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A Prospective Cohort Study among Migrant Men Who have Sex with Men in Beijing, China

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ABSTRACT

Objectives: The purpose of the study was to investigate the incidence of HIV and syphilis and their related factors, as well as to examine the predictors associated with seroconversion among migrant men who have sex with men in Beijing, China.

Design: Prospective cohort study.

Setting: Yunnan, China.

Participants: 511 HIV-negative migrant MSM.

Outcome measures: HIV and syphilis incidence rates, factors associated with HIV/syphilis seroconversion and cohort retention.

Results: Of the 511 participants, 60.3% (308) and 52.4% (273) were retained at the four-month and eight-month follow-up visits, respectively. The HIV and syphilis incidence rates were 7.83 (95% CI 4.48 to 12.72) and 11.11 (95% CI 6.47 to 17.80) cases per 100 person-years, respectively. HIV seroconversion was significantly associated with having first anal intercourse at 15 or younger (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56) and ever had group sex (aHR = 4.30, 95% CI 1.40 to 13.18). Bisexual orientation (aHR = 5.09, 95% CI 1.02 to 25.57) was negatively associated with syphilis seroconversion. Predictors associated with both four-month and eight-month retention rates included age ≥ 25 years old and living in Beijing for more than one year.

Conclusions: The high incidence of HIV and syphilis among migrant MSM are cause for concern. A comprehensive strategy should be implemented to maintain a higher retention rate among migrant MSM.

Strengths and limitations of this study

- First cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing.
- Cox regression analysis and stepwise multiple logistic regression were used to identify factors associated with

HIV/syphilis seroconversion and cohort retention, respectively.

- Retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between those retained in the study and those lost to follow-up.
- Sampling methods may have led to selection bias.
- No outflow population was included, and the proportions of migrants from different provinces varied, which lead to difficulty of generalization of the data.

INTRODUCTION

In China, sexual transmission has become the major route for HIV transmission in the last decade.[1] As an increasing proportion of people living with HIV/AIDS (PLWHA), cases attributed to MSM transmission rose from 7.3% in 2005 to 11% in 2007. The 2011 HIV epidemic assessment report showed that among the estimated 780,000 people living with HIV/AIDS, homosexual contact accounted for 17.4% of infections, with an increase from 14.7% in 2009.[2] A growing number of studies have revealed the upward trend of HIV prevalence among MSM in different parts of China. For example, the prevalence increased from 10.4% in 2006 to 12.5% in 2007 in Chongqing,[3] from 0.4% in 2004 to 5.8% in 2006 in Beijing,[4] and from 5.7% in 2007 and 6.2% in 2008 to 8.1% in 2009 in Shenyang.[5]

In recent years, there is growing awareness that internal migration within China may be shifting the HIV epidemic by broadening social and sexual mixing.[1] Data from national behavioral surveillance during 2004-2005 showed that migrant HIV/AIDS cases accounted for more than 50% of total infections in nine different provinces.[6] Moreover, studies implemented among MSM in metropolises also revealed a high proportion of migrants among MSM, such as in Beijing (88%),[7] Chongqing (80.3%)[3] and Shanghai (79.7%).[8] Although migration itself does not spread HIV and other sexually transmitted diseases (STD), it may increase the possibility of infection when combined with high risk behaviors, which are prevalent among MSM. It has been confirmed in numerous studies that high risk behaviors such

as unprotected anal sex, commercial sex, group sex, casual sex and having multiple sexual partners were prevalent among MSM in China.[9-11] On the other hand, perceived stigma and discrimination due to traditional Chinese culture and conservative social values have increasingly led Chinese MSM to disguise their sexual orientation with matrimony, which leads to a potential risk of transmitting HIV to the general population via heterosexual transmission.[10] As for migrants, without the stability of family or a home community and with low educational levels, limited knowledge about HIV/AIDS prevention, and discrimination and marginalization from the mainstream metropolitan society, high risk behaviors may happen more frequently.[12, 13] Furthermore, due to China's household registration system and urban social security system, migrants have limited access to comprehensive, convenient and long-term health services.[14] Recently, some cross-sectional studies in China demonstrated that compared to local MSM, migrant MSM engage in more high risk sexual behaviors such as multiple sexual partners, higher frequencies of anal and oral intercourse, and unprotected sexual behaviors with males and females.[11, 15] As a marginal and vulnerable subpopulation, migrant MSM should be accorded a high level of consideration by researchers.

Beijing, the capital of China and a center of political, economic and cultural activity, is a magnet for the migrant population. In 2009, Beijing's metropolitan population included some 72.6 million migrants, and the migrant population accounted for 70% of the population increase from 2006 to 2009 (China National Bureau of Statistics, 2009). According to statistics from the Beijing Municipal Bureau of Health, 4722 (73.98%) HIV/AIDS cases from the cumulative data were from domestic provinces, and 44% of the 501 new HIV/AIDS cases in the first five months of 2009 were among male homosexuals.[16] In addition, prior research among MSM in Beijing revealed that with the increasing epidemic of HIV among MSM in recent years, the number of migrants among recruited participants also showed a remarkable upward trend.[4, 7] This phenomenon implies that: 1) migrant MSM play a main role in the MSM sphere in Beijing, 2) this marginal population emerged gradually with the constant improvement of sampling methods, and 3) more targeted studies of this subpopulation are urgently needed, while at present only a few cross-sectional

studies have been conducted to investigate its HIV/STD infections and relative risk factors.[17, 18] Thus, the purpose of this research was to assess the incidence of HIV and syphilis and examine the predictors associated with seroconversion and retention in a prospective cohort study among migrant MSM in Beijing, China.

METHODS

Study Design and Study Population

This prospective cohort study was conducted in Beijing, the capital of China. Participants were recruited through three methods. First, study participants were recruited directly through website advertisements by a nongovernmental AIDS volunteer group (http://www.hivolunt.net). Second, peer recruiters were hired and trained to distribute flyers with study-related information at MSM-frequented venues (e.g., MSM clubs, bars, parks and bathhouses). Thirdly, study participants were encouraged to refer their peers to enroll in the study. Once a potential participant had been referred or identified, local research team members approached the individual to verify eligibility, which included age ≥18 years old, male individual, HIV-negative, had sex with another male in the past 12 months, lacked permanent household registration in Beijing and provided written informed consent. A total of 547 participants were screened during the baseline screening survey from September to October 2009, of whom 36 were HIV-positive. Thus a total of 511 eligible and consenting MSM were enrolled into the prospective cohort. Participants were followed up for four and eight months after the baseline survey. At each study visit (baseline, four-month follow-up and eight-month follow-up), eligible participants were interviewed by trained health professionals in a private room of the study clinic, and blood plasma specimens were collected and analyzed for HIV and syphilis antibodies by experienced physicians. One week later, each participant received their test results anonymously by a private identification code. All participants who tested positive for HIV/syphilis received additional posttest counseling and referrals to relevant free services. Every participant received 50 RMB (7.4 USD), 12 free condoms and one free lubricant after each completed study visit.

Every participant was asked to provide at least two different and current contact sources, and reminder calls were made before the follow-up day to verify that the exact time of the visit would be convenient for them. The study protocol and informed consent forms were approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention of the China Center for Disease Control and Prevention.

Data Collection and Laboratory Tests

Questionnaire-based interviews were conducted on a one-on-one basis in a separate private room of the district clinic. Data on demographics, sexual behavior and history of sexually transmitted diseases (STDs) were collected. Participants' questionnaires and blood specimens were linked through assignment of a unique identifier code in the follow-up visits.

Blood specimens were tested for HIV and syphilis infections. The HIV infection status was screened by an ELISA (InTec Products Company, Xiamen, China) screening, and confirmed by a HIV-1/2 Western Blot (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Syphilis infection was determined by a rapid plasma reagin (RPR) test (Shanghai Rongsheng, Shanghai, China), and confirmed using Treponema pallidum particle assay (TPPA) test (Fujirebio Inc, Tokyo, Japan).

Statistical Analysis

Questionnaire data were double-entered and then checked for accuracy using Epi Data software (The Epi Data Association Odense, Denmark, version 3.1). Data were analyzed using Stata/SE (StataCorp LP, USA, version 12.0 for Windows). HIV seroconversion was estimated to have occurred at the midpoint between the time of baseline HIV test and the time of the follow-up HIV test with a seropositive result. Syphilis seroconversion was estimated to have occurred at the midpoint between the time of a confirmed seronegative and the time of a confirmed seropositive.

HIV/syphilis incidence density was calculated based on a Poisson distribution, with number of seroconversions within the follow-up period as the numerator and person-years (PY) over the entire follow-up period as the denominator. Categorical factors associated with retention rate were analyzed by univariate logistic regression, including baseline demographic and behavioral characteristics. A stepwise multiple logistic regression (out 0.05, in 0.02) was used to select independent factors for the retention rate. A Cox regression model was used in univariate and multiple regression analyses to identify correlates of time to HIV seroconversion. Statistically significant variables in univariate analysis were entered simultaneously into a multivariate Cox proportional hazard regression model to determine the adjusted hazard ratio (aHR) for HIV/syphilis seroconversion-related risk factors.

RESULTS

Baseline Characteristics of the Participants

A total of 547 participants were screened at baseline; 36 (6.58%) were HIV antibody seropositive and syphilis prevalence was 29.62%. Finally, 511 participants were HIV seronegative and eligible to continue the study. Of them, 27.59% were syphilis seropositive.

Of 511 participants, the median age was 29 years; 94.32% belonged to the Han ethnic group; 64.77% were single, 22.90% were married or cohabiting, and 12.33% were separated or divorced or widowed. For education level, 73.19% had received a high school education or lower. About half (54.01%) had monthly incomes < 300US$. Participants who identified themselves as exclusively homosexual or bisexual accounted for 60.67% and 37.57%, respectively. A total of 16.05% and 44.03% of the participants thought it was impossible or improbable they would be infected with HIV, respectively. The median age of sexual debut was 20 years, and 58.71% experienced their sexual debut with a male. The median age of first anal intercourse was 22, and 58.65% of them did not use a condom at first anal intercourse. In the past year, 78.67% of the participants had ever received condoms, 65.17% had ever received lubricant, 23.68% had

ever taken part in peer education, 18.40% had ever received examination or treatment for STDs and 52.49% had ever received voluntary counseling and testing services (VCTs).

Regarding behaviors in the past six months among participants, the median number of male sex partners was three. For high risk behaviors, 327 (63.99%) had oral sex with male sex partners, 22 (6.73%) of them had consistent condom use with regular sex partners, and 26 (7.95%) with casual partners; 511 (100%) had anal sex with male sex partners, 13.11% of them had consistent condom use with regular sex partners, and 66 (18.70%) with casual partners. A total of 61 (11.94%) participants had ever engaged in commercial sexual behavior, among whom 35 (57.38%) had paid for sex and 43 (70.49%) received money. A total of 59 (11.55%) had ever engaged in group sex, which happened almost exclusively (96.61%) among males. A total of 166 (32.49%) had ever engaged in sex under the influence of alcohol, among whom 152 (92.77%) had homosexual intercourse while intoxicated (table 1).

Table 1 Sociodemographic characteristics of the 547 study participants in the cohort of migrant MSM in Beijing

Variables	n	%
Overall, N	547	100
Age (median, years)	29	-
18-24	149	29.16
≥25	362	70.84
Ethnicity		
Han	482	94.32
Minority	29	5.68
Marital status		
Single	331	64.77
Married	114	22.31
Cohabiting with male or female sex partner	3	0.59
Separated or divorced or widowed	63	12.33
Duration of stay in Beijing		
< 1 year	173	33.85
≥ 1 year	338	66.14
Education level		
High school and below	374	73.19
College and above	137	26.81
Monthly income (US$)		
< 300	276	54.01

≥ 300	235	45.99
Self-reported sexual orientation		
Homosexual	310	60.67
Heterosexual	8	1.57
Bisexual	192	37.57
Other	1	0.2
Self-reported risk of HIV infection		
Impossible	82	16.05
Improbable	225	44.03
Possible	74	14.48
Probable	15	2.94
No idea	115	22.5
Age of sexual debut (median,years)	20	
Gender of first sexual partner		
Male	300	58.71
Female	211	41.29
Age of first anal intercourse(median, years)	22	
Number of male sex partners in the last 6 months (median)	3	
Number of female sex partners in the last 6 months (median)	0	
Oral sex with regular partners with a consistent condom use in the past 6 months	22	6.73
Oral sex with casual partners with a consistent condom use in the past 6 months	26	7.95
Anal sex with regular partners with a consistent condom use in the past 6 months	67	13.11
Anal sex with casual partners with a consistent condom use in the past 6 months	66	18.7
Ever had commercial sexual behavior	61	11.94
Ever had group sex	59	11.55
Alcohol use prior to sex	166	32.49
Have ever received condoms	402	78.67
Have ever received lubricant	333	65.17
Have ever received peer education	121	23.68
Have ever received examination or treatment for STD	94	18.4
Have ever received voluntary counseling and testing (VCT) services	268	52.45
Have ever received educational materials on AIDS/STD	302	59.1

MSM, men who have sex with men; STD, sexually transmitted disease.

Incidence of infections of HIV, syphilis and factors predicting HIV and syphilis seroconversion

During the eight-month follow-up, 16 HIV seroconversions were observed over 204.27 person-years of observation, resulting in an incidence rate of 7.83 per 100 person-years (PY) (95% CI 4.48 to 12.72). At the four-month visit, the incidence of HIV was 8.33 per 100 PY (95% CI 3.81 to 15.81) and at the eight-month visit it was 3.83 per 100 PY (95% CI 1.54 to 7.89). During the eight-month follow-up period, syphilis incidence was 11.11 per 100 PY (95% CI

6.47 to 17.80). At the four-month and eight-month visits, the syphilis incidence was 10.03 per 100 PY (95% CI 4.33 to 19.76) and 15.25 per 100 PY (95% CI 6.97 to 28.94), respectively (table 2).

Table 2. Univariate and multivariate analyses of participant characteristics associated with incident HIV infection among migrant MSM in Beijing.

Factors	No. of HIV seroconversions	Cumulative PY	HIV incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	16	204.27	7.83				
Education							
Junior college and below	13	143.95	9.03	1.00			
Above junior college	3	60.32	4.97	0.56(0.16 to 1.98)	0.370		
Seeking partner through Internet							
NO	12	109.45	10.96	1.00			
YES	4	94.81	4.22	0.39(0.12 to 1.20)	0.100		
Age of first anal intercourse (median,years)							
≥15	14	200.99	6.97	1.00		1.00	
<15	2	3.28	60.98	8.28(1.88 to 36.46)	0.005	9.20(1.94 to 43.56)	0.005
Ever had group sex							
NO	11	183.48	6	1.00		1.00	
YES	5	20.78	24.06	3.95(1.37 to 11.38)	0.011	4.30(1.40 to 13.18)	0.011
Knowledge of HIV/AIDS was acquired from							
Media							
NO	12	109.65	10.94	1.00			
YES	4	94.62	4.23	0.39(0.12 to 1.20)	0.100		
Internet							
NO	6	108.59	5.53	1.00			
YES	10	95.68	10.45	0.38(0.12 to 1.19)	0.097		

PY, person-years; HR, hazard ratio.

Multivariate Cox regression analyses indicated that age ≤ 15 years old at first anal intercourse (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56, p=0.050) and ever had group sex (aHR=4.30, 95% CI 1.40 to 13.18, p=0.011) were significantly associated with time to HIV seroconversion. For syphilis incidence, bisexual orientation (aHR=5.09, 95% CI 1.02 to 25.57, p=0.048) was significantly identified as a risk factor (table 3).

Table 3. Univariate and multivariate analyses of participant characteristics associated with incident syphilis infection among migrant MSM in Beijing.

Factors	No. of syphilis seroconversions	Cumulative PY	Syphilis incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Self-reported sexual orientation							
Homosexual	9	96.89	9.29	1.00			
Heterosexual	0	1.42	0	-			
Bisexual	8	54.64	14.64	5.56(1.10 to 27.05)	0.038	5.09(1.02 to 25.57)	0.048
Other	0	0	-	-			
Number of female sex partners in the last 6 months (median)							
0	16	149.9	10.67	1.00			
≥2	1	3.05	32.79	9.22(1.13 to 75.37)	0.038		
Seeking partners in bar/dancing hall/tearoom/chamber							
NO	11	129.41	8.5	1.00			
YES	6	23.55	25.48	3.12(0.75 to 13.07)	0.119		

Predictors of cohort retention

Of the 511 participants, 60.3% (308) were retained in the cohort at the four-month follow-up and 52.4% (273) were retained at the eight-month follow-up.

Univariate factors among baseline characteristics which were significantly associated with four-month retention were analysed with stepwise multiple logistic regression. Four factors were kept in the final model, including age > 25 years old (adjusted odds ratio (AOR) = 1.81, 95% CI 1.07 to 3.06, p = 0.026), living in Beijing for more than one year (AOR = 3.68, 95% CI 2.04 to 6.64, p < 0.001), had at least one female sex partners in the last six months (AOR = 0.48, 95% CI 0.29 to 0.80, p=0.005), and had ever received VCTs in the past 12 months (AOR =1.71, 95% CI 1.07 to 2.72, p<0.024) (table 4).

Table 4. Factors Associated With Four-Month Retention Rate in a Cohort Study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis.

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value

Age						
18-24	149	46.98(70)	1.00		1.00	
≥25	362	65.75(238)	2.17(1.47 to 3.19)	<0.001	1.81(1.07 to 3.06)	0.026
Duration of stay in Beijing						
< 1 year	95	34.74(33)	1.00		1.00	
≥ 1 year	416	66.27(208)	3.66(2.29 to 5.85)	<0.001	3.68 (2.04 to 6.64)	<0.001
Number of female sex partners in the last 6 months						
0	382	64.66 (247)	1.00		1.00	
≥1	129	47.29 (61)	0.49(0.33 to 0.74)	0.001	0.48(0.29 to 0.80)	0.005
Have received voluntary counseling and testing (VCT) service in the past 12 months						
No	243	51.85 (126)	1.00		1.00	
Yes	268	67.91 (182)	1.97(1.37 to 2.81)	<0.001	1.71(1.07 to 2.72)	0.024

For eight-month retention, age> 25 years old (AOR = 1.76, 95% CI 1.16 to 2.68, p = 0.008), living in Beijing for more than one year (AOR = 1.68, 95% CI 1.03 to 2.73, p = 0.039), first sexual partner was female (AOR = 0.60, 95% CI 0.41 to 0.88, p = 0.009), ever had group sex (AOR = 0.50, 95% CI 0.28 to 0.89, p = 0.019), and had received lubricant in the past 12 months (AOR = 2.31, 95% CI 1.56 to 3.42, p < 0.001) were retained in the final model using stepwise multiple logistic regression analysis (table 5).

Table 5. Factors Associated With Eight-Month Retention Rate in a Cohort Study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis.

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	44.30(66)	1.00		1.00	
≥25	362	57.18(207)	1.68(1.14 to 2.47)	0.008	1.76(1.16 to 2.68)	0.008
Duration of stay in Beijing						
< 1 year	78	48.72 (38)	1.00		1.00	
> 1 year	338	58.88 (199)	2.17(1.37 to 3.43)	<0.001	1.68 (1.03 to 2.73)	0.039
Gender of the first sexual partner						
Male	300	58.33 (175)	1.00		1.00	
Female	211	46.45 (98)	0.62(0.43 to 0.88)	0.008	0.60 (0.41 to 0.88)	0.009
Ever had group sex						
NO	452	54.87 (248)	1.00		1.00	
YES	59	42.37 (25)	0.61(0.35 to 1.05)	0.072	0.50 (0.28 to 0.89)	0.019
Have received lubricant in the past 12 months						
NO	109	34.86 (38)	1.00		1.00	

YES	402	58.46 (235)	2.59(1.78 to 3.77)	<0.001	2.31 (1.56 to 3.42)	<0.001

DISCUSSION

Our study found that the prevalence of HIV (6.58%) among migrant MSM was at a high epidemic level, which was highlighted in comparison to that of the migrant population (0%) in Beijing.[19] Additionally, it was higher than the 4.8% in 2007 among general MSM in Beijing.[20] Although it was lower than 8.0% in 2009, the proportion of the migrant population was also as high as 88%.[7] A similar result (5.9%) was found in a recent cross-sectional study among migrant MSM.[17] Incidence in this subgroup (7.83/100PY) was consistent with that of migrant MSM (8.51/100PY) in a MSM cohort study in Beijing, and higher than the incidence of permanent resident MSM.[21] It was also higher than the incidence of general MSM in different parts of China.[22, 23]

The study found that participants whose first anal intercourse occurred before age 15 had significantly higher risk for HIV seroconversion. An American study of young minority MSM found that study participants who had an MSM sexual debut before 16 years old were more likely to have psychological problems and high risk behaviors like exchanging sex and drug use.[24] Early sexual debut would have a deep and long-term influence on an individual's developing sexual concept, but appropriate sex-education has generally been shunned in traditional Chinese education. Our study indicated that early sex-education should target young people to delay the age of first sexual activity. Another risk factor significantly associated with HIV incidence was ever had group sex. An explanation of this observation is that psychological stress caused by stigma and discrimination hinders the development of longer-term relationships between MSM,[25] and having sex with multiple sex partners increases the chance of HIV transmission. This indicates a need for confidentiality and support services for migrant MSM. Serious attention should be paid to the prevalence of STDs. The prevalence rate of syphilis (29.62%) was higher than those of previous studies conducted among MSM in Beijing, such as 19.8% in 2007,[20] and 22.0% in 2009.[7] It was also higher than those of MSM from many other

provinces.[23, 26] The incidence of syphilis (11.11/100PY) was also at an extremely high level compare to 8.06/100PY in a cohort study among MSM during the same period in 2009.[21] High prevalence of syphilis among MSM was a common risk factor for encouraging HIV infection because of the biological and behavioral links between syphilis and HIV.[27] The multiple analyses significantly revealed self-identified bisexuals were five times more likely than homosexuals to be infected with syphilis. One major reason for this outcome could be that bisexuals may have more varied sexual behaviors with a wider range of sexual partners, including males and females. In addition, a cross-sectional study among young migrant MSM in Beijing discovered that MSM who were engaged in bisexual behavior had a higher rate of unprotected sex with stable female partners and were less likely to take part in prevention behaviors,[18] which was consistent with our finding that those who had at least one female sex partner and those whose first sexual partner was female were significantly more likely to be lost at four-month and eight-month follow-up visits respectively. Moreover, only 18.4% of the participants received examination or treatment for sexually transmitted diseases in the past 12 months, which may be caused by the high cost of health services and low coverage of health insurance for the migrant population.[14] Low risk-awareness might be another reason for their lower access to HIV/STD test and treatment. All of these emphasize an urgent need for widespread and accurate syphilis screening and affordable treatment for migrant MSM in Beijing.

In our study, the retention rate was lower than in previous cohort studies implemented among general MSM in Beijing (86.2% in 2007, 86.8% in 2009).[21, 22] From the multiple analyses, participants who were less than 25 years old were more likely to be lost at both four-month and eight-month follow-up visits. Similar problems have occurred among studies of young MSM in the US.[28] A plausible reason for this observation was that many young people in China have poor knowledge of safe sexual behaviors. Traditional interventions are more pragmatic but less attractive and appropriate for young people. A qualitative investigation implemented among young MSM in Milwaukee and Detroit offered some new approaches, such as that HIV prevention efforts should be embedded in the context of broader life

and relationship issues facing young MSM.[29] As differences almost certainly exist between young Chinese and American MSM, predictors of retention among young MSM in Beijing deserve further discussion.

As for positive predictors, we found those who had been in Beijing for more than one year or who had received condoms or lubricant were more likely to be maintained in this cohort. A similar result was discovered in Yangzhou.[30] Migrant MSM who stay longer in Beijing may have more chances to receive effective and stable intervention services, and their potential impact on increasing awareness of self-protection would encourage them to pay closer attention to advances in research. As a result, migrants may be more likely to remain with the investigation to show their support. From the results of our study, the coverage of intervention on this population was limited. Aimed at the mobility problem inherent to migrant populations, a specific strategy of intervention aimed at migrant MSM is imminently needed.

This study has a number of limitations. Firstly, retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between participants retained in the study and those lost to follow-up. Secondly, using non-random sampling methods may have led to selection bias. Thirdly, the sample size was insufficient, and some potential relevant factors may be concealed by the small sample size. Lastly, the study subjects were all inflow population and did not include outflow population, and the proportion of migrants from different provinces varied. There is no evidence to show the data could be generalized to other regions.

In conclusion, this is the first cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing. With highly prevalent risk behaviors, the migrant MSM had a high level of HIV incidence, and the epidemic of syphilis among this subgroup was extremely serious. Bisexual MSM were at a high risk of syphilis seroconversion, and were more concealed among migrant MSM. Future prevention efforts should include screening and appropriate treatment for syphilis. Multiple modes of intervention services need to be improved and implement for this marginalised group. A greater understanding of risk behaviors and the HIV/STD epidemic among migrant MSM needs to be investigated in

the future.

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CONTRIBUTORS

ZP, RY and NW conceived and designed the experiments, HL and LW performed the experiments, HM and WM analyzed the data, HZ and YZ contributed reagents/materials/analysis tools, HM, WM and ZP wrote the paper, all authors read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors have no conflict of interest to declare.

Data sharing statement

Extra data is available by emailing zhihangpeng@njmu.edu.cn.

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1-2
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	3
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	5
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	10
Outcome data	15*	Report numbers of outcome events or summary measures over time	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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High Incidence of HIV and syphilis among Migrant Men Who have Sex with Men in Beijing, China: A Prospective Cohort Study

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High Incidence of HIV and syphilis among Migrant Men Who have Sex with Men in Beijing, China: A Prospective Cohort Study

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ABSTRACT

Objectives: The purpose of the study was to investigate the incidence of HIV and syphilis and their related factors, as well as to examine the predictors associated with seroconversion among migrant men who have sex with men in Beijing, China.

Design: Prospective cohort study.

Setting: Beijing, China.

Participants: 511 HIV-negative migrant MSM.

Primary and secondary outcome measures: Sociodemographic and behavioral information of participants, HIV and syphilis incidence rates, and factors associated with HIV/syphilis seroconversion and cohort retention.

Results: Of the 511 participants, 60.3% (308) and 52.4% (273) were retained at the four-month and eight-month follow-up visits, respectively. The HIV and syphilis incidence rates were 7.83 (95% CI 4.48 to 12.72) and 11.11 (95% CI 6.47 to 17.80) cases per 100 person-years, respectively. HIV seroconversion was significantly associated with had first anal intercourse at age 15 or younger (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56) and ever had group sex (aHR = 4.30, 95% CI 1.40 to 13.18). Bisexual orientation (aHR = 5.09, 95% CI 1.02 to 25.57) was significantly associated with syphilis seroconversion. Predictors associated with both four-month and eight-month retention rates included age ≥ 25 years old and living in Beijing for more than one year.

Conclusions: The high incidence of HIV and syphilis among migrant MSM are cause for concern. A comprehensive strategy should be implemented to maintain a higher retention rate among migrant MSM.

Strengths and limitations of this study

- First cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing.
- Cox regression analysis and stepwise multiple logistic regression were used to identify factors associated with

HIV/syphilis seroconversion and cohort retention, respectively.

- Retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between those retained in the study and those lost to follow-up.
- Sampling methods may have led to selection bias.
- No outflow population was included, and the proportions of migrants from different provinces varied, which may lead to difficulties with generalization of the data.

INTRODUCTION

In China during the last decade, sexual transmission has become the major route for HIV transmission.[1] As an increasing proportion of infections among people living with HIV/AIDS (PLWHA), cases attributed to homosexual transmission rose from 7.3% in 2005 to 16.1% in 2011.[2] The 2011 HIV epidemic assessment report showed that among the estimated 780,000 people living with HIV/AIDS, homosexual transmission accounted for 17.4% of infections, an increase from 14.7% in 2009.[3] A growing number of studies have revealed the upward trend of HIV incidence among MSM in different parts of China. For example, incidence increased from 8.0 to 15.4 per 100 person-years during 2006–2009 in Chongqing, from 5.1 to 10.2 per 100 person-years during 2007–2009 in Liaoning, from 5.7 to 8.2 per 100 person-years during 2008-2011 in Jiangsu and from 3.5 to 6.3 per 100 person-years during 2010–2012 in Zhejiang.[4]

In recent years, there has been growing awareness that internal migration within China may be shifting the HIV epidemic by broadening social integration and connecting populations from different regions through sexual networks.[1] Data from national behavioral surveillance during 2004-2005 showed that migrant HIV/AIDS cases accounted for more than 50% of total infections in nine mainland provinces.[5] Numbers of cohort study on MSM have been implemented in China to reveal HIV epidemic among MSM, however the retentions of MSM were not so high in most of them.

Retentions of these cohort studies can hardly maintain over 70% at 12-months follow-up, few of them even below 20%.[6-9] There are reasons for low retention rates, and migration of MSM may be an important one.[8] Moreover, studies implemented among urban MSM also revealed a high proportion of migrants among MSM in major cities, such as in Beijing (88%),[10] Chongqing (80.3%)[11] and Shanghai (79.7%).[12] Although migration itself does not spread HIV or other sexually transmitted diseases (STDs), it may increase the possibility of infection when combined with high risk behaviors, which are prevalent among MSM. It has been confirmed in numerous studies that high risk behaviors such as unprotected anal sex, commercial sex, group sex, casual sex and having multiple sexual partners are prevalent among MSM in China.[13-15] On the other hand, perceived stigma and discrimination due to traditional Chinese culture and conservative social values have increasingly led Chinese MSM to disguise their sexual orientation with matrimony, which leads to a potential risk of transmitting HIV to the general population via heterosexual transmission.[14] As for migrants, lacking the stability of a family or a home community and with generally low educational levels, limited knowledge of HIV/AIDS prevention, and discrimination and marginalization from the mainstream metropolitan society, high risk behaviors may occur more frequently.[16, 17] Furthermore, due to China's household registration system and urban social security system, migrants have limited access to comprehensive, convenient and long-term health services.[18] Recently, some cross-sectional studies in China demonstrated that compared to local MSM, migrant MSM engage in more high risk sexual behaviors such as multiple sexual partners, higher frequencies of anal and oral intercourse, and unprotected sexual behaviors with both males and females.[15, 19] As a marginal and vulnerable subpopulation, migrant MSM should be accorded a high level of consideration by researchers.

Beijing, the capital of China and a center of political, economic and cultural activity, is a magnet for the migrant population. In 2012, Beijing's metropolitan population included some 7.7 million migrants, with the migrant population accounting for 37.4% of the total population of Beijing (China National Bureau of Statistics, 2013). According to statistics from the Beijing Municipal Bureau of Health, the proportion of MSM in HIV/AIDS cases increased from

22.8% in 2006 to 69.1% at the end of October 2013.[20] In addition, prior research among MSM in Beijing revealed that with the increasing epidemic of HIV among MSM in recent years, the number of migrants among recruited participants also showed a remarkable upward trend.[10, 11] This phenomenon implies the following: (1) migrant MSM play a main role in MSM society in Beijing; (2) this marginal population emerged gradually with the constant improvement of sampling methods; and (3) more targeted studies of this subpopulation are urgently needed, while at present only a few cross-sectional studies have been conducted to investigate its HIV/STD infections and relative risk factors.[21, 22] Thus, the purpose of this research was to assess the incidence of HIV and syphilis and examine the predictors associated with seroconversion and retention in a prospective cohort study among migrant MSM in Beijing, China.

METHODS

Study Design and Study Population

This prospective cohort study was conducted in Beijing. Participants were all Chinese citizens and were recruited through three methods. First, study participants were recruited directly through website advertisements by a nongovernmental AIDS volunteer group (http://www.hivolunt.net). Second, peer recruiters were hired and trained to distribute flyers with study-related information at MSM-frequented venues (e.g., MSM clubs, bars, parks and bathhouses). Thirdly, study participants were encouraged to refer their peers to enroll in the study. Once a potential participant had been referred or identified, local research team members approached the individual to verify eligibility, which included age ≥18 years old, male individual, HIV-negative, had sex with another male in the past 12 months, lacked permanent household registration in Beijing and provided written informed consent. A total of 547 participants were screened during the baseline screening survey from September to October 2009, of whom 36 were HIV-positive and 162 were syphilis-positive. In consideration of the curability and repeatability of syphilis infection, participants who were syphilis-positive at baseline were still recruited in the cohort. Thus a total of 511 eligible and consenting

MSM were enrolled into the prospective cohort, of whom 141 were syphilis-positive. Participants were followed up for four and eight months after the baseline survey. At each study visit (baseline, four-month follow-up and eight-month follow-up), eligible participants were interviewed by trained health professionals in a private room of the study clinic, and blood plasma specimens were collected and analyzed for HIV and syphilis antibodies by experienced physicians. One week later, each participant received their test results anonymously by a private identification code. All participants who tested positive for HIV/syphilis received additional posttest counseling and referrals to relevant free services. Every participant received 50 RMB (7.4 USD), 12 free condoms and one free lubricant after each completed study visit. Every participant was asked to provide at least two different and current contact methods, and reminder calls were made before the follow-up day to verify that the exact time of the visit would be convenient for them. The study protocol and informed consent forms were approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention of the China Center for Disease Control and Prevention (Figure 1).

Data Collection and Laboratory Tests

Questionnaire-based interviews were conducted on a one-on-one basis in a separate private room of the district clinic. Data on demographics, sexual behavior and history of STDs were collected. Participants' questionnaires and blood specimens were linked through assignment of a unique identifier code in the follow-up visits.

Blood specimens were tested for HIV and syphilis infection. The HIV infection status was screened by an ELISA (InTec Products Company, Xiamen, China) screening, and confirmed by an HIV-1/2 Western Blot (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Syphilis infection was determined by a rapid plasma reagin (RPR) test (Shanghai Rongsheng, Shanghai, China), and confirmed using Treponema pallidum particle assay (TPPA) test (Fujirebio Inc, Tokyo, Japan).

Statistical Analysis

Questionnaire data were double-entered and then checked for accuracy using EpiData software (The EpiData Association, Odense, Denmark, version 3.1). Data were analyzed using Stata/SE (StataCorp LP, USA, version 12.0 for Windows). HIV seroconversion was estimated to have occurred at the midpoint between the time of baseline HIV test and the time of the follow-up HIV test with a seropositive result. Syphilis seroconversion was estimated to have occurred at the halfway point between the previous visit and the visit where seroconversion occurred. HIV/syphilis incidence density was calculated based on a Poisson distribution, with number of seroconversion incidents within the follow-up period as the numerator and person-years (PY) over the entire follow-up period as the denominator. Categorical factors associated with retention rate were analyzed by univariate logistic regression, including baseline demographic and behavioral characteristics. A stepwise multiple logistic regression (out 0.05, in 0.02) was used to select independent factors for the retention rate. A Cox regression model was used in univariate and multiple regression analyses to identify correlates of time to HIV seroconversion. Statistically significant variables in univariate analysis ($P<0.10$) were entered simultaneously into a multivariate Cox proportional hazard regression model to determine the adjusted hazard ratio (aHR) for HIV/syphilis seroconversion-related risk factors.

RESULTS

Baseline Characteristics of the Participants

Of 511 participants, the median age was 29 years; 94.32% belonged to the Han ethnic group; 64.77% were single, 22.90% were married or cohabiting, and 12.33% were separated or divorced or widowed. For education level, 73.19% had received a high school education or lower. About half (54.01%) had monthly incomes < 300US$. Participants who identified themselves as exclusively homosexual or bisexual accounted for 60.67% and 37.57%, respectively. A total of 16.05% and 44.03% of the participants thought it was impossible or improbable they would be infected with HIV,

respectively. The median age of sexual debut was 20 years, and 58.71% experienced their sexual debut with a male. The median age of first anal intercourse was 22, and 58.65% of participants did not use a condom at first anal intercourse. In the past year, 78.67% of the participants had ever received condoms, 65.17% had ever received lubricant, 23.68% had ever taken part in peer education, 18.40% had ever received examination or treatment for STDs and 52.49% had ever received voluntary counseling and testing services (VCTs).

Regarding behaviors in the past six months among participants, the median number of male sex partners was three. For high risk behaviors, 327 (63.99%) had oral sex with male sex partners, 22 (6.73%) of them had consistent condom use with regular sex partners, and 26 (7.95%) with casual partners; 511 (100%) had anal sex with male sex partners, 13.11% of them had consistent condom use with regular sex partners, and 66 (18.70%) with casual partners. A total of 61 (11.94%) participants had ever engaged in commercial sexual behavior, among whom 35 (57.38%) had paid for sex and 43 (70.49%) had received money for sex. A total of 59 (11.55%) had ever engaged in group sex, which happened almost exclusively (96.61%) among males. A total of 166 (32.49%) had ever engaged in sex under the influence of alcohol, among whom 152 (92.77%) had homosexual intercourse while intoxicated (Table 1).

Table 1 Sociodemographic characteristics of the 547 study participants in the cohort of migrant MSM in Beijing

Variables	n	%
Overall, N	511	100
Age (median, years)	29	-
18-24	149	29.16
≥25	362	70.84
Ethnicity		
Han	482	94.32
Minority	29	5.68
Marital status		
Single	331	64.77
Married	114	22.31
Cohabiting with male or female sex partner	3	0.59
Separated or divorced or widowed	63	12.33
Duration of stay in Beijing		
< 1 year	173	33.85

≥ 1 year	338	66.14
Education level		
High school and below	374	73.19
College and above	137	26.81
Monthly income (US$)		
< 300	276	54.01
≥ 300	235	45.99
Self-reported sexual orientation		
Homosexual	310	60.67
Heterosexual	8	1.57
Bisexual	192	37.57
Other	1	0.2
Self-reported risk of HIV infection		
Impossible	82	16.05
Improbable	225	44.03
Possible	74	14.48
Probable	15	2.94
No idea	115	22.5
Age of sexual debut (median,years)	20	
Gender of first sexual partner		
Male	300	58.71
Female	211	41.29
Age of first anal intercourse(median, years)	22	
Had first anal intercourse before 15 years-old	13	2.54
Number of male sex partners in the last 6 months (median)	3	
Number of female sex partners in the last 6 months (median)	0	
Oral sex with regular partners with consistent condom use in the past 6 months	22	6.73
Oral sex with casual partners with consistent condom use in the past 6 months	26	7.95
Anal sex with regular partners with consistent condom use in the past 6 months	67	13.11
Anal sex with casual partners with consistent condom use in the past 6 months	66	18.7
Ever had commercial sexual behavior	61	11.94
Ever had group sex	59	11.55
Alcohol use prior to sex	166	32.49
Ever had sexually transmitted diseases (STDs)	84	16.44
Have ever received condoms	402	78.67
Have ever received lubricant	333	65.17
Have ever received peer education	121	23.68
Have ever received examination or treatment for STD	94	18.4
Have ever received voluntary counseling and testing (VCT) services	268	52.45
Have ever received educational materials on AIDS/STD	302	59.1

MSM, men who have sex with men; STD, sexually transmitted disease.

Incidence of infections of HIV, syphilis, HIV-syphilis co-infection and factors predicting HIV and syphilis seroconversion

During the eight-month follow-up, 16 HIV seroconversions were observed over 204.27 person-years of observation, resulting in an incidence rate of 7.83 per 100 person-years (PY) (95% CI 4.48 to 12.72). At the four-month visit, the incidence of HIV was 8.33 per 100 PY (95% CI 3.81 to 15.81) and at the eight-month visit it was 3.83 per 100 PY (95% CI 1.54 to 7.89). During the eight-month follow-up period, syphilis incidence was 11.11 per 100 PY (95% CI 6.47 to 17.80). At the four-month and eight-month visits, the syphilis incidence was 10.03 per 100 PY (95% CI 4.33 to 19.76) and 15.25 per 100 PY (95% CI 6.97 to 28.94), respectively. Six HIV seroconversions were observed becoming syphilis-positive over 52.10 person-years, resulting in an incidence of co-infection of 11.52 per 100 PY (4.23 to 25.07). Multivariate Cox regression analysis indicated that age ≤ 15 years old at first anal intercourse (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56, p=0.050) and ever had group sex (aHR=4.30, 95% CI 1.40 to 13.18, p=0.011) were significantly associated with time to HIV seroconversion (Table 2). For syphilis incidence, bisexual orientation (aHR=5.09, 95% CI 1.02 to 25.57, p=0.048), had more than one sex partners in the last 6 months (aHR=9.22, 95% CI 1.13 to 73.37, p=0.038) was significantly identified as risk factors (Table 3).

Table 2 Multivariate analyses of participant characteristics associated with incident HIV infection among migrant MSM in Beijing

Factors	No. of HIV seroconversions	Cumulative PY	HIV incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	16	204.27	7.83				
Education							
Junior college and below	13	143.95	9.03	1.00			
Above junior college	3	60.32	4.97	0.56(0.16 to 1.98)	0.370		
Seeking partner through Internet							
NO	12	109.45	10.96	1.00			
YES	4	94.81	4.22	0.39(0.12 to 1.20)	0.100		
Age of first anal intercourse (median,years)							
≥15	14	200.99	6.97	1.00		1.00	
<15	2	3.28	60.98	8.28(1.88 to 36.46)	0.005	9.20(1.94 to 43.56)	0.005

Ever had group sex							
NO	11	183.48	6	1.00		1.00	
YES	5	20.78	24.06	3.95(1.37 to 11.38)	0.011	4.30(1.40 to 13.18)	0.011
Knowledge of HIV/AIDS was acquired from							
Media							
NO	12	109.65	10.94	1.00			
YES	4	94.62	4.23	0.39(0.12 to 1.20)	0.100		
Internet							
NO	6	108.59	5.53	1.00			
YES	10	95.68	10.45	0.38(0.12 to 1.19)	0.097		
Consistent condom use during oral sex with regular partners in the past 6 months							
NO	1	9.45		1.00			
YES	15	194.82		0.73(0.10 to 5.50)	0.758		
Consistent condom use during oral sex with casual partners in the past 6 months							
NO	0	7.70	0	1.00			
YES	9	128.67	6.99	-	-		
Consistent condom use during anal sex with regular partners in the past 6 months							
NO	3	29.18	10.28	1.00			
YES	13	175.09	7.42	0.72(0.21 to 2.53)	0.609		
Consistent condom use during anal sex with casual partners in the past 6 months							
NO	2	27.56	7.26	1.00			
YES	10	115.99	8.62	1.19(0.26 to 5.42)	0.825		

PY, person-years; HR, hazard ratio.

Table 3 Multivariate analyses of participant characteristics associated with incident syphilis infection among migrant MSM in Beijing

Factors	No. of syphilis seroconversions	Cumulative PY	Syphilis incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	17	152.95	11.11				
Self-reported sexual orientation							
Homosexual	9	96.89	9.29	1.00			
Heterosexual	0	1.42	0	-			
Bisexual	8	54.64	14.64	5.56(1.10 to 27.05)	0.038	5.09(1.02 to 25.57)	0.048
Other	0	0	-	-			
Number of female sex partners in the last 6 months							
≤1	16	149.9	10.67	1.00			
≥2	1	3.05	32.79	9.22(1.13 to 75.37)	0.038		
Seeking partners in bar/dancing hall/tearoom/chamber							
NO	11	129.41	8.5	1.00			
YES	6	23.55	25.48	3.12(0.75 to 13.07)	0.119		
Consistent condom use during oral sex with regular partners in the past 6 months							

NO	1	6.24	16.03	1.00	
YES	16	146.71	10.91	0.24(0.03 to 1.99)	0.188
Consistent condom use during oral sex with casual partners in the past 6 months					
NO	0	4.37	0	1.00	
YES	8	92.58	8.64	-	
Consistent condom use during anal sex with regular partners in the past 6 months					
NO	2	24.52	8.16	1.00	
YES	15	128.43	11.68	0.57(0.11 to 2.80)	0.485
Consistent condom use during anal sex with casual partners in the past 6 months					
NO	0	19.80	0	1.00	
YES	11	83.21	13.22	-	

Predictors of cohort retention

Of the 511 participants, 60.3% (308) were retained in the cohort at the four-month follow-up and 54.6% (274) were retained at the eight-month follow-up.

Univariate factors among baseline characteristics which were significantly associated with four-month retention were analysed with stepwise multiple logistic regression. Four factors were kept in the final model, including age > 25 years old (adjusted odds ratio (AOR) = 1.81, 95% CI 1.07 to 3.06, p = 0.026), living in Beijing for more than one year (AOR = 3.68, 95% CI 2.04 to 6.64, p < 0.001), had at least one female sex partners in the last six months (AOR = 0.48, 95% CI 0.29 to 0.80, p=0.005), and had ever received VCTs in the past 12 months (AOR =1.71, 95% CI 1.07 to 2.72, p<0.024) (Table 4).

Table 4 Factors associated with four-month retention rate in a cohort study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	46.98(70)	1.00		1.00	
≥25	362	65.75(238)	2.17(1.47 to 3.19)	<0.001	1.81(1.07 to 3.06)	0.026
Duration of stay in Beijing						
< 1 year	95	34.74(33)	1.00		1.00	
≥ 1 year	416	66.27(208)	3.66(2.29 to 5.85)	<0.001	3.68 (2.04 to 6.64)	<0.001
Number of female sex partners in the last 6 months						

0	382	64.66 (247)	1.00		1.00	
≥1	129	47.29 (61)	0.49(0.33 to 0.74)	0.001	0.48(0.29 to 0.80)	0.005
Have received voluntary counseling and testing (VCT) service in the past 12 months						
No	243	51.85 (126)	1.00		1.00	
Yes	268	67.91 (182)	1.97(1.37 to 2.81)	<0.001	1.71(1.07 to 2.72)	0.024

For eight-month retention, age> 25 years old (AOR = 1.76, 95% CI 1.16 to 2.68, p = 0.008), living in Beijing for more than one year (AOR = 1.68, 95% CI 1.03 to 2.73, p = 0.039), first sexual partner was female (AOR = 0.60, 95% CI 0.41 to 0.88, p = 0.009), ever had group sex (AOR = 0.50, 95% CI 0.28 to 0.89, p = 0.019), and had received lubricant in the past 12 months (AOR = 2.31, 95% CI 1.56 to 3.42, p < 0.001) were retained in the final model using stepwise multiple logistic regression analysis (Table 5).

Table 5 Factors associated with eight-month retention rate in a cohort study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	44.30(66)	1.00		1.00	
≥25	362	57.18(207)	1.68(1.14 to 2.47)	0.008	1.76(1.16 to 2.68)	0.008
Duration of stay in Beijing						
< 1 year	78	48.72 (38)	1.00		1.00	
> 1 year	338	58.88 (199)	2.17(1.37 to 3.43)	<0.001	1.68 (1.03 to 2.73)	0.039
Gender of the first sexual partner						
Male	300	58.33 (175)	1.00		1.00	
Female	211	46.45 (98)	0.62(0.43 to 0.88)	0.008	0.60 (0.41 to 0.88)	0.009
Ever had group sex						
NO	452	54.87 (248)	1.00		1.00	
YES	59	42.37 (25)	0.61(0.35 to 1.05)	0.072	0.50 (0.28 to 0.89)	0.019
Have received lubricant in the past 12 months						
NO	109	34.86 (38)	1.00		1.00	
YES	402	58.46 (235)	2.59(1.78 to 3.77)	<0.001	2.31 (1.56 to 3.42)	<0.001

DISCUSSION

Our study found that the prevalence of HIV (6.58%) among migrant MSM was at a high epidemic level, which was highlighted in comparison to that of a previous study among migrant general population (0%) in Beijing.[23] Additionally, it was higher than the 4.8% in 2007 among general MSM in Beijing.[24] A similar result (5.9%) was found in a recent cross-sectional study among migrant MSM.[23] Incidence in this subgroup (7.83/100PY) was consistent with that of migrant MSM (8.51/100PY) in a MSM cohort study in Beijing, and higher than the incidence of permanent resident MSM.[25] It was also higher than the incidence of general MSM in different parts of China.[6, 7]

The study found that participants whose first anal intercourse occurred before age 15 had significantly higher risk for HIV seroconversion. An American study of young minority MSM found that study participants who had an MSM sexual debut before 16 years old were more likely to have psychological problems and high risk behaviors like exchanging sex and drug use.[26] Early sexual debut could have a deep and long-term influence on an individual's developing sexual concept, but appropriate sex education has generally been shunned in traditional Chinese education. Our study indicated that early sex education should be combined with Chinese characteristics, and relevant measures need to be implemented as soon as possible. Another risk factor significantly associated with HIV incidence was ever had group sex. An explanation of this observation is that psychological stress caused by stigma and discrimination hinders the development of longer-term relationships between MSM,[27] and having sex with multiple partners increases the chance of HIV transmission. This indicates a need for confidentiality and support services for migrant MSM. Serious attention should also be paid to the prevalence of STDs. The prevalence rate of syphilis (29.62%) was higher than those of previous studies conducted among MSM in Beijing, such as 19.8% in 2007,[24] and 22.0% in 2009.[10] The incidence of syphilis (11.11/100PY) was also at an extremely high level compare to 8.06/100PY in a cohort study among MSM during the same period in 2009.[25] High prevalence of syphilis among MSM was a common risk factor for encouraging HIV infection because of the biological and behavioral links between syphilis and HIV.[28]

The multiple regression analysis significantly revealed that self-identified bisexuals were five times more likely than

homosexuals to be infected with syphilis. One major reason for this outcome could be that bisexuals may have more varied sexual behaviors with a wider range of sexual partners, including males and females. In addition, a cross-sectional study among young migrant MSM in Beijing discovered that MSM who were engaged in bisexual behavior had a higher rate of unprotected sex with stable female partners and were less likely to take part in prevention behaviors,[18] which was consistent with our finding that those who had at least one female sex partner and those whose first sexual partner was female were significantly more likely to be lost at four-month and eight-month follow-up visits, respectively. MSM face strong social pressure and stigma in China, which may lead them to hide their sexual orientation by unwillingly engaging in heterosexual relationships; thus, many Chinese MSM will potentially enter a heterosexual marriage due to social and familial pressure,[4] Concerned about disclosing their MSM behavior to their female partners, bisexual MSM may be more reluctant to be followed up. Also, bisexual MSM are more likely to engage in risk behaviors, such as having unprotected sex to indicate loyalty to their female partners and having commercial or casual sex with men. Moreover, only 18.4% of the participants reported having received an examination or treatment for sexually transmitted diseases in the past 12 months, which may be related to the high cost of health services and low coverage of health insurance for the migrant population.[18] Low risk-awareness might be another reason for their lower access to HIV/STD test and treatment. All of these emphasize an urgent need for widespread and accurate syphilis screening and affordable treatment for migrant MSM in Beijing.

In our study, the retention rate was lower than in previous cohort studies implemented among general MSM in Beijing (86.2% in 2007, 86.8% in 2009).[25, 26] From the multiple regression analysis, participants who were less than 25 years old were more likely to be lost at both four-month and eight-month follow-up visits. Similar problems have occurred among studies of young MSM in the US.[29] A plausible reason for this observation was that many young people in China have poor knowledge of safe sexual behaviors. Traditional interventions are more pragmatic but less attractive and appropriate for young people. A qualitative investigation implemented among young MSM in Milwaukee and Detroit

offered some new approaches, such as embedding HIV prevention efforts in the context of broader life and relationship issues facing young MSM.[30] As differences almost certainly exist between young Chinese and American MSM, predictors of retention among young MSM in Beijing deserve further investigation.

As for positive predictors, we found those who had been in Beijing for more than one year or who had received lubricant were more likely to be maintained in this cohort at both four-month and eight-month follow-up visits. As these services are provided by local communities, we found similar results as those in Yangzhou.[8] Migrant MSM who stay longer in Beijing may have more chances to receive effective and stable intervention services, and the potential impact on their increasing awareness of self-protection might encourage them to pay closer attention to advances in research. As a result, migrants may be more likely to remain with the investigation to show their support. However, the data showed that receiving voluntary counseling and testing (VCT) service in the past 12 months was a positive factor at four-month follow-up visit, which was replaced by receiving lubricant at eight-month visit. This indicate that factors associated with retention rate may change as time goes on. In other words, different factors may have a unique impact on retention rate in different periods, which implies that we should adjust methods for interventions over time so as to keep the entire cohort more stable. From the results of our study, the coverage of intervention on this population was limited. Aimed at the mobility problem inherent to migrant populations, a specific strategy of intervention targeted at migrant MSM is imminently needed.

This study has a number of limitations. Firstly, retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between participants retained in the study and those lost to follow-up. Secondly, using non-random sampling methods may have led to selection bias. Thirdly, the sample size was insufficient, and some potentially relevant factors may be concealed by the small sample size. Lastly, the study subjects were all inflow population and did not include outflow population, and the proportion of migrants from different provinces varied. There is no evidence to show the data could be generalized to other regions.

To our knowledge, this is the first cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing. With highly prevalent risk behaviors, the migrant MSM had a high level of HIV incidence, and the epidemic of syphilis among this subgroup was extremely serious. Bisexual MSM were at a high risk of syphilis seroconversion, and were more concealed among migrant MSM. Future prevention efforts should include screening and appropriate treatment for syphilis. Multiple modes of intervention services need to be improved and implement for this marginalised group. For the sake of bisexual MSM's health, as well as for their partners', more attention need to be paid on female partners of bisexual MSM to encourage them to take test and be followed-up. A greater understanding of risk behaviors and the HIV/STD epidemic among migrant MSM needs to be investigated in the future.

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CONTRIBUTORS

ZP, RY and NW conceived and designed the experiments, HL and LW performed the experiments, HM and WM analyzed the data, HZ and YZ contributed reagents/materials/analysis tools, HM, WM and ZP wrote the paper, and all authors read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors have no conflict of interest to declare.

Data sharing statement

Extra data is available by emailing zhihangpeng@njmu.edu.cn.

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Figure legend:

Figure 1. Study flowchart of the migrant MSM cohort, with focus on the HIV and syphilis incidence

High Incidence of HIV and syphilis among Migrant Men Who have Sex with Men in Beijing, China: A Prospective Cohort Study

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Keywords: HIV; syphilis; male homosexuality; cohort study; China

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ABSTRACT

Objectives: The purpose of the study was to investigate the incidence of HIV and syphilis and their related factors, as well as to examine the predictors associated with seroconversion among migrant men who have sex with men in Beijing, China.

Design: Prospective cohort study.

Setting: ~~Yunnan~~Beijing, China.

Participants: 511 HIV-negative migrant MSM.

Primary and secondary o~~O~~utcome measures: Sociodemographic and behavioral information of participants, HIV and syphilis incidence rates, and factors associated with HIV/syphilis seroconversion and cohort retention.

Results: Of the 511 participants, 60.3% (308) and 52.4% (273) were retained at the four-month and eight-month follow-up visits, respectively. The HIV and syphilis incidence rates were 7.83 (95% CI 4.48 to 12.72) and 11.11 (95% CI 6.47 to 17.80) cases per 100 person-years, respectively. HIV seroconversion was significantly associated with ~~having~~ had first anal intercourse at age 15 or younger (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56) and ever had group sex (aHR = 4.30, 95% CI 1.40 to 13.18). Bisexual orientation (aHR = 5.09, 95% CI 1.02 to 25.57) was significantly associated with syphilis seroconversion. Predictors associated with both four-month and eight-month retention rates included age ≥ 25 years old and living in Beijing for more than one year.

Conclusions: The high incidence of HIV and syphilis among migrant MSM are cause for concern. A comprehensive strategy should be implemented to maintain a higher retention rate among migrant MSM.

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Strengths and limitations of this study

- First cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing.

- Cox regression analysis and stepwise multiple logistic regression were used to identify factors associated with HIV/syphilis seroconversion and cohort retention, respectively.
- Retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between those retained in the study and those lost to follow-up.
- Sampling methods may have led to selection bias.
- No outflow population was included, and the proportions of migrants from different provinces varied, which ~~lead~~may lead to ~~difficulty~~ difficulties ~~of~~ with generalization of the data.

INTRODUCTION

In China during the last decade, sexual transmission has become the major route for HIV transmission ~~in the last decade~~.[1] As an increasing proportion of infections among people living with HIV/AIDS (PLWHA), cases attributed to homosexual transmission rose from 7.3% in 2005 to ~~11~~16.1% in ~~2007~~2011.[2] The 2011 HIV epidemic assessment report showed that among the estimated 780,000 people living with HIV/AIDS, homosexual ~~contact~~ transmission accounted for 17.4% of infections, ~~with~~ an increase from 14.7% in 2009.[3] A growing number of studies have revealed the upward trend of HIV ~~prevalence~~ incidence among MSM in different parts of China. For example, ~~the prevalence~~ incidence increased from 8.0 to 15.4 per 100 person-years during 2006–2009 ~~from 10.4% in 2006 to 12.5% in 2007~~ in Chongqing,[3] from 5.1 to 10.2 per 100 person-years during 2007–2009 in Liaoning~~from 0.4% in 2004 to 5.8% in 2006 in Beijing~~,[4] ~~and~~ from 5.7 to 8.2 per 100 person-years during 2008-2011 in Jiangsu~~from 5.7% in 2007 and 6.2% in 2008 to 8.1% in 2009 in Shenyang~~and from 3.5 to 6.3 per 100 person-years during 2010–2012 in Zhejiang.[4b5]

In recent years, there ~~is~~ has been growing awareness that internal migration within China may be shifting the HIV epidemic by broadening social ~~mixing~~integration ~~, accompanied by sexual mixing between~~communities among ~~and combining~~connecting populations from different regions ~~by~~ through sexual ~~activities~~networks.[1] Data from national

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behavioral surveillance during 2004-2005 showed that migrant HIV/AIDS cases accounted for more than 50% of total infections in nine ~~different~~ mainland provinces.[~~6~~5] Numbers of cohort study on MSM have been implemented in China to reveal HIV epidemic among MSM, however the retentions of MSM were not so high in most of them. Retentions of these cohort studies can hardly maintain over 70% at 12-months follow-up, few of them even below 20%.[6-9] There are reasons for low retention rates, and migration of MSM may be an important one.[8] Moreover, studies implemented among urban MSM ~~in metropolises~~ also revealed a high proportion of migrants among MSM in major cities, such as in Beijing (88%),[~~7~~10] Chongqing (80.3%)[3,11] and Shanghai (79.7%).[~~8~~12] Although migration itself does not spread HIV ~~and~~ or other sexually transmitted diseases (STDs), it may increase the possibility of infection when combined with high risk behaviors, which are prevalent among MSM. It has been confirmed in numerous studies that high risk behaviors such as unprotected anal sex, commercial sex, group sex, casual sex and having multiple sexual partners ~~were~~ are prevalent among MSM in China.[~~9~~13, ~~11~~15] On the other hand, perceived stigma and discrimination due to traditional Chinese culture and conservative social values have increasingly led Chinese MSM to disguise their sexual orientation with matrimony, which leads to a potential risk of transmitting HIV to the general population via heterosexual transmission.[~~10~~14] As for migrants, ~~without the no~~lacking the stability of a family or a home community ~~and without~~but and with generally low educational levels, limited knowledge ~~about~~ of HIV/AIDS prevention, and discrimination and marginalization from the mainstream metropolitan society, high risk behaviors may ~~happen~~ occur more frequently.[~~12~~16, ~~17~~] Furthermore, due to China's household registration system and urban social security system, migrants have limited access to comprehensive, convenient and long-term health services.[~~14~~18] Recently, some cross-sectional studies in China demonstrated that compared to local MSM, migrant MSM engage in more high risk sexual behaviors such as multiple sexual partners, higher frequencies of anal and oral intercourse, and unprotected sexual behaviors with both males and females.[~~11~~15, ~~15~~19] As a marginal and vulnerable subpopulation, migrant MSM should be accorded a high level of consideration by researchers.

Beijing, the capital of China and a center of political, economic and cultural activity, is a magnet for the migrant population. In 20092012, Beijing's metropolitan population included some 72.67.7 million migrants, and with the migrant population accounted accounting for 7037.4% of the total population of Beijing increase from 2006 to 2009 (China National Bureau of Statistics, 20092013). According to statistics from the Beijing Municipal Bureau of Health, the proportion of MSM in HIV/AIDS cases had increased from 22.8% in 2006 to 69.1% at the end of October, 2013. 4722 (73.98%) HIV/AIDS cases from the cumulative data were from Chinese provinces, and 44% of the 501 new HIV/AIDS cases in the first five months of 2009 were among male homosexuals.[1620] In addition, prior research among MSM in Beijing revealed that with the increasing epidemic of HIV among MSM in recent years, the number of migrants among recruited participants also showed a remarkable upward trend.[4, 710, 11] This phenomenon implies thatthe following: (1) migrant MSM play a main role in the MSM sphere society in Beijing,,; (2) this marginal population emerged gradually with the constant improvement of sampling methods,,; and (3) more targeted studies of this subpopulation are urgently needed, while at present only a few cross-sectional studies have been conducted to investigate its HIV/STD infections and relative risk factors.[1721, 1822] Thus, the purpose of this research was to assess the incidence of HIV and syphilis and examine the predictors associated with seroconversion and retention in a prospective cohort study among migrant MSM in Beijing, China.

METHODS

Study Design and Study Population

This prospective cohort study was conducted in Beijing, the capital of China. Participants were all Chinese citizens and were recruited through three methods. First, study participants were recruited directly through website advertisements by a nongovernmental AIDS volunteer group (http://www.hivolunt.net). Second, peer recruiters were hired and trained to distribute flyers with study-related information at MSM-frequented venues (e.g., MSM clubs, bars, parks and

bathhouses). Thirdly, study participants were encouraged to refer their peers to enroll in the study. Once a potential participant had been referred or identified, local research team members approached the individual to verify eligibility, which included age ≥18 years old, male individual, HIV-negative, had sex with another male in the past 12 months, lacked permanent household registration in Beijing and provided written informed consent. A total of 547 participants were screened during the baseline screening survey from September to October 2009, of whom 36 were HIV-positive and 1262 were syphilis-positive. In consideration of the curability and repeatability of syphilis infection, participants who were syphilis-positive at baseline were still recruited in the cohort. Thus a total of 511 eligible and consenting MSM were enrolled into the prospective cohort, of whom 141 were syphilis-positive. Participants were followed up for four and eight months after the baseline survey. At each study visit (baseline, four-month follow-up and eight-month follow-up), eligible participants were interviewed by trained health professionals in a private room of the study clinic, and blood plasma specimens were collected and analyzed for HIV and syphilis antibodies by experienced physicians. One week later, each participant received their test results anonymously by a private identification code. All participants who tested positive for HIV/syphilis received additional posttest counseling and referrals to relevant free services. Every participant received 50 RMB (7.4 USD), 12 free condoms and one free lubricant after each completed study visit. Every participant was asked to provide at least two different and current contact ~~method~~~~ways~~methods, and reminder calls were made before the follow-up day to verify that the exact time of the visit would be convenient for them. The study protocol and informed consent forms were approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention of the China Center for Disease Control and Prevention (Figure 1).

Data Collection and Laboratory Tests

Questionnaire-based interviews were conducted on a one-on-one basis in a separate private room of the district clinic. Data on demographics, sexual behavior and history of ~~sexually transmitted diseases (~~STDs~~)~~ were collected.

Participants' questionnaires and blood specimens were linked through assignment of a unique identifier code in the follow-up visits.

Blood specimens were tested for HIV and syphilis infections. The HIV infection status was screened by an ELISA (InTec Products Company, Xiamen, China) screening, and confirmed by an HIV-1/2 Western Blot (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Syphilis infection was determined by a rapid plasma reagin (RPR) test (Shanghai Rongsheng, Shanghai, China), and confirmed using Treponema pallidum particle assay (TPPA) test (Fujirebio Inc, Tokyo, Japan).

Statistical Analysis

Questionnaire data were double-entered and then checked for accuracy using Epi–Data software (The Epi–Data Association, Odense, Denmark, version 3.1). Data were analyzed using Stata/SE (StataCorp LP, USA, version 12.0 for Windows). HIV seroconversion was estimated to have occurred at the midpoint between the time of baseline HIV test and the time of the follow-up HIV test with a seropositive result. ~~In consideration of the curability and repeatedability infection of syphilis infection, participants who had negative seroconversion during follow-up period continued to be retainregarded as negative object of observation. Thus~~ Syphilis seroconversion was estimated to have occurred at the ~~midpoint~~ halfway point between the ~~time of a confirmed seronegative and the time of a confirmed seropositive~~previous visit and the visit where seroconversion occurred. HIV/syphilis incidence density was calculated based on a Poisson distribution, with number of seroconversion incidents within the follow-up period as the numerator and person-years (PY) over the entire follow-up period as the denominator. Categorical factors associated with retention rate were analyzed by univariate logistic regression, including baseline demographic and behavioral characteristics. A stepwise multiple logistic regression (out 0.05, in 0.02) was used to select independent factors for the retention rate. A Cox regression model was used in univariate and multiple regression analyses to identify correlates of time to HIV

seroconversion. Statistically significant variables in univariate analysis (P<0.10) were entered simultaneously into a multivariate Cox proportional hazard regression model to determine the adjusted hazard ratio (aHR) for HIV/syphilis seroconversion-related risk factors.

RESULTS

Baseline Characteristics of the Participants

~~A total of 547 participants were screened at baseline; 36 (6.58%) were HIV antibody seropositive and syphilis prevalence was 29.62%. Finally, 511 participants were HIV seronegative and eligible to continue the study. Of them, 27.59% were syphilis seropositive.~~

Of 511 participants, the median age was 29 years; 94.32% belonged to the Han ethnic group; 64.77% were single, 22.90% were married or cohabiting, and 12.33% were separated or divorced or widowed. For education level, 73.19% had received a high school education or lower. About half (54.01%) had monthly incomes < 300US$. Participants who identified themselves as exclusively homosexual or bisexual accounted for 60.67% and 37.57%, respectively. A total of 16.05% and 44.03% of the participants thought it was impossible or improbable they would be infected with HIV, respectively. The median age of sexual debut was 20 years, and 58.71% experienced their sexual debut with a male. The median age of first anal intercourse was 22, and 58.65% of ~~them~~ participants did not use a condom at first anal intercourse. In the past year, 78.67% of the participants had ever received condoms, 65.17% had ever received lubricant, 23.68% had ever taken part in peer education, 18.40% had ever received examination or treatment for STDs and 52.49% had ever received voluntary counseling and testing services (VCTs).

Regarding behaviors in the past six months among participants, the median number of male sex partners was three. For high risk behaviors, 327 (63.99%) had oral sex with male sex partners, 22 (6.73%) of them had consistent condom use with regular sex partners, and 26 (7.95%) with casual partners; 511 (100%) had anal sex with male sex partners,

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13.11% of them had consistent condom use with regular sex partners, and 66 (18.70%) with casual partners. A total of 61 (11.94%) participants had ever engaged in commercial sexual behavior, among whom 35 (57.38%) had paid for sex and 43 (70.49%) had received money for sex. A total of 59 (11.55%) had ever engaged in group sex, which happened almost exclusively (96.61%) among males. A total of 166 (32.49%) had ever engaged in sex under the influence of alcohol, among whom 152 (92.77%) had homosexual intercourse while intoxicated (Table 1).

Table 1 Sociodemographic characteristics of the 547 study participants in the cohort of migrant MSM in Beijing

Variables	n	%
Overall, N	511	100
Age (median, years)	29	-
18-24	149	29.16
≥25	362	70.84
Ethnicity		
Han	482	94.32
Minority	29	5.68
Marital status		
Single	331	64.77
Married	114	22.31
Cohabiting with male or female sex partner	3	0.59
Separated or divorced or widowed	63	12.33
Duration of stay in Beijing		
< 1 year	173	33.85
≥ 1 year	338	66.14
Education level		
High school and below	374	73.19
College and above	137	26.81
Monthly income (US$)		
< 300	276	54.01
≥ 300	235	45.99
Self-reported sexual orientation		
Homosexual	310	60.67
Heterosexual	8	1.57
Bisexual	192	37.57
Other	1	0.2
Self-reported risk of HIV infection		
Impossible	82	16.05
Improbable	225	44.03
Possible	74	14.48

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Probable	15	2.94
No idea	115	22.5
Age of sexual debut (median,years)	20	
Gender of first sexual partner		
Male	300	58.71
Female	211	41.29
Age of first anal intercourse(median, years)	22	
Had first anal intercourse before 15 years old	13	2.54
Number of male sex partners in the last 6 months (median)	3	
Number of female sex partners in the last 6 months (median)	0	
Oral sex with regular partners with a consistent condom use in the past 6 months	22	6.73
Oral sex with casual partners with a consistent condom use in the past 6 months	26	7.95
Anal sex with regular partners with a consistent condom use in the past 6 months	67	13.11
Anal sex with casual partners with a consistent condom use in the past 6 months	66	18.7
Ever had commercial sexual behavior	61	11.94
Ever had group sex	59	11.55
Alcohol use prior to sex	166	32.49
Ever had sexually transmitted diseases (STDs)	84	16.44
Have ever received condoms	402	78.67
Have ever received lubricant	333	65.17
Have ever received peer education	121	23.68
Have ever received examination or treatment for STD	94	18.4
Have ever received voluntary counseling and testing (VCT) services	268	52.45
Have ever received educational materials on AIDS/STD	302	59.1

MSM, men who have sex with men; STD, sexually transmitted disease.

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Incidence of infections of HIV, syphilis, HIV-syphilis co-infection and factors predicting HIV and syphilis seroconversion

During the eight-month follow-up, 16 HIV seroconversions were observed over 204.27 person-years of observation, resulting in an incidence rate of 7.83 per 100 person-years (PY) (95% CI 4.48 to 12.72). At the four-month visit, the incidence of HIV was 8.33 per 100 PY (95% CI 3.81 to 15.81) and at the eight-month visit it was 3.83 per 100 PY (95% CI 1.54 to 7.89). During the eight-month follow-up period, syphilis incidence was 11.11 per 100 PY (95% CI 6.47 to 17.80). At the four-month and eight-month visits, the syphilis incidence was 10.03 per 100 PY (95% CI 4.33 to 19.76) and 15.25 per 100 PY (95% CI 6.97 to 28.94), respectively (Table 2). Six HIV seroconversions were observed over 52.10 person-years of becoming syphilis-positive over 52.10 person-years observation, resulting in an incidence of

co-infection of 11.52 per 100 PY (4.23 to 25.07).

Multivariate Cox regression analyseis indicated that age ≤ 15 years old at first anal intercourse (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56, p=0.050) and ever had group sex (aHR=4.30, 95% CI 1.40 to 13.18, p=0.011) were significantly associated with time to HIV seroconversion (Table 2). For syphilis incidence, bisexual orientation (aHR=5.09, 95% CI 1.02 to 25.57, p=0.048), had more than one sex partners in the last 6 months (aHR=9.22, 95% CI 1.13 to 73.37, p=0.038) was significantly identified as risk factors (Table 3).

Table 2 ~~Univariate and M~~multivariate analyses of participant characteristics associated with incident HIV infection among migrant MSM in Beijing~~.~~

Factors	No. of HIV seroconversions	Cumulative PY	HIV incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	16	204.27	7.83				
Education							
Junior college and below	13	143.95	9.03	1.00			
Above junior college	3	60.32	4.97	0.56(0.16 to 1.98)	0.370		
Seeking partner through Internet							
NO	12	109.45	10.96	1.00			
YES	4	94.81	4.22	0.39(0.12 to 1.20)	0.100		
Age of first anal intercourse (median,years)							
≥15	14	200.99	6.97	1.00		1.00	
≤15	2	3.28	60.98	8.28(1.88 to 36.46)	0.005	9.20(1.94 to 43.56)	0.005
Ever had group sex							
NO	11	183.48	6	1.00		1.00	
YES	5	20.78	24.06	3.95(1.37 to 11.38)	0.011	4.30(1.40 to 13.18)	0.011
Knowledge of HIV/AIDS was acquired from							
Media							
NO	12	109.65	10.94	1.00			
YES	4	94.62	4.23	0.39(0.12 to 1.20)	0.100		
Internet							
NO	6	108.59	5.53	1.00			
YES	10	95.68	10.45	0.38(0.12 to 1.19)	0.097		
Consistent condom use during o~~O~~ral sex with regular partners ~~with a consistent condom use~~ in the past 6 months							
NO	1	9.45		1.00			
YES	15	194.82		0.73(0.10 to 5.50)	0.758		
Consistent condom use during ~~O~~oral sex with casual partners ~~with a consistent condom use~~ in the past 6 months							

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NO	0	7.70	0	1.00	
YES	9	128.67	6.99	-	-
eConsistent condom use during aAnal sex with regular partners with a consistent condom use in the past 6 months					
NO	3	29.18	10.28	1.00	
YES	13	175.09	7.42	0.72(0.21 to 2.53)	0.609
Consistent condom use during aAnal sex with casual partners with a consistent condom use in the past 6 months					
NO	2	27.56	7.26	1.00	
YES	10	115.99	8.62	1.19(0.26 to 5.42)	0.825

PY, person-years; HR, hazard ratio.

Multivariate Cox regression analyses indicated that age ≤ 15 years old at first anal intercourse (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56, p=0.050) and ever had group sex (aHR=4.30, 95% CI 1.40 to 13.18, p=0.011) were significantly associated with time to HIV seroconversion (Table 2). For syphilis incidence, bisexual orientation (aHR=5.09, 95% CI 1.02 to 25.57, p=0.048) was significantly identified as a risk factor (Table 3).

Table 3 Univariate and Multivariate analyses of participant characteristics associated with incident syphilis infection among migrant MSM in Beijing.

Factors	No. of syphilis seroconversions	Cumulative PY	Syphilis incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	17	152.95	11.11				
Self-reported sexual orientation							
Homosexual	9	96.89	9.29	1.00			
Heterosexual	0	1.42	0	-			
Bisexual	8	54.64	14.64	5.56(1.10 to 27.05)	0.038	5.09(1.02 to 25.57)	0.048
Other	0	0	-	-			
Number of female sex partners in the last 6 months							
≤1	16	149.9	10.67	1.00			
≥2	1	3.05	32.79	9.22(1.13 to 75.37)	0.038		
Seeking partners in bar/dancing hall/tearoom/chamber							
NO	11	129.41	8.5	1.00			
YES	6	23.55	25.48	3.12(0.75 to 13.07)	0.119		
Consistent condom use during oOral sex with regular partners with a consistent condom use in the past 6 months							
NO	1	6.24	16.03	1.00			
YES	16	146.71	10.91	0.24(0.03 to 1.99)	0.188		
Consistent condom use during oOral sex with casual partners with a consistent condom use in the past 6 months							
NO	0	4.37	0	1.00			

YES	8	92.58	8.64	-	
Consistent condom use during aAnal sex with regular partners ~~with a consistent condom use~~ in the past 6 months					
NO	2	24.52	8.16	1.00	
YES	15	128.43	11.68	0.57(0.11 to 2.80)	0.485
Consistent condom use during aAnal sex with casual partners ~~with a consistent condom use~~ in the past 6 months					
NO	0	19.80	0	1.00	
YES	11	83.21	13.22	-	

Predictors of cohort retention

Of the 511 participants, 60.3% (308) were retained in the cohort at the four-month follow-up and 54.6% (274) were retained at the eight-month follow-up.

Univariate factors among baseline characteristics which were significantly associated with four-month retention were analysed with stepwise multiple logistic regression. Four factors were kept in the final model, including age > 25 years old (adjusted odds ratio (AOR) = 1.81, 95% CI 1.07 to 3.06, p = 0.026), living in Beijing for more than one year (AOR = 3.68, 95% CI 2.04 to 6.64, p < 0.001), had at least one female sex partners in the last six months (AOR = 0.48, 95% CI 0.29 to 0.80, p=0.005), and had ever received VCTs in the past 12 months (AOR =1.71, 95% CI 1.07 to 2.72, p<0.024) (Table 4).

Table 4 ~~factors~~ Factors associated with four-month retention rate in a cohort study of migrant ~~msm~~ MSM in ~~beijing~~Beijing, ~~c~~China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	46.98(70)	1.00		1.00	
≥25	362	65.75(238)	2.17(1.47 to 3.19)	<0.001	1.81(1.07 to 3.06)	0.026
Duration of stay in Beijing						
< 1 year	95	34.74(33)	1.00		1.00	
≥ 1 year	416	66.27(208)	3.66(2.29 to 5.85)	<0.001	3.68 (2.04 to 6.64)	<0.001
Number of female sex partners in the last 6 months						
0	382	64.66 (247)	1.00		1.00	
≥1	129	47.29 (61)	0.49(0.33 to 0.74)	0.001	0.48(0.29 to 0.80)	0.005
Have received voluntary counseling and testing (VCT) service in the past 12 months						
No	243	51.85 (126)	1.00		1.00	

Yes	268	67.91 (182)	1.97(1.37 to 2.81)	<0.001	1.71(1.07 to 2.72)	0.024

For eight-month retention, age> 25 years old (AOR = 1.76, 95% CI 1.16 to 2.68, p = 0.008), living in Beijing for more than one year (AOR = 1.68, 95% CI 1.03 to 2.73, p = 0.039), first sexual partner was female (AOR = 0.60, 95% CI 0.41 to 0.88, p = 0.009), ever had group sex (AOR = 0.50, 95% CI 0.28 to 0.89, p = 0.019), and had received lubricant in the past 12 months (AOR = 2.31, 95% CI 1.56 to 3.42, p < 0.001) were retained in the final model using stepwise multiple logistic regression analysis (Table 5).

Table 5 ~~, factors~~ Factors associated with eight-month retention rate in a cohort study of migrant ~~msm~~ MSM in ~~beijing~~Beijing, ~~china~~China, using stepwise multiple logistic analysis~~,~~

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	44.30(66)	1.00		1.00	
≥25	362	57.18(207)	1.68(1.14 to 2.47)	0.008	1.76(1.16 to 2.68)	0.008
Duration of stay in Beijing						
< 1 year	78	48.72 (38)	1.00		1.00	
> 1 year	338	58.88 (199)	2.17(1.37 to 3.43)	<0.001	1.68 (1.03 to 2.73)	0.039
Gender of the first sexual partner						
Male	300	58.33 (175)	1.00		1.00	
Female	211	46.45 (98)	0.62(0.43 to 0.88)	0.008	0.60 (0.41 to 0.88)	0.009
Ever had group sex						
NO	452	54.87 (248)	1.00		1.00	
YES	59	42.37 (25)	0.61(0.35 to 1.05)	0.072	0.50 (0.28 to 0.89)	0.019
Have received lubricant in the past 12 months						
NO	109	34.86 (38)	1.00		1.00	
YES	402	58.46 (235)	2.59(1.78 to 3.77)	<0.001	2.31 (1.56 to 3.42)	<0.001

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DISCUSSION

Our study found that the prevalence of HIV (6.58%) among migrant MSM was at a high epidemic level, which was highlighted in comparison to that of a previous study among~~the~~ migrant general population (0%) in –Beijing.[19~~22~~]

Additionally, it was higher than the 4.8% in 2007 among general MSM in Beijing.[24,20] ~~Although it was lower than 8.0% in 2009, the proportion of the migrant population was also as high as 88%.[7]~~ A similar result (5.9%) was found in a recent cross-sectional study among migrant MSM.[17,23] Incidence in this subgroup (7.83/100PY) was consistent with that of migrant MSM (8.51/100PY) in a MSM cohort study in Beijing, and higher than the incidence of permanent resident MSM.[21,25] It was also higher than the incidence of general MSM in different parts of China.[22, 23, 6, 7]

The study found that participants whose first anal intercourse occurred before age 15 had significantly higher risk for HIV seroconversion. An American study of young minority MSM found that study participants who had an MSM sexual debut before 16 years old were more likely to have psychological problems and high risk behaviors like exchanging sex and drug use.[24,26] Early sexual debut ~~would~~ could have a deep and long-term influence on an individual's developing sexual concept, but appropriate sex education has generally been shunned in traditional Chinese education. Our study indicated that early sex ~~-~~education should be combined with Chinese characteristics, and relevant measures need to be implemented as soon as possible. Another risk factor significantly associated with HIV incidence was ever had group sex. An explanation of this observation is that psychological stress caused by stigma and discrimination hinders the development of longer-term relationships between MSM,[25,27] and having sex with multiple ~~sex~~ partners increases the chance of HIV transmission. This indicates a need for confidentiality and support services for migrant MSM. Serious attention should also be paid to the prevalence of STDs. The prevalence rate of syphilis (29.62%) was higher than those of previous studies conducted among MSM in Beijing, such as 19.8% in 2007,[20,24] and 22.0% in 2009.[7,10] ~~It was also higher than those of MSM from many other provinces.[23, 26]~~ The incidence of syphilis (11.11/100PY) was also at an extremely high level compare to 8.06/100PY in a cohort study among MSM during the same period in 2009.[21,25] High prevalence of syphilis among MSM was a common risk factor for encouraging HIV infection because of the biological and behavioral links between syphilis and HIV.[27,28]

The multiple regression ~~analyses~~ analysis significantly revealed that self-identified bisexuals were five times more

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likely than homosexuals to be infected with syphilis. One major reason for this outcome could be that bisexuals may have more varied sexual behaviors with a wider range of sexual partners, including males and females. In addition, a cross-sectional study among young migrant MSM in Beijing discovered that MSM who were engaged in bisexual behavior had a higher rate of unprotected sex with stable female partners and were less likely to take part in prevention behaviors,[~~1~~8~~18~~] which was consistent with our finding that those who had at least one female sex partner and those whose first sexual partner was female were significantly more likely to be lost at four-month and eight-month follow-up visits, respectively. MSM face strong social pressure and stigma in China, which may lead them to hide their sexual orientation by unwillingly engaging in heterosexual relationships.; thus, ~~most of~~many Chinese MSM will potentially enter a heterosexual marriage due to social and famil~~y~~ial pressure.[~~b~~4, ~~c~~] ~~Being afraid of~~Concerned about disclosing their ~~homosexuality~~MSM behavior to their female partners, bisexual MSM ~~will~~may be more reluctant to be followed up. Also, bisexual MSM are more likely to ~~take~~engage in risk behaviors, such as having unprotected sex ~~for~~to indicat~~ing~~e loyalty to their female partners and having commercial or casual sex with men ~~to conceal their orientation.~~ Moreover, only 18.4% of the participants reported having received an examination or treatment for sexually transmitted diseases in the past 12 months, which may be ~~caused by~~related to the high cost of health services and low coverage of health insurance for the migrant population.[~~1~~4~~18~~] Low risk-awareness might be another reason for their lower access to HIV/STD test and treatment. All of these emphasize an urgent need for widespread and accurate syphilis screening and affordable treatment for migrant MSM in Beijing.

In our study, the retention rate was lower than in previous cohort studies implemented among general MSM in Beijing (86.2% in 2007, 86.8% in 2009).[~~2~~1~~25~~, 2~~6~~2~~]~~ From the multiple regression ~~analyses~~analysis, participants who were less than 25 years old were more likely to be lost at both four-month and eight-month follow-up visits. Similar problems have occurred among studies of young MSM in the US.[~~28~~29~~]~~ A plausible reason for this observation was that many young people in China have poor knowledge of safe sexual behaviors. Traditional interventions are more pragmatic but less

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attractive and appropriate for young people. A qualitative investigation implemented among young MSM in Milwaukee and Detroit offered some new approaches, such as ~~that~~ embedding HIV prevention efforts ~~should be embedded~~ in the context of broader life and relationship issues facing young MSM.[29,30] As differences almost certainly exist between young Chinese and American MSM, predictors of retention among young MSM in Beijing deserve further ~~discussion~~investigation.

As for positive predictors, we found those who had been in Beijing for more than one year or who had received lubricant were more likely to be maintained in this cohort ~~both in~~at both four-month and eight-month follow-up visits. As these services are provided by local communities, we found similar results as those in Yangzhou.[308] Migrant MSM who stay longer in Beijing may have more chances to receive effective and stable intervention services, and the ~~their~~ potential impact on their increasing awareness of self-protection ~~would~~ might encourage them to pay closer attention to advances in research. As a result, migrants may be more likely to remain with the investigation to show their support. However, the data showed that receiving voluntary counseling and testing (VCT) service in the past 12 months was a positive factor at four-month follow-up visit, which was replaced by receiving lubricant at eight-month visit. This indicate that factors associated with retention rate may change as time goes on. In other words, different factors may have a unique impact on retention rate in different ~~time~~ periods, which impl~~y~~ies that we should adjust methods for interventions ~~factors~~ over~~in~~ time so as to keep the entire cohort more stable. From the results of our study, the coverage of intervention on this population was limited. Aimed at the mobility problem inherent to migrant populations, a specific strategy of intervention ~~aimed~~ targeted at migrant MSM is imminently needed.

This study has a number of limitations. Firstly, retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between participants retained in the study and those lost to follow-up. Secondly, using non-random sampling methods may have led to selection bias. Thirdly, the sample size was insufficient, and some potentially relevant factors may be concealed by the small sample

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size. Lastly, the study subjects were all inflow population and did not include outflow population, and the proportion of migrants from different provinces varied. There is no evidence to show the data could be generalized to other regions.

~~In conclusion~~To our knowledge, this is the first cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing. With highly prevalent risk behaviors, the migrant MSM had a high level of HIV incidence, and the epidemic of syphilis among this subgroup was extremely serious. Bisexual MSM were at a high risk of syphilis seroconversion, and were more concealed among migrant MSM. Future prevention efforts should include screening and appropriate treatment for syphilis. Multiple modes of intervention services need to be improved and implement for this marginalised group. ~~To encourage bisexual MSM to test and be followed-up,~~ For the sake of bisexual MSM's health, as well as for their partners', more attention need to be paid on ~~their~~ female partners of bisexual MSM to encourage them to take test and be followed-up ~~for both of the two groups' health~~. A greater understanding of risk behaviors and the HIV/STD epidemic among migrant MSM needs to be investigated in the future.

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

CONTRIBUTORS

ZP, RY and NW conceived and designed the experiments, HL and LW performed the experiments, HM and WM analyzed the data, HZ and YZ contributed reagents/materials/analysis tools, HM, WM and ZP wrote the paper, and all authors read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors have no conflict of interest to declare.

Data sharing statement

Extra data is available by emailing zhihangpeng@njmu.edu.cn.

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Figure legend:

Figure 1. Study flowchart of the migrant MSM cohort, with focus on the HIV and syphilis incidence

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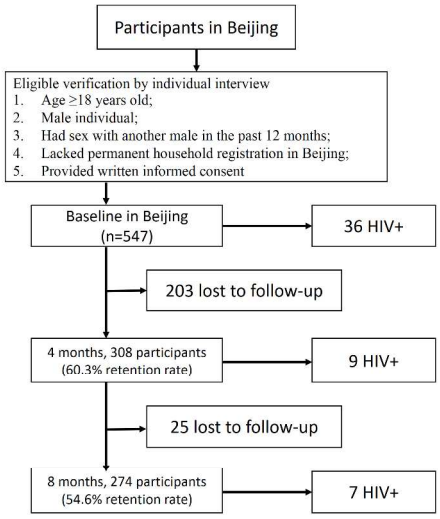

Figure 1. Study flowchart of the migrant MSM cohort, with focus on the HIV and syphilis incidence (N=547).

338x190mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1-2
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	3
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	5
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	10
Outcome data	15*	Report numbers of outcome events or summary measures over time	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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High Incidence of HIV and syphilis among Migrant Men Who have Sex with Men in Beijing, China: A Prospective Cohort Study

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Secondary Subject Heading:	Epidemiology, Sexual health, Infectious diseases
Keywords:	HIV & AIDS < INFECTIOUS DISEASES, Epidemiology < INFECTIOUS DISEASES, SEXUAL MEDICINE

High Incidence of HIV and syphilis among Migrant Men Who have Sex with Men in Beijing, China: A Prospective Cohort Study

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Keywords: HIV; syphilis; male homosexuality; cohort study; China

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ABSTRACT

Objectives: The purpose of the study was to investigate the incidence of HIV and syphilis and their related factors, as well as to examine the predictors associated with seroconversion among migrant men who have sex with men in Beijing, China.

Design: Prospective cohort study.

Setting: Beijing, China.

Participants: 511 HIV-negative migrant MSM.

Primary and secondary outcome measures: Sociodemographic and behavioral information of participants, HIV and syphilis incidence rates, and factors associated with HIV/syphilis seroconversion and cohort retention.

Results: Of the 511 participants, 60.3% (308) and 52.4% (273) were retained at the four-month and eight-month follow-up visits, respectively. The HIV and syphilis incidence rates were 7.83 (95% CI 4.48 to 12.72) and 11.11 (95% CI 6.47 to 17.80) cases per 100 person-years, respectively. HIV seroconversion was significantly associated with had first anal intercourse at age 15 or younger (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56) and ever had group sex (aHR = 4.30, 95% CI 1.40 to 13.18). Bisexual orientation (aHR = 5.09, 95% CI 1.02 to 25.57) was significantly associated with syphilis seroconversion. Predictors associated with both four-month and eight-month retention rates included age ≥ 25 years old and living in Beijing for more than one year.

Conclusions: The high incidence of HIV and syphilis among migrant MSM are a cause for concern. A comprehensive strategy should be implemented to maintain a higher retention rate among migrant MSM.

Strengths and limitations of this study

- First cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing.
- Cox regression analysis and stepwise multiple logistic regression were used to identify factors associated with HIV/syphilis seroconversion and cohort retention, respectively.
- Retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between those retained in the study and those lost to follow-up.
- Sampling methods may have led to selection bias.
- No outflow population was included, and the proportions of migrants from different provinces varied, which may lead to difficulties with generalization of the data.

INTRODUCTION

In China over the last decade, sexual transmission has become the dominant route of HIV transmission.[1]Cases attributed to homosexual transmission rose from 7.3% in 2005 to 16.1% in 2011, forming an increasing proportion of infections among people living with HIV/AIDS (PLWHA).[2] In the 2011 HIV epidemic assessment report, homosexual transmissions accounted for 17.4% of infections among the estimated 780,000 people living with HIV/AIDS, an increase from 14.7% in 2009.[3] A growing number of studies have revealed an upward trend of HIV incidence among MSM in different parts of China. For example, incidence increased from 8.0 to 15.4 per 100 person-years during 2006–2009 in Chongqing, from 5. to 6.3 per 100 person-years during 2010–2012 in Zhejiang.[4]1 to 10.2 per 100 person-years during 2007–2009 in Liaoning, from 5.7 to 8.2 per 100 person-years during 2008-2011 in Jiangsu and from 3.5

In recent years, there has been growing awareness that internal migration within China may be shifting the HIV epidemic by broadening social integration and connecting populations from different regions through sexual networks.[1] Data from national behavioral surveillance from 2004-2005 showed that in nine mainland provinces, migrant HIV/AIDS cases accounted for more than 50% of total infections.[5] A number of cohort studies on MSM have been implemented in China that reveal an HIV epidemic among MSM, but in most of these studies MSM retention was not very high. Retention rates for these cohort studies are rarely maintained over 70% at 12-months follow-up, and a few of them were even below 20%.[6- 9] Reasons for these low rates may include migration of MSM.[8] Moreover, studies implemented among urban MSM also revealed a high proportion of migrants among MSM in major cities, such as in Beijing (88%),[10] Chongqing (80.3%)[11] and Shanghai (79.7%).[12] Although migration itself does not spread HIV or other sexually transmitted diseases (STDs), it may increase the possibility of infection when combined with high risk behaviors, which are prevalent among MSM. It has been confirmed in numerous studies that high risk behaviors such

as unprotected anal sex, commercial sex, group sex, casual sex and having multiple sexual partners are prevalent among MSM in China.[13-15] On the other hand, perceived stigma and discrimination due to traditional Chinese culture and conservative social values have increasingly led Chinese MSM to marry female sexual partners, which leads to a potential risk of transmitting HIV to the general population via heterosexual transmission.[14] As for migrants, lacking the stability of a family or a home community and hampered by generally low educational levels, limited knowledge of HIV/AIDS prevention, and discrimination and marginalization from the mainstream metropolitan society, high risk behaviors may occur more frequently.[16, 17] Furthermore, due to China's household registration system and urban social security system, migrants have limited access to comprehensive, convenient and long-term health services.[18] Recently, some cross-sectional studies in China demonstrated that compared to local MSM, migrant MSM engage in more high risk sexual behaviors such as multiple sexual partners, higher frequencies of anal and oral intercourse, and unprotected sexual behaviors with both males and females.[15, 19] As a marginal and vulnerable subpopulation, migrant MSM should be accorded a high level of consideration by researchers.

Beijing, the capital of China and a center of political, economic and cultural activity, is a magnet for the migrant population. In 2012, Beijing's metropolitan population included some 7.7 million migrants, with migrants accounting for 37.4% of the total population of Beijing (China National Bureau of Statistics, 2013). According to statistics from the Beijing Municipal Bureau of Health, the proportion of MSM among HIV/AIDS cases increased from 22.8% in 2006 to 69.1% at the end of October 2013.[20] In addition, prior research among MSM in Beijing revealed that with the increasing epidemic of HIV among MSM in recent years, the number of migrants among recruited participants also showed a noticeable upward trend.[10, 11] This phenomenon implies the following: (1) migrant MSM play a main role in MSM society in Beijing; (2) this marginal population emerged gradually with the constant improvement of sampling methods; and (3) more targeted studies of this subpopulation are urgently needed, since at present only a few cross-sectional studies have been conducted to investigate their HIV/STD infections and relative risk factors.[21, 22] Thus,

the purpose of this research was to assess the incidence of HIV and syphilis and examine the predictors associated with seroconversion and retention in a prospective cohort study among migrant MSM in Beijing, China.

METHODS

Study design and study population

This prospective cohort study was conducted in Beijing. Participants were all Chinese citizens and were recruited through three methods. First, study participants were recruited directly through website advertisements by a nongovernmental AIDS volunteer group (http://www.hivolunt.net). Second, peer recruiters were hired and trained to distribute flyers with study-related information at MSM-frequented venues (e.g., MSM clubs, bars, parks and bathhouses). Thirdly, study participants were encouraged to refer their peers to enroll in the study. Once a potential participant had been referred or identified, local research team members approached the individual to verify eligibility, which included age ≥18 years old, male gender, HIV-negative, had sex with another male in the past 12 months, lacked permanent household registration in Beijing and provided written informed consent.

We calculated the sample size using the equation $n = \frac{\left(z_\alpha \sqrt{2\overline{pq}} + z_\beta \sqrt{p_0 q_0 + p_1 q_1}\right)^2}{(p_1 - p_0)^2}$, where α and β are 0.05 and 0.10 and the corresponding z_α and z_β are 1.96 and 1.282. p_0 represents the prevalence of HIV among general MSM in Beijing, which was set at 0.02 according to the estimates of the HIV epidemic in 2012 and 2013 in Beijing; p_1 represents the HIV prevalence among migrant MSM in Beijing, which was estimated to be higher than p_0 as 0.06, so the n was calculated to be 502. Considering the possibility of loss to follow-up, we increased the target sample size by 10%. A total of 547 participants were screened during the baseline screening survey from September to October 2009, of whom 36 were HIV-positive and 162 were syphilis-positive. In consideration of the curability and reinfection potential of syphilis, participants who were syphilis-positive at baseline were still recruited in the cohort. Thus, a total of 511 eligible and consenting MSM were enrolled into the prospective cohort, of whom 141 were syphilis-positive.

Participants were followed up for four and eight months after the baseline survey. At each study visit (baseline, four-month follow-up and eight-month follow-up), eligible participants were interviewed by trained health professionals in a private room of the study clinic, and blood plasma specimens were collected and analyzed for HIV and syphilis antibodies by experienced physicians. One week later, each participant received their test results anonymously by a private identification code. All participants who tested positive for HIV/syphilis received additional posttest counseling and referrals to relevant free services. Every participant received 50 RMB (7.4 USD), 12 free condoms and one free lubricant after each completed study visit. Every participant was asked to provide at least two different and current contact methods, and reminder calls were made before the follow-up day to verify that the exact time of the visit would be convenient for them. The study protocol and informed consent forms were approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention of the China Center for Disease Control and Prevention (Figure 1).

Data collection and laboratory tests

Questionnaire-based interviews were conducted on a one-on-one basis in a separate private room of the district clinic. Data on demographics, sexual behavior and history of STDs were collected. Participants' questionnaires and blood specimens were linked through assignment of a unique identifier code in the follow-up visits.

Blood specimens were tested for HIV and syphilis infection. HIV infection status was screened by an ELISA (InTec Products Company, Xiamen, China) screening and confirmed by an HIV-1/2 Western Blot (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Syphilis infection was determined by a rapid plasma reagin (RPR) test (Shanghai Rongsheng, Shanghai, China) and confirmed using a Treponema pallidum particle assay (TPPA) test (Fujirebio Inc, Tokyo, Japan).

Statistical analysis

Questionnaire data were double-entered and then checked for accuracy using EpiData software (The EpiData Association, Odense, Denmark, version 3.1). Data were analyzed using Stata/SE (StataCorp LP, USA, version 12.0 for Windows). HIV seroconversion was estimated to have occurred at the midpoint between the time of the baseline HIV test and the time of the follow-up HIV test with a seropositive result. Syphilis seroconversion was estimated to have occurred at the halfway point between the previous visit and the visit where seroconversion occurred. HIV/syphilis incidence density was calculated based on a Poisson distribution, with number of seroconversion incidents within the follow-up period as the numerator and person-years (PY) over the entire follow-up period as the denominator. Categorical factors associated with retention rate were analyzed by univariate logistic regression, including baseline demographic and behavioral characteristics. A stepwise multiple logistic regression (out 0.05, in 0.02) was used to select independent factors for the retention rate. A Cox regression model was used in univariate and multiple regression analyses to identify correlates of time to HIV seroconversion. Statistically significant variables in univariate analysis ($P<0.10$) were entered simultaneously into a multivariate Cox proportional hazard regression model to determine the adjusted hazard ratio (aHR) for HIV/syphilis seroconversion-related risk factors.

RESULTS

Baseline characteristics of the participants

Among 511 participants, the median age was 29 years; 94.32% belonged to the Han ethnic group; 64.77% were single, 22.90% were married or cohabiting, and 12.33% were separated or divorced or widowed. In terms of education level, 73.19% had received a high school education or lower. About half (54.01%) had monthly incomes < 300US$. Participants who identified themselves as exclusively homosexual or as bisexual accounted for 60.67% and 37.57%, respectively. A total of 16.05% and 44.03% of the participants thought it was impossible or improbable they would be

infected with HIV, respectively. The median age of sexual debut was 20 years, and 58.71% experienced their sexual debut with a male. The median age of first anal intercourse was 22, and 58.65% of participants did not use a condom at first anal intercourse. In the past year, 78.67% of the participants had ever received condoms, 65.17% had ever received lubricant, 23.68% had ever taken part in peer education, 18.40% had ever received examination or treatment for STDs and 52.49% had ever received voluntary counseling and testing services (VCTs).

Regarding behaviors in the past six months among participants, the median number of male sex partners was three. For high risk behaviors, 327 (63.99%) had oral sex with male sex partners, 22 (6.73%) of them had consistent condom use with regular sex partners, and 26 (7.95%) with casual partners; 511 (100%) had anal sex with male sex partners, 13.11% of them had consistent condom use with regular sex partners, and 66 (18.70%) with casual partners. A total of 61 (11.94%) participants had ever engaged in commercial sexual behavior, among whom 35 (57.38%) had paid for sex and 43 (70.49%) had received money for sex. A total of 59 (11.55%) had ever engaged in group sex, which happened almost exclusively (96.61%) among males. A total of 166 (32.49%) had ever engaged in sex under the influence of alcohol, among whom 152 (92.77%) had homosexual intercourse while intoxicated (Table 1).

Table 1. Sociodemographic characteristics of the 511 study participants in the cohort of migrant MSM in Beijing

Variables	n	%
Overall, N	511	100
Age (median, years)	29	-
18-24	149	29.16
≥25	362	70.84
Ethnicity		
Han	482	94.32
Minority	29	5.68
Marital status		
Single	331	64.77
Married	114	22.31
Cohabiting with male or female sex partner	3	0.59
Separated or divorced or widowed	63	12.33
Duration of stay in Beijing		
< 1 year	173	33.85

≥ 1 year	338	66.14
Education level		
High school and below	374	73.19
College and above	137	26.81
Monthly income (US$)		
< 300	276	54.01
≥ 300	235	45.99
Self-reported sexual orientation		
Homosexual	310	60.67
Heterosexual	8	1.57
Bisexual	192	37.57
Other	1	0.2
Self-reported risk of HIV infection		
Impossible	82	16.05
Improbable	225	44.03
Possible	74	14.48
Probable	15	2.94
No idea	115	22.5
Age of sexual debut (median,years)	20	
Gender of first sexual partner		
Male	300	58.71
Female	211	41.29
Age of first anal intercourse(median, years)	22	
Had first anal intercourse before 15 years-old	13	2.54
Number of male sex partners in the last 6 months (median)	3	
Number of female sex partners in the last 6 months (median)	0	
Oral sex with regular partners with consistent condom use in the past 6 months	22	6.73
Oral sex with casual partners with consistent condom use in the past 6 months	26	7.95
Anal sex with regular partners with consistent condom use in the past 6 months	67	13.11
Anal sex with casual partners with consistent condom use in the past 6 months	66	18.7
Ever had commercial sexual behavior	61	11.94
Ever had group sex	59	11.55
Alcohol use prior to sex	166	32.49
Ever had STDs	84	16.44
Have ever received condoms	402	78.67
Have ever received lubricant	333	65.17
Have ever received peer education	121	23.68
Have ever received examination or treatment for STD	94	18.4
Have ever received VCT services	268	52.45
Have ever received educational materials on AIDS/STD	302	59.1

MSM, men who have sex with men; STD, sexually transmitted disease.

Incidence of infections of HIV, syphilis, HIV-syphilis co-infection and factors predicting HIV and syphilis seroconversion

During the eight-month follow-up, 16 HIV seroconversions were observed over 204.27 person-years of observation, resulting in an incidence rate of 7.83 per 100 person-years (PY) (95% CI 4.48 to 12.72). At the four-month visit, the incidence of HIV was 8.33 per 100 PY (95% CI 3.81 to 15.81) and at the eight-month visit it was 3.83 per 100 PY (95% CI 1.54 to 7.89). During the eight-month follow-up period, syphilis incidence was 11.11 per 100 PY (95% CI 6.47 to 17.80). At the four-month and eight-month visits, the syphilis incidence was 10.03 per 100 PY (95% CI 4.33 to 19.76) and 15.25 per 100 PY (95% CI 6.97 to 28.94), respectively. Six HIV seroconversion cases were observed becoming syphilis-positive over 52.10 person-years, resulting in an incidence of co-infection of 11.52 per 100 PY (4.23 to 25.07).

Multivariate Cox regression analysis indicated that age ≤ 15 years old at first anal intercourse (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56, p=0.050) and ever had group sex (aHR=4.30, 95% CI 1.40 to 13.18, p=0.011) were significantly associated with time to HIV seroconversion (Table 2). For syphilis incidence, bisexual orientation (aHR=5.09, 95% CI 1.02 to 25.57, p=0.048) and had more than one sex partners since last investigation (aHR=9.22, 95% CI 1.13 to 73.37, p=0.038) were significantly identified as risk factors (Table 3).

Table 2. Multivariate analyses of participant characteristics associated with incident HIV infection among migrant MSM in Beijing

Factors	No. of HIV seroconversions	Cumulative PY	HIV incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	16	204.27	7.83				
Education							
Junior college and below	13	143.95	9.03	1.00			
Above junior college	3	60.32	4.97	0.56(0.16 to 1.98)	0.370		
Seeking partner through Internet							
NO	12	109.45	10.96	1.00			
YES	4	94.81	4.22	0.39(0.12 to 1.20)	0.100		
Age of first anal intercourse (median, years)							

≥15	14	200.99	6.97	1.00		1.00	
<15	2	3.28	60.98	8.28(1.88 to 36.46)	0.005	9.20(1.94 to 43.56)	0.005
Ever had group sex							
NO	11	183.48	6	1.00		1.00	
YES	5	20.78	24.06	3.95(1.37 to 11.38)	0.011	4.30(1.40 to 13.18)	0.011
Knowledge of HIV/AIDS was acquired from							
Media							
NO	12	109.65	10.94	1.00			
YES	4	94.62	4.23	0.39(0.12 to 1.20)	0.100		
Internet							
NO	6	108.59	5.53	1.00			
YES	10	95.68	10.45	0.38(0.12 to 1.19)	0.097		
Consistent condom use during oral sex with regular partners since last investigation							
NO	1	9.45		1.00			
YES	15	194.82		0.73(0.10 to 5.50)	0.758		
Consistent condom use during oral sex with casual partners since last investigation							
NO	0	7.70	0	1.00			
YES	9	128.67	6.99	-	-		
Consistent condom use during anal sex with regular partners since last investigation							
NO	3	29.18	10.28	1.00			
YES	13	175.09	7.42	0.72(0.21 to 2.53)	0.609		
Consistent condom use during anal sex with casual partners since last investigation							
NO	2	27.56	7.26	1.00			
YES	10	115.99	8.62	1.19(0.26 to 5.42)	0.825		

PY, person-years; HR, hazard ratio.

Table 3. Multivariate analyses of participant characteristics associated with incident syphilis infection among migrant MSM in Beijing

Factors	No. of syphilis seroconversions	Cumulative PY	Syphilis incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	17	152.95	11.11				
Ever had female sex partner(s)							
No	9	96.89	9.29	1.00			
Yes	8	54.64	14.64	5.56(1.10 to 27.05)	0.038	5.09(1.02 to 25.57)	0.048
Other	0	0	-	-			
Number of female sex partners since last investigation							
≤1	16	149.9	10.67	1.00			
≥2	1	3.05	32.79	9.22(1.13 to 75.37)	0.038		
Seeking partners in bar/dancing hall/tearoom/chamber							
NO	11	129.41	8.5	1.00			
YES	6	23.55	25.48	3.12(0.75 to 13.07)	0.119		

Consistent condom use during oral sex with regular partners in the past 6 months					
NO	1	6.24	16.03	1.00	
YES	16	146.71	10.91	0.24(0.03 to 1.99)	0.188
Consistent condom use during oral sex with casual partners in the past 6 months					
NO	0	4.37	0	1.00	
YES	8	92.58	8.64	-	
Consistent condom use during anal sex with regular partners in the past 6 months					
NO	2	24.52	8.16	1.00	
YES	15	128.43	11.68	0.57(0.11 to 2.80)	0.485
Consistent condom use during anal sex with casual partners in the past 6 months					
NO	0	19.80	0	1.00	
YES	11	83.21	13.22	-	

Predictors of cohort retention

Of the 511 participants, 60.3% (308) were retained in the cohort at the four-month follow-up and 54.6% (274) were retained at the eight-month follow-up.

Univariate factors among baseline characteristics which were significantly associated with four-month retention were analysed with stepwise multiple logistic regression. Four factors were kept in the final model, including age > 25 years old (adjusted odds ratio (AOR) = 1.81, 95% CI 1.07 to 3.06, p = 0.026), living in Beijing for more than one year (AOR = 3.68, 95% CI 2.04 to 6.64, p < 0.001), had at least one female sex partner since last investigation (AOR = 0.48, 95% CI 0.29 to 0.80, p=0.005), and had ever received VCTs in the past 12 months (AOR =1.71, 95% CI 1.07 to 2.72, p<0.024) (Table 4).

Table 4. Factors associated with four-month retention rate in a cohort study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	46.98(70)	1.00		1.00	
≥25	362	65.75(238)	2.17(1.47 to 3.19)	<0.001	1.81(1.07 to 3.06)	0.026
Duration of stay in Beijing						
< 1 year	95	34.74(33)	1.00		1.00	
≥ 1 year	416	66.27(208)	3.66(2.29 to 5.85)	<0.001	3.68 (2.04 to 6.64)	<0.001

Number of female sex partners since last investigation						
0	382	64.66 (247)	1.00		1.00	
≥1	129	47.29 (61)	0.49(0.33 to 0.74)	0.001	0.48(0.29 to 0.80)	0.005
Have received VCT service in the past 12 months						
No	243	51.85 (126)	1.00		1.00	
Yes	268	67.91 (182)	1.97(1.37 to 2.81)	<0.001	1.71(1.07 to 2.72)	0.024

For eight-month retention, age> 25 years old (AOR = 1.76, 95% CI 1.16 to 2.68, p = 0.008), living in Beijing for more than one year (AOR = 1.68, 95% CI 1.03 to 2.73, p = 0.039), first sexual partner was female (AOR = 0.60, 95% CI 0.41 to 0.88, p = 0.009), ever had group sex (AOR = 0.50, 95% CI 0.28 to 0.89, p = 0.019), and had received lubricant in the past 12 months (AOR = 2.31, 95% CI 1.56 to 3.42, p < 0.001) were retained in the final model using stepwise multiple logistic regression analysis (Table 5).

Table 5. Factors associated with eight-month retention rate in a cohort study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	44.30(66)	1.00		1.00	
≥25	362	57.18(207)	1.68(1.14 to 2.47)	0.008	1.76(1.16 to 2.68)	0.008
Duration of stay in Beijing						
< 1 year	78	48.72 (38)	1.00		1.00	
> 1 year	338	58.88 (199)	2.17(1.37 to 3.43)	<0.001	1.68 (1.03 to 2.73)	0.039
Gender of the first sexual partner						
Male	300	58.33 (175)	1.00		1.00	
Female	211	46.45 (98)	0.62(0.43 to 0.88)	0.008	0.60 (0.41 to 0.88)	0.009
Ever had group sex						
NO	452	54.87 (248)	1.00		1.00	
YES	59	42.37 (25)	0.61(0.35 to 1.05)	0.072	0.50 (0.28 to 0.89)	0.019
Have received lubricant in the past 12 months						
NO	109	34.86 (38)	1.00		1.00	
YES	402	58.46 (235)	2.59(1.78 to 3.77)	<0.001	2.31 (1.56 to 3.42)	<0.001

DISCUSSION

Our study found that the prevalence of HIV (6.58%) among migrant MSM was at a highly epidemic level, which was remarkable compared to that of a previous study among the general migrant population (0%) in Beijing.[23] Additionally, it was higher than the 4.8% in 2007 among general MSM in Beijing.[24] A similar result (5.9%) was found in a recent cross-sectional study among migrant MSM.[23] Incidence in this subgroup (7.83/100PY) was consistent with that of migrant MSM (8.51/100PY) in a MSM cohort study in Beijing, and higher than the incidence of permanent resident MSM.[25] It was also higher than the incidence of general MSM in different parts of China.[6, 7]

The study found that participants whose first anal intercourse occurred before age 15 had significantly higher risk for HIV seroconversion. An American study of young minority MSM found that study participants who had an MSM sexual debut before 16 years old were more likely to have psychological problems and high risk behaviors like exchanging sex and drug use.[26] Early sexual debut could have a deep and long-term influence on individuals' attitudes towards sex, but appropriate sex education has generally been shunned in traditional Chinese education. Our study indicated that early sex education should be combined with Chinese characteristics, and relevant measures need to be implemented as soon as possible. Another risk factor significantly associated with HIV incidence was ever had group sex. An explanation of this observation is that psychological stress caused by stigma and discrimination hinders the development of longer-term relationships between MSM,[27] and having sex with multiple partners increases the chance of HIV transmission. This indicates a need for confidentiality and supportive service for migrant MSM. Serious attention should also be paid to the prevalence of STDs. The prevalence rate of syphilis (29.62%) was higher than in previous studies conducted among MSM in Beijing, such as 19.8% in 2007[24] and 22.0% in 2009.[10] The incidence of syphilis (11.11/100PY) was also extremely high compared to 8.06/100PY in a cohort study among MSM during the same period in 2009.[25] High prevalence of syphilis among MSM is a common risk factor for encouraging HIV infection because of the biological and behavioral links between syphilis and HIV.[28]

The multiple regression analysis significantly revealed that self-identified bisexuals were five times more likely than

homosexuals to be infected with syphilis. One major reason for this outcome could be that MSM who had had sex with females may have more varied sexual behaviors with a wider range of sexual partners, including males and females. In addition, a cross-sectional study among young migrant MSM in Beijing discovered that MSM who were engaged in bisexual behavior had a higher rate of unprotected sex with stable female partners and were less likely to take part in preventive behaviors,[18] which was consistent with our finding that those who had at least one female sex partner and those whose first sexual partner was female were significantly more likely to be lost at four-month and eight-month follow-up visits, respectively. MSM face strong social pressure and stigma in China, which may lead them to hide their sexual orientation by unwillingly engaging in heterosexual relationships; thus, many Chinese MSM will potentially enter a heterosexual marriage due to social and familial pressure.[4] Concerned about disclosing their MSM behavior to their female partners, bisexual MSM may be more reluctant to be followed up. Also, MSM with female partners are more likely to be engaged in risk behaviors, such as having unprotected sex to demonstrate loyalty to their female partners and having commercial or casual sex with men. Moreover, only 18.4% of the participants reported having received an examination or treatment for sexually transmitted diseases in the past 12 months, which may be related to the high cost of health services and low coverage of health insurance for the migrant population.[18] Low risk-awareness might be another reason for their lower access to HIV/STD test and treatment. All of these emphasize an urgent need for widespread and accurate syphilis screening and affordable treatment for migrant MSM in Beijing.

In our study, the retention rate was lower than previous cohort studies implemented among general MSM in Beijing (86.2% in 2007, 86.8% in 2009).[25, 26] From the multiple regression analysis, participants who were less than 25 years old were more likely to be lost at both four-month and eight-month follow-up visits. Similar problems have occurred among studies of young MSM in the US.[29] A plausible reason for this observation was that many young people in China have poor knowledge of safe sexual behaviors. Traditional interventions are more pragmatic but less attractive and appropriate for young people. A qualitative investigation implemented among young MSM in Milwaukee and Detroit

offered some new approaches, such as combining HIV/AIDS care intervention with their daily lives and helping solve problems of social relationships bothering young MSM.[30] However, as Chinese young MSM are almost certainly different from Americans in some aspects, measures of intervention among young MSM in Beijing deserve further investigation.

As for positive predictors, we found those who had been in Beijing for more than one year or who had received lubricant were more likely to be maintained in this cohort at both four-month and eight-month follow-up visits. As these services are provided by local communities, we found similar results in Yangzhou.[8] Migrant MSM who stay longer in Beijing may have more chances to receive effective and stable intervention services, and the potential impact on their increasing awareness of self-protection might encourage them to pay closer attention to advances in research. As a result, migrants may be more likely to remain with the investigation to show their support. However, the data showed that receiving VCT service in the past 12 months was a positive factor at the four-month follow-up visit, which was replaced by receiving lubricant at the eight-month visit. This indicates that factors associated with retention rate may change as time goes on, which implies that we should adjust methods for interventions over time so as to keep the entire cohort more stable. From the results of our study, the coverage of intervention on this population was limited. Aimed at the mobility problem inherent to migrant populations, a specific strategy of intervention targeted at migrant MSM is imminently needed.

This study has a number of limitations. Firstly, retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between participants retained in the study and those lost to follow-up. Secondly, using non-random sampling methods may have led to selection bias. Thirdly, the sample size was insufficient, and some potentially relevant factors may be concealed by the small sample size. Lastly, the study subjects were all inflow population and did not include outflow population, and the proportion of migrants from different provinces varied. There is no evidence to show the data could be generalized to other regions.

To our knowledge, this is the first cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing. With highly prevalent risk behaviors, the migrant MSM had a high level of HIV incidence, and the epidemic of syphilis among this subgroup was extremely serious. Bisexual MSM were at a high risk of syphilis seroconversion, and were more concealed among migrant MSM. Future prevention efforts should include screening and appropriate treatment for syphilis. Multiple modes of intervention services need to be improved and implement for this marginalised group. For the sake of bisexual MSM's health, as well as for their partners', more attention need to be paid on female partners of bisexual MSM to encourage them to take test and be followed-up. A greater understanding of risk behaviors and the HIV/STD epidemic among migrant MSM needs to be investigated in the future.

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CONTRIBUTORS

ZP, RY and NW conceived and designed the experiments, HL and LW performed the experiments, HM and WM analyzed the data, HZ and YZ contributed reagents/materials/analysis tools, HM, WM and ZP wrote the paper, and all authors read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors have no conflict of interest to declare.

Data sharing statement

No additional data available.

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Figure legend:

Figure 1. Study flowchart of the migrant MSM cohort, with focus on HIV and syphilis incidence.

High Incidence of HIV and syphilis among Migrant Men Who have Sex with Men in Beijing, China: A Prospective Cohort Study

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ABSTRACT

Objectives: The purpose of the study was to investigate the incidence of HIV and syphilis and their related factors, as well as to examine the predictors associated with seroconversion among migrant men who have sex with men in Beijing, China.

Design: Prospective cohort study.

Setting: Beijing, China.

Participants: 511 HIV-negative migrant MSM.

Primary and secondary outcome measures: Sociodemographic and behavioral information of participants, HIV and syphilis incidence rates, and factors associated with HIV/syphilis seroconversion and cohort retention.

Results: Of the 511 participants, 60.3% (308) and 52.4% (273) were retained at the four-month and eight-month follow-up visits, respectively. The HIV and syphilis incidence rates were 7.83 (95% CI 4.48 to 12.72) and 11.11 (95% CI 6.47 to 17.80) cases per 100 person-years, respectively. HIV seroconversion was significantly associated with had first anal intercourse at age 15 or younger (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56) and ever had group sex (aHR = 4.30, 95% CI 1.40 to 13.18). Bisexual orientation (aHR = 5.09, 95% CI 1.02 to 25.57) was significantly associated with syphilis seroconversion. Predictors associated with both four-month and eight-month retention rates included age ≥ 25 years old and living in Beijing for more than one year.

Conclusions: The high incidence of HIV and syphilis among migrant MSM are a cause for concern. A comprehensive strategy should be implemented to maintain a higher retention rate among migrant MSM.

Strengths and limitations of this study

- First cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing.
- Cox regression analysis and stepwise multiple logistic regression were used to identify factors associated with

HIV/syphilis seroconversion and cohort retention, respectively.

- Retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between those retained in the study and those lost to follow-up.
- Sampling methods may have led to selection bias.
- No outflow population was included, and the proportions of migrants from different provinces varied, which may lead to difficulties with generalization of the data.

INTRODUCTION

In China ~~during~~ over the last decade, sexual transmission has become the ~~major~~ dominant route ~~for~~ of HIV transmission.[1] ~~As an increasing proportion of infections among people living with HIV/AIDS (PLWHA), c~~Cases attributed to homosexual transmission rose from 7.3% in 2005 to 16.1% in 2011, forming an increasing proportion of infections among people living with HIV/AIDS (PLWHA).[2] ~~The~~ In the 2011 HIV epidemic assessment report ~~showed that among the estimated 780,000 people living with HIV/AIDS~~, homosexual transmissions accounted for 17.4% of infections among the estimated 780,000 people living with HIV/AIDS, an increase from 14.7% in 2009.[3] A growing number of studies have revealed an upward trend of HIV incidence among MSM in different parts of China. For example, incidence increased from 8.0 to 15.4 per 100 person-years during 2006–2009 in Chongqing, from 5.1 to 10.2 per 100 person-years during 2007–2009 in Liaoning, from 5.7 to 8.2 per 100 person-years during 2008-2011 in Jiangsu and from 3.5 to 6.3 per 100 person-years during 2010–2012 in Zhejiang.[4]

In recent years, there has been growing awareness that internal migration within China may be shifting the HIV epidemic by broadening social integration and connecting populations from different regions through sexual networks.[1]

Data from national behavioral surveillance ~~during~~ from 2004-2005 showed that in nine mainland provinces, migrant HIV/AIDS cases accounted for more than 50% of total infections ~~in nine mainland provinces~~.[5] ~~Numbers~~ A number of

cohort ~~study~~ studies on MSM have been implemented in China ~~to~~ that reveal an HIV epidemic among MSM, ~~however~~ but in most of these studies ~~the~~ MSM retention~~s of MSM were~~ was not ~~so~~ very high ~~in most of them~~. ~~Retentions~~ Retention rates for~~of~~ these cohort studies ~~can~~ are ~~hardly~~ rarely maintained over 70% at 12-months follow-up, and a few of them were even below 20%.[6-9] ~~There are r~~Reasons for these low ~~retention~~ rates~~, and~~ may include migration of MSM ~~may be an important one~~.[8] Moreover, studies implemented among urban MSM also revealed a high proportion of migrants among MSM in major cities, such as in Beijing (88%),[10] Chongqing (80.3%)[11] and Shanghai (79.7%).[12] Although migration itself does not spread HIV or other sexually transmitted diseases (STDs), it may increase the possibility of infection when combined with high risk behaviors, which are prevalent among MSM. It has been confirmed in numerous studies that high risk behaviors such as unprotected anal sex, commercial sex, group sex, casual sex and having multiple sexual partners are prevalent among MSM in China.[13-15] On the other hand, perceived stigma and discrimination due to traditional Chinese culture and conservative social values have increasingly led Chinese MSM to ~~disguise their sexual orientation~~get married ~~with a~~ marry female sexual partners ~~with matrimony~~, which leads to a potential risk of transmitting HIV to the general population via heterosexual transmission.[14] As for migrants, lacking the stability of a family or a home community and ~~with~~ hampered by generally low educational levels, limited knowledge of HIV/AIDS prevention, and discrimination and marginalization from the mainstream metropolitan society, high risk behaviors may occur more frequently.[16, 17] Furthermore, due to China's household registration system and urban social security system, migrants have limited access to comprehensive, convenient and long-term health services.[18] Recently, some cross-sectional studies in China demonstrated that compared to local MSM, migrant MSM engage in more high risk sexual behaviors such as multiple sexual partners, higher frequencies of anal and oral intercourse, and unprotected sexual behaviors with both males and females.[15, 19] As a marginal and vulnerable subpopulation, migrant MSM should be accorded a high level of consideration by researchers.

Beijing, the capital of China and a center of political, economic and cultural activity, is a magnet for the migrant

population. In 2012, Beijing's metropolitan population included some 7.7 million migrants, with ~~the~~ migrants ~~population~~ accounting for 37.4% of the total population of Beijing (China National Bureau of Statistics, 2013). According to statistics from the Beijing Municipal Bureau of Health, the proportion of MSM ~~in~~ among HIV/AIDS cases increased from 22.8% in 2006 to 69.1% at the end of October 2013.[20] In addition, prior research among MSM in Beijing revealed that with the increasing epidemic of HIV among MSM in recent years, the number of migrants among recruited participants also showed a ~~remarkable~~ noticeable upward trend.[10, 11] This phenomenon implies the following: (1) migrant MSM play a main role in MSM society in Beijing; (2) this marginal population emerged gradually with the constant improvement of sampling methods; and (3) more targeted studies of this subpopulation are urgently needed, ~~while~~ since at present only a few cross-sectional studies have been conducted to investigate ~~its~~ their HIV/STD infections and relative risk factors.[21, 22] Thus, the purpose of this research was to assess the incidence of HIV and syphilis and examine the predictors associated with seroconversion and retention in a prospective cohort study among migrant MSM in Beijing, China.

METHODS

Study ~~Design~~ design and ~~Study~~ study ~~Population~~population

This prospective cohort study was conducted in Beijing. Participants were all Chinese citizens and were recruited through three methods. First, study participants were recruited directly through website advertisements by a nongovernmental AIDS volunteer group (http://www.hivolunt.net). Second, peer recruiters were hired and trained to distribute flyers with study-related information at MSM-frequented venues (e.g., MSM clubs, bars, parks and bathhouses). Thirdly, study participants were encouraged to refer their peers to enroll in the study. Once a potential participant had been referred or identified, local research team members approached the individual to verify eligibility, which included age ≥18 years old, male ~~individual~~gender, HIV-negative, had sex with another male in the past 12

months, lacked permanent household registration in Beijing and provided written informed consent.

We calculated the sample size useding the equation $n = \frac{\left(z_\alpha \sqrt{2\overline{pq}} + z_\beta \sqrt{p_0 q_0 + p_1 q_1}\right)^2}{(p_1 - p_0)^2}$ ~~to calculate the sample size~~, where α and β are 0.05 and 0.10,~~–~~ and the corresponding z_α and z_β are 1.96 and 1.282. p_0 represents the prevalence of HIV among general MSM in Beijing, which was set ~~to be~~at 0.02 according to the estimat~~ion~~es of the HIV epidemic in 2012 and 2013 in Beijing; p_1 represents the HIV prevalence among migrant MSM in Beijing, which was estimated to be higher than p_0 as 0.06, ~~thus~~so the n was calculated to be 502. Considering the possibility of loss to follow-up, we increased the target sample size by 10%. A total of 547 participants were screened during the baseline screening survey from September to October 2009, of whom 36 were HIV-positive and 162 were syphilis-positive. In consideration of the curability and ~~repeatability~~ reinfection potential of syphilis ~~infection~~, participants who were syphilis-positive at baseline were still recruited in the cohort. Thus, a total of 511 eligible and consenting MSM were enrolled into the prospective cohort, of whom 141 were syphilis-positive. Participants were followed up for four and eight months after the baseline survey. At each study visit (baseline, four-month follow-up and eight-month follow-up), eligible participants were interviewed by trained health professionals in a private room of the study clinic, and blood plasma specimens were collected and analyzed for HIV and syphilis antibodies by experienced physicians. One week later, each participant received their test results anonymously by a private identification code. All participants who tested positive for HIV/syphilis received additional posttest counseling and referrals to relevant free services. Every participant received 50 RMB (7.4 USD), 12 free condoms and one free lubricant after each completed study visit. Every participant was asked to provide at least two different and current contact methods, and reminder calls were made before the follow-up day to verify that the exact time of the visit would be convenient for them. The study protocol and informed consent forms were approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention of the China Center for Disease Control and Prevention (Figure 1).

Data ~~Collection~~ collection and ~~Laboratory~~ laboratory ~~Tests~~tests

Questionnaire-based interviews were conducted on a one-on-one basis in a separate private room of the district clinic. Data on demographics, sexual behavior and history of STDs were collected. Participants' questionnaires and blood specimens were linked through assignment of a unique identifier code in the follow-up visits.

Blood specimens were tested for HIV and syphilis infection. ~~The~~ HIV infection status was screened by an ELISA (InTec Products Company, Xiamen, China) screening~~,~~ and confirmed by an HIV-1/2 Western Blot (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Syphilis infection was determined by a rapid plasma reagin (RPR) test (Shanghai Rongsheng, Shanghai, China)~~,~~ and confirmed using a Treponema pallidum particle assay (TPPA) test (Fujirebio Inc, Tokyo, Japan).

Statistical ~~A~~analysis

Questionnaire data were double-entered and then checked for accuracy using EpiData software (The EpiData Association, Odense, Denmark, version 3.1). Data were analyzed using Stata/SE (StataCorp LP, USA, version 12.0 for Windows). HIV seroconversion was estimated to have occurred at the midpoint between the time of the baseline HIV test and the time of the follow-up HIV test with a seropositive result. Syphilis seroconversion was estimated to have occurred at the halfway point between the previous visit and the visit where seroconversion occurred. HIV/syphilis incidence density was calculated based on a Poisson distribution, with number of seroconversion incidents within the follow-up period as the numerator and person-years (PY) over the entire follow-up period as the denominator. Categorical factors associated with retention rate were analyzed by univariate logistic regression, including baseline demographic and behavioral characteristics. A stepwise multiple logistic regression (out 0.05, in 0.02) was used to select independent factors for the retention rate. A Cox regression model was used in univariate and multiple regression analyses to identify correlates of time to HIV seroconversion. Statistically significant variables in univariate analysis

(P<0.10) were entered simultaneously into a multivariate Cox proportional hazard regression model to determine the adjusted hazard ratio (aHR) for HIV/syphilis seroconversion-related risk factors.

RESULTS

Baseline ~~Characteristics~~ characteristics of the ~~Participants~~participants

~~Of~~ Among 511 participants, the median age was 29 years; 94.32% belonged to the Han ethnic group; 64.77% were single, 22.90% were married or cohabiting, and 12.33% were separated or divorced or widowed. ~~For~~ In terms of education level, 73.19% had received a high school education or lower. About half (54.01%) had monthly incomes < 300US$. Participants who identified themselves as exclusively homosexual or as bisexual accounted for 60.67% and 37.57%, respectively. A total of 16.05% and 44.03% of the participants thought it was impossible or improbable they would be infected with HIV, respectively. The median age of sexual debut was 20 years, and 58.71% experienced their sexual debut with a male. The median age of first anal intercourse was 22, and 58.65% of participants did not use a condom at first anal intercourse. In the past year, 78.67% of the participants had ever received condoms, 65.17% had ever received lubricant, 23.68% had ever taken part in peer education, 18.40% had ever received examination or treatment for STDs and 52.49% had ever received voluntary counseling and testing services (VCTs).

Regarding behaviors in the past six months among participants, the median number of male sex partners was three. For high risk behaviors, 327 (63.99%) had oral sex with male sex partners, 22 (6.73%) of them had consistent condom use with regular sex partners, and 26 (7.95%) with casual partners; 511 (100%) had anal sex with male sex partners, 13.11% of them had consistent condom use with regular sex partners, and 66 (18.70%) with casual partners. A total of 61 (11.94%) participants had ever engaged in commercial sexual behavior, among whom 35 (57.38%) had paid for sex and 43 (70.49%) had received money for sex. A total of 59 (11.55%) had ever engaged in group sex, which happened almost exclusively (96.61%) among males. A total of 166 (32.49%) had ever engaged in sex under the influence of

alcohol, among whom 152 (92.77%) had homosexual intercourse while intoxicated (Table 1).

Table ~~1~~ 1. Sociodemographic characteristics of the ~~547~~ 511 study participants in the cohort of migrant MSM in Beijing

Variables	n	%
Overall, N	511	100
Age (median, years)	29	-
18-24	149	29.16
≥25	362	70.84
Ethnicity		
Han	482	94.32
Minority	29	5.68
Marital status		
Single	331	64.77
Married	114	22.31
Cohabiting with male or female sex partner	3	0.59
Separated or divorced or widowed	63	12.33
Duration of stay in Beijing		
< 1 year	173	33.85
≥ 1 year	338	66.14
Education level		
High school and below	374	73.19
College and above	137	26.81
Monthly income (US$)		
< 300	276	54.01
≥ 300	235	45.99
Self-reported sexual orientation		
Homosexual	310	60.67
Heterosexual	8	1.57
Bisexual	192	37.57
Other	1	0.2
Self-reported risk of HIV infection		
Impossible	82	16.05
Improbable	225	44.03
Possible	74	14.48
Probable	15	2.94
No idea	115	22.5
Age of sexual debut (median,years)	20	
Gender of first sexual partner		
Male	300	58.71
Female	211	41.29
Age of first anal intercourse(median, years)	22	
Had first anal intercourse before 15 years-old	13	2.54

Number of male sex partners in the last 6 months (median)	3	
Number of female sex partners in the last 6 months (median)	0	
Oral sex with regular partners with consistent condom use in the past 6 months	22	6.73
Oral sex with casual partners with consistent condom use in the past 6 months	26	7.95
Anal sex with regular partners with consistent condom use in the past 6 months	67	13.11
Anal sex with casual partners with consistent condom use in the past 6 months	66	18.7
Ever had commercial sexual behavior	61	11.94
Ever had group sex	59	11.55
Alcohol use prior to sex	166	32.49
Ever had ~~sexually transmitted diseases (STDs)~~STDs	84	16.44
Have ever received condoms	402	78.67
Have ever received lubricant	333	65.17
Have ever received peer education	121	23.68
Have ever received examination or treatment for STD	94	18.4
Have ever received ~~voluntary counseling and testing (VCT)~~VCT services	268	52.45
Have ever received educational materials on AIDS/STD	302	59.1

MSM, men who have sex with men; STD, sexually transmitted disease.

Incidence of infections of HIV, syphilis, HIV-syphilis co-infection and factors predicting HIV and syphilis seroconversion

During the eight-month follow-up, 16 HIV seroconversions were observed over 204.27 person-years of observation, resulting in an incidence rate of 7.83 per 100 person-years (PY) (95% CI 4.48 to 12.72). At the four-month visit, the incidence of HIV was 8.33 per 100 PY (95% CI 3.81 to 15.81) and at the eight-month visit it was 3.83 per 100 PY (95% CI 1.54 to 7.89). During the eight-month follow-up period, syphilis incidence was 11.11 per 100 PY (95% CI 6.47 to 17.80). At the four-month and eight-month visits, the syphilis incidence was 10.03 per 100 PY (95% CI 4.33 to 19.76) and 15.25 per 100 PY (95% CI 6.97 to 28.94), respectively. Six HIV ~~seroconversions~~ seroconversion cases were observed becoming syphilis-positive over 52.10 person-years, resulting in an incidence of co-infection of 11.52 per 100 PY (4.23 to 25.07).

Multivariate Cox regression analysis indicated that age ≤ 15 years old at first anal intercourse (adjusted hazard ratio (aHR) = 9.20, 95% CI 1.94 to 43.56, p=0.050) and ever had group sex (aHR=4.30, 95% CI 1.40 to 13.18, p=0.011) were significantly associated with time to HIV seroconversion (Table 2). For syphilis incidence, bisexual orientation

(aHR=5.09, 95% CI 1.02 to 25.57, p=0.048~~),~~) and had more than one sex partners ~~in the last 6 months~~since last investigation (aHR=9.22, 95% CI 1.13 to 73.37, p=0.038) ~~was~~ were significantly identified as risk factors (Table 3).

Table ~~2~~ 2. Multivariate analyses of participant characteristics associated with incident HIV infection among migrant MSM in Beijing

Factors	No. of HIV seroconversions	Cumulative PY	HIV incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	16	204.27	7.83				
Education							
Junior college and below	13	143.95	9.03	1.00			
Above junior college	3	60.32	4.97	0.56(0.16 to 1.98)	0.370		
Seeking partner through Internet							
NO	12	109.45	10.96	1.00			
YES	4	94.81	4.22	0.39(0.12 to 1.20)	0.100		
Age of first anal intercourse (~~median,years~~median, years)							
≥15	14	200.99	6.97	1.00		1.00	
<15	2	3.28	60.98	8.28(1.88 to 36.46)	0.005	9.20(1.94 to 43.56)	0.005
Ever had group sex							
NO	11	183.48	6	1.00		1.00	
YES	5	20.78	24.06	3.95(1.37 to 11.38)	0.011	4.30(1.40 to 13.18)	0.011
Knowledge of HIV/AIDS was acquired from							
Media							
NO	12	109.65	10.94	1.00			
YES	4	94.62	4.23	0.39(0.12 to 1.20)	0.100		
Internet							
NO	6	108.59	5.53	1.00			
YES	10	95.68	10.45	0.38(0.12 to 1.19)	0.097		
Consistent condom use during oral sex with regular partners ~~in the past 6 months~~since last investigations							
NO	1	9.45		1.00			
YES	15	194.82		0.73(0.10 to 5.50)	0.758		
Consistent condom use during oral sex with casual partners since last investigation~~in the past 6 months~~							
NO	0	7.70	0	1.00			
YES	9	128.67	6.99	-	-		
Consistent condom use during anal sex with regular partners since last investigation~~in the past 6 months~~							
NO	3	29.18	10.28	1.00			
YES	13	175.09	7.42	0.72(0.21 to 2.53)	0.609		
Consistent condom use during anal sex with casual partners since last investigation~~in the past 6 months~~							
NO	2	27.56	7.26	1.00			
YES	10	115.99	8.62	1.19(0.26 to 5.42)	0.825		

PY, person-years; HR, hazard ratio.

Table ~~3~~ 3. Multivariate analyses of participant characteristics associated with incident syphilis infection among migrant MSM in Beijing

Factors	No. of syphilis seroconversions	Cumulative PY	Syphilis incidence (/100PY)	Univariate		Multivariate	
				HR (95% CI)	p Value	Adjusted HR (95% CI)	p Value
Total	17	152.95	11.11				
~~Self-reported sexual orientation~~Ever had female sex partner(s)							
~~Homosexual~~No	9	96.89	9.29	1.00			
~~Heterosexual~~	~~0~~	~~1.42~~	~~0~~	-			
~~Bisexual~~Yes	8	54.64	14.64	5.56(1.10 to 27.05)	0.038	5.09(1.02 to 25.57)	0.048
Other	0	0	-	-			
Number of female sex partners since last investigation~~in the last 6 months~~							
≤1	16	149.9	10.67	1.00			
≥2	1	3.05	32.79	9.22(1.13 to 75.37)	0.038		
Seeking partners in bar/dancing hall/tearoom/chamber							
NO	11	129.41	8.5	1.00			
YES	6	23.55	25.48	3.12(0.75 to 13.07)	0.119		
Consistent condom use during oral sex with regular partners in the past 6 months							
NO	1	6.24	16.03	1.00			
YES	16	146.71	10.91	0.24(0.03 to 1.99)	0.188		
Consistent condom use during oral sex with casual partners in the past 6 months							
NO	0	4.37	0	1.00			
YES	8	92.58	8.64	-			
Consistent condom use during anal sex with regular partners in the past 6 months							
NO	2	24.52	8.16	1.00			
YES	15	128.43	11.68	0.57(0.11 to 2.80)	0.485		
Consistent condom use during anal sex with casual partners in the past 6 months							
NO	0	19.80	0	1.00			
YES	11	83.21	13.22	-			

Predictors of cohort retention

Of the 511 participants, 60.3% (308) were retained in the cohort at the four-month follow-up and 54.6% (274) were retained at the eight-month follow-up.

Univariate factors among baseline characteristics which were significantly associated with four-month retention were analysed with stepwise multiple logistic regression. Four factors were kept in the final model, including age > 25 years

old (adjusted odds ratio (AOR) = 1.81, 95% CI 1.07 to 3.06, p = 0.026), living in Beijing for more than one year (AOR = 3.68, 95% CI 2.04 to 6.64, p < 0.001), had at least one female sex partner~~s~~ since last investigation~~in the last six months~~ (AOR = 0.48, 95% CI 0.29 to 0.80, p=0.005), and had ever received VCTs in the past 12 months (AOR =1.71, 95% CI 1.07 to 2.72, p<0.024) (Table 4).

Table ~~4~~ 4. Factors associated with four-month retention rate in a cohort study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age						
18-24	149	46.98(70)	1.00		1.00	
≥25	362	65.75(238)	2.17(1.47 to 3.19)	<0.001	1.81(1.07 to 3.06)	0.026
Duration of stay in Beijing						
< 1 year	95	34.74(33)	1.00		1.00	
≥ 1 year	416	66.27(208)	3.66(2.29 to 5.85)	<0.001	3.68 (2.04 to 6.64)	<0.001
Number of female sex partners since last investigation~~in the last 6 months~~						
0	382	64.66 (247)	1.00		1.00	
≥1	129	47.29 (61)	0.49(0.33 to 0.74)	0.001	0.48(0.29 to 0.80)	0.005
Have received ~~voluntary counseling and testing (VCT)~~VCT service in the past 12 months						
No	243	51.85 (126)	1.00		1.00	
Yes	268	67.91 (182)	1.97(1.37 to 2.81)	<0.001	1.71(1.07 to 2.72)	0.024

For eight-month retention, age> 25 years old (AOR = 1.76, 95% CI 1.16 to 2.68, p = 0.008), living in Beijing for more than one year (AOR = 1.68, 95% CI 1.03 to 2.73, p = 0.039), first sexual partner was female (AOR = 0.60, 95% CI 0.41 to 0.88, p = 0.009), ever had group sex (AOR = 0.50, 95% CI 0.28 to 0.89, p = 0.019), and had received lubricant in the past 12 months (AOR = 2.31, 95% CI 1.56 to 3.42, p < 0.001) were retained in the final model using stepwise multiple logistic regression analysis (Table 5).

Table ~~5~~ 5. Factors associated with eight-month retention rate in a cohort study of migrant MSM in Beijing, China, using stepwise multiple logistic analysis

Factor	N	Retention rate % (n)	OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value

Age						
18-24	149	44.30(66)	1.00		1.00	
≥25	362	57.18(207)	1.68(1.14 to 2.47)	0.008	1.76(1.16 to 2.68)	0.008
Duration of stay in Beijing						
< 1 year	78	48.72 (38)	1.00		1.00	
> 1 year	338	58.88 (199)	2.17(1.37 to 3.43)	<0.001	1.68 (1.03 to 2.73)	0.039
Gender of the first sexual partner						
Male	300	58.33 (175)	1.00		1.00	
Female	211	46.45 (98)	0.62(0.43 to 0.88)	0.008	0.60 (0.41 to 0.88)	0.009
Ever had group sex						
NO	452	54.87 (248)	1.00		1.00	
YES	59	42.37 (25)	0.61(0.35 to 1.05)	0.072	0.50 (0.28 to 0.89)	0.019
Have received lubricant in the past 12 months						
NO	109	34.86 (38)	1.00		1.00	
YES	402	58.46 (235)	2.59(1.78 to 3.77)	<0.001	2.31 (1.56 to 3.42)	<0.001

DISCUSSION

Our study found that the prevalence of HIV (6.58%) among migrant MSM was at a highly epidemic level, which was ~~highlighted~~ remarkable ~~in comparison~~compared to that of a previous study among the general migrant ~~general~~ population (0%) in Beijing.[23] Additionally, it was higher than the 4.8% in 2007 among general MSM in Beijing.[24] A similar result (5.9%) was found in a recent cross-sectional study among migrant MSM.[23] Incidence in this subgroup (7.83/100PY) was consistent with that of migrant MSM (8.51/100PY) in a MSM cohort study in Beijing, and higher than the incidence of permanent resident MSM.[25] It was also higher than the incidence of general MSM in different parts of China.[6, 7]

The study found that participants whose first anal intercourse occurred before age 15 had significantly higher risk for HIV seroconversion. An American study of young minority MSM found that study participants who had an MSM sexual debut before 16 years old were more likely to have psychological problems and high risk behaviors like exchanging sex and drug use.[26] Early sexual debut could have a deep and long-term influence on ~~an~~ individual~~'s~~s' ~~developing~~ attitudes towards sex~~ual concept~~, but appropriate sex education has generally been shunned in traditional

Chinese education. Our study indicated that early sex education should be combined with Chinese characteristics, and relevant measures need to be implemented as soon as possible. Another risk factor significantly associated with HIV incidence was ever had group sex. An explanation of this observation is that psychological stress caused by stigma and discrimination hinders the development of longer-term relationships between MSM,[27] and having sex with multiple partners increases the chance of HIV transmission. This indicates a need for confidentiality and supportive services for migrant MSM. Serious attention should also be paid to the prevalence of STDs. The prevalence rate of syphilis (29.62%) was higher than those of in previous studies conducted among MSM in Beijing, such as 19.8% in 2007,[24] and 22.0% in 2009.[10] The incidence of syphilis (11.11/100PY) was also at an extremely high level compared to 8.06/100PY in a cohort study among MSM during the same period in 2009.[25] High prevalence of syphilis among MSM was is a common risk factor for encouraging HIV infection because of the biological and behavioral links between syphilis and HIV.[28]

The multiple regression analysis significantly revealed that self-identified bisexuals were five times more likely than homosexuals to be infected with syphilis. One major reason for this outcome could be that bisexuals MSM who had had sex with females may have more varied sexual behaviors with a wider range of sexual partners, including males and females. In addition, a cross-sectional study among young migrant MSM in Beijing discovered that MSM who were engaged in bisexual behavior had a higher rate of unprotected sex with stable female partners and were less likely to take part in prevention preventive behaviors,[18] which was consistent with our finding that those who had at least one female sex partner and those whose first sexual partner was female were significantly more likely to be lost at four-month and eight-month follow-up visits, respectively. MSM face strong social pressure and stigma in China, which may lead them to hide their sexual orientation by unwillingly engaging in heterosexual relationships; thus, many Chinese MSM will potentially enter a heterosexual marriage due to social and familial pressure,[4] Concerned about disclosing their MSM behavior to their female partners, bisexual MSM may be more reluctant to be followed up. Also,

bisexual MSM who havewith female partners are more likely to be engaged in risk behaviors, such as having unprotected sex to indicate demonstrate loyalty to their female partners and having commercial or casual sex with men. Moreover, only 18.4% of the participants reported having received an examination or treatment for sexually transmitted diseases in the past 12 months, which may be related to the high cost of health services and low coverage of health insurance for the migrant population.[18] Low risk-awareness might be another reason for their lower access to HIV/STD test and treatment. All of these emphasize an urgent need for widespread and accurate syphilis screening and affordable treatment for migrant MSM in Beijing.

In our study, the retention rate was lower than in previous cohort studies implemented among general MSM in Beijing (86.2% in 2007, 86.8% in 2009).[25, 26] From the multiple regression analysis, participants who were less than 25 years old were more likely to be lost at both four-month and eight-month follow-up visits. Similar problems have occurred among studies of young MSM in the US.[29] A plausible reason for this observation was that many young people in China have poor knowledge of safe sexual behaviors. Traditional interventions are more pragmatic but less attractive and appropriate for young people. A qualitative investigation implemented among young MSM in Milwaukee and Detroit offered some new approaches, such as embeddcombining HIV/AIDS prevention care efforts intervention in with the context of broader their daily life lives and helping solve problems of social relationships issues facing bothering young MSM.[30] However, as Chinese young MSM are almost certainly different withfrom American's in some aspects,As differences almost certainly exist between young Chinese and American MSM, predictors measures of retention intervention among young MSM in Beijing deserve further investigation.

As for positive predictors, we found those who had been in Beijing for more than one year or who had received lubricant were more likely to be maintained in this cohort at both four-month and eight-month follow-up visits. As these services are provided by local communities, we found similar results as those in Yangzhou.[8] Migrant MSM who stay longer in Beijing may have more chances to receive effective and stable intervention services, and the potential impact

on their increasing awareness of self-protection might encourage them to pay closer attention to advances in research. As a result, migrants may be more likely to remain with the investigation to show their support. However, the data showed that receiving ~~voluntary counseling and testing (~~ VCT~~)~~ service in the past 12 months was a positive factor at the four-month follow-up visit, which was replaced by receiving lubricant at the eight-month visit. This indicates that factors associated with retention rate may change as time goes on~~. In other words, different factors may have a unique impact on retention rate in different periods~~, which implies that we should adjust methods for interventions over time so as to keep the entire cohort more stable. From the results of our study, the coverage of intervention on this population was limited. Aimed at the mobility problem inherent to migrant populations, a specific strategy of intervention targeted at migrant MSM is imminently needed.

This study has a number of limitations. Firstly, retention rates were relatively low, which means that the estimates of HIV/syphilis seroconversions may be biased because no evidence showed a balance between participants retained in the study and those lost to follow-up. Secondly, using non-random sampling methods may have led to selection bias. Thirdly, the sample size was insufficient, and some potentially relevant factors may be concealed by the small sample size. Lastly, the study subjects were all inflow population and did not include outflow population, and the proportion of migrants from different provinces varied. There is no evidence to show the data could be generalized to other regions.

To our knowledge, this is the first cohort study to assess incidence of HIV and syphilis among migrant MSM in Beijing. With highly prevalent risk behaviors, the migrant MSM had a high level of HIV incidence, and the epidemic of syphilis among this subgroup was extremely serious. Bisexual MSM were at a high risk of syphilis seroconversion, and were more concealed among migrant MSM. Future prevention efforts should include screening and appropriate treatment for syphilis. Multiple modes of intervention services need to be improved and implement for this marginalised group. For the sake of bisexual MSM's health, as well as for their partners', more attention need to be paid on female partners of bisexual MSM to encourage them to take test and be followed-up. A greater understanding of risk behaviors and the

HIV/STD epidemic among migrant MSM needs to be investigated in the future.

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CONTRIBUTORS

ZP, RY and NW conceived and designed the experiments, HL and LW performed the experiments, HM and WM analyzed the data, HZ and YZ contributed reagents/materials/analysis tools, HM, WM and ZP wrote the paper, and all authors read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors have no conflict of interest to declare.

Data sharing statement

Extra data is available by emailing zhihangpeng@njmu.edu.cn.

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Figure legend:

Figure 1. Study flowchart of the migrant MSM cohort, with focus on ~~the~~ HIV and syphilis incidence.

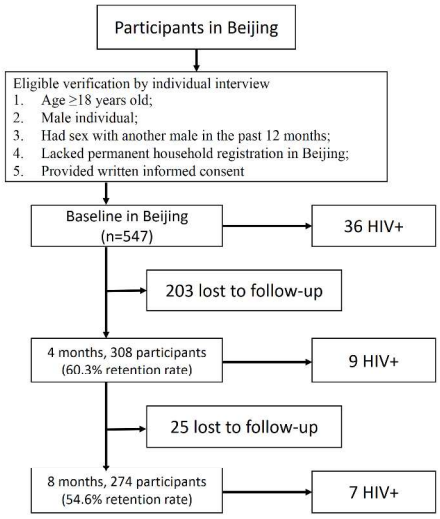

Figure 1. Study flowchart of the migrant MSM cohort, with focus on the HIV and syphilis incidence (N=547).

338x190mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	3-4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	4
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	7
		(c) Summarise follow-up time (eg, average and total amount)	10
Outcome data	15*	Report numbers of outcome events or summary measures over time	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-11

		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.