

Correlates of Incident Infections for HIV, Syphilis, and Hepatitis B Virus in A Cohort of Men Who Have Sex with Men in Beijing

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Abstract

Recent data suggest that the prevalence of HIV/syphilis infections among men who have sex with men (MSM) in China increased rapidly. This cohort study was to assess the correlates of the incident infections for HIV, syphilis, and hepatitis B virus (HBV) among sexually active and HIV-negative MSM in China. A cohort of 507 HIV-seronegative MSM was recruited from November 2006 to February 2007. Sociodemographics, sexual and drug use behaviors, uptake of HIV-prevention services, and HIV, syphilis, and HBV seroconversions were assessed at 6- and 12-month follow-up. The incidence rates were 2.6 per 100 person-years for HIV, 16.9 per 100 person-years for syphilis, and 3.3 per 100 person-years for HBV. Multivariate Cox regression analyses showed that syphilis infection (hazard ratio [HR] = 3.6; 95% confidence interval [CI]: 1.1–11.6) and no perceived risk of HIV infection (HR = 6.0; 95% CI: 1.6–22.7) were independently associated with HIV seroconversion. Predictors for syphilis seroconversion included less education (HR = 1.87; 95% CI: 1.1–3.3), found male sex partners through bathhouses/public washrooms/parks (HR = 2.19; 95% CI: 1.2–4.0), drank alcohol 4 or more times monthly (HR = 1.95; 95% CI: 1.1–3.6), and had sexually transmitted diseases (HR = 2.65; 95% CI: 1.5–4.5). The only predictor for incident HBV seroconversion was having more male sex partners in the past 3 months (HR = 11.8; 95% CI: 1.5–90.4). Alarming high incidence rates of HIV, syphilis, and HBV were found among MSM concurrently with high prevalent risky behaviors and low uptakes of health care services. The findings of this study underscore the urgent needs for a comprehensive intervention strategy to curtail the rapid spread of HIV, syphilis, and HBV.

Introduction

MEN WHO HAVE SEX WITH MEN (MSM) have been harshly and disproportionately impacted upon by HIV and continue to be a major driver for the HIV/AIDS epidemic in the world.^{1,2} In the United States, MSM accounted for approximately 45% of newly reported HIV/AIDS diagnoses in 2006 and nearly 54% of cumulative AIDS diagnoses.³ In Australia, New Zealand, and most western European countries, MSM contributed to as much as 70% of all HIV infections.⁴ In Indonesia, MSM represent 15% of reported AIDS cases, 29% in Singapore, 32% in Hong Kong, and 33% in the Philippines.⁵

In China, injection drug use (IDU) and commercial blood/plasma collection have been the major sources for HIV infection,^{6–8} however, the risk is increasingly attributable to unprotected sex, either through heterosexual contacts or unprotected homosexual sex between men, accounting for nearly half of all new infections in 2007.⁸ Recent data indicated an emerging epidemic among MSM in the main cities.^{9–17} According to the China Ministry of Health, 2–4% of adult males in China are primarily homosexual in their sexual behaviors which corresponds to 5–10 million men.¹⁸ Because of the large size of the population, the recent rapid increase of HIV prevalence in MSM in China could mean a new emerging HIV epidemic.

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Sexually transmitted diseases (STDs) have reemerged as a major public health problem in China three decades after their near elimination.^{19–21} Since the first resurgent cases of syphilis were recognized in China in 1979, the annual reported incidence (1/100,000) of syphilis increased from 0.02 in 1985, to 0.23 in 1990, and rapidly rose to 13.35 in 2006.²² Ulcerative STDs like syphilis are of particular concern, as they have been found to increase the likelihood of HIV infection by 2 to 5 times.^{23,24} HIV infection, in turn, may increase the acquisition of other STDs and alter the natural history and response to the standard therapy of ulcerative STDs, resulting in “epidemiologic synergy” between HIV and other STDs.^{25,26}

MSM are socially marginalized and a stigmatized group in Chinese society; the traditional Chinese culture does not openly endorse homosexual behaviors.^{27,28} Most MSM, under social pressure, hide their sexual orientation. Approximately one third are married and an even higher proportion of Chinese MSM have had sex with women.^{23,29} Whereas previous research provides only cross-sectional data on the incidence rates of HIV, syphilis and hepatitis B virus (HBV) infections,^{9,13,30–32} a limited number of cohort studies with small sample sizes and/or poor retention rates among MSM were conducted recently in China.^{33,34} This is the first cohort study among MSM in China to assess the correlates of HIV, syphilis, and HBV seroconversions among this group in Beijing.

Methods

Study design and participants

This study was carried out among MSM in Beijing, China. After a baseline survey was completed, the study participants were recruited through a website advertisement, experienced peer recruiters, and peer referrals from November 2006 to February 2007. All potential participants were assessed for the eligibility in a district HIV testing and counseling clinic in downtown Beijing. The recruiting criteria included that participants be male, HIV-seronegative, 18 or more years of age, have had sex with another male in the past 3 months, and willing to complete the follow-up study. A total of 541 MSM were assessed and screened, 507 of them were eligible and enrolled in the 12-month cohort study. All eligible participants were asked to return for evaluation at 6 and 12 months. A written informed consent was received from all agreed participants before interview. All participants then completed an HIV/STD risk assessment interview. Client-centered pre-testing counseling and risk reduction was provided on HIV/syphilis, HBV infections, and other STDs. Posttest counseling was provided when returned for their testing results. Results were provided anonymously with a preassigned unique code. All participants were offered 10 free condoms and 2 bottles of lubricant. The participants detected with HIV-infection were provided free clinical examination, CD4 cell counts, and viral load measurement, and referred to the local government ongoing HIV prevention, care, and treatment programs.

Treatment for hepatitis B and C infections were referred to the local hospitals and HBV vaccination were referred to local vaccination programs of local district Centers for Disease Control and Prevention (CDC). The study was approved by the Institutional Review Boards of both the National Center for AIDS/STD Control and Prevention of the China CDC and Vanderbilt University. A written procedure was followed in maintaining high retention rates at every 6-month follow-up

visit. At least two different contact sources were provided from all participants. Participant Information File System (PIFS) software program was utilized to manage the locator information. The follow-up visits were to be scheduled on the “scheduled date,” whenever possible. Appointment reminder procedures were followed at every 6-month follow-up visit.

Participant interview and data collection

Structured questionnaire-based interviews were carried out by the trained health professionals on a one-on-one basis in a private room. A unique and confidential identification code was assigned to each study participant. Data were collected including (1) sociodemographic information, e.g., age, residence, education, marital status, ethnicity, income, and housing status; (2) behavioral information, e.g., self-identified sexual orientation, the number of male sex partners, had sex with foreign male partners, participated in male group sex, had commercial sex with male partners, had unprotected anal intercourse with regular or casual male partners, had sex with female sex partners, frequency of alcohol intoxication, drug use, and diagnosed with any STDs; and (3) information on the received HIV-related prevention services, and received HIV counseling and testing in the past.

Laboratory tests

All blood samples were tested for HIV/syphilis and HBV infections. HIV infection was determined with an enzyme-linked immunosorbent assay (ELISA) (Beijing Wantai Biological Medicine Company, Beijing, China) screening and an HIV-1/2 Western blot confirmation (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Hepatitis B surface antigen (HBsAg) was tested with an ELISA (Beijing Wantai Biological Medicine Company). Syphilis was determined with an ELISA screening (Beijing Wantai Biological Production Company) and a confirmatory testing using a Passive Particle Agglutination Test for Detection of Antibodies to *Treponema pallidum* (TPHA™, OMEGA, UK).

Statistical analyses

Data were double examined with EpiData software (EpiData 3.0™ for Windows; The EpiData Association, Odense, Denmark). Statistical Analysis System (SAS 9.1™ for Windows; SAS Institute Inc., Cary, NC) was applied for all the analyses. HIV/syphilis and HBV incidence rates and their 95% confidence intervals (CIs) were analyzed with incidence density per 100 person-years of follow-up. Univariate Cox regression models were applied to assess the effect of both fixed covariates, e.g., gender, education, ethnicity, and marital status and time-dependent covariates, e.g., sexual behaviors. Variables that were significantly ($p < 0.05$) associated with time to seroconversion in the univariate analyses were included in the multivariate Cox regression models.

Results

The baseline participants

Of 507 eligible participants recruited, the median age was 26 years (from 18 to 62 years); 91.9% belonged to the Han ethnic group; and 72.3% received college or higher level education; 34.5% were Beijing residents; 67.1% single, 14.6%

married or cohabiting with female sex partners; the median monthly income was US\$300. Of the participants, 54.2% identified themselves as exclusively homosexual and 38.7% predominantly homosexual, whereas 7.1% identified as predominantly heterosexual with only incidental homosexual activities. The median number of male partners in a lifetime was 10. Of the participants, 40% ever received an HIV test and/or HIV-related intervention services. In the past 3 months, 72.6% sought male sex partners via the Internet; 4.1% had sex with foreign male partners; 7.3% had group sex with male sex partners; 6.3% had commercial sex with another male and 3.9% were money boys; 14.2% had sex with female partners; 21.1% drank alcohol 1 or more times per week in the past 3 months; and only 0.8% used illicit drugs (mainly ketamine and ecstasy). One third reported no perceived risk of HIV infection via unprotected sex in the past. In the past month, 21.3% and 15.0% of the participants had unprotected anal intercourse with regular and casual male sex partners, respectively; 7.1% had unprotected sex with female partners.

HIV, syphilis and HBV incidence rates and retention rate

Of 507 participants, the seroincidence rate was 2.6 per 100 person-years (95% CI: 1.1-4.1) for HIV during the 12-month follow-up, 16.9 per 100 person-years (95% CI: 12.4-21.3) for syphilis and 3.3 per 100 person-years (95% CI: 1.5- 5.1) for HBV. Of the 507 participants, 86.2% (437) were retained in the cohort at the 12-month follow-up visit. Analysis of HIV-1 sequence from the pol regions indicated that HIV-1 strains in these participants were 7 CRF01-AE and 2 CRF07-BC, respectively. And, no HIV drug resistance was found among HIV seroconversions.

Correlates for HIV, syphilis, and HBV seroconversions

Univariate Cox regression analyses indicated that several factors were significantly associated with HIV seroconversion, including less education, had commercial sex with men in the past 3 months, had no perceived risk of HIV infection via unprotected sex in the past 3 months, and had a syphilis infection (Table 1). The multivariate model identified two statistically significant risk factors for HIV seroconversion; no perceived risk of HIV infection via unprotected sex (HR = 6.00, 95% CI: 1.59-22.66) and having a syphilis infection (HR = 3.55, 95% CI: 1.08-11.63; Table 2).

Independent predictors for syphilis seroconversion included less education (HR = 1.87, 95% CI: 1.05-3.34; 12 years or less versus more 12 years of education), found male sex partners via bathhouse/public washroom/park in the past 3 months (HR = 2.19, 95% CI: 1.20-4.02), drank alcohol 4 or more times per month in the past 3 months (HR = 1.95, 95% CI: 1.06-3.57), and had any STDs diagnosed by a physician in the past (HR = 2.65, 95% CI: 1.54-4.54; Table 3). The only independent predictor for incident HBV seroconversion was having more male sex partners in the past 3 months (HR = 11.76, 95% CI: 1.53-90.41; ≥ 2 versus < 2 ; Table 2).

Discussion

This study indicates that the incidence rates for HIV, syphilis and HBV are alarmingly high among Beijing's MSM. These findings suggested that HIV, syphilis, and HBV are

spreading rapidly among MSM in Beijing. The high HIV incidence is similar to the rates estimated by BED-capture enzyme immunoassay among this group in our previous cross-sectional studies in Beijing in 2005 (2.9%, 95% CI: 1.0%-5.0%) and 2006 (3.6%, 95% CI: 1.3%-5.9%).¹³ HIV incidence rates in this study are also similar to the rates estimated in the two cohort studies in two major cities in The Netherlands³⁵ and the EXPLORE cohort study in six large cities in the United States,³⁶ where MSM continue to comprise the largest proportion of new HIV infections. So far, MSM have not contributed a large proportion of the HIV cases in China,³⁷ however, recent reports of high prevalence of HIV among MSM in Chongqing (10.8%) and Beijing (4.8%)^{9,12} signals that HIV has been introduced into the sexual networks of MSM in China. It seems that China is following the path of some of the other Asian countries where HIV-1 infection is no longer confined to historically high-risk populations.³⁸

The high prevalence of syphilis found in this study was consistent with other reports among MSM in different cities (6.9-19.1%) in China.^{17,30-32} The sero-incidence of syphilis in this study (16.9 per 100 person-years) was much higher than that among IDUs (4.7 per 100 person-years) and female sex workers (6.2 per 100 person-years) in China.³⁹ The present study found syphilis and no perceived risk of HIV infection via unprotected sex were independently associated with HIV sero-conversion. Two thirds of participants in this study have no perceived risk of HIV infection via unprotected sex, they could continue to engage in unprotected anal sex. More than half of the participants have never received a test for HIV. These findings underline the urgency of expanding more effective HIV-prevention measures, e.g., treatment of STDs as a measure of prevention for HIV, expanding HIV testing services accompanied by high-quality risk reduction counseling that includes an in-depth personalized risk assessment, clarification of risk perceptions, and negotiation of steps to reduce risks. High prevalence and incidence of syphilis among MSM demonstrated that a large number of MSM were participating in unprotected sexual behaviors that place them at high risk for HIV and other STDs.^{40,41} The epidemiologic synergistic relationship between STDs, particularly between ulcerative diseases like syphilis and HIV infection, have been evidenced.^{9,42} Syphilis is a disaster in China and many studies find syphilis and HIV co-infection among MSM. It is unclear whether syphilis here simply a marker of risk behavior or is amplifying HIV acquisition. The high sero-incidence of syphilis among MSM found in this prospective study suggested that prevalent risky sexual behaviors could be the major driver to fuel and amplify the rapid spread of HIV among this group. These findings underline the urgently needs integrated intervention efforts for controlling the epidemics of both HIV and syphilis.

Our study found predictors of syphilis seroconversion including the low levels of education, having found male sex partners via bathhouses, public bathrooms, parks, drinking alcohol 4 or more times per month, and having had an STD diagnosed by a clinic physician in the past. These findings suggest that prevention efforts should target those with less education and focus on MSM-frequented venues like bathhouses, public bathrooms, and parks via active outreach providing education materials, condom distribution and promotion, and effective behavioral intervention. One third of MSM reported having an STD diagnosed by clinic physicians

TABLE 1. FACTORS ASSOCIATED WITH HIV SEROCONVERSIONS IN A 12-MONTH FOLLOW-UP STUDY AMONG MEN WHO HAVE SEX WITH MEN IN BEIJING, CHINA

Factors		No. of seroconversions	Person-years	Incidence rate	HR (95% CI)	p Value
Age (years)	< 25	6	282.98	2.12	1.00	
	≥ 25	5	142.45	3.51	1.69 (0.52, 5.55)	0.3847
Ethnicity	Han	11	392.05	2.80	1.00	
	Minority	0	33.38	0	—	0.9941
Years of education	> 12	5	317.72	1.57	1.00	
	≤ 12	6	107.71	5.57	3.78 (1.15, 12.42)	0.0282
Beijing permanent residents	No	10	271.25	3.69	1.00	
	Yes	1	154.17	0.65	0.16 (0.02, 1.28)	0.0850
Married or cohabited with female sex partners	No	9	360.02	2.50	1.00	
	Yes	2	65.41	3.06	1.29 (0.28, 5.99)	0.7429
Living in own house or with parents	No	9	309.24	2.91	1.00	
	Yes	2	116.19	1.72	0.56 (0.12, 2.61)	0.4630
Monthly income, P3M ^a (median, US dollar)	≤ 300	7	210.63	3.32	1.00	
	> 300	4	214.80	1.86	0.54 (0.16, 1.86)	0.3329
Found male sex partners through Internet, P3M	No	2	165.00	1.21	1.00	
	Yes	9	260.42	3.46	2.95 (0.64, 13.68)	0.1660
Found male sex partners through bathhouse/public washroom/park, P3M	No	8	363.07	2.20	1.00	
	Yes	3	62.35	4.81	2.22 (0.59, 8.38)	0.2383
Number of male sex partners, P3M (median)	≤ 2	5	288.18	1.74	1.00	
	> 2	6	137.24	4.37	2.63 (0.80, 8.63)	0.1103
Participated in male group sex, P3M	No	11	414.47	2.65	1.00	
	Yes	0	10.96	0	—	0.9921
Had commercial sex with men, P3M	No	10	420.86	2.38	1.00	
	Yes	1	4.57	25.13	9.59 (1.22, 75.20)	0.0315
Had unprotected anal intercourse with regular male sex partners, P1M ^b	No	11	335.52	3.28	1.00	
	Yes	0	89.91	0	—	0.9906
Had unprotected anal with casual male sex partners, P1M	No	9	396.36	2.27	1.00	
	Yes	2	29.07	6.88	3.45 (0.74, 16.06)	0.1151
Had unprotected sex with regular female sex partners, P1M	No	10	401.46	2.49	1.00	
	Yes	1	23.96	4.17	1.78 (0.23, 13.88)	0.5843
Had unprotected sex with casual female sex partners, P1M	No	11	414.39	2.65	1.00	
	Yes	0	11.04	0	—	0.9945
Drank alcohol, P3M (times/month)	< 4	9	345.27	2.61	1.00	
	≥ 4	2	80.15	2.50	1.00 (0.22, 4.63)	1.0000
Perceived risk of HIV infection	Yes	3	293.22	1.02	1.00	
	No	8	132.21	6.05	6.21 (1.65, 23.43)	0.0070
Diagnosed any sexually transmitted diseases in the past	No	6	293.55	2.04	1.00	
	Yes	5	131.88	3.79	1.82 (0.55, 5.96)	0.3240
Syphilis infection	No	6	347.50	1.73	1.00	
	Yes	5	77.93	6.42	3.74 (1.14, 12.26)	0.0293
Received HIV-intervention services in the past	No	7	270.61	2.58	1.00	
	Yes	4	154.82	2.58	1.03 (0.30, 3.53)	0.9595
Received a test for HIV in the past	No	5	215.18	2.32	1.00	
	Yes	6	210.25	2.85	1.20 (0.37, 3.93)	0.7651

^aIn the past 3 months.^bIn the past 1 month.

HR, hazard ratio; CI, confidence interval.

TABLE 2. FACTORS ASSOCIATED WITH HIV AND SYPHILIS SEROCONVERSIONS IN A 12-MONTH FOLLOW-UP STUDY OF MEN WHO HAVE SEX WITH MEN IN MULTIVARIATE COX REGRESSION MODELS

Factors		<i>Model 1 HIV seroconversion</i>		<i>Model 2 Syphilis seroconversion</i>	
		<i>HR (95%CI)</i>	<i>p Value</i>	<i>HR (95%CI)</i>	<i>p Value</i>
Years of education	> 12			1.00	
	≤ 12			1.87 (1.05, 3.34)	0.0328
Found male sex partners through bathhouse/ public washroom/park, P3M	No			1.00	
	Yes			2.19 (1.20, 4.02)	0.0110
Drank alcohol, P3M (times/month)	< 4			1.00	
	≥ 4			1.95 (1.06, 3.57)	0.0317
Diagnosed any sexually transmitted diseases in the past	No			1.00	
	Yes			2.65 (1.54, 4.54)	0.0004
Perceived risk of HIV infection	Yes	1.00			
	No	6.00 (1.59, 22.66)	0.0082		
Syphilis infection	No	1.00			
	Yes	3.55 (1.08, 11.63)	0.0367		

HR, hazard ratio; CI, confidence interval.

in this study, in general practice, and even in STD clinics; Chinese physicians do not always test for syphilis and rarely recommend a test for HIV. This emphasizes the need for training physicians in providing accurate STD screening, standard care, and treatment for MSM in China to reduce the risk for HIV acquisition or transmission.

Drug abuse is prevalent among MSM in Western countries and often account for a major risk for HIV spread in this population. Illicit drug use is less common among Chinese MSM,^{9,13,17} however, our study found a high prevalence of alcohol use among this group that contributed to high rates of syphilis incident infections. In light of the rapid development of the economy and urbanization, alcohol production and consumption and numbers of admitted patients with alcohol-related physical and mental diseases have increased steadily.^{43,44} Studies have indicated that individuals who drink more heavily are more likely to have multiple sexual partners and are less likely to use condoms consistently.^{45,46} These reports are consistent with the findings in this study and suggest that the intervention efforts targeted at MSM also need to directly address the use of alcohol in China.

The high incidence and prevalence rates of serological markers of HBV also indicated that this group was at risk of transmitting HBV. Hepatitis B among MSM should be an eminently preventable infection because of available of the effective vaccine.⁴⁷ This study did not examine coverage of HBV vaccination; however, we believe that innovative means of reaching this group for vaccination should be highlighted. HBV vaccination for HBV negative participants in this study were referred to local vaccination clinic of local district CDC. The high incidence of HBV and prevalent multiple sexual partners highlighted that HBV vaccination for MSM should be routinely offered as intervention strategy to control the epidemic of HBV among this group. These findings underline the urgency for comprehensive better targeted intervention to control the emerging epidemics of HIV, syphilis and HBV among this high-risk group.

We recognized the limitations of this study. Our subject recruitment using multiple methods did not guarantee a

representative sample of all MSM in the community. Selection bias might lead to overestimation or underestimation of the true incidence rates for HIV, syphilis and HBV. Our group is continuing this cohort study with an improved research design and to steer future research efforts toward innovative interventions for MSM in China. We believe that the data will help guide public health planning, prevention measures and clinical research planning, and help mobilize health professionals and non-governmental organizations to control the rapid rise of HIV, syphilis, HBV, and other STDs among MSM.

International dynamic trends on HIV incidence are inconsistent.⁴⁸⁻⁵¹ Many factors may explain the different causes for the observed dynamic changes of HIV incidence in one geographical area but not another while seemingly sharing facilitating cofactors such as surges in unsafe anal sex with the coexistence of STD epidemics. China has scaled up the effort to tackle the epidemic among MSM group. However, the low uptake of prevention services remains an immense challenge with MSM. This study found that more than half of the participants had never received HIV-related prevention services and had never received HIV counseling and testing; therefore, a large proportion of MSM are unaware of their HIV serostatus. Clearly, persons who are unaware of their infection cannot take steps to reduce transmission to others or facilitate testing of partners who might also be infected. HIV counseling and testing plays a pivotal role in the public health response to the HIV epidemic and is a vital point of entry to HIV/AIDS prevention services and attendant "positive prevention."⁵² The majority of persons who are aware of their HIV-positive status reduce sexual behaviors that might transmit HIV and take advantage of effective therapies.⁵³

"For too long, AIDS activists, academics, and national and international institutions have given insufficient emphasis to aligning prevention priorities with epidemic transmission dynamics."⁵⁴ Such is the case with current HIV intervention efforts for MSM in China. High incidence rates of HIV, syphilis and HBV, together with prevalent risky sexual behaviors and low uptake of HIV-prevention services indicated

TABLE 3. FACTORS ASSOCIATED WITH SYPHILIS SEROCONVERSIONS IN A 12-MONTH FOLLOW-UP STUDY AMONG MEN WHO HAVE SEX WITH MEN IN BEIJING, CHINA

Factors		No. of seroconversions	Person-years	Incidence rate	HR (95% CI)	p Value
Age (years)	< 25	40	210.40	19.01	1.00	0.1995
	≥ 25	15	116.22	12.91	0.68 (0.38, 1.23)	
Ethnicity	Han	51	298.97	17.06	1.00	0.7758
	Minority	4	27.65	14.47	0.16 (0.42, 3.21)	
Years of education	> 12	33	254.38	12.97	1.00	0.0014
	≤ 12	22	72.23	30.46	2.41 (1.41, 4.14)	
Beijing permanent residents	No	38	204.07	18.62	1.00	0.2950
	Yes	17	122.54	13.87	0.74 (0.42, 1.30)	
Married or cohabited with female sex partners	No	45	278.79	16.14	1.00	0.4432
	Yes	10	47.83	20.91	1.31 (0.66, 2.59)	
Living in own house or with parents	No	40	237.83	16.82	1.00	0.9902
	Yes	15	88.78	16.90	1.00 (0.55, 1.82)	
Monthly income, P3M (median, US dollar)	≤ 300	28	175.49	15.96	1.00	0.6828
	> 300	27	151.12	17.87	1.12 (0.66, 1.89)	
Found male sex partners through Internet, P3M	No	16	118.69	13.48	1.00	0.2470
	Yes	39	207.93	18.76	1.41 (0.79, 2.52)	
Found male sex partners through bathhouse/public washroom/park, P3M	No	40	281.35	14.22	1.00	0.0042
	Yes	15	45.27	33.13	2.38 (1.31, 4.31)	
Number of male sex partners, P3M (median)	≤ 2	33	233.61	14.13	1.00	0.0552
	> 2	22	93.01	23.65	1.70 (0.99, 2.91)	
Participated in male group sex, P3M	No	53	318.97	16.62	1.00	0.5014
	Yes	2	7.64	26.18	1.62 (0.40, 6.66)	
Had commercial sex with men, P3M	No	52	323.28	16.08	1.00	0.0014
	Yes	3	3.33	90.09	6.78 (2.09, 21.95)	
Had unprotected anal intercourse with regular male sex partners, P1M	No	45	257.11	17.50	1.00	0.5921
	Yes	10	69.51	14.39	0.83 (0.42, 1.64)	
Had unprotected anal with casual male sex partners, P1M	No	52	308.42	16.86	1.00	0.9783
	Yes	3	18.20	16.48	0.98 (0.31, 3.15)	
Had unprotected sex with regular female sex partners, P1M	No	54	303.41	17.80	1.00	0.1600
	Yes	1	23.20	4.31	0.24 (0.03, 1.75)	
Had unprotected sex with casual female sex partners, P1M	No	52	318.54	16.32	1.00	0.1544
	Yes	3	8.08	37.13	2.33 (0.73, 7.46)	
Drank alcohol, P3M (times/month)	< 4	38	267.16	14.22	1.00	0.0135
	≥ 4	17	59.46	28.59	2.06 (1.16, 3.65)	
Perceived risk of HIV infection	Yes	36	229.12	15.71	1.00	0.4332
	No	19	97.49	19.49	1.25 (0.72, 2.18)	
Diagnosed any sexually transmitted diseases in the past	No	31	246.82	12.56	1.00	0.0010
	Yes	24	79.8	30.08	2.44 (1.43, 4.16)	
Received HIV-related prevention services in the past	No	32	212.29	15.07	1.00	0.3053
	Yes	23	114.33	20.12	1.32 (0.77, 2.26)	
Received a test for HIV in the past	No	20	175.90	11.37	1.00	0.0103
	Yes	35	150.72	23.22	2.05 (1.19, 3.56)	

HR, hazard ratio; CI, confidence interval.

that HIV, syphilis and HBV rapidly spread among Beijing's MSM. The findings of this study highlighted that an effective multicomponent biomedical and behavioral intervention strategy is needed urgently, including education about appropriate health-seeking behavior,⁵⁵ the promotion of condom use through enhancing peer norms within MSM networks,⁵⁶ HIV prevention on the Internet due to China has hundreds of MSM websites, expanded testing for HIV, syphilis and HBV, actively bridging to care and treatment for HIV-infected individuals and HBV vaccination for HIV-negative individuals, along with alcohol control and harm reduction. The innovative prevention measures for HIV transmission reduction, e.g., preexposure prevention (PrEP), ART for prevention, should be examined in the context of Chinese MSM. Reducing stigma associated with homosexuality should be one of key components in improving health care engagement. The control strategy should also be responsive to the current behavioral risk patterns and transmission dynamics of epidemics of HIV, HBV, and other STDs.

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