of the newly approved nine-valent HPV vaccine, which protects against HPV 52 and 58.[24] In addition, the prevalence of specific HPV genotypes should enable policy makers to plan more accurately if HPV DNA testing was to be used for cervical cancer screening (table 3).

In this study, Indian women were independently more likely to be HPV-positive compared with their Chinese and Malay counterparts. However, the higher prevalence of HPV among Indian ethnicity in our sample does not reflect the ethnic distribution of cervical cancers in Malaysia, where incidence is highest in the Chinese population.[2]

The widowed women in our study showed a 3.5-fold higher risk of HPV infection compared with unmarried women, a finding supported by another study in the USA.[11] These infections seemed to be long-term persistent infections since most of the women did not report having a current partner (82.6%) or any new sexual partner in the past 12 months (86%). Using the Swedish National Cervical Screening Register from 1969 to 2011, bereavement was found to be associated with a 62% increased risk of HPV 16 infection, high viral load and recurrent infection.[25] Second, exposure to severely stressful life events (like loss of a partner or a parent) may increase host vulnerability to persistence or reactivation of oncogenic HPV and subsequently cervical cancer.[25 26]

Our finding that women with partners who are away for long periods or have other sexual partners was independently associated with higher risk of HPV infection suggests that male behaviours play a significant defining role in the epidemiology of HPV in women in our population. This finding is also corroborated by a well-designed multinational study by the International Agency for Research on Cancer, which showed that HPV prevalence was higher among women whose male partners had sexual exposures outside of the relationship.[27]

The need for an effective Malaysian cervical cancer screening programme was evident from our data since the HPV prevalence was significantly higher in women who were less likely to have been adequately screened by Pap (64.9% vs 34.4%, P=0.03). Self-sampling paired with HPV primary screening may offer a feasible national strategy in Malaysia, where the overall HR-HPV prevalence is low, especially since the Malaysian women found self-collection of a vaginal self-swab to be highly acceptable and preferable to Pap screening among the majority of participants.[7]

Some limitations to our study are noted. The opportunistic recruitment from primary care clinics may have led to

Table 3 Distribution of HPV genotypes by age group, ethnicity, marital status and partner's behaviours

Cervicovaginal HPV	HPV-positive n (%)	HR-HPV-positive n (%)	HPV 16-positive n (%)	HPV 52-positive n (%)	HPV 58-positive n (%)	HPV 18-positive n (%)	HPV 45-positive n (%)	HPV 31-positive n (%)	HPV 6/11-positive n (%)	HPV 16/18-positive n (%)	HPV 6/11/16/18-positive n (%)	HPV 6/11/16/18/31/33/45/52/58-positive n (%)
Age group												
18–24 (n=76)	9 (11.9)	8 (10.5)	2 (2.6)	0	0	1 (1.3)	0	1 (1.3)	1 (1.3)	3 (3.9)	4 (5.3)	5 (6.6)
25–30 (n=239)	15 (6.3)	13 (5.4)	5 (2.1)	2 (0.8)	1 (0.4)	2 (0.8)	0	1 (0.4)	2 (0.8)	7 (2.9)	9 (3.8)	12 (5.0)
31–40 (n=374)	30 (8.0)	29 (7.8)	4 (1.1)	5 (1.3)	4 (1.1)	0	6 (1.6)	3 (0.8)	2 (0.5)	4 (1.1)	6 (1.6)	22 (5.9)
41–50 (n=296)	17 (5.7)	15 (5.1)	3 (1.0)	5 (1.7)	2 (0.7)	1 (0.3)	0	1 (0.3)	2 (0.7)	4 (1.4)	6 (2.0)	14 (4.7)
51–60 (n=205)	15 (7.3)	15 (7.3)	2 (1.0)	0	4 (2.0)	3 (1.5)	2 (1.0)	1 (0.5)	0	5 (2.4)	5 (2.4)	9 (4.4)
Ethnicity												
Malay (n=599)	33 (5.5)	31 (5.2)	8 (1.3)	4 (0.7)	2 (0.3)	4 (0.7)	3 (0.5)	4 (0.7)	2 (0.3)	12 (2.0)	14 (2.3)	24 (4.0)
Chinese (n=272)	16 (5.9)	14 (5.1)	2 (0.7)	2 (0.7)	4 (1.5)	2 (0.7)	3 (1.1)	1 (0.4)	2 (0.7)	4 (1.5)	6 (2.2)	14 (5.1)
Indian (n=294)	35 (11.9)	34 (11.6)	5 (1.7)	6 (0.2)	5 (1.7)	1 (0.3)	2 (0.7)	2 (0.7)	2 (0.7)	6 (2.0)	8 (2.7)	22 (7.5)
Others (n=25)	2 (8.0)	1 (4.0)	1 (4.0)	0	0	0	0	0	1 (4.0)	1 (4.0)	2 (8.0)	2 (8.0)
Marital status												
Single/not married (n=49)	4 (8.2)	3 (6.1)	1 (2.0)	0	0	0	0	1 (2.0)	1 (2.0)	1 (2.0)	2 (4.1)	2 (4.1)
Married (n=1053)	67 (6.4)	63 (6.0)	13 (2.1)	8 (0.8)	10 (0.9)	4 (0.4)	6 (0.6)	5 (0.5)	5 (0.5)	17 (1.6)	22 (2.1)	49 (4.7)
Divorced (n=42)	5 (11.9)	5 (11.9)	2 (4.8)	1 (2.4)	0	1 (2.4)	1 (2.4)	0	0	3 (7.1)	3 (7.1)	4 (9.5)
Widowed (n=46)	10 (21.7)	9 (19.6)	0	3 (6.5)	1 (2.2)	2 (4.3)	1 (2.2)	1 (2.2)	1 (2.2)	2 (4.3)	3 (6.5)	7 (15.2)
Partner's behaviours												
Stays at home and no other partner (n=769)	36 (4.7)	34 (4.4)	3 (0.4)	6 (0.8)	5 (0.7)	3 (0.4)	5 (0.7)	1 (0.1)	3 (0.4)	6 (0.8)	9 (1.2)	25 (3.3)
Stays at home but have other partner (n=108)	11 (10.2)	10 (9.3)	4 (3.7)	2 (1.9)	2 (1.9)	0	0	0	1 (0.9)	4 (3.7)	5 (4.6)	8 (7.4)
Stays away but no partner (n=101)	11 (10.9)	9 (8.9)	2 (2.0)	0	1 (1.0)	2 (2.0)	0	1 (1.0)	2 (2.0)	4 (4.0)	6 (5.9)	9 (8.9)
Stays away and has other partner (n=51)	7 (13.7)	7 (13.7)	2 (3.9)	1 (2.0)	0	0	0	2 (3.9)	0	2 (3.9)	2 (3.9)	5 (9.8)
No current partner (n=149)	21 (14.1)	20 (13.4)	5 (3.4)	3 (2.0)	3 (2.0)	2 (1.3)	3 (2.0)	3 (2.0)	1 (0.7)	7 (4.7)	8 (5.4)	15 (10.1)

HPV, human papillomavirus; HR, high-risk.

Table 4 Factors independently associated with any HPV genotype infection (n=1174)

Variable	n	Adjusted prevalence ratio* (95% CI)	P value
Age category			
18–24	73	1.00	
25–30	237	0.60 (0.26 to 1.37)	0.223
31–40	369	0.70 (0.33 to 1.49)	0.357
41–50	294	0.47 (0.19 to 1.13)	0.090
51–60	201	0.51 (0.21 to 1.23)	0.132
Ethnicity			
Malay	590	1.00	
Chinese	269	1.25 (0.62 to 2.55)	0.535
Indian	291	**2.16 (1.12 to 4.17)**	**0.021†**
Others	24	1.24 (0.31 to 4.95)	0.759
Marital status			
Married	1040	1.00	
Single/not married	48	0.70 (0.24 to 2.01)	0.493
Divorced	41	1.55 (0.56 to 4.31)	0.403
Widowed	45	**2.48 (1.04 to 5.90)**	**0.047†**
Pap smear history			
No	404	1.00	
Yes	762	0.67 (0.43 to 1.05)	0.080
Don't know	8	1.03 (0.14 to 7.79)	0.974
Partner's circumcision status			
No	373	1.00	
Yes	632	1.06 (0.55 to 2.04)	0.862
Don't know/decline to answer	20	0.63 (0.13 to 3.17)	0.573
Partner's behaviours			
Stays at home and no other partner	766	1.00	
Stays at home but have other partner	107	**2.25 (1.19 to 4.25)**	**0.013†**
Stays away but no partner	101	**2.45 (1.28 to 4.70)**	**<0.007†**
Stays away and has other partner	51	**3.19 (1.50 to 6.80)**	**<0.003†**
No current partner	149	1.99 (0.90 to 4.40)	0.089

*P value <0.05 is considered statistically significant and is marked in bold font.
†Derived using a multivariable Poisson regression model including age, ethnicity, marital status, Pap smear history, partner's circumcision status and partner's behaviour as covariates.
HPV, human papillomavirus.

oversampling of women with comorbid health problems. However, women were not approached if they appeared to be physically unwell. We also acknowledge a lower response rate, particularly among Chinese women. The disconnect between the lower HPV prevalence observed in our Chinese participants with national estimates of higher cervical cancer rates among the Chinese in Malaysia suggests the presence of a participation bias, and perhaps an underestimate of the true burden of HPV in this ethnic group. Despite these limitations, we believe that these data provide crucial information for public health administrators. Many countries have used similar convenience samples to guide both screening programme development[26 28] and the evaluation of vaccine effectiveness for a population.[29]

The findings from this study have direct implications for national cervical cancer prevention policies. Particularly, the health economic modelling for the national cervical cancer control programme should now take into account the top three most prevent HR-HPV genotypes in the Malaysian population, namely HPV16, 52 and 58. Knowledge of the HPV prevalence within the different age groups will also greatly facilitate the transition of traditional Pap smear screening programmes to HPV DNA testing within a vaccinated population.

Key messages

- The overall prevalence of cervicovaginal human papillomavirus (HPV) infection among a healthy, community-based, multiethnic Asian population is 7.2%.
- Women from the youngest cohort (18–24 years old) had the highest rates of HPV infection at 11.9%.
- The top three most common genotypes of HPV cervicovaginal infection among Malaysians are HPV 16, 52 and 58, respectively.
- The implementation of comprehensive cervical cancer prevention programmes should take into account the prevalence of HPV infection within the target population.

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