RESEARCH PAPER

Awareness and acceptance of human papillomavirus (HPV) vaccination among males attending a major sexual health clinic in Wuxi, China: A cross-sectional study

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ABSTRACT

Objective: To study the awareness and acceptance of human papillomavirus (HPV) vaccination among sexually active men having sex with men (MSM) and men not having sex with men (MNSM) attending the largest sexual health clinic in Wuxi, China. **Methods:** A questionnaire about participants' socio-demographic characteristics and view on HPV vaccination was collected. **Results:** A total of 186 MSM and 182 MNSM were recruited. Among MSM, 12.4% were under 20 years old, 64.5% never married and 56.5% from Jiangsu Province (where Wuxi City is located); 64.0% had resided in Wuxi for over 2 years, 64.5% had high school education or more, and 83.9% had an income of 5000 RMB or less per month compared to figures of 5.5%, 50.6%, 73.6%, 54.9%, 86.8% and 64.8% among MNSM, respectively (All *P* values < 0.05). Among these 2 groups of men, 18.4% and 23.1% had heard of HPV; 10.2% and 15.4% had heard of HPV vaccine; and 26.2% and 20.2% would take HPV vaccine before sexual debut, respectively. MNSM were significantly more willing to take HPV vaccine than MSM (70.9 vs 34.9%, *p* < 0.001). Factors associated with HPV vaccine acceptance among MSM included engaging mostly in receptive anal sex (Odds ratio (OR)=3.9, 95% Confidence interval (CI): 1.8–13.5), never using a condom in anal sex in the past 6 months (3.5, 1.5–20.2), ever diagnosed with a sexually transmitted infection (STI) (3.4, 1.3–8.4) and ever receiving HIV related services (1.6, 1.1–4.4). Among MNSM these Factors included commercial sex with women (1.7, 1.2–8.6), never using a condom in commercial sex (1.6, 1.4–7.6) and STI diagnosis (2.0, 1.6–7.3). **Conclusions:** Sexually active MSM and MNSM in Wuxi lacked knowledge of HPV and HPV vaccination. The majority of these at-risk men would not benefit from HPV vaccination as their age at first sex proceeded perceived age of vaccine uptake. Aggressive education aimed at increasing knowledge of HPV and HPV vaccination among these men is warranted.

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Introduction

Human papillomavirus (HPV) infection is widespread^{1–3} and usually asymptomatic.⁴ HPV types 6 and 11 are the types most commonly associated with anogenital warts,⁵ while types 16 and 18 are associated with HPV related malignancies including anal and cervical cancer.^{1–3,6} HPV 16 and 18 together cause about 80% of anal cancers in men.^{7–9} Association was found between HIV seropositivity and HPV detection.^{10,11} Patients with anogenital warts and HPV-related cancers suffer heavy economic/psychological burdens, and self-image and sexual-related concerns.^{12,13} The prophylactic quadrivalent HPV vaccine is effective in preventing infection with HPV types 6, 11, 16 and 18 and in reducing the incidence of anogenital warts and anal intraepithelial neoplasia in both men having sex with men (MSM) and men not having sex with men (MNSM).^{14,15} Clinical trials had shown that the quadrivalent HPV vaccine had an efficacy of 85.6% in preventing persistent anogenital HPV infection of vaccine types among MNSM and an efficacy of 94.9% in preventing persistent anogenital

HPV infection of vaccine types among young MSM.¹⁶ Studies have shown that it is cost-effective to vaccinate either all men or selectively young MSM.^{7,17,18} Studies have documented national-level effect of female HPV vaccination.¹⁹ Male HPV vaccination, in addition to the existing female HPV vaccination programs, may help achieve herd immunity.²⁰

China had a population of 480 million sexually active men aged 15–59,²¹ among whom about 3.1–6.3 million were estimated to be MSM.²² HPV infection was high among homosexually active men in China, especially those infected with HIV. A study in Beijing with 578 sexually active MSM found 62.1% had anal HPV. The most prevalent HPV genotypes were HPV6 (19.6%), HPV16 (13.0%) and HPV11 (7.6%), all of which included in the quadrivalent HPV vaccine.¹¹ HPV is also prevalent among the general male population. A study with 2,236 male residents in Henan Province found that the prevalence of genital HPV infection to be 17.5%.²³ The prevalence of genital warts among men attending sexual health clinics was 20.3%.²⁴

By September 2013, 45 countries had implemented free HPV vaccination programs for girls and young women.²⁵ However, to date no countries have introduced universal, free vaccination of boys other than Australia.²⁶ Whether universal male vaccination or selective MSM vaccination programs will work best is dependent not only on the prevalence of HPV among these men, but to a large extent on how they view HPV vaccination. In China, other than 2 studies about view on HPV vaccination among college students,^{27,28} there had been no study that addressed the views on HPV vaccination among MSM and MNSM who are at high risk for HPV infection. Currently HPV vaccine is not yet available in China for either women or men. The country is likely to introduce existing HPV vaccines such as Gardasil (Merck) in the near future.²⁹ To advise HPV vaccination strategy, our study aimed to investigate the knowledge and attitude toward HPV and HPV vaccination among both MSM and MNSM in Wuxi, China, who were at high risk for HPV infection. We also aimed to define the age MSM would choose to disclose their sexuality to a health care provider to obtain the HPV vaccine if it was provided free of charge to MSM.

Results

Participant characteristics

A total of 387 men (196 MSM and 191 MNSM) were approached, among whom 19 (10 MSM and 9 MNSM) declined to participate. As a result 368 respondents (186 MSM and 182 MNSM) were included in our study with a participation rate of 95.1% (94.9% for MSM and 95.3% for MNSM). Significant differences were found in social-demographic characteristics between MSM and MNSM (All P values < 0.05). Among MSM: 23 (12.4%) were under 20 years old, 120 (64.5%) never married and 105 (56.5%) from Jiangsu Province (where Wuxi City is located); 119 (64.0%) had resided in Wuxi for over 2 years, 120 (64.5%) had high school education or more, and the majority (83.9%) had an income of 5000 RMB (1 USD = 6.2 RMB) or less per month. Among MNSM: 10 (5.5%) were under 20 years old, 92 (50.6%) not married and 134 (73.6%) from Jiangsu Province; 100 (54.9%) had resided in Wuxi for over 2 years and, 158 (86.8%) had high school education or more, and the majority (64.8%) had an income of 5000 RMB or less per month (Table 1).

Sexual Behaviors

Among MSM, 81.7% had had anal sex with men in the past 6 months, with 29.6% having 2 or more male sex partner and 39.2% consistently using a condom in anal sex, in the same period. Over half (54.8%) took both insertive and receptive roles in anal sex with men. Two in 5 (40.3%) had ever had sex with a woman. Among MNSM, nearly half (46.2%) had commercial sex with female in the past 3 months, with 19.1% having more than 1 commercial female sex partners and 28.6% always using a condom in vaginal intercourse (data not shown).

Table 1. Socio-demographic Characteristics among MSM and MNSM in Wuxi, China.

Variables	MSM		MNSM		p
	n	%	n	%	
Age group (years)					0.004
<20	23	12.4	10	5.5	
20–40	131	70.4	148	81.3	
>40	32	17.2	24	13.2	
Marital status					0.022
Not married	120	64.5	92	50.5	
Married	66	35.5	90	49.5	
Location					0.001
Jiangsu	105	56.5	134	73.6	
Other province	81	43.5	48	26.4	
Length of local residency (years)					0.004
≤ 2	67	36.0	82	45.1	
>2	119	64.0	100	54.9	
Education					<0.001
Middle school or less	66	35.5	24	13.2	
High school or more	120	64.5	158	86.8	
Monthly income (RMB)					<0.001
≤ 5000	156	83.9	118	64.8	
>5000	30	16.1	64	35.2	

Awareness of HPV, HPV vaccine and view on HPV vaccination

No significant differences were found in awareness of HPV (23.1% vs 18.4%, $\chi^2=1.292$, $p=0.637$), HPV vaccine (15.4% vs 10.2%, $\chi^2=2.207$, $p=0.542$), ever testing for HPV (9.9% vs 6.6%, $\chi^2=1.453$, $p=0.716$) and willingness to pay for HPV vaccine (22.0% vs 18.8%, $\chi^2=0.566$, $p=0.851$) between MNSM and MSM. Significantly more MNSM were willing to accept free HPV vaccine than MSM (70.9% vs 34.9%, $\chi^2=47.651$, $p < 0.001$) (Fig. 1). If the vaccine was offered free of charge to MSM, the median reported age among MSM to disclose sexuality to a doctor in order to obtain the vaccine was 25 years old compared to 27 years old among MNSM if the vaccine was offered free of charge to all men. Only 26.2% of MSM and 20.2% of MNSM would take free vaccine at or before 20 and 19 years old, the median ages when these men started their sex life. MSM and MNSM declined free vaccination mostly because they thought it was unnecessary to take HPV vaccine: 57.8% MSM and 43.5% MNSM considered themselves to be at low risk for HPV infection.

Figure 1. Differences of view on HPV and HPV vaccine between MSM and MNSM in Wuxi, China.

Factors associated with willingness to take free HPV vaccine

As shown in Table 2, in multivariate logistic regression, playing receptive role in anal sex (OR: 3.856, 95%CI: 1.773–13.509), never using a condom in anal sex in the past 6 months (OR: 3.461, 95%CI: 1.452–20.184), diagnosis with an STI in the past 12 months (OR: 3.347, 95%CI: 1.259–8.378) and ever receiving HIV/AIDS related service (OR: 1.635, 95%CI: 1.112–4.375) were factors associated with the uptake of free HPV vaccine among MSM.

As shown in Table 3, in multivariate logistic regression, residing in Wuxi longer than 2 years (OR: 1.928, 95%CI: 1.391–4.936), never using a condom in anal sex in the past 6 months (OR: 1.665, 95%CI: 1.203–11.268), diagnosis of an

STI in the past 12 months (OR: 1.836, 95%CI: 1.286–9.437) were associated with the willingness to take free HPV vaccine before 20 years old among MSM.

As shown in Table 4, in multivariate logistic regression, having had commercial sex with a female in the past 3 months (OR: 1.712, 95%CI: 1.235–8.576), never using a condom in commercial sex in the past 3 months (OR: 1.557, 95%CI: 1.336–7.592) and diagnosis of an STI (OR: 2.012, 95%CI: 1.642–7.268) were factors influenced acceptant decision of free HPV vaccine among MNSM.

As shown in Table 5, in multivariate logistic regression, having had commercial sex with a female in the past 3 months (OR: 2.536, 95%CI: 1.383–13.604), never using a condom in commercial sex in the past 3 months (OR: 1.721, 95%CI:

Table 2. Factors Associated with Willingness to Take Free HPV Vaccine among MSM in Wuxi, China.

Characteristics	n	%	Crude OR(95%CI)	P	Adjust OR(95%CI)	P
Age group (years)						
<20	23	33.1	Ref			
20–40	131	35.1	1.019(0.324–3.256)	0.217		
>40	32	39.1	1.208(0.254–2.371)	0.379		
Marital status						
Not married	120	33.3	Ref			
Married	66	37.9	1.281(0.592–8.373)	0.288		
Location						
Jiangsu	105	37.1	Ref			
Other province	81	32.1	0.849(0.175–2.823)	0.392		
Length of local residency (years)						
≤2	67	29.9	Ref			
>2	119	37.8	1.802(0.635–5.262)	0.129	1.313(0.624–2.886)	0.451
Education						
Middle school or less	66	34.8	Ref			
High school or more	120	35.0	1.136(0.189–2.414)	0.732		
Monthly income (RMB)						
≤5000	156	34.0	Ref			
>5000	30	40.0	1.372(0.627–4.736)	0.526		
Role in anal sex						
Insertive	57	20.6	Ref			
Receptive	27	66.7	3.843(1.721–13.568)	0.012	3.856(1.773–13.509)	0.031
Both	102	45.6	2.237(0.703–6.284)	0.105	2.236(0.711–6.254)	0.055
Number of male sex partner in the past 6 months						
≤1	131	38.2	Ref			
>1	55	27.3	0.835(0.252–2.234)	0.681		
Condom use in anal sex in the past 6 months						
Always	63	22.2	Ref			
Sometimes	74	37.8	2.136(0.709–6.218)	0.176	2.137(0.738–6.291)	0.264
Never	49	46.9	3.434(1.458–20.147)	0.024	3.461(1.452–20.184)	0.034
Ever sex with female						
No	111	37.8	Ref			
Yes	75	30.7	0.771(0.232–2.162)	0.293		
Ever heard of HPV						
No	150	29.3	Ref			
Yes	36	58.3	1.633(0.116–5.374)	0.001	1.658(0.174–5.308)	0.128
Ever tested for HPV						
No	173	32.9	Ref			
Yes	13	61.5	1.756(0.199–43.545)	0.381		
Ever heard of HPV vaccine						
No	166	33.1	Ref			
Yes	20	50.0	1.776(0.146–31.682)	0.255		
Ever diagnosed STIs in the past 12 months						
No	171	31.0	Ref			
Yes	15	80.0	3.309(1.247–8.393)	0.007	3.347(1.259–8.378)	0.022
Ever accepted HIV/AIDS related service						
No	67	19.4	Ref			
Yes	119	43.7	1.637(1.191–4.334)	0.007	1.635(1.112–4.375)	0.037
Ever tested HIV in the past 12 months						
No	149	32.2	Ref			
Yes	37	45.9	1.488(0.196–4.284)	0.425		

Table 3. Factors Associated with Willingness to Take Free HPV Vaccine before 20 years old among MSM in Wuxi, China.

Characteristics	n	%	Crude OR(95%CI)	P	Adjust OR(95%CI)	P
Age group (years)						
<20	9	33.3	Ref			
20–40	46	26.1	0.837(0.256–3.413)	0.805		
>40	10	20.0	0.776(0.398–2.767)	0.432		
Marital status						
Not married	48	29.2	Ref			
Married	17	17.6	0.808(0.114–22.525)	0.041	0.938(0.163–3.751)	0.193
Location						
Jiangsu	39	25.6	Ref			
Other province	26	26.9	1.136(0.567–2.089)	0.373		
Length of local residency (years)						
≤2	20	15.0	Ref			
>2	45	31.0	1.932(1.376–4.954)	0.031	1.928(1.391–4.936)	0.045
Education						
Middle school or less	23	34.8	Ref			
High school or more	42	21.4	0.835(0.278–12.157)	0.898		
Monthly income (RMB)						
≤5000	53	18.9	Ref			
>5000	12	58.3	2.363(0.565–9.523)	0.631		
Role in anal sex						
Insertive	25	28.0	Ref			
Receptive	8	12.5	0.851(0.278–12.168)	0.027	0.625(0.432–5.108)	0.535
Both	32	27.1	0.935(0.467–5.109)	0.087	0.916(0.347–3.763)	0.287
Number of male sex partner in the past 6 months						
≤1	44	20.5	Ref			
>1	21	38.1	1.434(0.487–8.598)	0.831		
Condom use in anal sex in the past 6 months						
Always	24	33.3	Ref			
Sometimes	28	17.9	0.654(0.227–6.368)	0.125	0.856(0.225–2.987)	0.449
Never	13	40.8	1.676(1.255–11.247)	0.005	1.665(1.203–11.268)	0.013
Ever sex with female						
No	42	33.3	Ref			
Yes	23	13.0	0.434(0.177–7.365)	0.456		
Ever heard of HPV						
No	44	25.0	Ref			
Yes	21	28.6	1.023(0.369–8.732)	0.204		
Ever tested for HPV						
No	57	28.1	Ref			
Yes	8	12.5	0.768(0.105–14.673)	0.527		
Ever heard of HPV vaccine						
No	55	29.1	Ref			
Yes	10	10.0	0.566(0.177–15.473)	0.941		
Ever diagnosed STIs in the past 12 months						
No	53	18.9	Ref			
Yes	12	50.0	1.809(1.237–9.451)	0.039	1.836(1.286–9.437)	0.041
Ever accepted HIV/AIDS related service#						
No	13	23.1	Ref			
Yes	52	26.9	1.432(0.287–9.165)	0.128	1.307(0.313–3.225)	0.705
Ever tested HIV in the past 12 months						
No	48	29.2	Ref			
Yes	17	17.6	0.871(0.136–7.966)	0.722		

1.138–5.672) and ever accepted HIV/AIDS related service (OR: 1.646, 95%CI: 1.115–9.683) were associated with the uptake of free HPV vaccine at or before 19 years old among MNSM.

Discussions

To our knowledge this is the first study from China that addressed how MSM and MNSM who are at high risk for HPV infection view HPV vaccination. Men in our study were at high-risk for HIV/STI infection. In our study MSM were at high risk as over 8% (15/186) were diagnosed with STIs in the past 12 months and only one third (63/186) consistently used a condom in anal sex with other men in the past 6 months. Albeit not all MNSM attending this sexual health clinic had visited female sex workers, a substantial of them (84/182, 46%) had

done so in the past 3 months. The rate of MNSM ever visiting female sex workers in their lifetime would be much higher. Moreover, only 28.6% (24/84) of MNSM consistently used a condom in their sex with female sex workers in the past 3 months. Studies have shown that female sex workers had high prevalence of HIV and other STIs which put their clients at high risk for these infections. A systematic review found that among female sex workers in China, the prevalence of active syphilis ranged 0.8–12.5% (median=6.9%), herpes 29.7–70.8% (median=56.2%), chlamydia 3.9–58.6% (median=25.7%), gonorrhea 2.0–85.4% (median=16.4%), trichomoniasis 7.1–43.2% (median=12.5%) and HIV 0–10.3% (median=0.6%).³⁰

HPV vaccine, like other vaccines against infections that could be sexually transmitted, such as hepatitis A vaccine and hepatitis B vaccine, should best be given to people before their

Table 4. Factors Associated with Willingness to Take Free HPV Vaccine among MNSM in Wuxi, China.

Characteristics	n	%	Crude OR(95%CI)	P	Adjust OR(95%CI)	P
Age group (years)						
<20	10	50.0	Ref			
20–40	149	70.2	1.661(0.609–5.437)	0.103	1.809(0.132–3.744)	0.577
>40	24	83.1	1.832(0.879–2.246)	0.187	1.963(0.35–3.262)	0.093
Marital status						
Not married	92	71.7	Ref			
Married	90	70.0	0.845(0.221–1.567)	0.792		
Location						
Jiangsu	134	68.7	Ref			
Other province	48	77.1	1.221(0.436–2.982)	0.453		
Length of local residency (years)						
≤2	82	68.3	Ref			
>2	100	73.0	1.243(0.572–2.881)	0.494		
Education						
≤Middle school	24	58.3	Ref			
>High school	158	72.8	1.432(0.509–3.932)	0.011	1.255(0.636–2.645)	0.271
Monthly income (RMB)						
≤5000	118	71.2	Ref			
>5000	64	70.3	0.987(0.431–2.079)	0.832		
Commercial sex with female in the past 3 months						
No	98	61.2	Ref			
Yes	84	82.1	1.775(1.283–8.579)	0.002	1.712(1.235–8.576)	0.022
Number of commercial female sex partners in the past 3 months						
≤1	166	69.9	Ref			
>1	16	81.3	1.433(0.284–9.749)	0.844		
Condom use in commercial sex in the past 3 months						
Always	24	56.4	Ref			
Sometimes	40	61.6	1.336(0.199–4.671)	0.159	1.047(0.331–1.348)	0.482
Never	20	85.7	1.932(1.386–5.874)	0.041	1.557(1.336–7.592)	0.003
Ever heard of HPV						
No	140	70.7	Ref			
Yes	42	71.4	1.253(0.465–9.308)	0.929		
Ever tested for HPV						
No	164	70.9	Ref			
Yes	18	64.1	0.937(0.188–14.538)	0.721		
Ever heard of HPV vaccine						
No	154	70.1	Ref			
Yes	28	75.0	1.176(0.369–11.688)	0.022	1.858(0.737–4.455)	0.505
Ever accepted HIV/AIDS related service						
No	22	54.5	Ref			
Yes	160	73.1	1.806(0.325–9.274)	0.237		
Ever diagnosed STIs in the past 12 months						
No	162	68.5	Ref			
Yes	20	90.0	2.018(1.677–7.283)	0.037	2.012(1.642–7.268)	0.009
Ever tested HIV in the past 12 months						
No	166	72.9	Ref			
Yes	16	50.0	0.577(0.315–1.372)	0.213		

sexual debut when they have not yet been affected by HPV and their immune response robust. However, the HPV vaccine is the single most expensive vaccine to date. On average, men were considerably less affected by HPV-related life-threatening cancers compared to women. The cost-effectiveness and positive impact of vaccinating younger and older women against cervical cancer has been well documented.^{19,31} The cost-effectiveness of vaccinating all men is supposed suboptimal. However, targeted vaccination of subgroups in the male population disproportionately affected by HPV may be cost-effective. Mathematical models have demonstrated targeted HPV vaccination of both younger and older MSM.⁷ Recently published studies had argued for targeted HPV vaccination among older and HIV-positive MSM.^{32,33} Another subpopulation—men attending sexual health clinics—may also be considered in the HPV vaccination program. If the vaccine was given for MSM only, they would need to disclose their sexual orientation in order to get it. There might be a few barriers facing this vaccination

strategy: 1) teenage MSM might have not yet realized their sexual orientation and thus will not identify themselves as being an MSM; 2) parents of teenage MSM may have not discovered their sons' sexuality or have not agreed with HPV vaccination; 3) in some cultures discrimination and stigma against homosexuality and bisexuality is prevalent which lays a barrier for MSM to come out of the closet, even to their doctors. These issues need to be addressed in the HPV vaccination program targeting MSM. Campaigns aimed at reducing discrimination against MSM among health care providers are essential. Efforts should be made to make MSM feel more comfortable coming out to their doctors in order to get contextualized treatment.

Very few MSM and MNSM had ever heard of either HPV (23.1%, 18.4%) or HPV vaccine (15.4%, 10.2%). These rates were comparable to that among general women and at-risk women populations in China. A Chinese study with 11,681 women aged 15–59 years found that only 24% of general women had ever heard of HPV. This study also found that less

Table 5. Factors Associated with Willingness to Take Free HPV Vaccine before 19 years old among MNSM in Wuxi, China.

Characteristics	n	%	Crude OR(95%CI)	P	Adjust OR(95%CI)	P
Age group (years)						
<20	5	20.0	Ref			
20–40	104	19.2	0.806(0.477–2.934)	0.246		
>40	20	25.0	1.332(0.318–5.576)	0.334		
Marital status						
Not married	66	24.2	Ref			
Married	63	15.9	0.664(0.143–2.878)	0.697		
Location						
Jiangsu	97	19.6	Ref			
Other province	32	21.9	1.189(0.347–4.651)	0.032	1.443(0.781–2.156)	0.059
Length of local residency (years)						
≤2	56	26.8	Ref			
>2	73	15.1	0.507(0.187–1.766)	0.635		
Education						
≤Middle school	14	7.1	Ref			
>High school	115	21.7	3.745(0.871–17.517)	0.025	1.137(0.854–1.469)	0.462
Monthly income (RMB)						
≤5000	83	20.5	Ref			
>5000	46	19.6	0.826(0.285–2.549)	0.421		
Commercial sex with female in the past 3 months						
No	58	13.8	Ref			
Yes	71	25.4	2.536(1.377–13.608)	0.006	2.536(1.383–13.604)	0.034
Number of commercial female sex partners in the past 3 months						
≤1	135	18.5	Ref			
>1	4	25.0	1.499(0.189–18.273)	0.721		
Condom use in commercial sex in the past 3 months						
Always	18	17.8	Ref			
Sometimes	32	29.9	1.707(1.185–5.671)	0.139	1.156(0.746–1.639)	0.301
Never	14	21.4	1.988(1.374–8.865)	0.016	1.721(1.138–5.672)	0.014
Ever heard of HPV						
No	105	22.9	Ref			
Yes	24	8.3	0.379(0.197–1.288)	0.246		
Ever tested for HPV						
No	117	17.1	Ref			
Yes	12	50.0	3.867(0.535–30.291)	0.181	1.343(0.667–2.225)	0.055
Ever heard of HPV vaccine						
No	110	19.1	Ref			
Yes	19	26.3	1.566(0.378–8.764)	0.341		
Ever accepted HIV/AIDS related service						
No	15	20.0	Ref			
Yes	114	20.2	1.235(0.277–7.012)	0.012	1.646(1.115–9.683)	0.036
Ever diagnosed STIs in the past 12 months						
No	111	18.0	Ref			
Yes	18	33.3	1.611(1.145–9.655)	0.525		
Ever tested HIV in the past 12 months						
No	119	19.3	Ref			
Yes	10	30.0	1.431(0.375–8.076)	0.509		

than 20% of healthcare providers recognized sexually naive women as the most appropriate population for HPV vaccination.³⁴ Even among sex workers – women who are the highest risk for HPV infection – despite the majority (71%) had heard of cervical cancer, only 22% had ever heard of HPV and 13.3% had ever heard of HPV vaccine, with presumably even less knowing the linkage between HPV and cervical cancer.³⁵

Among MSM less than 1 in 5 (18.3%) were willing to pay for HPV vaccine given its high price and just more than a third (34.9%) would be willing to disclose their sexuality to a doctor in order to get HPV vaccine, even if it was free of charge to MSM. Our figure on the acceptance of HPV vaccine among MSM was lower than that in a recently published systematic review on data from various countries (36–74%).³⁶ This may be because of the lack of knowledge of HPV vaccine and the perception that HPV vaccine was a female vaccine and irrelevant to men.³⁶ Younger MSM may be more accepting of HPV vaccination. An Australian study of 200 MSM aged 16 to 20 found

that of these young men 86% would be willing to take the vaccine if it was free of charge to MSM, albeit only 30% would purchase it.³⁷ In contrast, most (71%) MNSM attending the sexual health clinic were willing to take HPV vaccine if it was free of charge. This may be largely due to their exposure to STIs and high perception of risk.

MSM in our study stated a median age of 25 years to receive HPV vaccine compared to 27 years old among MNSM. Existing studies showed that the median age of first sex was 20 years among MSM³⁸ and 19 among MNSM.³⁵ HPV vaccine was recommended to be taken before sex debut. This was the reason we chose the age of 20 years among MSM and 19 among MNSM as cut-off age in comparing the willingness to take free vaccine. In our study only 26.2% of men would take free vaccine by 20 years old. This is problematic as the great majority of these men who were at high risk for HPV infection might miss the best time to receive vaccination. This raises the question as to how effective the selective vaccination of MSM would

be in preventing HPV acquisition. Ideally vaccination should precede the onset of any sexual activity, but the reality is that at present, there have been no countries other than Australia that offer free, universal school based HPV vaccine programs to young boys.²⁶ In settings where the vaccine is not provided for all boys because of high cost, it should be given to priority groups of men, such as MSM and MNSM attending sexual health clinics who are at high risk for HPV infection. The best time to provide selective HPV vaccination to MSM might be the time when men have realized their sexuality but have not yet commenced sex with men.³⁷ For MSM in our sample, the vaccination should be given before the age of 20 or even earlier.

MSM at higher risk for HPV were more likely to accept free HPV vaccine and report an early uptake of the vaccine. For example, compared to MSM engaging in insertive anal sex only, those engaging in receptive anal sex only were nearly 4 times as likely to accept HPV vaccine if it was free of charge to MSM. MSM reporting less frequency of condom use and experience of STIs were also more likely to accept free HPV vaccine. This is encouraging as MSM engaging in receptive anal sex are at higher risk for HIV and other STIs³⁹ which may facilitate HPV transmission.⁴⁰ Similarly, MNSM at higher risk for HPV infection were more likely to accept free HPV vaccine.

There were a number of limitations in our study: 1) Due to the nature of convenience sampling method and venues of recruitment in only 1 sexual health clinic, participants in our study may not represent MSM and MNSM in other parts of China. 2) The questionnaire was designed by our research team and validity and reliability were not tested before the research. Similar questions have also been used in other published studies for similar research objectives. 3) HPV DNA and antibody were not tested which limited our capacity to explain the association between HPV risk and acceptance of HPV vaccine. 4) Detailed questions about the perception about risk for HPV and the knowledge of morbidities caused by HPV were not asked which restricted our understanding of factors influencing HPV vaccine uptake. 5) Our research, with sensitive questions, may have involved some socially desirable responses. This may have lead to an overestimate of the acceptance of HPV vaccination. However, by self-completing an anonymous questionnaire, participants did not need to worry about their answer being identified, which would contribute to a reduced socially desirability bias.

HPV vaccine is not yet available in China.⁴¹ Pap smear screening project can facilitate early detection of cervical intraepithelial neoplasia and timely treatment may help prevent cervical cancer, but without vaccination, both females and males are at risk for HPV infection. Very few people have heard of HPV, let alone HPV vaccine, and even fewer people would know about the linkage between HPV and cancers including cervical cancer and anal cancer. Lau et al. found among Chinese sexually active MSM, those who had better knowledge of HPV (adjusted odds ratio (AOR) = 0.48–0.66), perceived higher susceptibility (AOR = 0.32–0.55) and severity (AOR = 0.12–0.60) related to HPV and HPV related diseases and worried more about contracting genital warts and penile/anal cancer (AOR = 0.40–0.55), were more likely to report less unprotected anal intercourse and/or multiple male sex partnerships. Therefore it is warranted to reduce HIV related risk behaviors by increasing levels of knowledge, cognitions, and

fear related to HPV and related diseases. It is important to integrate prevention of HIV with prevention of sexually transmitted infections, such as HPV.⁴² In men the burdens of HPV, including genital warts and anal cancer, are disproportionately concentrated among at-risk subgroups such as MSM and MNSM attending sexual clinics. Vaccinating these subgroups of men would have the highest cost-effectiveness and substantially decrease burdens of HPV infection in men. However, the low awareness of HPV and acceptance of HPV vaccination, together with late perceived age of HPV vaccine uptake would restrict the impact of HPV prevention. This could potentially be improved by aggressive education in sexual health clinics on the consequences of HPV infection and preventative measures among these subgroups of men.

Sexually active MSM and MNSM in China lacked knowledge of HPV. The majority of these men were reluctant to purchase the vaccine. MSM mainly had difficulty in taking the HPV vaccine if the vaccine was free of charge to MSM only and they needed to disclose their sexuality. MNSM attending a sexual health clinic were comparatively more likely to take the vaccine if it is free for men. Aggressive education is necessary to increase the knowledge of HPV and HPV vaccine among these men in China.

Materials and Methods

Subject and recruitment

This study was conducted between April and July 2014 in Wuxi, China. Convenience sampling method was used to recruit men at risk for HIV and other sexually transmitted infections (STIs) from the sexual health clinic affiliated to Wuxi Center for Disease Control and Prevention (CDC), Wuxi, Jiangsu, China. This clinic is the largest sexual health clinic in Wuxi City, providing HIV/STI check-up, treatment and counseling services to over 8,000 clients annually. Men were eligible if they were 18 years or older and consented to do this survey. During the study period a trained investigator approached all men attending the clinic. After screening and giving informed consent, all eligible men self-completed a questionnaire in a private consulting room, with minimum assistance from the investigator. On average it took 10 minutes to complete the questionnaire. In this study we defined men having sex with men (MSM) as men who had ever had anal and/or oral sex with other men. We defined men not having sex with men (MNSM) as men who had never had anal or oral sex with other men. This definition may not reflect their sexual identity or attraction. Before enrolling in the study, participants were informed that HPV could potentially lead to genital warts, cervical cancer and anal cancer. HPV vaccination course was available as 3 doses over 6 months, at a cost of around US\$450, the approximate cost of vaccination.²⁶

A self-administered questionnaire was designed by the research team including a series of single-item questions. We collected information on socio-demographic characteristics of men, including age, marital status, location, length of local residency, income and education.

We asked questions on sexual behaviors, HIV testing and access to related services. For all men we asked: 1) Have you

ever been diagnosed with an STI? 2) Have you ever received any HIV-related services? 3) Have you tested for HIV in the past 12 months? 4) What is the result of your latest HIV test? For MSM, 1) Have you ever had anal sex with men in the past 6 months? 2) How many men have you had anal sex with in the past 6 months? 3) How often did you use condoms in anal sex with men in the past 6 months? 4) What sexual role did you usually play in anal sex with men? 5) Have you ever had sex with a woman? For MNSM, 1) Have you ever had commercial sex with a woman in the past 3 months? 2) How many commercial female sex partners have you had in the past 3 months? 3) How often did you use condoms in sex with commercial female sex partners in the past 3 months?

We also asked questions on the awareness of HPV, HPV vaccine and acceptance of HPV vaccination. For MSM, we asked the following questions: 1) Have you heard of HPV before this study? 2) Have you ever tested for HPV? 3) Have you heard of HPV vaccine before this study? 4) Are you willing to purchase the HPV vaccine on your own? 5) If the HPV vaccine were provided free of charge to MSM, would you be willing to disclose your sexual orientation in order to get the vaccine? 6) At what age would you like to take the HPV vaccine? 7) Why would you decline the HPV vaccine? The first 6 questions had 2 choices: "Yes" and "No." The last question had 2 choices: "I have low risk for HPV infection" and "Other reasons." They are asked to write down the exact reason if they chose "Other reasons." For MNSM, we asked the same 7 question with question 5 worded as "If the HPV vaccine were provided free of charge to men, would you be willing to get the vaccine?" instead.

Statistical Analysis

A sample of 200 MSM and 200 MNSM was estimated to provide upper and lower 95% confidence intervals (CI) of between 2% and 7% around expected proportion of men having heard of HPV (15%). Sample characteristics were compiled using descriptive statistics. Proportions were used for categorical variables such as knowledge of HPV and attitudes toward the vaccine. Median and interquartile ranges (IQRs) were used for age of men and age stated by men for receiving free HPV vaccine. Chi-squared test was used to compare the willingness to take HPV vaccine between MSM and MNSM. Chi-squared test was also used to estimate differences in socio-demographic characteristics and view on HPV vaccination between men willing and not willing to take free HPV vaccine, with a p value <0.05 being regarded as statistically significant. Variables with a p value of <0.2 in chi-square tests were entered into a multivariate logistic regression model to explore factors associated with of the uptake of free HPV vaccine. A histogram was used to demonstrate the difference in HPV knowledge and acceptance of HPV vaccine, comparing MSM to MNSM. Statistical analyses were conducted using STATA 13.0 (StataCorp, Texas, USA).

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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