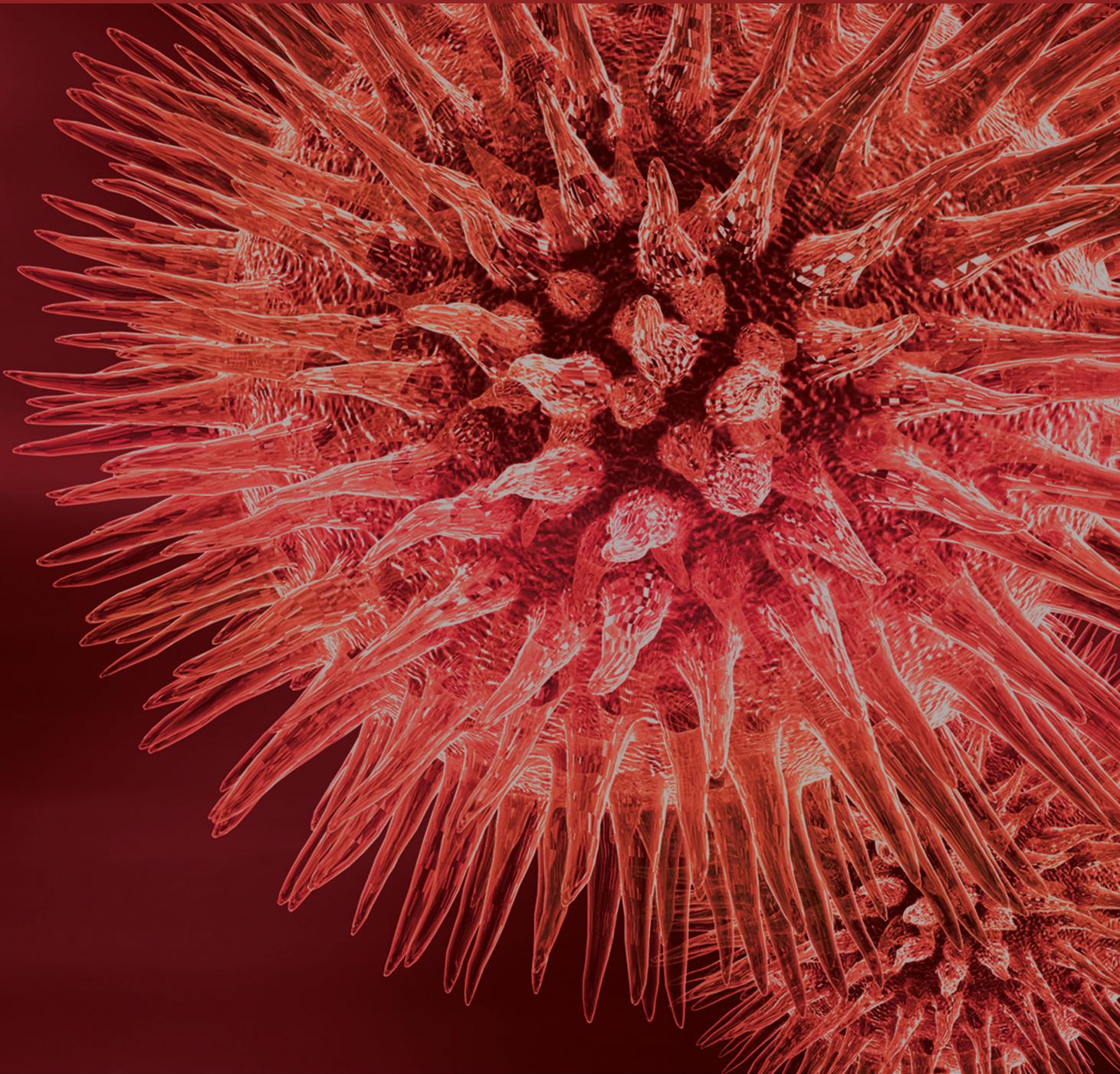


BioMed Research International

Dynamics of the HIV Epidemic in MSM

Guest Editors: Yujiang Jia, Muktar H. Aliyu, and Z. Jennifer Huang





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Editorial

Dynamics of the HIV Epidemic in MSM

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This special issue documents a unique pattern of the HIV epidemic and its associated factors among men who have sex with men (MSM) in China. In high-income countries AIDS has disproportionately impacted MSM. MSM account for the preponderance of prevalent AIDS cases in the United States, Canada, the European Union, Australia, and New Zealand [1–11]. In contrast, in many low- and middle-income countries the HIV epidemic is driven by heterosexual sex, injection drug use, and/or contaminated blood collection and transfusion, with MSM comprising a small proportion of all HIV cases [10–12]. However, recent data show a trend of increase in HIV cases among MSM in Asia, Africa, South America, and Eastern Europe [8–16]. China is one of the countries facing the challenge of an emerging HIV epidemic in MSM. In China, rates of HIV infection in injecting drug users have fallen, remained stable and at low levels in female sex workers, but markedly increased in MSM. The latest national report revealed that the proportion of newly diagnosed HIV cases due to male homosexual contact has increased from 12.2% in 2007 to 32.5% in 2009; while the national HIV prevalence among MSM had a 4.5-fold increase in the past ten years (i.e., from 1.4% in 2001 to 6.3% in 2011) [17]. HIV cases resulting from transmission associated with illegal blood donations have been largely eliminated following the crackdown on unscrupulous blood donors in the late 1990s. The purpose of this special issue is to improve our understanding of the dynamics of the HIV epidemic and its associated factors that are driving the epidemic among MSM in China.

One of the papers in this special issue is by Y. Zhou and colleagues and it describes differences in the prevalence

of HIV and syphilis among MSM living in Chinese cities with differing levels of economic development. The authors report a pooled prevalence of 6.5% among MSM nationally, with higher rates in economically less developed cities than in the developed cities. The paper by E. P. F. Chow et al. on the other hand reveals that HIV prevalence among Chinese MSM has increased rapidly in all Chinese regions in recent years. One of the papers summarizes findings from three cross-sectional surveys in Beijing that demonstrate a disturbing rise in HIV incidence among MSM in Beijing. Y. Zeng and colleagues suggest that this epidemiologic trend is not limited to Beijing, as their paper revealed an increase in HIV prevalence from 13.0% to 19.7% from 2006 to 2013 with an increase of 1.0% per year among MSM in Chongqing. These findings support the inference that MSM in China have become an important risk group that should be targeted by HIV prevention programs.

Risk factors associated with HIV among MSM in China are multidimensional. Such factors may be biological (sexually transmitted diseases, e.g., syphilis), behavioral (unprotected sexual behaviors, overlapping bisexual and commercial sex, and increasing substance use), or sociocultural/environmental (e.g., migration, stigma, and social support). Emphasis of familial tie and procreation in Chinese culture put pressure on MSM to lead a double life and conceal their sexual orientation to family. Consequently, MSM in China often encounter stigma and discrimination. Effective intervention and control measures for HIV need to take all of these multidimensional factors into account. In their contribution, E. P. F. Chow and colleagues review the involvement of MSM in high-risk activities (e.g., commercial sex and intravenous drug use) and the community and

governmental responses to the HIV epidemic among Chinese MSM. D. Li and colleagues found that recent HIV infection is associated with bisexual activity and a negative attitude towards safe sex.

Unprotected anal intercourse is a recognized risk factor for HIV transmission in MSM. J. T. F. Lau et al. report geographic variations in factors associated with unprotected anal intercourse among MSM in Shenzhen and Hong Kong. In Shenzhen such factors included being able to find someone to share one's sexual orientation, disclosure of sexual orientation to family members, HIV risk perception, and alcohol or drug use, while disclosure of sexual orientation to family members was the only significant factor identified among Hong Kong MSM.

Recreational drug and alcohol use has increased considerably in China in the past three decades, accompanying a rapidly expanding economy, urbanization, and globalization. The global literature suggests that drug and alcohol use is associated with sexual risk behaviors. The independent association of nitrite inhalant use with more casual sex partners and HIV infection reported by D. Li and colleagues underscores the need for interventions targeting nitrite inhalant use. Y. Liu et al. also show that MSM who consumed alcohol more than once per week were more likely to use illicit drugs, have sex with women, have unprotected insertive or receptive anal sex with men, have more than ten lifetime male sex partners, predominantly practice insertive anal sex, and trade sex for money. M. Liao and colleagues had similar findings, with more frequent episodes of alcohol use being independently associated with unprotected anal sex, bisexual identity, multiple male sex partners, drug use, and higher levels of HIV/AIDS-related stigma and discrimination. Taken together, these findings provide the basis for strengthening alcohol use prevention and risk reduction initiatives among MSM as part of a comprehensive HIV risk reduction approach and for further exploring the interaction between alcohol use and HIV transmission.

Chinese traditional culture emphasizes familial responsibilities; homosexual preferences are highly stigmatized and MSM face strong social pressure to conceal their sexual orientation. Stigma surrounding HIV/AIDS is a barrier to HIV prevention, treatment, and care. People who hold stigmatizing attitudes are also less likely to adopt preventive behaviors and more likely to have multiple sexual partners, a commercial sex partner, and engage in other HIV-related high risk behaviors. D. Huang et al. report low levels of stigmatizing attitudes to be associated with uptake of HIV testing services and utilization of free condoms/lubricants. The authors stress the importance of addressing HIV/AIDS-related stigmatizing/discriminatory attitudes and other barriers when delivering HIV-related interventions and testing services.

The Chinese government has significantly scaled up HIV surveillance and prevention efforts among MSM over the past decade, including the use of community-based approaches via grassroots organizations. However, the lack of an enabling legal and financial environment undermines the role of community-based organizations in HIV surveillance

and prevention. The hidden nature of homosexual activity coupled with the prevailing stigma and discrimination hinders the successful delivery of timely, high-quality and effective HIV prevention, care and treatment services that are responsive to the unique needs of MSM in China. We hope that the knowledge generated by the articles in this special issue will contribute to the development of innovative HIV prevention programs that will do just that.

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Review Article

Prevalence of HIV and Syphilis Infection among Men Who Have Sex with Men in China: A Meta-Analysis

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Objectives. To figure out the most current prevalence of HIV and syphilis in MSM in China. **Methods.** A meta-analysis was conducted on the studies searched through PubMed, CNKI, and Wanfang published between 1 January 2009 and 11 April 2013. **Results.** Eighty-four eligible studies, either in Chinese or in English, were included in this review. The pooled prevalence of HIV and syphilis infection in MSM in China was 6.5% and 11.2%, respectively. The subgroup analyses indicated that the prevalence of HIV infection was higher in the economically less developed cities than that in the developed cities (7.5% versus 6.1%, $P < 0.05$). In contrast, the prevalence of syphilis infection was lower in less developed cities than in developed cities (8.6% versus 15.1%). Studies with a sample size smaller than 500 had a lower prevalence of HIV and syphilis infection than those with a sample size greater than 500 (5.9% versus 7.2% for HIV; 11.0% versus 11.5% for syphilis, respectively). **Conclusions.** HIV and syphilis infection are prevalent in MSM in China. The different prevalence of HIV and syphilis infection between developing and developed cities underscores the need to target prevention strategies based on economic conditions.

1. Introduction

The human immunodeficiency virus (HIV) and syphilis infection epidemics present an intractable problem to the world. This is also true in China, where there is a marked increase of people living with HIV/AIDS, from 740,000 in 2009 to 780,000 in 2011. Approximately 17.4% of new HIV cases are attributed to homosexual transmission [1]. It was said that the epidemic of HIV infection among men who have sex with men (MSM) has been the gravest of the six newborn HIV/AIDS challenges in China [2]. From 2009 to 2013, the prevalence of HIV among MSM ranged from 1.7% to 21.0% in China [3, 4]. A recent meta-analysis reported that almost 5.3% (95% CI: 4.8%–5.8%) of MSM in China were living with HIV, which was more than 90 times higher than the general public [5]. The prevalence of syphilis in MSM increased from 6.9% to 11.8% between 2003 and 2009 [6, 7].

The fast growth of the HIV epidemic has been observed in some reports [5, 8]. Although there have been several meta-analyses on prevalence of HIV and syphilis in MSM [5, 8, 9], the most recent meta-analysis only included studies until 2008. Thus, it is important for us to have a better and more thorough understanding of the current prevalence of HIV and syphilis. Therefore, we performed a meta-analysis of all available literature published from 2009 to 2013.

Given the poor awareness of AIDS-related knowledge in economically developing cities, which may lead to higher prevalence of marriage and bisexuality and lower condom use than economically developed cities, we also carried out a subgroup analysis to explore the differences in HIV and syphilis prevalence between developing and developed cities in China. Results from the analyses may guide future policies for more rational allocation of prevention and treatment resources.

2. Methods

2.1. Search Strategy. A systematic review of published articles was conducted by searching the following database: PubMed, Chinese National Knowledge Infrastructure (CNKI), and Wanfang from January 1, 2009, to April 11, 2013. Search terms included HIV, AIDS, syphilis, STD, sexually transmitted disease, prevalence, MSM, homosexual, gay, sex between men, and China. Reference lists were also referred to for additional articles. This review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement issued in 2009.

2.2. Study Selection. Studies were included if they met the following criteria: (1) published in Chinese or English language; (2) cross-sectional or cohort studies that reported either HIV or syphilis prevalence or both; (3) HIV and syphilis infection was diagnosed from at least two laboratory serologic testing methods; (4) articles that presented study design information, including study period, study site, and sampling method. Studies were excluded if (1) the study participants were MB (Money Boys) or young MSM (younger than 18 years old); (2) the sample size was smaller than 150. Studies with no specific study cities were also excluded from subgroup analyses. If articles with the same data were published in both Chinese and English, the English source was included.

2.3. Data Extraction. The first author extracted the following data from the included studies, which was later verified by the second author: the first author and published year, study period, study site, sampling methods, average age of MSM participants, sample size, and prevalence of HIV infection or syphilis infection or both. The study sites were divided into developing and developed cities (as assessed on the basis of based on per capita gross domestic product (GDP) for each city). Developing cities were defined as those with a per capita GDP lower than 15,000 RMB and developed cities were defined as cities with per capita GDP higher than 15,000 RMB. GDP of each city per person-year was obtained from <http://tieba.baidu.com/p/2312163828>. Disagreements were resolved by discussion. If no consensus could be reached, a third author would be referred to.

2.4. Validity Assessment. Validity assessments were accomplished by two workers. Studies were considered to be of high validity if they met the following criteria: (1) reported both HIV and syphilis infection; (2) used two or more recruitment methods; (3) sample size larger than 500; (4) published in English.

2.5. Statistical Analysis. Meta-analyses of the prevalence of HIV and syphilis infection among MSM were carried out by Meta-Analyst software (Beta 3.13). Q-test (significance level $P < 0.10$) and I^2 (significance level $I^2 > 0.25$) statistics were calculated to measure homogeneity of studies. Studies that had either Q (0.10 or I^2) 0.25 were defined as heterogeneous. Potential publication bias was assessed by

Begg's test. Pooled prevalence of HIV and syphilis infection, 95% confidence intervals, and the relative weight for each study were calculated by using random effects models. Due to the heterogeneity which is commonly observed in meta-analysis concerning sensitive groups such as MSM, we conducted a meta-regression with 10,000 permutations in a Monte Carlo simulation to explore the sources of between-study heterogeneity with the following covariates: economy status, sampling methods, sample size, and published year. Subgroup analyses were conducted to obtain the prevalences of HIV and syphilis from different stratifications.

3. Results

3.1. Study Selection for Meta-Analyses. 1222 articles were retrieved after the initial search from databases and another 6 articles were included from reference lists. A total of 1096 articles were removed after screening of titles and abstracts because they were not topically relevant ($N = 1077$), were reviews ($N = 7$), and used the same data ($N = 12$). 151 articles were eligible for full-text screening and 67 were further excluded because they did not report the sampling methods or study site ($N = 19$), did not mention the study period ($N = 5$), had a sample size smaller than 150 ($N = 4$), included MB or young MSM ($N = 6$), presented neither HIV nor syphilis prevalence ($N = 12$), just used one method to diagnosis syphilis ($N = 20$), and tested HIV infection by urine ($N = 1$). The detailed process of data selection is illustrated by Figure 1.

3.2. Study Characteristic. Eighty-four studies with estimates of HIV prevalence (English 18, Chinese 66) and seventy-six studies with estimates of syphilis prevalence (English 17, Chinese 59) were finally identified in this review, which covers 59 cities from 29 provinces and municipalities in China (no studies from Hainan, Tibet, Hong Kong, Macao, and Taiwan). The prevalence of HIV and syphilis ranged from 1.7% to 21.0% and 0.9% to 31.2%, respectively [3, 4, 10–89]. In the meta-analysis of pooled prevalence of HIV, the sample size ranged from 150 to 6101 (total 71,845), and in the estimating of syphilis prevalence, the sample size oscillated between 157 and 6101 (total 65,162). About half of them were located in developing cities (50.7% and 51.4% in analyses of HIV and syphilis prevalence, resp.). The following sampling methods were used to recruit participants: snow ball ($N = 27$), respondent driven sampling (RDS) ($N = 15$), multiple sampling methods ($n = 23$), and others ($N = 19$). The basic information of the 84 included studies is represented in Table 1.

3.3. Pooled Prevalence of HIV and Syphilis. According to our meta-analyses, the estimates of HIV prevalence in MSM in China ranged from 1.7% to 21.0%. The pooled prevalence of HIV infection was 6.5% (95% CI 5.6% to 7.4%), as seen in Figure 2, with substantial heterogeneity ($P < 0.001$, $I^2 = 0.490$). Estimates of syphilis prevalence ranged from 0.9% to 31.2% and the overall prevalence was 11.2% (95% CI 10.0% to

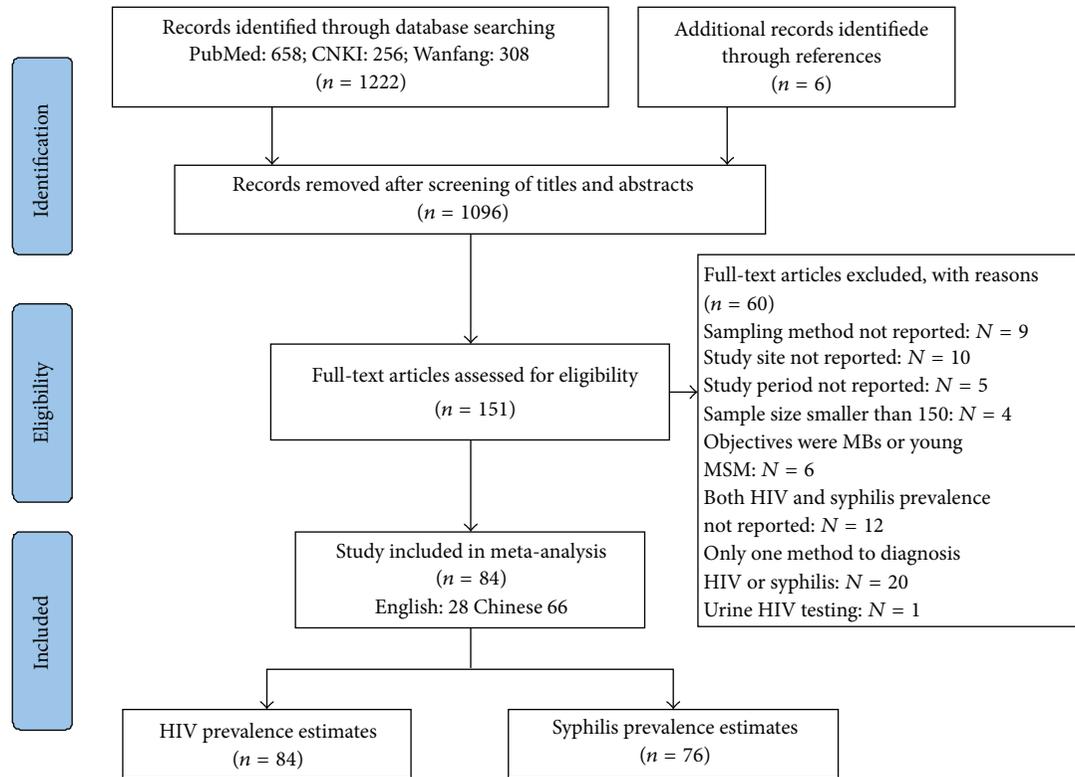


FIGURE 1: Flow chart of the meta-analysis studies selection.

TABLE 1: Meta-regression and subgroup analyses of HIV and syphilis prevalence among men who have sex with men in China.

Study characteristic	Stratified meta-analysis			
	HIV Prevalence (95% CI)	HIV Meta-regression (β , P value)	Syphilis Prevalence (95% CI)	Syphilis Meta-regression (β , P value)
Sample size				
<500	5.9% (5.0–7.0%)	1.017	11.0% (9.3–12.9%)	1.007
>500	7.2% (5.8–8.9%)	$P = 0.056$	11.5% (9.8–13.5%)	$P = 0.670$
Sampling methods				
RDS	7.4% (5.7–9.7%)	0.996	9.1% (7.1–11.6%)	1.009
Snow ball	7.2% (5.4–9.4%)	$P = 0.356$	13.3% (10.8–16.2%)	$P = 0.198$
Multiple Methods	5.9% (4.5–7.7%)		10.5% (8.2–13.3%)	
Others	6.2% (5.6–7.4%)		12.2% (10.0–14.9%)	
Economy status				
<15,000\$	7.5% (6.5–8.6%)	0.971	8.8% (7.7–10.0%)	1.074
>15,000\$	6.1% (4.7–8.0%)	$P = 0.002$	15.5% (13.0–18.3%)	$P = 0.000$
Published year				
2009–2010	5.9% (5.1–6.9%)	1.017	12.1% (10.6–13.7%)	–0.980
2011–2013	7.6% (6.1–9.5%)	$P = 0.063$	9.6% (7.6–12.1%)	$P = 0.217$

32.6%), as shown in Figure 3, with substantial heterogeneity observed ($P < 0.001$, $I^2 = 0.489$).

3.4. Meta-Regression and Subgroup Analyses. Results of meta-regression indicated that economic status and sample size contributed to the heterogeneity between studies (Table 2).

Four and two studies were further excluded because of the absence of specific study cities in the subgroup analyses of HIV and syphilis prevalence by different economic status, respectively. The prevalence of HIV infection was slightly higher in developing cities (7.5%) than in developed cities (6.1%), whereas the prevalence of syphilis was significantly lower in developing cities (8.6%) than in developed cities

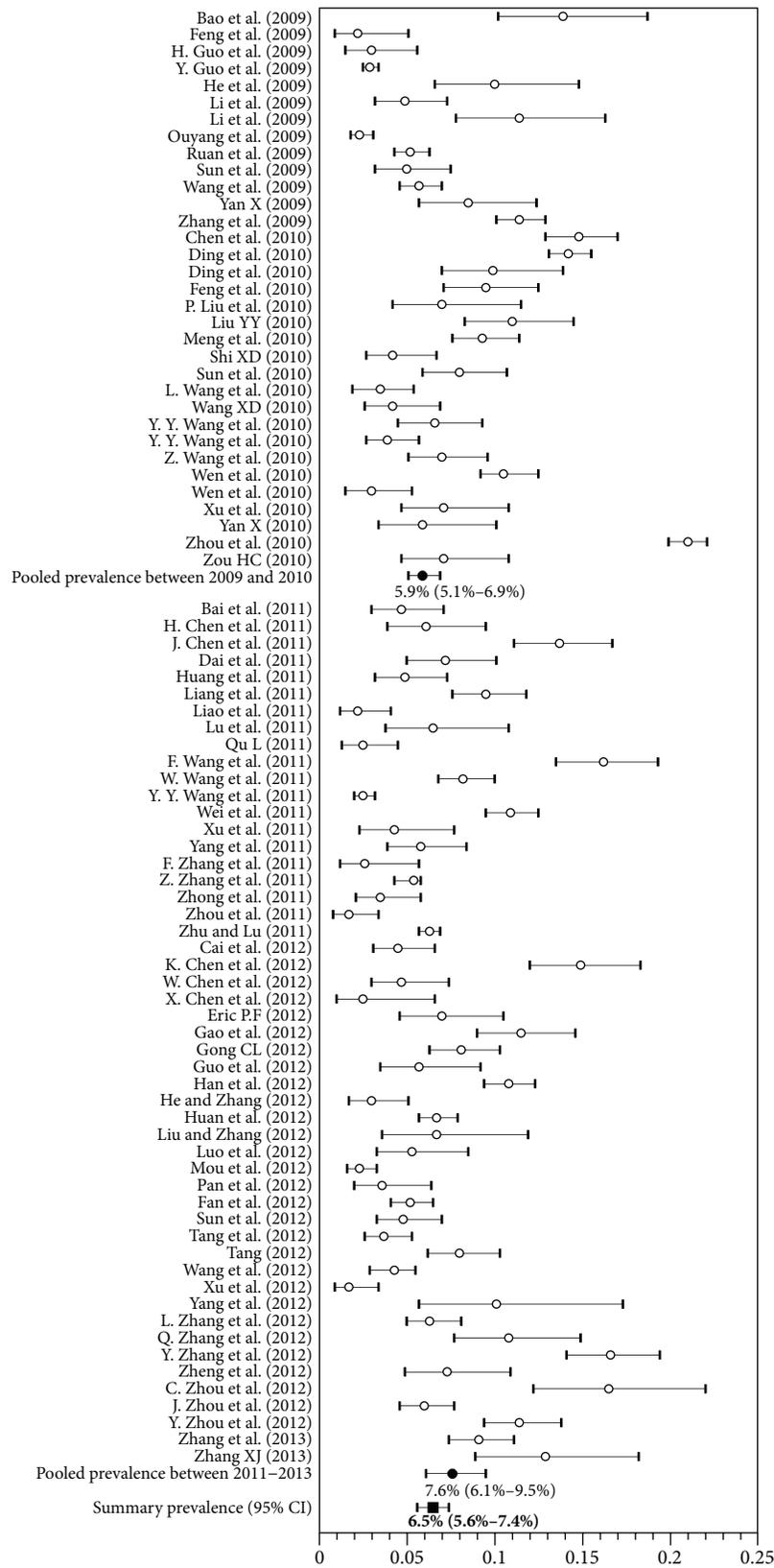


FIGURE 2: Forest plot showing the meta-analyses of pooled prevalence of HIV among men who have sex with men in China.

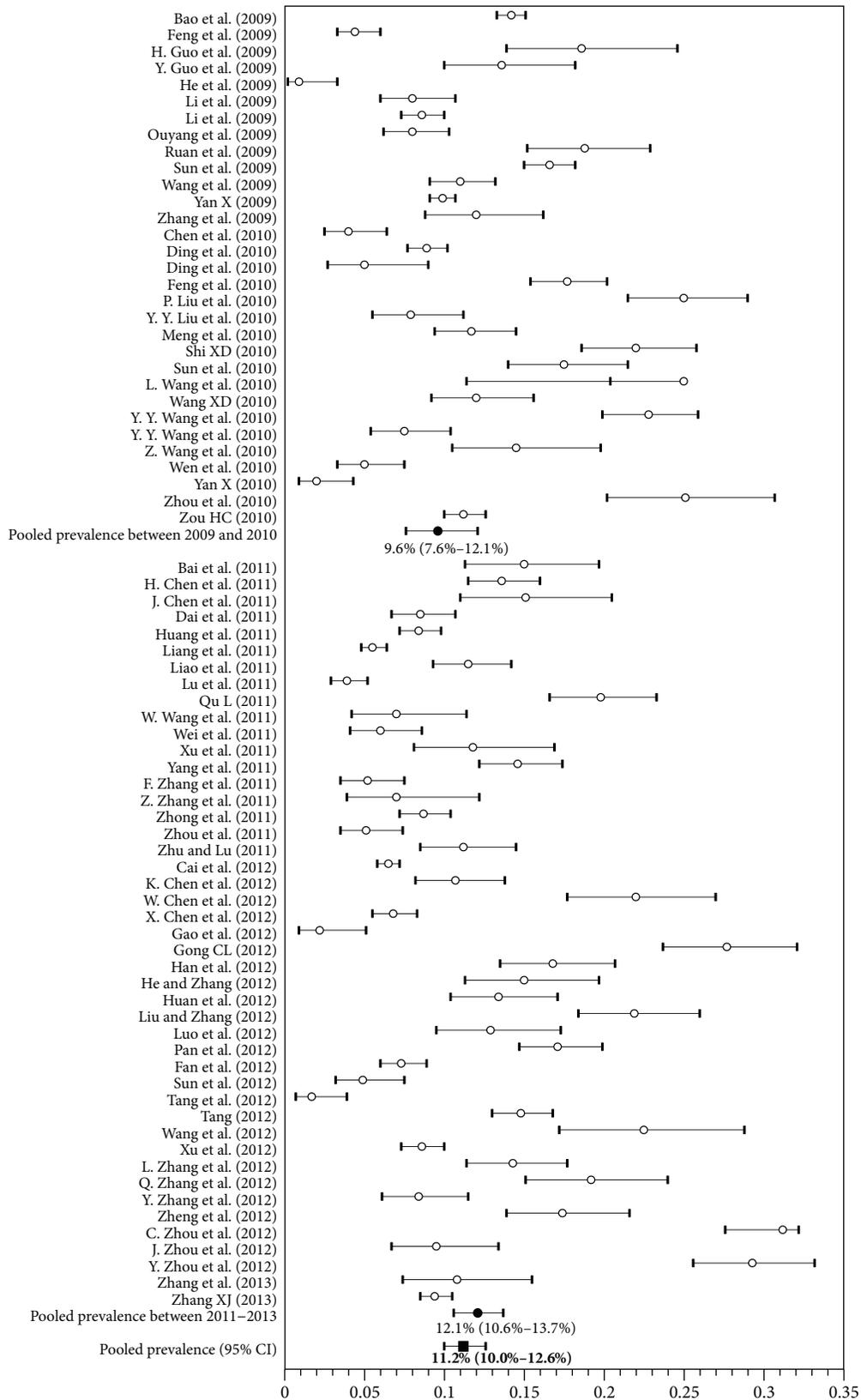


FIGURE 3: Forest plot showing the meta-analyses of the pooled prevalence of syphilis among men who have sex with men in China.

TABLE 2: Basic information of the 84 included studies.

First author, published year	Sample size	Sampling methods	Location	Economy status	Prevalence (%)	
					HIV	Syphilis
Liang, 2011 [35]	511	Multiple methods	Foshan	Developed	7.0	8.0
Sun, 2009 [50]	401	Multiple methods	Dalian	Developed	4.2	17.5
Yang, 2012 [72]	264	VCT	Fuyang	Developing	5.7	
Chen, 2012 [15]	400	Snow ball	Guilin	Developing	3.5	4.0
Wen, 2010 [64]	452	Snow ball	Guangzhou	Developed	4.9	6.0
Huang, 2011 [32]	395	Snow ball	Hefei	Developing	3.0	13.4
Wang, 2009 [54]	1348	Multiple Methods	Heilongjiang	Developing	2.3	14.8
Wang, 2010 [61]	200	Snow ball	Lanzhou	Developing	7.0	12.5
Wang, 2012 [58]	400	RDS	Mianyang	Developing	11.0	23.5
Lu, 2011 [40]	354	RDS	Nanchang	Developing	4.2	7.9
Chen, 2010 [3]	469	Snow ball	Nanning	Developing	1.7	10.7
Bao, 2009 [11]	6101	RDS	14 cities	Classified ^a	6.3	14.0
Chen, 2012 [16]	300	Snow ball	Yangzhou	Developed	7.3	22.0
Li, 2009 [34]	1773	Multiple methods	Chongqing	Developing	10.6	8.4
Guo, 2009 [27]	204	Venues-based	Tianjin	Developed	5.9	18.7
Liu, 2012 [90]	507	Snow ball	Changsha	Developed	4.3	25.1
Qu, 2011 [91]	805	Snow ball	2 cities	Developed	3.7	14.1
Chen, 2011 [12]	831	VCT	Kunming	Developing	11.4	13.6
Zhou, 2011 [83]	1166	Snow ball	Chongqing	Developing	14.8	8.7
Han, 2012 [92]	272	Venues-based	Taiyuan	Developing	8.5	13.6
Tang, 2011 [93]	408	Venues-based	Guilin	Developing	2.5	4.9
Xu, 2011 [69]	436	Venues-based	Liaoning	Dropped out ^b	3.0	5.0
Bai et al., 2011 [94]	280	Snow ball	Suzhou	Developed	7.1	15.0
Zhou, 2011 [95]	491	RDS	Chongqing	Developing	14.9	5.1
Fan, 2012 [47]	500	RDS	Beijing	Developed	8.0	22.0
Liao et al., 2011 [96]	2996	Multiple methods	Shandong	Developed	2.5	5.5
Feng et al., 2009 [97]	2044	Venues-based	Chongqing	Developing	11.5	8.9
He, 2009 [29]	423	RDS	Guangzhou	Developed	1.3	14.8
Eric, 2011 [98]	288	Snow ball	Yuxi	Developing	10.8	
Zheng, 2012 [81]	157	Multiple methods	Beijing	Developed	2.5	7.0
Wei, 2011 [63]	220	Snow ball	Taizhou	Developing	13.4	14.5
Zhong et al., 2011 [99]	379	RDS	Guangzhou	Developed	5.2	17.5
Zhang, 2012 [74]	503	RDS	Chongqing	Developing	15.7	6.6
Xiao, 2009 [66]	1692	Multiple methods	Chongqing	Developing	10.8	8.6
Xiao, 2010 [67]	4983	Multiple methods	20 cities	Dropped out ^b	2.9	9.8
Zhang et al., 2011 [100]	302	Snow ball	Beijing	Developed	9.9	19.2
Zhang et al., 2012 [101]	3314	Snow ball	Chongqing	Developing	14.2	9.4
Zhang, 2013 [75]	463	Snow ball	Harbin	Developing	9.5	14.3
Guo et al., 2009 [102]	433	Venues-based	2 cities	Developed	5.8	27.7
Ruan et al., 2009 [103]	541	Multiple methods	Beijing	Developed	4.8	19.8
Zou et al., 2010 [104]	429	Internet	2 cities	Classified ^a	4.8	11.4
Wang, 2011 [105]	2020	Surveillance	4 cities	Developing	2.3	
Gao, 2012 [106]	962	Multiple methods	Beijing	Developed	6.3	17.7
Zhou et al., 2010 [107]	550	Multiple methods	Beijing	Developed	4.5	
Zhou, 2012 [108]	294	VCT	Shanghai	Developed	6.1	9.5

TABLE 2: Continued.

First author, published year	Sample size	Sampling methods	Location	Economy status	Prevalence (%)	
					HIV	Syphilis
Ouyang, 2009 [44]	617	RDS	Chongqing	Developing	16.8	10.9
Meng, 2010 [42]	287	Multiple methods	Changde	Developing	3.5	12.9
Tang, 2012 [52]	303	Multiple methods	Dazhou	Developing	3.6	1.7
Sun, 2012 [49]	2006	Multiple methods	Dalian	Developed	5.2	16.6
Dai, 2011 [109]	1315	VCT	Guangzhou	Developed	5.4	6.8
Mou, 2012 [110]	1526	Venues-based	Guangzhou	Developed	5.7	
Wen, 2010 [64]	452	Snow ball	Guangzhou	Developed	4.9	6.0
Wang, 2011 [111]	300	RDS	Kunshan	Developed	5.3	25.0
Sun, 2010 [112]	1350	RDS	2 cities	Developing	5.2	7.3
Zhu, 2011 [88]	259	Surveillance	Wuxi	Developed	13.9	25.1
Zhang, 2009 [76]	231	RDS	Urumqi	Developing	2.2	10.8
Chen, 2011 [113]	889	Snow ball	Lanzhou	Developing	6.0	13.6
Hong et al., 2009 [114]	593	Venues-based	Changzhou	Developed	13.7	31.2
Liu, 2012 [37]	661	Snow ball	Nanjing	Developed	3.9	11.5
He, 2012 [115]	235	Multiple methods	Geermu	Developing	4.3	0.9
Gong, 2010 [24]	252	Snow ball	Quanzhou	Developing	2.6	2.2
Zhang, 2012 [77]	300	RDS	Shenzhen	Developed	7.0	12.0
Pan, 2012 [45]	675	Multiple methods	Shenzhen	Developed	8.0	41.2
Shi, 2010 [116]	906	Venues-based	Shenzhen	Developed	4.2	14.5
Cai, 2012 [117]	5232	VCT	Shenzhen	Developed	6.5	21.0
Wang, 2010 [55]	900	RDS	Shenyang	Developed	9.3	11.0
Wang, 2011 [118]	450	Venues-based	Shijiazhuang	Developing	2.2	7.6
Wang, 2010 [61]	150	Snow ball	Shijiazhuang	Developing	6.7	11.3
Bai et al., 2011 [119]	280	Multiple methods	Suzhou	Developed	7.3	22.0
Zhang et al., 2011 [73]	717	Multiple methods	Suzhou	Developed	8.1	14.6
Xu et al., 2012 [70]	211	Multiple methods	Taizhou	Developing	10.0	11.8
Wang et al., 2011 [57]	201	Snow ball	Urumqi	Developing	6.5	7.0
Liu et al., 2010 [38]	456	RDS	Wuhan	Developed	6.6	21.9
Zhang et al., 2011 [80]	404	Snow ball	Xining	Developing	7.2	8.4
Wang et al., 2010 [62]	750	Multiple methods	Yangzhou	Developed	9.3	22.8
Chen et al., 2012 [14]	218	Snow ball	Chongqing	Developing	16.5	15.1
Yang et al., 2011 [71]	305	Multiple methods	Dali	Developing	3.0	2.0
Luo et al., 2012 [41]	1237	Snow ball	13 cities	Developing	8.2	3.9
Xu, 2010 [68]	1864	Multiple methods	4 cities	Classified ^a	6.7	
Ding et al., 2010 [19]	743	Snow ball	Chongqing	Developing	16.6	8.5
Ding et al., 2010 [20]	202	Snow ball	Chongqing	Developing	12.9	5.0
Li, 2009 [34]	1691	Multiple methods	Chongqing	Developing	10.9	8.6
Feng, 2010 [22]	946	Snow ball	Chongqing	Developing	15.8	
Guo et al., 2012 [25]	109	Surveillance	Zunyi	Developing	10.1	1.0

^aStudy sites were classified into different economy status when subgroup analysis was conducted; ^bStudy was dropped out then subgroup analysis was conducted.

(15.1%). Studies with a sample size smaller than 500 had a lower prevalence of HIV and syphilis infection than those with a sample size greater than 500 (5.9% versus 7.2%, 11.0% versus 11.5%, resp.) (Table 2).

Although the published year and sampling methods did not contribute to between-study variance, we also conducted subgroup analyses based on them. Although we only divided the published year into two groups, an uptrend of HIV

infection and a decrease in syphilis infection were still observed (Table 2).

4. Discussion

This is an updated meta-analysis that presents the most current prevalence of HIV and syphilis infection in MSM in China. In order to obtain the prevalence from developing

and developed cities, we also carried out a subgroup analysis by different economic status according to meta-regression. To our knowledge, this is the first study to compare the prevalence of HIV and syphilis infection between developing and developed cities in China. A national study survey of 61 cities by Wu reported the prevalence of HIV in MSM from the southwest, east, south, and northeast of China but did not account for the different economic conditions of each city [6].

Overall, eighty-four articles published between January 1, 2009, and April 11, 2013 were included in this review. It was observed that the prevalence of HIV and syphilis infection among MSM in China was 6.5% (95% CI 5.6% to 7.4%) and 11.2% (95% CI 10.0% to 12.6%), respectively, which was lower compared to other countries and cities. For instance, the prevalence of HIV among MSM was 14.2% in Brazil, 10.6% in Kenya, 21.5% in Senegal, 9.0% in Indonesia, 14.7% in India, and 24.6% in Thailand [120–123].

In spite of the relatively lower prevalence, there was evidence for the uptrend of HIV and syphilis infection among MSM in China. A meta-analysis of Chow reported that HIV infection among MSM has increased over the past years, from 1.4% (95% CI 0.8%–2.4%) during 2001–2003, to 2.3% (95% CI 2.0%–2.6%) during 2004–2006, and to 5.3% (95% CI 4.8%–5.8%) during 2007–2009 [8]. Results from our study indicate that the prevalence of HIV among MSM is still increasing. The expanding epidemic may be associated with the special role of MSM in China. Homosexuality is still not widely accepted by the general population. Therefore, marriage between MSM and women remains common, in which case MSM might act as a bridge for HIV transmission to other MSM and the general population. It was reported that the prevalence of bisexual behavior among MSM in China was as high as 31.2% [124].

The subgroup analyses showed that the prevalence of HIV infection was 7.5% from developing cities and 6.1% from developed cities, whereas the prevalence of syphilis was 8.6% from developing cities and 15.1% from developed cities. The exact reasons for this finding are unclear, but one possible reason is that syphilis is a curable disease and several large scale public health programs were conducted in several developing cities in the past few years [74].

Several limitations of our analyses must be kept in mind. First, substantial heterogeneity was observed in our analysis. We found that study site, sample size, and sampling methods contributed to the heterogeneities. These factors may also have contributed to the increasing trend of HIV and syphilis infection in MSM in China. A meta-analysis of Chow reported that articles published in English were more likely to present high prevalence than Chinese articles, which may have resulted in between-study variance. The presence of publication bias was also a considerable limitation in our analysis (Figure 4). With the strict inclusion criteria, we excluded studies with a sample size smaller than 150 and those with only one testing method to diagnose syphilis. There are also a large number of unpublished articles (e.g., government documents) and studies that reported relatively low prevalence. Third, there were few studies from rural areas, which may have led to an overestimation of HIV and syphilis

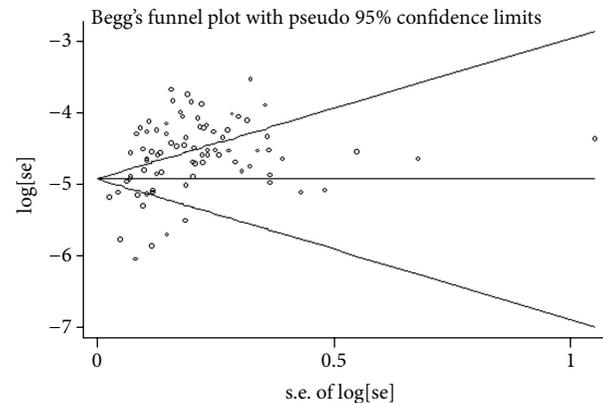


FIGURE 4: Begg's funnel plot showing the potential publication bias.

prevalence. More studies of rural MSM studies are needed in the future. Fourth, several studies that did not specify the city location were excluded from the subgroup analysis, which may have increased the possibility of publication bias. Fifth, the economic classification of the cities was only based on the per capita GDP; results may only partially reflect the true economic status of the city.

Despite the limitations listed above, our meta-analyses employed a strict inclusion criteria and valid search strategy in order to provide an objective, authentic, and current estimate of HIV and syphilis prevalence among MSM in China, with a large aggregate sample size of 75036. We also conducted a subgroup analysis to present the different prevalence rates of HIV and syphilis infection in developing and developed cities.

In conclusion, HIV and syphilis are prevalent among MSM in China; HIV prevalence is higher in developing cities than in developed cities, while the situation of syphilis is just the opposite. These results urgently indicate the need for strategies aimed at prevention, surveillance, and treatment. Moreover, corresponding policies should be drawn up by the local government on the basis of local economic status.

Conflict of Interests

There are no conflict of interests.

Acknowledgments

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Review Article

HIV Prevalence Trends, Risky Behaviours, and Governmental and Community Responses to the Epidemic among Men Who Have Sex with Men in China

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Purpose of Review. Numerous studies reported the rapid spread of HIV/AIDS epidemic among men who have sex with men (MSM) in China. This paper aims to investigate the overall epidemic trend and associated high-risk behaviours among Chinese MSM and to explore the governmental and community responses to the epidemic. *Recent Findings.* HIV prevalence among Chinese MSM increased rapidly in all Chinese regions in the past decade and disproportionately affected the Southwest China. In addition to the high-risk homosexual behaviours, overlapping bisexual, commercial, and drug use behaviours are commonly observed among Chinese MSM. The Chinese government has significantly expanded the surveillance efforts among MSM over the past decade. Community responses against HIV have been substantially strengthened with the support of international aid. However, lack of enabling legal and financial environment undermines the role of community-based organisations (CBOs) in HIV surveillance and prevention. *Conclusion.* HIV continues to spread rapidly among MSM in China. The hidden nature of MSM and the overlapping homosexual, bisexual, and commercial behaviours remain a challenge for HIV prevention among MSM. Strong collaboration between the government and CBOs and innovative intervention approaches are essential for effective HIV surveillance and prevention among MSM in China.

1. HIV Epidemic in China

Estimated 780,000 people in China are currently living with HIV/AIDS, accounting for 0.057% of the Chinese population in 2011 [1]. HIV epidemic was initiated and mainly transmitted by sharing injecting equipment among injecting drug users (IDU) in China in the past decade [2, 3]. However, sexual transmission, especially male-to-male homosexual transmission, has become the major mode of

HIV transmission in recent years [4, 5]. The latest national report revealed that the proportion of newly diagnosed HIV cases due to male homosexual contact has increased from 12.2% in 2007 to 32.5% in 2009 [5]; while the national HIV prevalence among MSM had a 4.5-fold increase in the past ten years (i.e., from 1.4% in 2001 to 6.3% in 2011) [1, 6]. The level of HIV prevalence in MSM is still relatively low compared to other Asian countries such as Cambodia (7.8%), Indonesia (9.0%), and Thailand (24.6%) [7]. Currently, Chinese MSM

represents about 2–4% of the sexually-active male population in China (i.e., 5–10 million) [8, 9].

The rapid spread of HIV epidemic among Chinese MSM has become a national concern [10]. Several published review articles on Chinese MSM have described the HIV disease burden and its transmission through high-risk sexual behaviours among MSM in China [11–13]. Extended from previous findings, this paper aims to (1) describe the trend of HIV epidemic among MSM in relation to the less investigated overlapping risk behaviours and (2) assess the current health polices and surveillance efforts from the Chinese government and community responses to the epidemic. Assessing these specific aspects provides insightful implications for the country's public health responses and informs relevant health policies.

2. Rapid Transmission of HIV among Chinese MSM

Growing trends of HIV epidemic among MSM have been observed in all Chinese provinces, municipalities, and autonomous regions; however, the epidemic varies geographically and temporally (Figure 1(a)). The national HIV prevalence has increased rapidly from 0.9% in 2003 to 6.3% in 2011 [14]. Several studies have also indicated that MSM recruited from gay venues (i.e., gay bars, saunas, and bathhouses) have a higher HIV prevalence compared with those MSM recruited from the Internet, clinics, or other settings [15–17]. Furthermore, HIV incidence have also increased in several municipalities and provinces (Figure 1(b)), such as Beijing Municipality (from 2.9 to 8.1 per 100 person-years during 2005–2010), Chongqing Municipality (from 8.0 to 15.4 per 100 person-years during 2006–2009), Liaoning Province (from 5.1 to 10.2 per 100 person-years during 2007–2009), Jiangsu Province (from 5.7 to 8.2 per 100 person-years during 2008–2011), and Zhejiang Province (from 3.5 to 6.3 per 100 person-years during 2010–2012). Provinces in the Southwest and Northwest regions consistently exhibit higher prevalence levels than other parts of China. Previous study showed that the proportion of all reported diagnosed cases that were attributed to male homosexual exposure in the city of Kunming of Southwest China has increased from 2.2% in 2000 to 42.2% in 2007 [18].

3. High-Risk Homosexual Behaviours

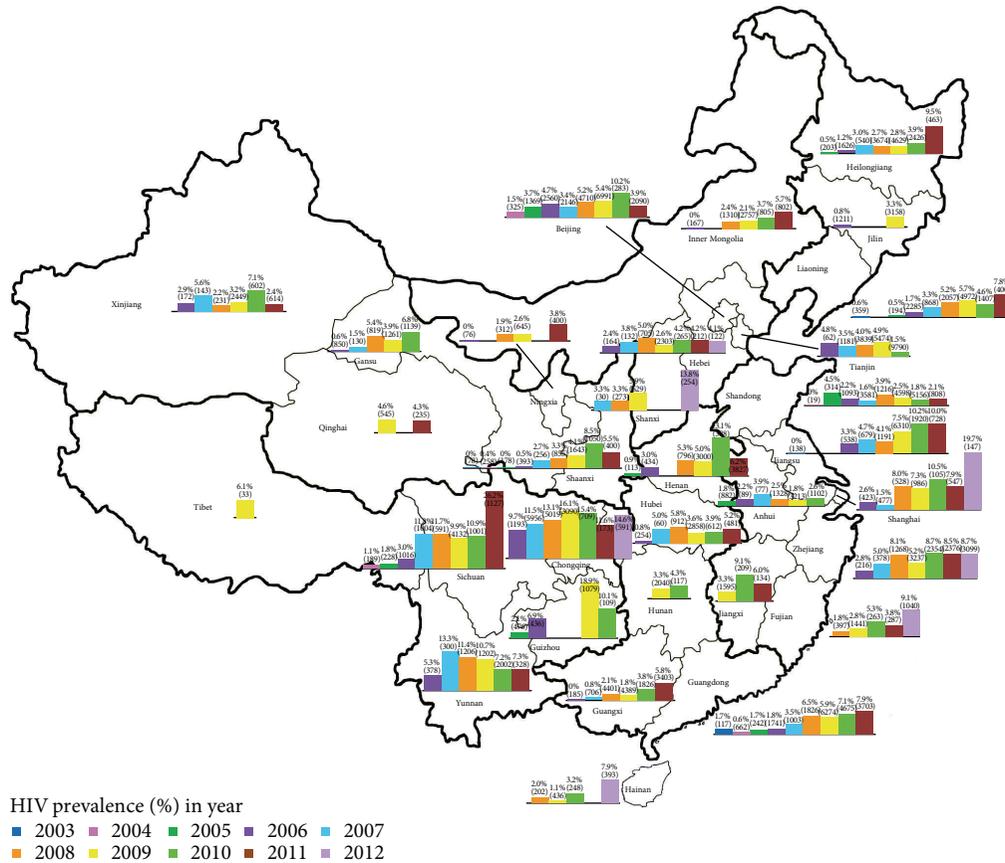
Approximately 85% and 90% of MSM have had anal sex and oral sex with men in the past six months, respectively [19, 20], and each Chinese MSM has approximately 7.2 ± 17.3 oral sex partners and 6.6 ± 15.6 anal sex partners [20]. Correct and consistent use of condoms can prevent HIV transmission by 85–90% [21–25]; however, condom usage varies across types of sexual partnerships among Chinese MSM. A recent systematic review and meta-analysis have demonstrated that regular male partnerships in Chinese MSM have the lowest consistent condom use during anal intercourse over the past six months (19.9%) compared with noncommercial casual (30.4%) and commercial partnerships

(58.0%) [26]. Low condom use is mainly due to the preference of better sexual sensation and the fear of making partners feeling untrusted. Since most of the MSM perceive oral sex as a “safe-sex” activity [27], the rate of condom use in oral sex is extremely low (~10%) [20, 28]. Apart from these, a substantial proportion of MSM also have participated in other sexual contacts such as rimming (26.0%) and fisting (27.6%) [20]. About 27.7% have reported experiencing bleeding during or after intercourse [20]. Although these unusual sexual practices are considered as low risk sexual activities, the exchange of body fluids (i.e. blood and semen) could possibly facilitate HIV transmission [29]. In addition, nonmonogamous relationships are common among Chinese MSM [14, 30, 31]. National behavioural surveillance reported that the proportion of MSM who had multiple male sex partners in the past six months increased from 68.0% in 2008 to 85.4% in 2011 [14], and about 18.6% have participated in group sex activities in the past 12 months [20].

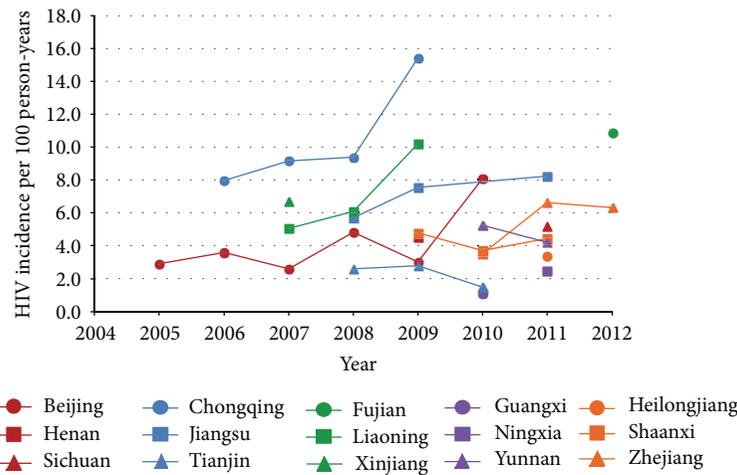
4. Prevalent Overlapping Risk Behaviours

4.1. Bisexual Behaviours. “Of the three kinds of unfilial conducts, having no posterity to continue the family line is the gravest” is one of the traditional family values in China [32]. Chinese parents expect children to marry and have children to continue the family line [33, 34]. Previous studies have reported that 25–35% of Chinese MSM are currently married to a female [35–37] and over 70% of MSM will potentially enter a heterosexual marriage during their lifetime due to social and family pressure [38–40]. Married MSM often have unprotected sex with their wives not only for the reason of reproduction [41], but also an indication of husbands' fidelity to their wives [42]. It has been reported that the rate of consistent condom use between MSM and female partners in the past six months is only 23.3% (95% CI: 11.3–42.1%) [12]. Moreover, a systematic review and meta-analysis estimated that about 68.0% of the HIV-positive Chinese MSM have unprotected vaginal intercourse (UVI) with their female partners [43]. Given that MSM who have sex with women is 1.3 (95% CI: 1.0–1.6) times higher risk of HIV compared to MSM who have sex with men only; female partners of bisexual MSM are at higher risk of HIV [44]. A recent study estimated that the HIV incidence among female partners of bisexual MSM has significantly increased 5.3 fold from 0.18 per 1000 person-years in 2002 to 0.88 per 1000 person-years in 2010 in China [45]. Bisexual behaviours of MSM pose potential threats of bridging HIV transmission to their female partners, spreading the epidemic into the general female population [46]. Disclosure of homosexuality is not common and only 11% of married Chinese MSM have disclosed their homosexuality to their wives [39]. Sexual harassment is common between homosexual men and their female partners, and 30% of wives have reported experiencing domestic violence by their homosexual or bisexual husbands [47].

4.2. Commercial Sexual Activities. Available studies have suggested that substantial proportion of Chinese MSM is also involved in the male-to-male commercial sex trade.



(a)



(b)

FIGURE 1: (a) HIV prevalence among MSM in China (2003–2012). HIV prevalence in Anhui [48–57]; Beijing [48, 58–81]; Chongqing [20, 35, 36, 48, 82–92]; Fujian [48, 93–98]; Gansu [36, 48, 99–101]; Guangdong [17, 46, 48, 52, 102–124]; Guangxi [48, 125–138]; Guizhou [48, 139–144]; Hainan [48, 68, 145–147]; Hebei [48, 148–157]; Heilongjiang [20, 48, 54, 69, 76, 77, 100, 158–166]; Henan [20, 48, 54, 69, 76, 77, 167–174]; Hubei [20, 48, 63, 175–179]; Hunan [48, 180–182]; Inner Mongolia [48, 100, 183–187]; Jiangsu [20, 48, 68, 188–206]; Jiangxi [48, 207–210]; Jilin [48, 100]; Liaoning [20, 48, 55, 68, 100, 163, 211–223]; Ningxia [48, 100, 224, 225]; Qinghai [226, 227]; Shaanxi [20, 48, 68, 228–231]; Shandong [48, 68, 180, 232–247]; Shanghai [20, 48, 68, 248–252]; Shanxi [48, 253–255]; Sichuan [20, 48, 69, 76, 77, 123, 256–268]; Tianjin [48, 68, 269–274]; Tibet [48, 275]; Xinjiang [48, 276–281]; Yunnan [48, 68, 168, 282–290]; and Zhejiang [48, 68, 291–303]. The percentages on the bar chart represent the prevalence of HIV infection among MSM and the numbers in the round bracket represent the total number of MSM screened; (b) HIV incidence among MSM in China (2005–2012). HIV incidence in Beijing [64, 70, 74, 304, 305]; Chongqing [306–308]; Fujian [98]; Guangxi [309]; Heilongjiang [310]; Henan [311]; Jiangsu [190, 312–316]; Liaoning [55, 216]; Ningxia [317]; Shaanxi [230, 318]; Sichuan [319]; Tianjin [272, 274]; Xinjiang [279]; Yunnan [289, 320]; and Zhejiang [299, 321].

Approximately 6.5–22.6% of the Chinese MSM have paid for sex with men [58, 232, 322, 323]; on the other hand, about 4.9–24.3% have sold sex to men in the past six months [58, 322–326]. In addition, male sex workers are coined as “money boys” or informally as “*yāzi*” (duck; who serves male and female clients) and “*é*” (goose; who serves male clients only) in the Chinese context [327]. Money boys have borne a disproportionate burden of HIV infection [11, 328–331]; however, very little epidemiological and sociobehavioural studies focus on this subpopulation. Previous studies have shown that money boys are usually younger, less educated, and more likely to have unprotected sex with multiple male clients compared to the broader MSM population [11, 328–330]. A survey has reported that about 13.2% of MSM are engaged in paid sex activity but only 59.7% have used condom at every anal sex over the past six months. Additionally, nearly half (i.e., 43.1%) of the money boys also have a heterosexual partnership but only 36.0% use condom with their female partners over the past six months [329]. Most of the money boys often move between cities for sex trade in order to avoid being recognised by the local community [11, 19, 328], such domestic migration potentially facilitates the transmission of HIV across geographical locations [332–334]. Recent review demonstrated that the odds of exposure to HIV among money boys are 1.3 (95% CI: 1.1–1.5) times higher than the odds of exposure to HIV among the broader MSM population [11].

4.3. Injecting Behaviours. It is shown that about 8% of MSM who also have injected drugs in the past 12 months [20]. China has a long history of illicit drug trafficking and high rates of HIV infection among IDU [2, 3, 335]. Recent national report revealed that six out of the 31 Chinese provinces (i.e., Yunnan, Xinjiang, Guangdong, Guangxi, Sichuan, and Guizhou) accounted for 84.2% of the HIV epidemic among the IDU population [336]. At the same time, MSM in these provinces also have the highest HIV prevalence across the country (Figure 1(a)). The overlapping risk behaviours among MSM who also inject drugs (MSM-IDU) are likely to facilitate HIV transmission [337, 338]. Currently, the injecting and needle-sharing behaviour among MSM in China is little known. It remains a challenge to promote public health interventions to this overlapping population [339].

5. Governmental Responses to HIV among Chinese MSM

Male-to-male sexual activity is no longer punishable by law in China [340, 341]. The Chinese supreme court has ruled to exclude sodomy as a criminal act in 1957 [102]. The Chinese government abolished the “Hooliganism Law” from the Chinese Criminal Code in 1997 [342, 343], which signifies the decriminalisation of homosexuality in China. Furthermore, the term “homosexuality” was also removed from the list of psychiatric disorders by the Chinese National Psychiatric Association in 2001 [344]. With the increasingly permissible

legal environment, the first HIV sentinel surveillance (HSS) site to target MSM was established in Heilongjiang Province in 2002 [345]. Two additional HSS sites for MSM were established in Anhui and Henan Provinces in 2005 [345]. The number of HSS sites further increased to 17 in 2009, covering eleven Chinese provinces [346]. Since then, there was a dramatic 6-fold increase in the number of HSS sites during 2009–2011 [347]. Currently, China hosts 108 HSS sites, monitoring HIV transmission and risk behaviours among MSM in all 31 Chinese provinces except the Tibet Autonomous Region (Figure 2) [14]. Routine epidemiological and behavioural information are collected in annual cross-sectional surveys [348, 349]. Participants are recruited through various methods, including snowball, venue-based, and internet recruitment sampling methods [14, 347]. Despite of this large scale-up of surveillance efforts, the current surveillance coverage remains insufficient to capture the trend of HIV and sexually transmitted infections (STIs) among MSM in many parts of the country [347, 350]. Recently, the central government funding for the HIV/AIDS responses has significantly scaled up from RMB 1.1 billion (~US\$ 154.2 million) in 2008 [5] to RMB 3.4 billion (~US\$ 497.3 million) in 2010 [351]. However, only US\$ 4.4 million in 2008 and US\$ 12.7 million in 2010 were set aside for MSM, accounting for only 2–3% of the total funding [148].

HIV testing service is a key component of HIV surveillance [352, 353]. Despite a significant increasing trend of HIV annual testing rate among MSM (from 11.0% in 2003 to 50.4% in 2011) [11], approximately 61.1–87.0% of HIV-infected MSM remain undiagnosed [18, 354]. The low HIV testing rate among Chinese MSM is associated with a number of psychological and structural barriers. The majority of MSM perceive themselves as healthy and with low risk of acquiring HIV [31, 355]. Double social stigma against gay men and HIV patients in China complicate MSM to disclose their sexual orientation and/or HIV positive status [20, 355, 356]. The Chinese Stigma Index Report revealed that 25% of Chinese medical staff had negative and discriminatory attitudes towards people living with HIV (PLHIV) in 2009 [357]. Lacking of trust obstructs the uptake of HIV testing and subsequent medical procedures among MSM [31, 358, 359]. Unawareness of HIV serostatus among HIV-infected MSM may continue to fuel the spread of the virus [358]. In terms of structural barriers, a large proportion of MSM are not aware of the locations of any HIV testing site in their neighbourhood [20, 355, 356], likely due to the lack of outreach of HIV intervention programs for MSM. However, successful roll-out of any of these interventions’ programs relies on their ability to protect the identity and privacy of MSM. Due to the anonymous nature of the Internet, a study revealed that the majority of Chinese MSM (84.7%) would prefer receiving HIV/AIDS-related intervention via Internet, instead of receiving the information from the China Centers for Disease Control and Prevention (CDC) (28.4%) and hospitals (22.8%) [360]. This shows that the non-face-to-face Internet-based intervention is a more acceptable approach to Chinese MSM.



FIGURE 2: Distribution of HIV national sentinel surveillance sites for men who have sex with men in China. The blue dots represent the location of 109 sentinel surveillance sites in 2011.

6. Community Responses to HIV among Chinese MSM

6.1. Development of Community-Based Organizations in China. Since early 1990s, several gay men voluntarily joined together and started to advocate for HIV prevention and awareness and knowledge of HIV/AIDS to the gay community [361]. They established the first telephone hotline “99575 Beijing Tongzhi Hotline” in Beijing, this hotline was served by health educators in order to provide health promotion, counselling services, harm reduction strategies, and safe sex practices to the local MSM community [102]. In 1997, a group of MSM established a community-based program named “Friends” in collaboration of with specialists and professions from public health, sociology, psychology, and legal areas. This program led to the subsequent publication of a bimonthly magazine named “Friend Exchange” in the following year. This magazine provided a comprehensive collection of information on HIV/AIDS, sexual orientation, academic researches, and personal life experiences of homosexual individuals [362–364]. This program gradually expanded

and was transformed into the first registered community-based organization (CBO) for gay and lesbians (i.e., the Beijing Gender Health Education Institute) in Beijing in 2002 [102]. The institute provided training program to promote self-acceptance of sexual identity and social justice and provide related psychological counselling to its participants. Furthermore, with the support of the Fifth Round of AIDS Program of Global Fund in China in 2005, this program had been significantly scaled up to promote HIV prevention and AIDS treatment among MSM [365]. The success of this program has led to the Chinese Ministry of Health’s decision to explicitly request all level of health departments to initiate health intervention programs among MSM [363]. Consequently, a large number of grassroots CBOs for MSM have been then established in major urban cities. A large cross-sectional study among MSM in 61 cities was conducted in 2009 to understand the geographical disparities of HIV epidemic and risk behaviours among the population [48], which has initiated a strong collaboration between local CDCs and MSM-targeted CBOs [366]. In 2013, China CDC

has pledged to provide greater support to CBOs participating in HIV/AIDS prevention activities [352].

6.2. The Unique Role of CBOs in HIV Surveillance and Prevention. CBOs play a unique role in confronting the HIV/AIDS epidemic among MSM in China. First, unlike other high-risk populations such as female sex workers and injecting drug users, gay relationships are not illegal in China and hence the Chinese government cannot exert authority over this population. In general, it is difficult for individual MSM to establish a well-trusted relationship with governmental bodies [359]. Due to social discrimination towards homosexuality and people living with HIV (PLHIV), most of Chinese MSM will conceal their homosexuality publicly [103]. Without the mediation of well-trusted CBOs that are representative of the MSM community, it has become apparent that the Chinese government cannot access to this population and conduct an effective epidemic surveillance [367–369]. Second, in comparison with the governmental institutions, CBOs are much less authoritative and more extensively rooted in the MSM community [370]. These organisations are capable of mobilising multiple channels through private entertainment establishments (e.g., gay bars, saunas), public venues (e.g., parks and clubs), and mass communication media (e.g., internet and hotlines) to effectively provide peer-education services, free condom and lubricant distribution, and peer-counselling and promote HIV voluntary counselling and testing (VCT) [371]. Third, CBOs are usually at a better position to engage the government to advocate for changes in health policies, allocation of resources, and rights for their community.

6.3. Barriers and Challenges Facing the Development of CBOs. Development of CBOs in MSM community faces several challenges. First, financial restriction obstructs the official registration of CBOs [372]. In particular, establishing a CBO at a national or local level in China requires a minimum of RMB 100,000 (US\$ 15,000) and RMB 30,000 (US\$ 4,500), respectively [373]. Due to the lack of enabling financial, political, and legal environment [372], very few of them obtain registered status [374]. As a result, they are not eligible to apply for governmental funds and are at risk to be banned by the Chinese government. Currently, the operation and development of MSM-based CBOs are mainly supported by external funding bodies such as Global Fund to Fight AIDS, Tuberculosis and Malaria, which is the largest funding source for Chinese CBOs [375, 376]. With the gradual withdraw of Global Fund and eventual termination in China in 2013, many of these CBOs is expected to dissolve in the absence of replacement funding from the government [377, 378]. Second, CBOs are lacking capacity [379–381]. Most of these organizations remain focusing on the primary intervention activities such as condom distribution and health advocacy but have limited experience on financial management, funding application, project planning, management, organization, and supervision [381]. The quick staff turnover, lack of collaboration with governmental bodies and research institutions also limit its development and expansion in the community [211].

7. Scientific Innovations in Responses to HIV among MSM

Several biobehavioural interventions have been shown to have significant impacts in preventing HIV transmission in recent years. First, male circumcision could significantly reduce 50–60% of HIV transmission via penile-vaginal sexual intercourse [382–384]. It is estimated that less than 5% of the total male Chinese population are circumcised [385]. However, 30.7–36.4% of MSM are willing to undergo circumcision [291, 386, 387]. Second, HIV preexposure prophylaxis (PrEP) may reduce the chance of HIV acquisition during sexual intercourse [388]. Studies showed that only 11.2% of MSM in Beijing are aware of PrEP but 67.8% are willing to use PrEP, if it is available in China [389]. An even higher rate of awareness of PrEP (22.1%) is reported among MSM in the Southwest China, where HIV is most prevalent [390].

8. Conclusions

MSM is an emerging highly at risk population for HIV transmission in China. Overlapping homosexual, bisexual, and commercial sexual activities and high-risk drug use behaviours are common among Chinese MSM. Due to the hidden nature of the population and the existing stigma and discrimination associated with HIV infection and homosexuality, Chinese MSM are reluctant to access healthcare and HIV testing services [40]. Hence, it remains a challenge to provide timely diagnosis, care, and treatment to HIV-infected individuals. A substantial scale-up of epidemiological and behavioural surveillance efforts is required. Furthermore, innovative technology-based HIV prevention via mobile apps, Internet, or short message service (SMS) should be promoted to target the unreached MSM subgroups [391]. Over the past decade, both Chinese government and grassroots CBOs have significantly increased their commitment and contribution towards HIV surveillance among MSM. CBOs play an irreplaceable role in the national surveillance effort and its close collaboration with the government is essential for any effective epidemic surveillance and prevention measures among Chinese MSM.

Conflict of Interests

All authors declare no conflict of interests in this study.

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Research Article

Risk Factors for HIV/Syphilis Infection and Male Circumcision Practices and Preferences among Men Who Have Sex with Men in China

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Objective. To investigate factors associated with HIV infection and the frequency and willingness of male circumcision among men who have sex with men (MSM) in Chengdu city, China. **Methods.** A cross-sectional survey provided information on participants' demographics, risk behaviors, circumcision, and uptake of HIV prevention services. **Results.** Of 570 participants, 13.3% were infected with HIV and 15.9% with syphilis. An estimated 43.0% of respondents reported having unprotected receptive anal intercourse, and 58.9% reported having ≥ 2 male sexual partners in the past 6 months. Multivariable logistic regression revealed that syphilis, more male sex partners, predominantly receptive anal intercourse, and exclusively receptive male sex were associated with HIV infection. Higher level of education and peer education service were inversely associated with HIV infection. Nearly a fifth (18.0%) of participants were circumcised. More than half of uncircumcised participants expressed willingness to be circumcised. **Conclusion.** This study reveals a high prevalence of HIV and syphilis among MSM in Chengdu province of China. The frequency of unprotected receptive anal intercourse and multiple male sexual partnerships highlight the urgency for an effective comprehensive HIV prevention strategy. Although the willingness to accept male circumcision (MC) is high, further research is needed to assess the protective effectiveness of MC among MSM.

1. Introduction

Since reports of the HIV virus began to emerge in the United States in the 1980s, the HIV epidemic has frequently been linked to men who have sex with men (MSM) [1]. Sexual transmission among MSM accounts for the majority of prevalent AIDS cases in Western Europe, United States, Canada, Australia, and New Zealand. In Africa, Asia, and

Latin America, the prevalence of HIV infection has increased rapidly in recent years [2]. Although HIV epidemics in low and middle income countries are mainly driven by heterosexual sex, injection drug use, and/or contaminated blood collection and transfusion, with MSM comprising a small share of all HIV cases, recent data shows rapid increases in the HIV epidemic among MSM in Asia, Africa, South America, Eastern Europe, and Central Asia [3]. In China,

meta-analyses among MSM indicated HIV prevalence rates in the range of 3.2%–15.8% for studies conducted during 2005–2008 [4] and a pooled syphilis prevalence of 9.1% for studies conducted from 2001 to 2008 [5]. A large national survey of 47,231 MSM in China indicated HIV and syphilis prevalence rates of 4.9% and 11.8% in 2008, respectively [6]. Data consistently indicated unprotected male-to-male sexual contact has become one of the major transmission routes for HIV in China [7].

Chengdu is one of the large metropolitan cities in Southwest China. There are estimated 71,000 MSM among its 4.5 million residents in 2007, among whom at least 10,000 are active members of the homosexual social network [8]. HIV/AIDS surveillance indicates that HIV prevalence increased rapidly from 1.06% (2/189) in 2004 [9] to 11.2% (51/456) in 2008 [10], a rate that is twice as high as the national average HIV prevalence among MSM [6].

Antiretroviral treatment and treatment of sexually transmitted infections (STIs) have been approved as effective prevention approaches for HIV, and increasingly promoted as a means of reducing HIV transmission among MSM [11–15]. There is compelling evidence that male circumcision reduces the risk of heterosexually acquired HIV infection in men. Three randomized clinical trials demonstrated that male circumcision (MC) reduced HIV acquisition risk among heterosexual men by approximately 60% [16–18]. The World Health Organization (WHO) and UNAIDS recommend male circumcision as an additional, important strategy for the prevention of heterosexually acquired HIV infection in men. Several studies of MSM who predominantly practice insertive anal intercourse (IAI) suggest some protective effect of male circumcision, as reported in Peru [19] South Africa [20], and Australia [21]. However, most studies have not found an association between HIV prevalence, incidence, and circumcision, likely because of multiple factors, including evidence that circumcision will not reduce HIV acquisition through unprotected receptive anal intercourse (RAI). In addition, African data may not be readily generalizable to MSM [22] and the potential efficacy of circumcision in reducing HIV infection among MSM is still unclear [23, 24].

In China, MC is not commonly practiced; while the prevalence of MC worldwide is almost 30%, it is only 5% among Chinese males [25]. Data on circumcision among Chinese adult men is very limited. There is no data available on MSM male circumcision in Sichuan. The purpose of this study was to assess the prevalence of HIV and syphilis, investigate factors associated with HIV infection, and the frequency and willingness to undergo male circumcision among MSM in Chengdu city of China.

2. Methods

2.1. Enrollment of Participants. A cross-sectional survey was conducted in Chengdu from June to September 2009. MSM eligible for the study included men 18–69 years of age who reported engaging in sex with men in the previous year.

Stratified-snowball sampling was used to recruit participants from the Chengdu MSM community [6]. A formative

assessment was conducted to determine the sizes of the MSM populations who most often seek sex partners at social venues including bars, tea houses, dance halls, public bath-houses/saunas, parks, public restrooms, and internet sites. Each venue represented a stratum of MSM to be surveyed. A community based organization, Chengdu Gay Community Organization (CGCO), helped to identify “seed” individuals (seed eligibility criteria: (1) meeting study criteria and (2) having a broad social network), who then began the referral chain. Our study recruited 18 seeds and each one was given an unlimited number of referral coupons to recruit other subgroup members. These individuals in turn were asked to provide information on other subgroup members. Recruitment ceased when the required sample size was reached [26]. All participants except for the seeds were required to present a coupon at their visit to be considered eligible for the survey. CGCO helped to identify, recruit, and record each participant to avoid recruiting the same participants from different seeds. Each participant who completed the survey received as incentive a US \$8 coupon as compensation for transportation costs.

2.2. Interview and Measures. The study included 8 steps, namely, participant identification, obtaining informed consent, pretest counseling, blood collection, questionnaire administration, genital exam, HIV and Syphilis rapid testing, and posttest counseling. Interview settings had two private interview/counseling rooms, two testing rooms, and one waiting room, which was located in Sichuan construction workers’ hospital (designated for Chengdu MSM STI testing and treatment services). All participants completed the written questionnaire via a face-to-face interview. The information collected in the questionnaire included demographic characteristics; HIV knowledge and attitudes; sexual history with other men and women, including unprotected anal intercourse, commercial sex; self-reported STD infection history, circumcision history, and history of receipt of HIV prevention services. A blood sample (approximately 8 mL) was collected from each individual and tested immediately on-site for HIV and current, active syphilis infection (not lifetime exposure). The rapid serological results were provided to the individual directly. CGCO’s trained health counselors were responsible for pre- and posttest counseling. Counseling was conducted in an individual setting to assure client’s privacy and confidentiality. During pretest counseling, consultants helped the participant to get mentally prepared through counseling on benefits of HIV testing and explaining the testing process. Pretest counseling lasted about 10 minutes. During the postcounseling, consultants provided test results, counseled on HIV prevention and HIV/STD risk reduction and provided appropriate referrals and take home information. Participants who tested positive were referred to the peer support project. Posttest counseling also gave participants sufficient time to react and to obtain emotional support, so it took about 15 minutes on average. Samples yielding inconclusive HIV results from rapid, on-site tests were subjected to confirmatory testing and participants were asked to return to receive their results. A genital examination was conducted as well.

2.3. Statistical Analysis. HIV prevalence was calculated by dividing the sum of all confirmed cases by all participants. In addition, the prevalence of circumcision, willingness to be circumcised, and the relationship between MC and HIV infection were analyzed. Univariate and multivariate logistic regressions analyses were used to assess the association between risk factors and HIV infection. Variables significant at a level of 0.2 in univariate logistic regression analyses were fitted into multivariate models. Multivariate logistic regression models were constructed to identify independent risk factors for HIV infection, while controlling for potential confounding factors. Missing values were treated as separate categories for clarity but otherwise received no special treatment. All regression models were run using complete cases. All statistical analyses were performed using SAS v9.2 for Windows (SAS Institute, Cary, NC).

2.4. Ethical Approval. This study was reviewed and approved by the Institutional Review Board of the National Center for AIDS/STD Control and Prevention, China Center for Disease Control and Prevention. Subjects provided signed informed consent and were assigned unique identification numbers so that anonymity could be maintained yet double testing prevented.

3. Results

3.1. Characteristics of Participants. A total of 570 eligible participants completed the survey. Two participants declined to participate in the study. The age of participants ranged from 18 to 69 years with median age of 26.5 years. Approximately 40% of participants were under 25 years of age. About 60% of participants had college or higher levels of education, and nearly three-quarters (71.4%) were never married. Approximately 46% were registered as Chengdu residents and nearly two-thirds (65.3%) self-identified as homosexual. Less than 30% (161/570) of respondents self-identified as bisexual, 5% did not state their sexual orientation or “did not know”, and 1% self-identified as heterosexual. The most common venues to find male sexual partners included the internet (59.1%), bars (18.2%), public bathhouses (10.5%), peer referral (6.7%), and parks or public restrooms (5.4%).

3.2. Sexual Behaviors. The age of sexual debut with a man ranged from 11 to 63 years with a median of 20 years. In terms of MSM anal sex, 34.2% of participants exclusively engaged in insertive anal intercourse (IAI), 25.3% predominantly (>50%) engaged in insertive anal intercourse, 20.7% exclusively engaged in receptive anal intercourse (RAI), and 19.4% predominantly engaged in receptive anal intercourse. In the 6 months preceding the study, the median number of male partners was 2 (range: 1 to 100), 16.5% of respondents reported having female sexual partners, and 21 (3.7%) admitted to paying for sex with “Money Boys” (MBs), while 26 respondents (4.6%) sold sex to male clients. The rate of consistent condom use (always used condoms when having sex) varied by type of sexual partners; 50.0% condom use while selling sex to male partners and 34.4% while having sex

with a female partner. About two-thirds of respondents used a condom in the last anal sex whereas 223 participants (43.0%) admitted to engaging in unprotected RAI.

3.3. Prevalence of HIV and Syphilis and Uptake of Related Prevention Services. HIV prevalence in the study population was 13.3% and syphilis prevalence was 15.9%. Syphilis-positive MSM had the highest HIV prevalence (37.8%) (Table 1). In the previous year, 84.0% of participants reported ever receiving HIV related services, 58.1% received peer education, 56.5% received HIV/STI knowledge booklet, 50.5% received free condoms, 46.8% received HIV testing and counseling, 46.1% received free lubricants, and 27.7% received STI testing. One-fifth of participants reported ever having STI-related symptoms in the past year (Table 2).

3.4. Factors Associated with HIV Infection. Multivariable logistic regression analysis suggested that a positive syphilis result, (AOR = 6.9; 95%CI: 3.5–13.5), having more male sex partners (AOR = 6.2; 95%CI = 2.0–19.1), predominantly engaging in receptive anal intercourse (AOR = 2.9; 95%CI: 1.2–6.9), and exclusively engaging in receptive male sex (AOR = 3.9; 95%CI: 1.6–9.3), was independently associated with HIV infection. Having a college education (AOR = 0.4; 95%CI: 0.2–0.9) and receipt of peer education services in the last year (AOR = 0.5; 95%CI: 0.3–0.8) were protective of HIV infection (Table 3).

In the entire group of MSM, circumcision was not associated with HIV, but the prevalence of syphilis was significantly lower among men who were circumcised than those who were uncircumcised (7.6% versus 17.5% resp., $P < 0.05$). These findings stayed the same after stratifying by participants' sexual role (IAI or RAI) in the past six months (Table 4).

3.5. Circumcision. Nearly a fifth of respondents (18.2%) reported having been circumcised, which was confirmed by clinical examination. The median age of circumcised participants was 20 years and ranged from 3 to 44 years. Reasons provided by circumcised MSM for the circumcision included a redundant foreskin (58.7%); 13.2% prevention of HIV and STIs (13.2%); personal hygiene (8.8%); to enhance sexual pleasure (5.9%) and cosmetic reasons to improve one's physical appearance (4.4%). The clinical examination indicated that more than half (53.2%) of individuals had foreskin problems, such as phimosis (1.1%), redundant foreskin (28.8%), and paraphimosis (11.6%). Among 504 uncircumcised men, 56.9% reported that they were willing to be circumcised; 30.4% were absolutely not willing to undergo circumcision, and 12.7% were not sure. For those participants who would accept male circumcision, the main reasons included prevention of HIV and STDs (49.0%), redundant foreskin (48.3%), enhance sexual pleasure (20.3%), getting free male circumcision medical services (16.8%), penile hygiene (9.8%), cosmetic reasons (7.7%), and peer influence (2.8%). The reasons of not accepting MC included no redundant foreskin problem (55.3%), inconvenient (12.1%), useless (8.8%), surgical complication (7.4%), and doubts about the effectiveness of MC as a HIV/STI prevention method (7.0%).

TABLE 1: Demographics, HIV/syphilis Infection, and risk factors among men who have sex with men in Chengdu, China, 2009.

Variables	N (%)	HIV (N, %)	Prevalence (%)
<i>Demographics</i>			
Age (years)			
18–24	226 (39.7)	29 (38.2)	12.8
25–34	210 (36.8)	26 (34.2)	12.4
≥35	134 (23.5)	21 (27.6)	15.7
Refused/missing	0	0	
Education			
Junior high	102 (17.9)	24 (31.6)	23.5
Senior high	130 (22.8)	22 (28.9)	16.9
College or higher	338 (59.3)	30 (39.5)	8.9
Refused/missing	0	0	
Marital status			
Never married	407 (71.4)	49 (64.5)	12.0
Married	76 (13.3)	10 (13.2)	13.2
Live with a partner (male/female)	44 (7.7)	8 (10.5)	5.9
Divorced/widowed	43 (7.5)	9 (11.8)	6.3
Refused/missing	0	0	
Household registration			
Local resident	261 (45.8)	26 (34.2)	10.0
Nonlocal resident	309 (54.2)	50 (65.8)	16.2
Refused/missing	0	0	
Time period of living in Chengdu			
0-1 years	61 (10.7)	9 (11.8)	14.8
1-2 years	54 (9.5)	8 (10.5)	14.8
≥2 years	455 (79.8)	59 (77.6)	13.0
Refused/missing	0	0	
Self-identified sexual orientation			
Homosexual	372 (65.3)	49 (64.5)	13.2
Heterosexual	7 (1.2)	0 (0)	0
Bisexual	191 (33.5)	27 (35.5)	14.1
Refused/missing	0	0	
<i>Sexual behavior in the past 6 months</i>			
Venues for finding sex partners			
Bars/tea houses/dance halls	104 (18.2)	16 (21.1)	15.4
Public bathhouses/saunas	60 (10.5)	11 (14.5)	5.0
Parks/public restroom	31 (5.4)	6 (7.9)	7.2
Internet sites	337 (59.1)	41 (53.9)	12.2
Refused/missing	38 (6.7)	2 (2.6)	
Anal sex with men			
Exclusively insertive	178 (31.2)	13 (17.1)	7.3
Predominantly insertive	132 (23.2)	19 (25.0)	14.4
Exclusively receptive	102 (17.9)	20 (25.3)	19.6
Predominantly receptive	108 (18.9)	22 (28.9)	20.4
Refused/missing	50 (8.8)	2 (2.6)	
Buy male sex			
No	549 (96.3)	72 (94.7)	13.1
Yes	21 (3.7)	4 (5.3)	19.0
Refused/missing	0	0	

TABLE 1: Continued.

Variables	N (%)	HIV (N, %)	Prevalence (%)
<i>Sell sex to a male</i>			
No	545 (95.6)	70 (92.1)	12.8
Yes	25 (4.4)	6 (7.9)	24.0
Refused/missing			
<i>Number of male sex partners</i>			
0	49 (8.6)	2 (2.6)	4.1
1	178 (31.2)	15 (19.7)	8.4
2–9	304 (53.3)	47 (61.8)	15.5
≥10	32 (5.6)	11 (14.5)	34.4
Refused/missing	7 (1.2)	2 (2.6)	
<i>Consistent condom use with male partner</i>			
Always	321 (51.1)	55 (72.3)	17.1
Sometimes or never	200 (34.7)	19 (25.0)	9.5
Refused/missing	49 (14.2)	2 (2.6)	
<i>Number of female sex partners</i>			
0	476 (83.5)	67 (88.2)	14.1
1	67 (11.8)	5 (6.6)	7.5
≥2	27 (4.7)	4 (5.3)	14.8
Refused/missing	0	0	
<i>HIV knowledge</i>			
<i>Correctly answered questions about HIV</i>			
No	261 (45.8)	50 (65.8)	19.1
Yes	309 (54.2)	26 (34.2)	8.4
Refused/missing	0	0	
<i>Biological outcome</i>			
<i>Syphilis</i>			
Negative	477 (83.7)	42 (55.3)	8.8
Positive	90 (15.8)	34 (44.7)	37.8
Refused/missing	3 (5.3%)	0	

4. Discussion

This study revealed an alarming prevalence of HIV among MSM in Chengdu, substantially higher than that among other vulnerable groups, for example, injection drug users (3.9%) and female sex workers (0.8%) in Chengdu [27] and higher than the overall prevalence among MSM in a large national survey across 61 cities [6]. The HIV prevalence in this study is similar to that reported from South and Southeast Asia (range: 14% to 18%) [28]. In the last decade, HIV prevalence among MSM in Chengdu has progressively increased, which is consistent with the national trend of homosexual transmission [29]. A significant epidemiological change is that unprotected male-to-male sex replaced IDU as the predominant mode of transmission for HIV in this large metropolitan city. Our finding underscores the urgent need to strategically target intervention prevention efforts toward MSMs.

STIs have been associated with biological risk for HIV infection in MSM, notably syphilis and infection with herpes simplex virus type 2, and more recently anal infection with

human papillomavirus [30]. High rates of undiagnosed and untreated syphilis are associated with the substantially higher rates of HIV infection [31]. In our study, syphilis prevalence is 15.9%, which was higher than that of the national survey [6]. After controlling for other risk factors, participants who were infected with syphilis were six times more likely to be infected by HIV. The finding of this study highlighted the needs for the treatment of STIs as one of the components of a comprehensive HIV prevention strategy.

The disproportionate HIV disease burden in MSM is explained largely by the high per-act and per-partner transmission probability of HIV transmission in receptive anal sex [28]. This study also shows that multiple male sex partners and receptive anal intercourse are associated with HIV infection. The participants in this study had an average of two male partners in the preceding 6 months. Of great concern, more than 5% of respondents reported having had at least ten male partners in the same time period. Besides, about two-thirds of participants engaged in IAI and 65.4% did not use condoms consistently. The finding of common unprotected receptive anal intercourse and multiple sex partners portend

TABLE 2: HIV/syphilis infection, HIV prevention services and male circumcision practices and preferences among men who have sex with men in Chengdu, China, 2009.

Variables	N (%)	HIV (N, %)	Prevalence (%)
<i>Received HIV prevention services in the past year</i>			
Free condom			
No	282 (49.5)	39 (51.3)	13.8
Yes	288 (50.5)	37 (48.7)	12.8
Refused/missing	0	0	
Free lubricants			
No	307 (53.4)	39 (51.3)	12.7
Yes	263 (46.1)	37 (48.7)	14.1
Refused/missing	0	0	
Peer education			
No	239 (41.9)	43 (56.6)	18.0
Yes	331 (58.1)	33 (43.4)	10.0
Refused/missing	0	0	
STD test or treatment			
No	412 (72.3)	62 (81.6)	15.0
Yes	158 (27.7)	14 (18.4)	8.8
Refused/missing	0	0	
HIV counseling or testing			
No	303 (53.2)	51 (67.1)	16.8
Yes	267 (46.8)	25 (32.9)	9.4
Refused/missing	0	0	
HIV/AIDS knowledge booklet			
No	248 (43.5)	45 (59.2)	18.1
Yes	322 (56.5)	31 (40.8)	9.6
Refused/missing	0	0	
<i>Male circumcision</i>			
Been circumcised			
No	504 (88.4)	67 (88.2)	13.3
Yes	66 (11.6)	9 (11.8)	13.6
Refused/missing	0	0	
Genital examination results			
Be circumcised	66 (11.6)	9 (11.8)	13.6
Phimosis	6 (1.1)	2 (2.6)	33.3
Redundant foreskin	164 (28.8)	19 (25.0)	11.6
Paraphimosis	66 (11.6)	7 (9.2)	10.6
Normal	268 (47.0)	39 (51.3)	14.6
Refused/missing	0	0	

the high risk of continuous rapid expansion of the HIV epidemic among the MSM community in Chengdu.

In our study, the coverage of a single intervention was about 28% to 58%, which were much less than 60–80% needed to have an effect on the HIV epidemic [32]. Multiple logistic regression result showed that those who received the peer education in the last year had lower chances to infect HIV. The significant relationship between peer education and HIV intervention may be contributed to the relative high coverage of peer education service. This finding underscored the need for scaling up the intervention effort.

The study was the first in Sichuan to assess the frequency of male circumcision and its association with HIV infection among MSM. One-fifth of participants reported having been circumcised, which was similar to the finding in Beijing, China [33] and much lower than the male circumcision prevalence (79%) in US [34]. When comparing self-reported and genital examination, the study found that participant can accurately report their circumcision status, which was consistent with an Australia's study [35]. Over half uncircumcised respondents in our study indicated that they would be willing to be circumcised, which was similar to

TABLE 3: Risk factors associated with HIV infection among MSM in Chengdu, China, 2009.

Factors	Univariate		Multivariate	
	OR (95%CI)	P-value	AOR (95%CI)	P value
Highest education (versus Junior high)				
Senior high	0.7 (0.3–1.3)	0.2132	0.9 (0.4–1.9)	0.7197
College or higher	0.3 (0.2–0.6)	0.0001	0.4 (0.2–0.9)	0.0295
MSM anal sex (versus exclusively insertive)				
Predominantly insertive	2.1 (1.0–4.5)	0.0461	1.5 (0.6–3.5)	0.3663
Exclusively receptive	3.1 (1.5–6.6)	0.003	2.9 (1.2–6.9)	0.0196
Predominantly receptive	3.2 (1.6–6.8)	0.0017	3.9 (1.6–9.3)	0.0023
Number of male sex partners in the past 6 months (versus 1)				
2–9	4.3 (1.0–18.3)	0.0486	1.7 (0.8–3.5)	0.1328
≥10	12.3 (2.5–60.5)	0.002	6.2 (2.0–19.1)	0.0016
Peer education (yes versus no)	0.5 (0.3–0.8)	0.006	0.5 (0.3–0.8)	0.028
Syphilis (positive versus negative)	6.3 (3.7–10.7)	<0.0001	6.9 (3.5–13.5)	<0.0001

Note: Multivariable logistic regression analysis was applied; OR: odds ratio; 95%CI: confidence interval; AOR: adjusted odds ratio.

TABLE 4: Association between HIV, syphilis, and circumcision among MSM, Chengdu, China, 2009.

Prevalence	Total MSM (<i>n</i> = 520)			MSM engaged in EIAI or PIAI (<i>N</i> = 310)			MSM engaged in ERAI or PRAI (<i>N</i> = 210)		
	Circumcised (%) (<i>n</i> = 60)	Uncircumcised (<i>n</i> = 460)	<i>P</i>	Circumcised (<i>n</i> = 38)	Uncircumcised (<i>n</i> = 272)	<i>P</i>	Circumcised (<i>n</i> = 22)	Uncircumcised (<i>n</i> = 188)	<i>P</i>
HIV	13.6	13.3	0.939	15.8	9.6	0.237	13.6	20.7	0.434
Syphilis	7.6	17.5	0.05	5.3	16.7	0.046	13.6	17.6	0.656

Note: Chi Square test was applied; EIAI: exclusively insertive anal intercourse; PIAI: predominantly insertive anal intercourse; ERAI: exclusively receptive anal intercourse; PRAI: predominantly receptive anal intercourse; due to missing data, sample size may differ.

the reports in Beijing, China [33] and other countries [36]. The relative low prevalence of male circumcision and a high willingness to be circumcised could be the evidence of the feasibility to promote MC as an intervention component of the multifaceted intervention strategy among MSM in Chengdu.

This study did not demonstrate an independent association of male circumcision with HIV infection whether we restricted the sample to men who engage in RAI or IAI. This finding is consistent with the findings from a clinical trial among MSM [37]. In contrast, in this study, being circumcised was associated with a lower frequency of syphilis among MSM (especially among those who engaged in IAI), which is consistent with a prospective study to assess circumcision status and a broad range of STIs among MSM [21]. Circumcision is unlikely to reduce URAI risk but could partially protect against HIV for MSM practicing unprotected insertive anal intercourse (UIAI) [22]. Consistent with previous research, our study found an association between male circumcision and lower frequency of syphilis among MSM (especially among those who engaged in IAI). Further studies with more incident HIV infections and among men who are exclusively insertive partners will likely provide greater power to determine if circumcision is associated with lower rates of HIV infection among MSM who engage in

insertive anal sex with HIV-infected partners among MSM in Chengdu.

This study has limitations. The study applied the snowball sampling method. Participants in the study may not be representative because of the biases associated with snowball sampling. However, compared with our previous study [10], the present study started from more seeds (eighteen) and had more diversity in demographic characteristics, especially with regard to age and education. With the exception of the clinical examination and HIV, syphilis serological testing, this study relied on self-reported data. Risk behaviors could be over- or underestimated due to social desirability regarding reporting. Additionally, the nature of the cross sectional design precluded the ascertainment of causality. This study did not find an independent association of circumcision with HIV infection, which may be caused by our use of prevalent cases.

In summary, this study demonstrated an alarming prevalence of HIV and syphilis among MSM in Chengdu. The common practice of unprotected receptive anal intercourse and multiple male sexual partnerships in our study population highlight the urgency for an effective comprehensive HIV prevention strategy, including the promotion of safer sex practices, treatment for STIs, the promotion of correct and consistent condom use, and the provision of HIV testing

and antiretroviral therapy. Further research will shed more light on optimal ways and desirability of integrating male circumcision into a comprehensive prevention package to restrain the rapid expansion of the HIV epidemic among MSM in Chengdu, China.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Research Article

HIV Risk Perception among HIV Negative or Status-Unknown Men Who Have Sex with Men in China

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Objective. To evaluate HIV risk perception and its associated factors among Chinese MSM. **Methods.** A cross-sectional study was conducted among MSM with an HIV negative or unknown status in Beijing, China, between 2011 and 2012. A questionnaire interview was conducted and a blood sample was collected for HIV and syphilis testing. **Results.** Of 887 MSM who reported they were HIV negative or did not know their HIV status before recruitment, only 7.3% reported a high risk of HIV infection, 28.0% medium risk, 52.2% low risk, and 12.5% no risk. In multivariate logistic regression models using those who reported a medium self-perceived risk as a reference group, self-reported high risk of HIV perception was associated with minority ethnicity (odds ratio [OR]: 2.91; 95% confidence interval [CI]: 1.03–8.19), self-reported history of sexually transmitted diseases (OR: 2.27; 95% CI: 1.25–4.10), and HIV testing times since the last HIV testing (OR: 0.47; 95% CI: 0.26–0.84); low self-perceived risk of HIV infection was related to full-time employment (OR: 1.58; 95% CI: 1.15–2.18) and illicit drug use (OR: 0.28; 95% CI: 0.10–0.75). **Conclusions.** The HIV/AIDS epidemic is rapidly rising among Beijing MSM, but more than half MSM did not perceive this risk.

1. Introduction

Data from Europe, North America, Latin America, Asia, and Sub-Saharan Africa indicate that human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) has been increasing over time, especially among men who have sex with men (MSM) [1–5]. In China, 17.4% were infected through homosexual contacts in 2011, rising from 11.0% in 2007 to 7.3% in 2005 [6]. Three prospective cohort studies which had been separately conducted among MSM in Beijing during 2006–2010 and followed for one year with more than 86.0% retention reported 2.6, 3.4, and 8.1 per 100 person-years of HIV incidence rates in 2007, 2009, and 2010, respectively [7–9]. Four cross-sectional studies showed that

HIV prevalence rate among MSM in Beijing significantly increased to 6.3% in 2009, from 5.8% in 2006, 4.6% in 2005, and 0.4% in 2004, representing a 15-times increase within 5 years from 2004 to 2009 [10, 11]. The rapid increase of HIV epidemic among MSM has reminded the Chinese government and researchers that comprehensive biomedical and behavioral interventions and other policies are urgently needed for preventing the spread of HIV in this high risk population.

Age, unmarried status, education, multiple or temporary sexual partners, and inconsistent condom use have been reported to be related to HIV risk among MSM [7, 11, 12]. Since China has adopted an open-door policy since the early 1980s, the Chinese society has become more tolerant

towards sex including homosexuality. Lack of sex knowledge and safer sex awareness among young people [13] and pursuit of sexual pleasure without condom use among MSM are prevalent, even though various policies, strategies, and interventions for HIV/AIDS prevention and control have been introduced and applied to the MSM population [7–10]. In addition, unprotected sex often occurs under drug or alcohol use among a proportion of MSM [14–16]. Therefore, risk awareness education is especially important to prevent and control HIV transmission among MSM [17, 18].

A qualitative study among MSM in Beijing and Chongqing found that the majority of participants were aware of the high HIV epidemic among MSM, but they did not think themselves at a high risk of HIV infection [19]. We conducted a quantitative assessment of HIV risk perception and its associated factors among Chinese MSM.

2. Methods

2.1. Study Design and Population. This study was conducted among MSM in Beijing, China, from January 2010 to July 2011. The study design and study population were described in detail elsewhere [20]. In brief, a local gay volunteer grassroots organization—Chaoyang Chinese AIDS Volunteer Group—recruited MSM participants from the community, sexually transmitted disease (STD) clinics, and voluntary HIV counseling and testing clinics using various approaches, such as website advertisements, outreach to MSM-frequented venues (e.g., MSM clubs, bars, and bathhouses), and peer-referrals. The primary aim of this study was to investigate HPV prevalence using genital and anal swab specimens among HIV-infected and uninfected MSM. This paper aimed to estimate a self-perceived risk of HIV infection among HIV seronegative or status-unknown MSM. Hence, those who have known their positive status are excluded from these analyses ($N = 233$). Written informed consent was obtained before the questionnaire interview and blood collection. This study was reviewed and monitored by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention (NCAIDS) of the Chinese Center for Disease Control and Prevention (NCAIDS IRB FWA00002958) and Vanderbilt University School of Medicine (VU IRB FWA00005756).

2.2. Data Collection. Questionnaire data of sociodemographic factors, drug and alcohol use, preferred sexual position during anal sex, self-reported sexual orientation, multiple concurrent male sexual partners in the last 12 months, traded sex for money in the past 12 months, forced to have sex with any male partners in the past 12 months, self-reported history of sexually transmitted diseases, ever having sex with female sexual partner(s), history of HIV testing, and self-perception of HIV/AIDS risk were collected by well-trained interviewers.

2.3. Blood Collection and Laboratory Tests. A physical examination was conducted by trained and experienced physicians to collect circumcision status. A blood sample was

collected to test for HIV and syphilis infections according to Chinese National Testing Protocols at the Institute of STD/AIDS Prevention and Treatment, Xicheng District Center for Disease Control and Prevention and the Beijing Jingcheng Venereal Hospital, Beijing, China. Each participant was assigned a unique code to link the anonymous questionnaire and blood. HIV infection status was determined by an enzyme immunoassay (Wantai Biological Medicine Company, Beijing, China), and positive samples were confirmed by HIV-uninfected 1/2 Western blot assay (HIV Blot 2.2 WB; Genelabs Diagnostics, Singapore, Singapore). Syphilis serology was determined through rapid plasma reagin (Shanghai Kehua Biotechnology Co., Ltd., Shanghai, China) and confirmed by the Treponema palladium particle assay (Fujirebio Inc., Tokyo, Japan).

2.4. Statistical Analysis. Data for questionnaire responses, physical examinations, and laboratory tests were entered independently by 2 study staff and verified with EpiData software (EpiData 3.1 for Windows; The EpiData Association Odense, Odense, Denmark). Completed databases were then analyzed with Statistical Analysis System (SAS 9.3 for Windows; SAS Institute Inc., Cary, NC, USA) software. Participants were asked a question: “How large do you think the risk of being infected with HIV?” And they could respond with one of four answers: (1) high risk; (2) medium risk; (3) low risk; and (4) no risk. Univariate logistic regression analyses were used to estimate the odds ratios (OR) and 95% confidence interval (CI) for the association between HIV risk perception and some demographic and behavioral factors, using medium risk as reference: (1) high risk versus medium risk; (2) low risk versus medium risk; and (3) no risk versus medium risk. Multivariable logistic regression was used to determine predictors of HIV risk perception using medium risk as the reference. All variables with $P < 0.10$ in univariate analyses were entered into the multivariate logistic model using stepwise selection. Separate logistic regression models were used to further evaluate the associations of HIV/syphilis infection with self-perceived risk of HIV infection without and with adjustment for potential confounders, such as age, ethnic, years of education, and full-time employment.

3. Results

A total of 1155 potential participants were recruited into the study and provided informed consent; 251 were excluded due to HIV-seropositive or unconfirmed HIV status; 17 were further excluded due to missing information on HIV risk perception. Therefore, a total of 887 HIV-uninfected participants were included in this analysis on HIV risk perception.

Table 1 presents basic characteristics of MSM who participated in this study. The average age at interview was 30.2 years; 94.0% were Han ethnics; 72.9% were never married; 52.5% received college education; 63.9% were employed full time; 2.8% ever having used illicit drugs; 24.8% reported alcohol drinking daily in the past 4 weeks. About two-thirds (65.7%) reported homosexual orientation and 33.1%

TABLE 1: Basic characteristics of men who have sex with men (MSM) in Beijing, China.

Characteristics ^a	<i>n</i> (<i>N</i> = 887)	%
Age at interview (year): mean ± SD ^b (range)	30.2 ± 7.9 (18–67)	
≤23	148	16.7
24–29	344	38.8
30–39	278	31.3
≥40	87	13.2
Ethnicity		
Han	834	94.0
Others	53	6.0
Ever married		
Never	647	72.9
Ever	240	27.1
Education (year)		
Primary school and lower (≤6)	23	2.6
Middle school (7–9)	145	16.4
Senior high (10–12)	253	28.5
College and higher (>12)	465	52.5
Employment status		
Full-time/tenured	565	63.9
Part-time/temporary	186	21.1
Retired/unemployed	47	5.3
Student	46	5.2
Others	40	4.5
Resident in Beijing		
No	691	78.0
Yes	195	22.0
Illicit drug use		
Never	861	97.2
Ever	25	2.8
Alcohol drinking in the past 4 weeks		
Never	41	4.6
Rarely	176	19.9
2–6 times per week	449	50.7
Daily	220	24.8
Sexual orientation		
Homosexual	577	65.7
Heterosexual	10	1.2
Bisexual	291	33.1
Preferred sexual position during anal sex		
Exclusively receptive	103	11.6
Mainly receptive	155	17.5
Exclusively insertive	181	20.4
Mainly insertive	224	25.2
Dual	193	21.8
No anal sex	31	3.5

TABLE 1: Continued.

Characteristics ^a	<i>n</i> (<i>N</i> = 887)	%
Self-perceived risk of HIV infection		
High	65	7.3
Medium	248	28.0
Low	463	52.2
No	111	12.5
HIV testing times since last HIV testing (month)		
Never	30	3.4
<3	282	31.8
3–5	326	36.8
6–11	132	14.9
≥12	117	13.2
HIV seropositive		
No	840	94.7
Yes	47	5.3
Syphilis seropositive		
No	739	83.3
Yes	148	16.7

^aSample size may vary for different characteristic variables due to missing data.

^bSD: standard deviation.

reported bisexual orientation. As for the role of anal sex, 29.1% preferred receptive, 45.6% preferred insertive, and 21.8% reported dual. Among this study population, only 3.4% had never had HIV testing and 83.4% reported having HIV testing in the past 12 months. Of 887 participants, 5.3% were confirmed as HIV positive and 16.7% as syphilis positive.

Only 7.3% perceived themselves at high risk of HIV infection; 28.0% perceived themselves to be at medium risk; 52.2% at low risk; and 12.5% at no risk. In unadjusted analyses, the following factors were associated with high risk perception compared with medium risk perception: younger age (OR, 0.96; 95% CI, 0.92–1.00; $P = 0.07$) and minority ethnicity (OR, 2.87; 95% CI, 1.05–7.87; $P = 0.04$), history of sexually transmitted diseases (OR, 2.17; 95% CI, 1.22–3.88; $P = 0.01$), and ≥3 months since last HIV testing (OR, 0.48; 95% CI, 0.27–0.84; $P = 0.01$). Factors associated with low risk perception were higher education level (OR, 1.37; 95% CI, 1.01–1.87; $P = 0.05$), full-time employment (OR, 1.64; 95% CI, 1.19–2.25; $P < 0.01$), and no history of illicit drug use (OR, 0.26; 95% CI, 0.10–0.69; $P = 0.01$). Factors associated with no self-perceived risk were lower education level (OR, 0.58; 95% CI, 0.37–0.92; $P = 0.02$), bisexual orientation (OR, 1.79; 95% CI, 1.11–2.88; $P = 0.02$), and ever had sex with female sexual partner(s) (OR, 2.02; 95% CI, 1.28–3.17; $P < 0.01$) (Table 2).

The factors significant in the univariate analyses were included in multivariate analyses (Table 3). Compared with those with medium risk perception, those with high risk perception tended to be minority ethnicity (OR, 2.91; 95% CI,

TABLE 2: Univariate analysis of factors associated with self-perceived risk of HIV infection among MSM in Beijing, China.

Factors ^a	Self-perceived HIV risk % (N)			Crude odds ratio (95% confidence interval)			
	High risk (n = 65)	Medium risk (n = 248)	Low risk (n = 463)	No risk (n = 111)	High versus medium	Low versus medium	No versus medium
Age at interview (year):							
Mean \pm standard deviation	28.1 \pm 5.6	29.9 \pm 7.2	30.6 \pm 8.1	30.7 \pm 9.2	0.96 (0.92, 1.00)	1.01 (0.99, 1.03)	1.01 (0.99, 1.04)
Ethnicity							
Han	89.2 (58)	96.0 (238)	93.1 (431)	96.4 (107)	1.00	1.00	1.00
Others	10.8 (7)	4.0 (10)	6.9 (32)	3.6 (4)	2.87 (1.05, 7.87)	1.77 (0.85, 3.66)	0.89 (0.27, 2.90)
Ever married							
Never	76.9 (50)	73.8 (183)	73.9 (342)	64.9 (72)	1.00	1.00	1.00
Ever	23.1 (15)	26.2 (65)	26.1 (121)	35.1 (39)	0.85 (0.44, 1.61)	1.00 (0.70, 1.42)	1.53 (0.94, 2.47)
Years of education							
\leq 12 years	40.0 (26)	50.8 (126)	43.0 (199)	64.0 (71)	1.00	1.00	1.00
>12 years	60.0 (39)	49.2 (122)	57.0 (264)	36.0 (40)	1.55 (0.89, 2.70)	1.37 (1.01, 1.87)	0.58 (0.37, 0.92)
Full-time employment							
No	35.4 (23)	43.3 (107)	31.8 (147)	38.2 (42)	1.00	1.00	1.00
Yes	64.6 (42)	56.7 (140)	38.2 (315)	61.8 (68)	1.40 (0.79, 2.46)	1.64 (1.19, 2.25)	1.24 (0.78, 1.96)
Residents in Beijing							
No	72.3 (47)	78.2 (194)	77.5 (359)	82.7 (91)	1.00	1.00	1.00
Yes	27.7 (18)	21.8 (54)	22.5 (104)	17.3 (19)	1.38 (0.74, 2.56)	1.04 (0.72, 1.51)	0.75 (0.42, 1.34)
Illicit drug use							
Never	95.4 (62)	95.1 (235)	98.7 (457)	96.4 (107)	1.00	1.00	1.00
Ever	4.6 (3)	4.9 (12)	1.3 (6)	3.6 (4)	0.95 (0.26, 3.46)	0.26 (0.10, 0.69)	0.73 (0.23, 2.32)
Alcohol drinking in the past 4 weeks							
Never	78.4 (51)	77.4 (192)	75.6 (350)	69.1 (76)	1.00	1.00	1.00
Rarely	13.9 (9)	19.0 (47)	20.3 (94)	23.6 (26)	0.72 (0.33, 1.57)	1.10 (0.74, 1.62)	1.40 (0.81, 2.42)
Often (\geq 2 times per week)	7.7 (5)	3.6 (9)	4.1 (19)	7.3 (8)	2.09 (0.67, 6.51)	1.16 (0.51, 2.61)	2.25 (0.84, 6.04)
Sexual orientation							
Homosexual	63.1 (41)	70.0 (170)	66.0 (305)	56.5 (61)	1.00	1.00	1.00
Heterosexual	1.5 (1)	1.2 (3)	0.9 (4)	1.8 (2)	1.38 (0.14, 13.63)	0.74 (0.16, 3.36)	1.86 (0.30, 11.39)
Bisexual	35.4 (23)	28.8 (70)	33.1 (153)	41.7 (45)	1.36 (0.76, 2.44)	1.22 (0.87, 1.71)	1.79 (1.11, 2.88)
Preferred anal position							
Exclusively/mainly receptive	33.9 (22)	32.5 (78)	29.0 (130)	27.2 (28)	1.00	1.00	1.00
Both insertive and receptive	21.5 (14)	23.8 (57)	23.0 (103)	18.5 (19)	0.87 (0.41, 1.85)	1.08 (0.71, 1.66)	0.93 (0.47, 1.82)
Exclusively/mainly insertive	44.6 (29)	43.8 (105)	48.0 (215)	54.4 (56)	0.98 (0.52, 1.83)	1.23 (0.85, 1.77)	1.49 (0.87, 2.55)
Unprotected anal sex in the past 6 months							
No	63.1 (41)	73.8 (183)	77.3 (358)	80.2 (89)	1.00	1.00	1.00
Yes	36.9 (24)	26.2 (65)	22.7 (105)	19.8 (22)	1.65 (0.93, 2.94)	0.83 (0.58, 1.18)	0.70 (0.40, 1.20)
Multiple concurrent male sexual partners in the past 12 months							
No	87.7 (57)	91.9 (228)	93.7 (434)	95.5 (106)	1.00	1.00	1.00
Yes	12.3 (8)	8.1 (20)	6.3 (29)	4.5 (5)	1.60 (0.67, 3.82)	0.76 (0.42, 1.38)	0.54 (0.20, 1.47)

TABLE 2: Continued.

Factors ^a	High risk (n = 65)	Self-perceived HIV risk % (N)		Crude odds ratio (95% confidence interval)			
		Medium risk (n = 248)	Low risk (n = 463)	No risk (n = 111)	High versus medium	Low versus medium	No versus medium
Traded sex for money in the past 12 months							
No	92.3 (60)	95.2 (236)	96.5 (447)	91.9 (102)	1.00	1.00	1.00
Yes	7.7 (5)	4.8 (12)	3.5 (16)	8.1 (9)	1.64 (0.56, 4.83)	0.70 (0.33, 1.51)	1.74 (0.71, 4.25)
Forced to have sex with any male sexual partners in the past 12 months							
No	93.8 (61)	96.0 (238)	97.4 (451)	96.4 (107)	1.00	1.00	1.00
Yes	6.2 (4)	4.0 (10)	2.6 (12)	3.6 (4)	1.56 (0.47, 5.15)	0.63 (0.27, 1.49)	0.89 (0.27, 2.90)
Self-reported history of sexually transmitted diseases							
No	59.4 (38)	76.0 (184)	77.1 (346)	84.1 (90)	1.00	1.00	1.00
Yes	40.6 (26)	24.0 (58)	22.9 (103)	15.9 (17)	2.17 (1.22, 3.88)	0.94 (0.65, 1.36)	0.60 (0.33, 1.09)
Ever had sex with female sexual partner(s)							
No	52.3 (34)	59.7 (148)	55.3 (256)	42.3 (47)	1.00	1.00	1.00
Yes	47.7 (31)	40.3 (100)	44.7 (207)	57.7 (64)	1.35 (0.78, 2.34)	1.20 (0.88, 1.64)	2.02 (1.28, 3.17)
Circumcision status by exam							
Uncircumcised	92.2 (59)	90.3 (215)	92.6 (411)	92.7 (102)	1.00	1.00	1.00
Circumcised	7.8 (5)	9.7 (23)	7.4 (33)	7.3 (8)	0.79 (0.29, 2.17)	0.75 (0.43, 1.31)	0.73 (0.32, 1.70)
Time since last HIV testing (month)							
<3	44.6 (29)	27.8 (69)	30.9 (143)	36.9 (41)	1.00	1.00	1.00
≥3 or never	55.4 (36)	72.2 (179)	69.1 (320)	63.1 (70)	0.48 (0.27, 0.84)	0.86 (0.61, 1.21)	0.66 (0.41, 1.06)
HIV seropositivity							
No	89.2 (58)	93.2 (231)	96.3 (446)	94.6 (105)	1.00	1.00	1.00
Yes	10.8 (7)	6.8 (17)	3.7 (17)	5.4 (6)	1.64 (0.65, 4.14)	0.52 (0.26, 1.03)	0.78 (0.30, 2.03)
Syphilis seropositivity							
No	78.5 (51)	81.0 (201)	86.2 (399)	79.3 (88)	1.00	1.00	1.00
Yes	21.5 (14)	19.0 (47)	13.8 (64)	20.7 (23)	1.17 (0.60, 2.30)	0.69 (0.45, 1.04)	1.12 (0.64, 1.95)

^aSample size may vary for different characteristic variables due to missing data.

TABLE 3: Multivariate analysis of factors associated with self-perceived risk of HIV infection among MSM in Beijing, China.

Factors	Adjusted OR (95% CI)		
	High versus medium	Low versus medium	No versus medium
Ethnicity			
Others versus Han	2.91 (1.03, 8.19)	—	—
Full-time employment			
Yes versus no	—	1.58 (1.15, 2.18)	—
Illicit drug use			
Ever versus never	—	0.28 (0.10, 0.75)	—
History of sexually transmitted diseases			
Yes versus no	2.27 (1.25, 4.10)	—	—
Ever had sex with female sexual partner(s)			
Yes versus no	—	—	1.93 (1.22, 3.05)
HIV testing times since last HIV testing (months)			
≥3 or never versus <3	0.47 (0.26, 0.84)	—	—

Note: OR: odds ratio; CI: confidence interval.

TABLE 4: Association of HIV risk perception with HIV and syphilis infections among MSM in Beijing, China.

Self-perceived risk of HIV infection	Unadjusted OR (95% CI)	<i>P</i> value	Adjusted OR* (95% CI)	<i>P</i> value
HIV seropositivity				
High risk	Ref.		Ref.	
Medium risk	0.61 (0.24, 1.54)	0.29	0.60 (0.23, 1.54)	0.28
Low risk	0.32 (0.13, 0.79)	0.01	0.35 (0.14, 0.90)	0.03
No risk	0.47 (0.15, 1.48)	0.20	0.46 (0.15, 1.49)	0.20
<i>P</i> _{trend}		0.07		0.16
Syphilis seropositivity				
High risk	Ref.		Ref.	
Medium risk	0.85 (0.44, 1.67)	0.64	0.77 (0.39, 1.53)	0.46
Low risk	0.58 (0.31, 1.12)	0.10	0.53 (0.27, 1.02)	0.06
No risk	0.95 (0.45, 2.01)	0.90	0.78 (0.36, 1.68)	0.53
<i>P</i> _{trend}		0.11		0.12

Note: OR: odds ratio; CI: confidence interval.

* Adjusted for age, ethnic, years of education, and full-time employment.

1.03–8.19; $P = 0.04$), have a history of sexually transmitted diseases (OR, 2.27; 95% CI, 1.25–4.10; $P = 0.01$), and have more than 3 months since last HIV testing (OR, 0.47; 95% CI, 0.26–0.84; $P = 0.01$). Those with low risk perception tended to be a full-time employee (OR, 1.58; 95% CI, 1.15–2.18; $P = 0.01$) and have a history of using illicit drugs (OR, 0.28; 95% CI, 0.10–0.75; $P = 0.01$). Those with no perceived HIV risk were more likely to have female sexual partners (OR, 1.93; 95% CI, 1.22–3.05; $P = 0.01$).

Table 4 presents the association between HIV risk perception and HIV and syphilis infections. A U-shape association between HIV seropositivity and self-perceived HIV risk was found, and a lower prevalence of HIV infection was observed among those perceiving themselves at low risk than that among those reporting high HIV risk (3.7% versus 10.8%; OR, 0.35; 95% CI, 0.14–0.90; $P = 0.03$) after adjusting for age, ethnicity, years of education, and full-time employment. There is a marginally statistically significant association between syphilis seropositivity and self-perceived risk of HIV infection (low risk versus high risk: 13.8% versus 21.5%; OR, 0.53; 95% CI, 0.27–1.02; $P = 0.06$).

4. Discussions

Our study found that a very small proportion of MSM in Beijing had high risk perception and about two-thirds perceived themselves at low or no risk. Several previous studies in the USA [18, 21–23] and Netherlands [17] also reported that over half of MSM perceived that they had low or no chance of contracting HIV. However, HIV has been endemic among MSM in Beijing [10, 11, 24]. Our study showed that men with high risk perception did have a higher HIV prevalence (10.8%) than those reporting medium or low risk (6.8% and 3.7%, resp.). A marginally significant U-shape trend also was observed for syphilis seropositivity. Such associations between HIV/syphilis infection and self-perceived risk of HIV infection reminded us that it is urgent to improve health education/interventions and increase their high risk of HIV infection among this population.

Behavioral change theories suggest that self-perception plays an important role in health behavior [25]. Among respondents in our survey, 3.4% had never been tested for HIV and over two-thirds had a test within the past 6 months.

There are various reasons for not taking a test among Chinese MSM, such as stigma and fear about learning their HIV status [26–28]. However, the prevalence of HIV testing was high in our study, and the coverage of HIV testing among MSM in Beijing has been expanded in the past two years [29]. Noninfected MSM tend not to take a test because they have low risk perception [23, 26, 28]. Hence, it is suggested that MSM or other high risk populations take HIV testing regularly, especially for those frequently engaging in high risk behaviors [30]. Those perceiving themselves as having a high risk of contracting HIV were more likely to seek HIV testing in the past 3 months, compared to those with perceived medium-, low-, or no risk. Providing routine HIV testing in medical care settings may increase HIV risk perception among MSM [22].

Studies have shown that those engaging in risk behaviors were likely to consider themselves at high risk [26]. In our study, it is interesting to find that a higher proportion of those perceiving themselves at high risk of HIV infection reported engaging in high risk behaviors, for example, 36.9% of those reporting unprotected anal sex and 12.3% of those reporting multiple concurrent male sexual partners. However, a moderate number of MSM still believed their chance of contracting HIV was low despite their involvement in risky sex in current and previous studies [18, 21, 22]. Though HIV testing has increased among MSM in Beijing, unprotected anal sex is still common [7, 29]. It is needed to increase risk perception among Chinese MSM.

Several previous studies found that MSM may be even less likely to be tested for STDs than HIV [31–33]. We did not test for STDs besides syphilis, but 33% of our study participants reported a history of STDs. Participants with high risk perception had an odds of >2 times of reporting a history of STDs than those in other risk perception groups. Hence, the promotion of STD testing can also be used as a complementary strategy to enhance risk perception among MSM.

Sex with both men and women is common among Chinese MSM. Nearly 60% of participants with no perceived risk of HIV infection reported ever had sex with female sexual partners, higher than those having a medium level of risk perception (40%). The potential for transmitting HIV from bisexual men to either men or women results largely from less condom use and sex with other MSM and women [34, 35]. Risk perception education should emphasize safe sex with both male and female sex partners.

Over half of our study sample received college education and were employed full time. Overall, there was no statistically significant relationship between education or employment with self-perceived risk, but a number of participants with high education and full-time employment thought that they were unlikely to acquire HIV. The risk awareness education program should consider that (1) MSM with lower educational attainment needs the basic information about the growing HIV/AIDS epidemic among MSM in China and the mechanisms of HIV transmission; (2) those with a higher level of education need more in-depth information about the importance of knowing HIV status through HIV testing and information to dispel incorrect information about HIV

risk, for example, (1) AIDS is an irrelevant disease; (2) some partners are less risky than others; and (3) cleaning after sex is one way to prevent from HIV transmission [19].

There are some limitations in our study. First, all questionnaire data were based on self-reporting; study participants may have provided responses based more on social desirability to please the interviewers than actual experiences, especially experiences involving sensitive questions. Therefore, it is unknown whether participants under-reported or over-reported their involvement in risky behaviors. Second, the potential factors for HIV risk perception may not be accurately measured using a single question. Third, the MSM who participated in this study are volunteers recruited using nonrandomized sampling. The study sample may not represent the entire MSM community in Beijing or in China. Finally, the potential reasons of low HIV risk perception were not investigated; qualitative assessment may explore these reasons.

5. Conclusions

In summary, this study found that few MSM have high self-perceived HIV risk, even with HIV at an epidemic level among MSM in Beijing, China. HIV prevention programs should emphasize increasing HIV risk awareness among Chinese MSM, particularly those who are unemployed and uneducated.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Research Article

Nitrite Inhalants Use and HIV Infection among Men Who Have Sex with Men in China

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Objective. This is the first study in China to examine the use of nitrite inhalants and its correlates among men who have sex with men (MSM) in Beijing, China. **Methods.** A cross-sectional survey was conducted in 2012. Structured interviews collected data on demographics, sexual and drug use behaviors, and the use of HIV services. Blood specimens were collected and tested for HIV and syphilis. **Results.** A total of 400 MSM eligible for the study were between 19 and 63 years of age and overall HIV prevalence was 6.0% (9.0% among nitrite inhalant users and 3.3% among nonusers). Nearly half (47.3%) of them reported ever using nitrite inhalants and 42.3% admitted using nitrite inhalants in the past year. Multivariable logistic analysis revealed that ever using nitrite inhalants in the past was independently associated with being aged ≤ 25 years, having higher education attainment, seeking sex via Internet, having casual partners in the past three months, and being HIV positive. **Conclusion.** The use of nitrite inhalants was alarmingly prevalent among MSM in Beijing. The independent association of the nitrite inhalant use with more casual sex partners and HIV infection underscored the need for intervention and prevention of nitrite inhalant use.

1. Introduction

Since 2007 sexual transmission has surpassed IDU and become the dominant mode of HIV transmission in China. The proportion of cumulative reported cases through homosexual transmission route has increased more than five times, from 2.5% to 13.7%, between 2006 and 2011 [1]. The national sentinel surveillance suggested that the HIV prevalence among men who have sex with men (MSM) increased from 0.9% in 2003 to 6.3% in 2011 [2]. It is estimated that homosexual transmission actually accounted for 29.4% of all newly infected HIV cases in 2011 [3]. Despite the implementation of numerous HIV prevention strategies targeting the promotion

of safer sex [4, 5] and expanding needle exchange programs and methadone maintenance therapy [6], the HIV epidemic continues to expand among MSM.

Recent study from USA and Britain indicated that synthetic drug has increasingly become an important risk factor fueling the HIV epidemic [7–10]. However, limited data is available about synthetic drug use among MSM in China. Synthetic drugs such as amphetamine-type stimulants (ATS) and ketamine have become popular in entertainment industries and are confirmed to increase risk of HIV seroconversion [11, 12]. Studies also show that amyl nitrites appear to have the strongest association with HIV seroconversion among synthetic drugs [7, 13].

Since the 1960s, amyl nitrites have been popularly used as an inhalant among homosexual and bisexual men in order to relax the anal sphincter and diastolic capillaries [14, 15] and achieve enhanced sexual intercourse and euphoria [16–18]. Unfortunately, amyl nitrites also appear to pose multiple health risks that disproportionately impact MSM. Amyl nitrites use has been independently associated with unprotected anal intercourse [10] incident sexually transmitted infections, unprotected intercourse with serodiscordant partners, and HIV seroconversion among MSM [9, 19]. Commonly known as “poppers,” “rush,” or “rush poppers,” nitrite inhalants in China include isopropyl phenylenes nitrate (2-propyl nitrate) and isobutyl nitrite (2-methylimino-nitrate) [20] and have become increasingly popular in MSM community. Epidemiological research of nitrite inhalants and HIV risk is well documented in Western countries [19–25]; however, there is limited information from China. This is the first study in China to investigate the prevalence and correlates of the use of nitrite inhalants among MSM.

2. Materials and Methods

2.1. Study Settings. A cross-sectional study of nitrite inhalants use among HIV positive and HIV negative MSM was conducted using the baseline data from an ongoing prospective cohort study in Beijing. The participants of the cohort study were contacted every 6 months, received an HIV test, and completed a survey on sexual behaviors. The baseline study was conducted from July to October 2012 by researchers from Beijing Jingcheng Venereal Hospital. The outreach workers recruited MSM participants from the community using a mixed method including website advertisements, community outreach to MSM-frequented venues (e.g., MSM clubs, bars, and bathhouses), and peer referrals as well as recruiting clients of sexually transmitted disease (STD) clinics and voluntary counseling and testing (VCT) clinics. Inclusion criteria were biological male who (1) was at least 18 years old, (2) self-reported ever having sex with men during the past three months, (3) was willing to provide blood samples to test for HIV, (4) completed the questionnaire interview, and (5) was physically able and willing to provide written informed consent. Written informed consent was obtained prior to the interview, physical examination, and collection of blood samples.

2.2. Data Collection. Data were collected by self-administrated structured questionnaire based surveys with computer-assisted self-interviewing (CASI) technology. The information collected included sociodemographic characteristics (e.g., age, ethnicity, education, marital status, occupation, Beijing residency, income, and health insurance status), sexual behavior (e.g., self-reported sexual orientation, age of sexual debut, venue for seeking a male sex partner, lifetime number of regular and casual sexual partners, sexual behavior in the past 3 months, and condom use in receptive and insertive anal intercourse in the past 3 months), nitrite inhalant use (e.g., sources of nitrite inhalants, number of

sexual partners while using nitrite inhalants, perceived effect of nitrite inhalants on number of sex partners, perceived effect of nitrate inhalants on sexual pleasure, duration of sexual activity, condom use, sexual role played when having anal sex and using nitrite inhalants, and frequency of nitrite inhalants use), history of ever having STD and HIV and syphilis infection status at present. The study protocol and informed consent procedures were reviewed and approved by the Ethics Review Committee of the Chaoyang Center for Disease Control and Prevention. Participants provided their written informed consent to participate in this study during the enrollment.

2.3. Specimen Collection and Laboratory Tests. The specimen collection and physical examination were performed by trained and experienced physicians at the Institute of STD/AIDS Prevention and Treatment, Beijing Jingcheng Venereal Hospital, Beijing, China. Each participant was assigned a unique code to link the anonymous questionnaire and blood specimen. HIV infection status was screened by an enzyme immunoassay (Wantai Biological Medicine Company, Beijing, China), and positive specimen were confirmed by HIV 1/2 Western blot assay (HIV Blot 2.2 WB; Genelabs Diagnostics, Singapore). Syphilis antibody was tested with the *Treponema pallidum* particle assay (TPPA, InTec Products, Inc., Xiamen, China).

2.4. Statistical Analysis. Questionnaire data collected by CASI were exported into a Microsoft Office Excel format and then merged with laboratory test results that had been independently entered and verified by two study staff members. Completed databases were then analyzed with Statistical Analysis System (SAS 9.3 for Windows; SAS Institute Inc., NC, USA) software. Descriptive analyses were performed to compare sociodemographic characteristics, sexual behaviors, and HIV infection status between nitrite inhalants users and nonusers. Pearson's chi-squared test was used to compare differences between nitrite inhalants users and nonusers for categorical variables, while *t* tests were used for the continuous variable of age. Logistic regression models were constructed to evaluate the associations between each variable with lifetime history of nitrite inhalants use and nitrite inhalants use in the past 3 months. Multivariable logistic regression was employed to identify significant predictors for lifetime history of nitrite inhalants use, nitrite inhalants use in the last 3 months, and nitrite inhalants use with unprotected anal sex. All variables that had *P* values < 0.1 in univariate analyses were simultaneously entered into the multivariable logistic model to reduce the risk for missing potentially relevant variables as well as reduce the impact of confounding variables. Crude odds ratios and adjusted odds ratios were calculated along with 95% confidence intervals (CI). Statistical significance was defined by *P* < 0.05.

3. Results

3.1. Demographics of Participants. A total of 611 MSM were approached to participate in this study. Of them, 74 participants declined to participate during the informed consent

process and 137 participants did not satisfy the inclusion criteria. The final sample size was 400 participants enrolled in the study from July to October 2012. The average age was 30 years (SD = 7.1, a range from 19 to 63), two-thirds (68.2%) did not have official Beijing resident permits termed "Hukou," 93.5% identified themselves as ethnically Han, 64.5% received college or higher level of education, 73.7% were unmarried, and 64.2% had monthly incomes above 3000 Yuan (equivalent to US\$ himself 484, and comparable to the average income level in Beijing). Regarding sexual orientation, the proportion of participants identifying itself as homosexual and bisexual was 71.5% and 24.5%, respectively.

3.2. Sexual Behaviors. Of the participants, 72.0% reported ever seeking sex partners via the Internet (Table 1), 22.5% reported ever having unprotected anal sex in the last month, 26.8% reported ever having unprotected anal sex in the past 3 months, 65.3% reported having a casual sex partner in the past 3 months, 54.5% reported having multiple sex partners in past 3 months, and 45% reported that they intended to have protected anal sex with casual sex partners in the future 3 months and 44% with regular sex partners.

3.3. The Use of Nitrite Inhalants. Of the participants, 47.3% reported ever using nitrite inhalants and 41.8% used nitrite inhalants at least once in the past year. Most participants had only begun using nitrite inhalants recently; the median time between initial use of nitrite inhalants and participation in the survey was one year. Participants on average snorted nitrite inhalants about twice (2.1) during their first experience of nitrite inhalants riding sex. The median reported that duration of efficacy for nitrite inhalants per use was 2 minutes (average duration: 3.8 minutes). Of 400 participants, 40.5% reported having sex with only one person after nitrite inhalants use and 4.5% reported having ≥ 2 sexual partners. Overall, 37.8% reported no change in the number of sex partners since starting to use nitrite inhalants, 36.0% reported that nitrite inhalants increased sexual pleasure, and 76.1% reported that their weekly frequency of having sex did not change after starting to use nitrite inhalants (Table 1). Participants who used nitrite inhalants were younger (59.8% versus 44.0%, $P = 0.009$), had higher educational attainment, were more likely to be single, and sought sexual partners via the Internet.

3.4. HIV Infection, Syphilis, and Nitrite Inhalants. HIV prevalence was six percent overall (24/400) and was significantly higher among those who ever used nitrite inhalants (9.0%, 17/189) compared with those who had never used nitrite inhalants (3.3%, 7/211) ($P = 0.017$). Syphilis prevalence was 22.8% overall (91/400) and was not significantly correlated with nitrite inhalants usage, lifetime or recent.

3.5. Correlates for Ever Using Nitrite Inhalants in the Lifetime or in the Past 3 Months. Multivariable logistic analysis showed that ever using nitrite inhalants in the lifetime was associated with younger age (<25 years), higher level of educational attainment, seeking partners via the Internet,

and HIV infection (Table 2). Nitrite inhalants use in the last 3 months was associated with higher level of educational attainment, seeking partners via the Internet, and having multiple partners (Table 2).

4. Discussion

To the best of our knowledge, this is the first study in China to investigate HIV infection and the use of nitrite inhalants among MSM. This study revealed that the use of nitrite inhalants became alarmingly prevalent among MSM in Beijing and that the use of nitrite inhalants is associated with HIV infection. Half of the participants (47.3%) ever used nitrite inhalants in the past and 42.3% used nitrite inhalants in the past year. The prevalence of the use of nitrite inhalants in the past year found in this study is higher than that reported from studies (13%–35%) in both Western countries and other Asian countries [20, 22, 26–32]. Only 5% reported starting to use nitrite inhalants more than one year ago. Moreover, because the median time interval since initial use of nitrite inhalants to participation in the survey was only one year; it appears that the use of nitrite inhalants is a relatively new phenomenon among Beijing MSM. Average age of initial nitrite inhalant users was about 29 years old, which is similar to the age found in a study in the U.S [33].

Our study showed that MSM who use nitrite inhalants were more likely to be younger and with higher education. This finding is consistent with Reisner et al. [8], Buchbinder et al. [27], Chen et al. [34], and Benotsch et al. [35]. The younger and better educated MSM may have a community that has higher technical capability and is familiar with Internet market for substances. On the other hand they were also reporting more casual sex partners [17, 18] which can also be the consequences of cyber connections. Studies on how MSM use online social network to access drug and sex is urgently needed to improve our understanding of the role of online social net in nitrite use and HIV risk behaviors.

On the other hand, this study did not show any significant differences in condom use between participants who did and did not use nitrite inhalants, regardless of whether or not having anal sex was with regular or casual partners. This result is different from other studies [20, 26] due to differences in sampling and survey methodology. Brewer sampled participants by random-digit telephone dialing, while the present study did not use probability sampling but social network based mixed methods. Also, Choi conducted face-to-face based questionnaire interviews, while we conducted interviews with CASI. Anecdotal evidence from this study suggests that CASI seems to have less social desirability bias than face-to-face based interviews. Therefore we believe our study is more reliable for reporting of sensitive behaviors like condom use. Another possible explanation is that the nitrite user in our study has higher education and income level and hence more knowledge about HIV and better access to condoms. A future qualitative in-depth interview study with some of the MSM may help explain the finding.

Our study may start a hypothesis that, in certain social network of MSM, the emerging synthetic drugs such as nitrite

TABLE 1: Demographic and nitrite inhalants use characteristics of men who have sex with men (MSM) in Beijing, 2012 (N = 400).

Characteristics	N	%
Age		
Mean (SD)	30.0 (7.1)	
Median (Q1, Q3)	29 (25, 33)	
Range	19–63	
Age		
<25 years	82	20.5
≥ 25 years	318	79.5
Ethnicity		
Han	374	93.5
Other	26	6.5
Married		
Yes (married, cohabiting, or divorced)	105	26.3
No	295	73.7
Years of schooling		
≤12	142	35.5
>12 (college and above)	258	64.5
Residency permit		
Beijing	127	31.8
Other	273	68.2
Monthly income		
≤3000 (CNY, 485USD)*	143	35.8
>3000	257	64.2
Sexual orientation		
Homosexual	286	71.5
¹ Other	114	28.5
Ever used nitrite inhalants		
Yes	189	47.3
No	211	52.8
Venue for seeking a male sex partner		
Internet	288	72
Other (park, bathroom)	112	28
Nitrite inhalants use in P12M		
Yes	167	41.8
No	17	4.3
Frequency of sex when using nitrite inhalants		
Never	3	0.8
Rarely	56	14
Sometimes	15	3.8
Every time	115	28.8
Having unprotected anal sex in last month		
Yes	90	22.5
No	135	33.8
Having unprotected anal sex in P3M		
Yes	107	26.8
No	133	33.3
Having casual sex partner in P3M		
Yes	261	65.3
No	139	34.7

TABLE 1: Continued.

Characteristics	N	%
Sources of nitrite inhalants		
Internet	49	12.3
Friends	114	28.5
Other sources	26	6.5
Number of sexual partners while using nitrite inhalants		
<2	162	40.5
≥2	18	4.5
Number of change of sexual partners since starting to use nitrite inhalants		
Increased	14	3.5
Decreased	7	1.8
No change	151	37.8
Not sure	17	4.3
Sexual role played when having anal sex and using nitrite inhalants		
Exclusive/mainly insertive	89	22.3
Exclusive/mainly receptive	74	18.5
Both, about the same	26	6.5
Nitrite inhalant use increases sexual pleasure		
Yes	144	36.0
No	45	11.3
Duration of sexual activity when using nitrite inhalants		
Longer	53	13.3
Shorter	14	3.5
Same	99	24.8
Frequency of condom use since starting use of nitrite inhalants		
Never use	14	3.5
Sometimes use, more frequently than before	10	2.5
Sometimes use, less frequently than before	16	4.0
Almost the same	48	12.0
Consistent condom use	101	25.3
Having multiple sex partners		
Yes	218	54.5
No	145	36.3
Number of casual partners in P3M		
1	88	22.0
2–5	87	21.8
>5	14	3.5
Having intentional protected anal sex with casual sex partners in F3M		
Yes	180	45.0
No	220	55.0
Having intentional protected anal sex with regular sex partners in F3M		
Yes	176	44.0
No	224	56.0
HIV serostatus		
Positive	24	6.0
Negative	376	94.0
Syphilis serostatus		
Positive	91	22.8
Negative	309	77.2

Note: * exchange rate 6.15–6.2:1 (CNY to USD); ¹other = heterosexual, or bisexual, or unknown; P12M: the past 12 months; P3M: the past 3 months. Numbers might not add to totals due to missing data; F3M: the future 3 months.

TABLE 2: Predictors for nitrite inhalants use among MSM in Beijing (N = 400).

Factors	N (%)	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Model 1			
Lifetime nitrite inhalants use			
Age			
≥25	140 (44.0)	0.53 (0.32, 0.87)*	0.47 (0.27, 0.83)†
<25	49 (59.8)		
Ever married			
No	152 (51.5)	1.95 (1.23, 3.10)†	
Yes (others)	37 (35.2)	1.00	
Years of schooling			
>12	140 (54.3)	2.25 (1.47, 3.44)†	2.02 (1.24, 3.29)†
≤12	49 (34.5)	1.00	1.00
Sexual orientation			
Homosexual	147 (51.4)	1.81 (1.16, 2.83)†	
Others	42 (36.8)	1.00	
Venue for seeking sex partners			
Internet	158 (54.9)	3.18 (1.98, 5.10)†	2.49 (1.45, 4.28)†
Others (park, bathroom)	31 (27.7)	1.00	1.00
Number of male sex partners in P3M			
>1	119 (54.6)	1.92 (1.29, 2.87)†	
≤1	61 (42.1)	1.00	
Protected anal sex in P3M			
Yes	80 (44.9)	0.69 (0.46, 1.05)	
No	100 (54.1)	1.00	
Having a casual partner in P3M			
Yes	135 (51.7)	1.69 (1.11, 2.56)*	2.04 (1.26, 3.30)†
No	54 (38.9)	1.00	1.00
HIV serostatus			
Positive	17 (70.8)	2.88 (1.17, 7.11)*	3.16 (1.16, 8.67)*
Negative	172 (45.7)	1.00	1.00
Model 2			
Recent nitrite inhalants use in the P3M			
Age			
≥25	62 (19.5)	0.7 (0.4, 1.2)	
<25	21 (25.6)	1.00	
Years of schooling			
>12	65 (25.2)	2.3 (1.3, 4.1)†	
≤12	18 (12.7)	1.00	
Sexual orientation			
Homosexual	64 (22.6)	1.4 (0.8, 2.5)	
Other	19 (16.7)	1.00	
Venue for seeking sexual partners			
Internet	73 (25.4)	3.5 (1.7, 7.0)†	3.9 (1.7, 8.9)†
Others (park, bathroom)	10 (8.9)	1.00	1.00
Number of male sex partners in P3M			
>1	57 (26.2)	2.1 (1.3, 3.6)†	5.0 (1.7, 14.9)†
≤1	26 (14.3)	1.00	
Protected anal sex with casual partners in P3M			
Yes	25 (18.8)	0.5 (0.3, 0.9)*	0.5 (0.2, 0.9)*
No	35 (32.7)	1.00	1.00
HIV serostatus			
Positive	5 (20.8)	1.0 (0.4, 2.8)	
Negative	78 (20.7)	1.00	

TABLE 2: Continued.

Factors	N (%)	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Syphilis serostatus			
Positive	16 (17.6)	0.8 (0.4, 1.4)	
Negative	67 (21.7)	1.00	

Note: P3M: the past 3 months; P12M: the past 12 months; * $P < 0.05$; † $P < 0.01$.

inhalants may not have any impact on condom use. The importance of noninjection drug use as a risk factor for HIV infection among MSM in Asia seems to be on the rise [27]. In China, methamphetamine and other drug uses among MSM have been reported with relatively low prevalence among MSM; however, nitrite inhalants use as an emerging sex stimulant became prevalent very recently. The popularity of nitrite over other drugs may be due to the fact that methamphetamines are illegal in China; whereas, nitrite inhalants are new and remain legal. There is a common perception that nitrite inhalants have no effect on risk behaviors, which facilitated their high prevalence among MSM. Certainly the fact that nitrite is legal and methamphetamine is illegal can generate reporting bias.

The present study also showed that odds of HIV infection among MSM who used nitrite inhalants were 3.1 times higher than nonusers, a finding that is consistent with other longitudinal and cross-sectional studies [7, 27, 36–39]. However, it is interesting that there was no correlation found between nitrite use and syphilis. One reason may be that new infection and long-term infection of syphilis were not differentiated, as the prevalence of syphilis included past infections that had already been treated as well as active infections. In addition, we asked about drug use by injection and none of the participants reported ever being injected with drug.

5. Findings to Informing Intervention

Additional analysis was conducted on intention to have protected anal sex in the future 3 months with regular partners and casual partners (data are not shown). Participants with younger age and higher education attainments and seeking sex partners via the Internet were more likely to be ready to consistently use condoms in the future 3 months. This could be useful information for policy makers and health professionals considering future intervention plans. Today, younger MSM are more likely engaging in modern social networks such as dynamic virtual lives via emerging media. Thus, Internet based social networks such as [40] “Weibo” (a microblog similar to “twitter” in China), QQ, “wechat,” texting message, and “Apps” via mobile phone/The Internet could be effective channels to deliver interventions on sexual stimulants and promote safer sex. Web-based social networks help overcome social isolation from migrant status and migrant young men were more likely to use them to locate new sexual partners. As two-thirds of our participants did not have Beijing residency permits, it is imperative to pay attention to migrant young men, despite the lack of significant correlation with nitrite inhalant use.

Among recent nitrite inhalant users, safer sex was associated with having multiple casual sex partners, younger age, and seeking partners via Internet. Participants with more partners may have perceived a higher chance of encountering HIV infected individuals, as a recent Hong Kong study showed [41]. According to Theory of Planned Behavior (TPB) [42], behavioral intention strongly predicts actual behavior in the future [43] or it may affect the behavior directly [44]. Educational information about the risks of HIV transmission from multiple unprotected sex partners and nitrite inhalants use should be disseminated via the Internet [41].

There were several limitations to this study. First, the cross-sectional design of this study precluded our ability to determine causal relationships. Results only indicate association between HIV infection and the use of nitrite inhalants, but temporal precedence could not be determined. Second, due to the fact that MSM are a socially “hidden” population, participants were recruited by nonprobabilistic sampling. Hence results may not have been representative of MSM in Beijing. However, HIV prevalence in the participants in the present study (6.0%) was similar to the other studies (5.6–6.5%) in Beijing, which recruited participants via respondent driven sampling, as well as HIV prevalence among MSM nationwide (6.3%) [45]. Third, participant responses may have been conditioned by social desirability that may have led to underreporting or overreporting of risky behaviors. Fourth, participant responses may have been influenced by recall bias, particularly lifetime events that may have occurred several years ago. In addition, our study did not differentiate recent or past syphilis status, since TPPA testing can only determine if the individual was ever infected with *Treponema pallidum*. The prevalence of TPPA positivity is comparable to previous reports [46]. The comparable age of the participants in other surveys [47, 48] in Beijing is another reflection of the representativeness of our sample. In spite of these limitations, our findings have important implications for public health intervention. We believe that the surge in common use of nitrite inhalants could fuel the rapid spread of HIV transmission. This cross-sectional study will serve as an important data source about novel recreational drugs among MSM in China and will help guide policy makers in developing appropriate HIV prevention policies.

In summary, this study revealed that the use of nitrite inhalants is alarmingly prevalent among MSM in Beijing. This study showed that the use of nitrite inhalants was associated with HIV infection. The independent association of nitrite inhalant use with more casual sex partners and HIV infection underscored the need for intervention and prevention of nitrite inhalant use and unprotected sex among MSM in Beijing. Further research is needed to assess the

impact of MSM social network in terms of substance use and sexual risk behaviors as well as nitrite inhalant use on the expanding HIV epidemic among MSM in China. HIV prevention strategies should incorporate the component of harm reduction addressing the use of nitrite inhalants.

Ethical Approval

The protocol has been cleared by the institutional review board of Chaoyang Center for Disease Control and Prevention (the approval no. 1206).

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contribution

Dongliang Li was the principal investigator and developed the conceptual framework of this study. Xueying Yang performed data retrieval and statistical analyses to prepare and write the initial draft of the paper. Xueying Yang, Zheng Zhang, Xiao Qi, and Dong Xiao contributed to data collection and survey organization. Stephen W. Pan, Yujiang Jia, and Z. Jennifer Huang contributed to revising, writing, and editing of the final draft of the paper. Yifei Hu conceptualized the paper, proposed statistical analysis framework, drafted the paper, and contributed to revising and editing of the final draft of the paper. Yuhua Ruan and Fengji Luo assisted in construction of the conceptual framework of the work and guided the data collection. All authors have read and approved the final version of the paper. Dongliang Li and Xueying Yang equally contributed to this paper.

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Research Article

Alcohol Use, Stigmatizing/Discriminatory Attitudes, and HIV High-Risk Sexual Behaviors among Men Who Have Sex with Men in China

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Objective. This research was conducted to assess the correlates of alcohol consumption and HIV/AIDS-related stigmatizing and discriminatory attitudes among men who have sex with men (MSM) in Shandong province, China. **Methods.** A cross-sectional survey provided demographics, sexual behaviors, illicit drug use, alcohol consumptions, and service utilization. **Results.** Of 1,230 participants, 82.8% were single, 85.7% aged <35 years, 47.2% had college or higher education, and 11.7% drank alcohol >3 times per week in the past six months. The average total score of stigmatizing and discriminatory attitude was 37.4 ± 4.4 . More frequent episodes of alcohol use were independently associated with higher levels of HIV/AIDS-related stigma and discrimination, unprotected anal sex, bisexual identity, multiple male sex partners, drug use, and lower levels of education. Expressing higher levels of HIV/AIDS-related stigmatizing and discriminatory attitudes was independently associated with alcohol use, unprotected male anal sex, bisexuals, more male sex partners, commercial sex with men, and non-receipt of peer education in the past year. **Conclusion.** HIV/AIDS-related stigmatizing and discriminatory attitudes are common and associated with alcohol use and unprotected sex among MSM. The finding highlights the needs to develop programs that would reduce HIV/AIDS-related stigmatizing and discriminatory attitudes and strengthen alcohol use prevention and risk reduction initiatives among MSM.

1. Introduction

The rapid rise in HIV prevalence among men who have sex with men (MSM) in many cities across the nation has drawn attention to the dynamics of the HIV epidemic in China [1–3]. It is estimated that about 2.2% of Chinese adult males had sex with another male [4]. According to the 2011 estimates for the HIV/AIDS epidemic in China, 81.6% of 48,000 HIV new cases were infected through sexual contact, 29.4% of those infected from sexual contact were through homosexual contact [2]. Under the strong influence of Confucianism and collectivism, Chinese traditional culture emphasizes familial

responsibilities; MSM behaviors are highly stigmatized and MSM face strong social pressure to hide their identity [5]. On the other hand, stigma surrounding HIV/AIDS has been shown to act as a barrier to HIV prevention, treatment, and care [6, 7]. People who hold stigmatizing attitudes are also less likely to adopt preventive behaviors and more likely to have multiple sexual partners, a commercial sex partner, and some other HIV-related high-risk behaviors [8, 9].

Alcohol consumption has increased considerably in China in the past three decades, accompanying a rapidly expanding economy, urbanization, and globalization [10]. The global literature suggests that alcohol consumption is

associated with a number of sexual risk behaviors and outcomes, including premarital intercourse, multiple sexual partners, and unprotected sex [11, 12]. As the most commonly used legal substance, drinking-related exposures to sexual risk behaviors and drinkers' increased biological susceptibility could lead to an increased risk of HIV and other sexually transmitted infections (STIs) [11]. Drink and HIV-related stigma/discrimination are common in the MSM community. Understanding the relationship between stigma, alcohol use, and sexual behavior among MSM has important intervention implications. The purpose of this study is to assess correlates for alcohol use and HIV/AIDS-related stigmatizing and discriminatory attitudes among MSM in Shandong province, China.

2. Methods

2.1. Study Participants. A cross-sectional study was conducted among MSM to collect demographic, sexual behaviors, illicit drug use, alcohol consumptions, and health service utilization by local Center for Disease Control and Prevention (CDC) in three cities, Jinan, Qingdao, and Yantai, in Shandong province, China, from April to June in 2011. Prior to the recruitment of the participants, we conducted informative research including in-depth interviews with key informants to gather the background information among MSM, the venues to access them, and selection of the candidates of the first group for interview. Participants were recruited from gay-oriented venues such as bars, night clubs, tea houses, bathhouses, saunas, public parks and bathrooms, outdoor cruising areas, and HIV testing sites. After these initial participants were approached and interviewed by trained public health staff, we asked the participants to refer their peers to attend the study. A mixed recruitment method, including community outreach, venue-based recruitment, and internet advertisement, was also applied in the study. All potential participants were invited for eligibility assessments. The enrollment criteria included male, 18 years of age or older, self-reported ever having sex with another male in the past 12 months, and willing to complete the study. Survey information was collected anonymously and handled in a confidential manner. Verbal informed consent was obtained from all participants before the interview. Voluntary participation, anonymity, and confidentiality were ensured for all participants. The study was approved by the Institutional Review Board of Shandong Center for Disease Control and Prevention.

2.2. Measures. Structured questionnaire-based interviews provided demographics (age, marital status, ethnicity, residency status and education, sexual, drug use, and alcohol drinking behaviors, access and utilization of HIV-related prevention services, and stigma and discriminatory attitudes towards People Living With HIV/AIDS (PLWHA)). The term "bisexual" was used for participants who were married or cohabiting with women or reported ever having sex with a woman in the past 6 months. Attitudes towards PLWHA

were measured by asking participants about their agreement/disagreement (1 = "yes," 2 = "no") with 22 statements [13]. The scale was adapted from two pilot investigations tested in Thailand and Zimbabwe and measured 3 dimensions of HIV/AIDS-related stigma and discrimination: shame, blame, and social isolation; perceived discrimination; and equity. The reliability (alpha) of the stigma measure was 0.83. The scale included questions such as "People living with HIV/AIDS should be ashamed"; "People living with HIV/AIDS face neglect from their family"; "People living with HIV/AIDS do not deserve any support." Items were summed to create total scale scores, with a range of 22–44 where a higher score means lower stigma and lower score indicates a higher stigma. Frequency of alcohol use was determined directly from responses to a single questionnaire item in which respondents were asked how often they drank in the past six months. Responses included "about every day," "5-6 days a week," "3-4 days a week," "1-2 days a week," "2-3 days a month," "less often than monthly," and "never." In the final analysis, the categories "About every day," "5-6 days a week," and "3-4 days a week" were collapsed into a single variable "more than 3 days per week," because of the low frequencies of individual responses when the original categories were considered separately. Serum samples were screened for HIV-1 antibodies by enzyme-linked immunosorbent assay (ELISA; Vironostika HIV Uni-Form plus O, bioMerieux, Holland) and confirmed by Western Blot test (HIV Blot 2.2 WB, Genelabs Diagnostics). Syphilis screening was performed by rapid plasma regain (RPR; Shanghai Rongsheng, China) and confirmed by Treponema pallidum particle assay test (TPPA; Fujirebioinc, Japan). Pre- and posttesting counseling were provided by local CDC.

2.3. Statistical Analysis. Survey data and blood testing results were recorded and assessed for congruency using EpiData software (EpiData 6.4 for Windows, the EpiData Association Odense, Denmark). The Statistical Program for Social Sciences software (SPSS software, Version 15.0; SPSS Inc., Chicago, IL, US) was utilized for all analyses. Univariate analyses were conducted for demographic, sexual, drug use, and drinking variables and related prevention services. Multivariable logistic regression analyses were conducted using a stepwise backward sequence. Variables with $P < 0.05$ in multivariable analysis were determined as statistically significant. Multiple linear regression analysis was applied to determine which predictors were independently associated with total stigma scale scores after controlling for potential confounders.

3. Results

3.1. Characteristics of Participants. Of 1,230 eligible participants, 82.8% were single, 85.7% were between 18 and 35 years of age, nearly half (47.2%) had college or higher levels of education, 28.6% were married or cohabiting with women or reported ever having sex with women in the past 6 months. More than two-thirds of respondents (68.7%) identified themselves as homosexual, a quarter (26.3%) identified

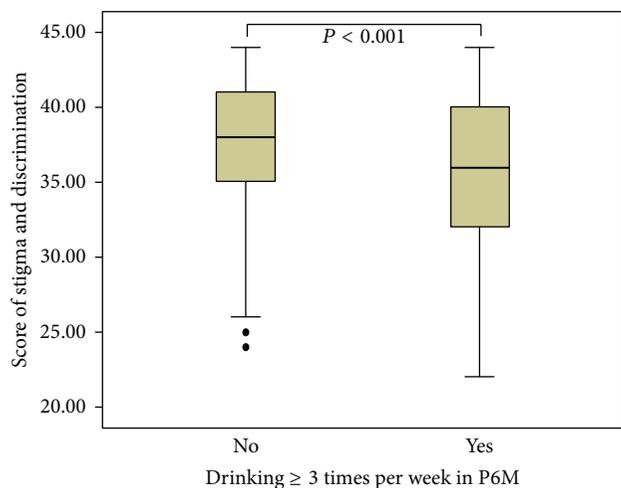


FIGURE 1: Comparisons of HIV/AIDS-related stigmatizing and discriminatory attitudes with the alcohol consumption for the participants who reported drinking ≥ 3 times per week in the past 6 months (P6M) in Shandong province, China.

themselves as bisexual, and 1.4% identified themselves as heterosexual; 19.4% were non-Shandong province residents, and 2.0% belonged to a non-Han minority ethnic group (Table 1).

3.2. Sexual Behaviors and Prevalence Rates of HIV and Syphilis. Approximately 91.4% of participants reported having had sex with men in the past six months, 54.3% had more than two male sex partners in the past week, 70.8% used a condom at last anal sex, and 31.3% consistently used condoms in the past 6 months with male partners. In addition, 27.2% of respondents admitted having had commercial sex with men, with only 29.8% reporting consistent condoms use in the past 6 months. Further, 21.5% of participants reported ever selling sex to another man, with only 31.1% of them reporting consistent condom use in the past 6 months. About one-quarter of respondents (23.4%) had sex with a female in the past 6 months, with one-third (32.5%) reporting consistent condom use over the same time period. Only 1.1% of participants reported ever using illicit drugs. Approximately half (50.7%) of participants received HIV testing in the past year, and three-quarters (75.2%) and 41.3% received condom promotion/HIV testing and counseling and peer education, respectively. Of all participants, 1.6% were HIV-infected and 6.8% were syphilis-infected (Table 2).

3.3. Correlates for Drinking Behaviors. Of the participants, 11.7% reported drinking alcohol ≥ 3 times per week in the past 6 months. Multivariable logistic regression analysis that indicated drinking behaviors was associated with higher levels of HIV/AIDS-related stigma and discrimination (AOR = 0.92, 95% CI: 0.87–0.96), unprotected male anal sex in the past 6 months (AOR = 1.9, 95% CI: 1.1–3.3), bisexual identity (AOR = 2.2, 95% CI: 1.3–3.9), more male sex partners in the past week (AOR = 1.5, 95% CI: 1.0–2.4; ≥ 2), drug use (AOR = 6.7,

95% CI: 2.0–22.3), and high school or lower education level (AOR = 1.6, 95% CI: 1.0–2.6) (Table 3).

3.4. Correlates for Stigma and Discrimination. The total score for stigmatizing and discriminatory attitudes among participants was 37.4 ± 4.4 , ranging from 22 to 44. The multivariate linear regression model indicated that MSM who drank alcohol ≥ 3 times per week in the past 6 months ($A\beta = 1.5$, 95% CI: 0.8–2.3), had unprotected male anal sex in the past 6 months ($A\beta = 1.7$, 95% CI: 1.1–2.2), have bisexual identity ($A\beta = 0.9$, 95% CI: 0.4–1.4), had more male sex partners in past week ($A\beta = 1.9$, 95% CI: 1.3–2.4; ≥ 2), had commercial sex with man in the past 6 months ($A\beta = 0.8$, 95% CI: 0.2–1.4), and are non-receipt of peer education in the past year ($A\beta = 1.7$, 95% CI: 1.2–2.2) were more likely to have lower HIV/AIDS-related stigma/discrimination score and thus exhibit more negative attitudes (Table 3, Figure 1).

4. Discussion

To the best of our knowledge, this is the first study from China that assesses HIV/AIDS-related stigmatizing and discriminatory attitudes and its relationship with alcohol consumption among MSM. This study revealed that HIV/AIDS-related stigmatizing and discriminatory attitudes were common among MSM and associated with drinking behavior, unprotected anal sex, and commercial sex among MSM in Shandong province, China. Confronting a rapid rise of HIV incidence among MSM in China, common negative attitudes towards PLWHA, excessive alcohol use behaviors, and bisexual and unprotected sex among this group have become emerging challenges in containing the epidemic. Stigma is particularly relevant to prevention and treatment in the HIV/AIDS pandemic [14]. The negative attitudes towards persons living with HIV/AIDS (PLWHA) are often associated with self-imposed isolation that results from individuals' reluctance to access services due to fear that family and community members may shun them for their drinking and drug use behaviors [15, 16]. On the other hand, Chinese cultural norms encourage social drinking. Alcohol is commonly consumed in social settings, particularly by men, as a normal part of their social life, to identify with new friends, maintain good relations, and celebrate events among friends. Other researchers have shown a consistent association between alcohol use and several sexual risk behaviors and HIV/STIs across both high-risk groups and general populations in China [17, 18]. Hence, in confronting the rapid expansion of the HIV/AIDS epidemic among MSM in China, the findings of the present study underline the urgent need to reduce the stigmatizing and discriminatory attitudes towards PLWHA and call for the need for alcohol use prevention and risk reduction among MSM communities.

This study shows that self-identification as bisexual is independently associated with drinking behaviors and with more negative attitudes towards PLWHA. Shandong is the second most populous province in China and the home of Confucius. Under the strong influence of Confucianism and collectivism, MSM behaviors are stigmatized and MSM face

TABLE 1: Demographics and biological outcomes among men who have sex with men in Shandong province, China.

Variables	Total		Drinking (≥ 3 times/week)		Stigma and discrimination
	N	%	N	%	\pm SD
Total	1230		144	11.7	37.4 \pm 4.4
<i>Demographics</i>					
Study sites					
Jinan	400	32.5	48	12.0	39.0 \pm 3.8
Qingdao	400	32.5	55	13.7	33.8 \pm 3.8 [‡]
Yantai	430	35.0	41	9.5	39.4 \pm 2.9
Recruited venue					
Bars, night clubs, or tea houses	329	26.7	49	14.9	36.7 \pm 4.2
Bathhouses or sauna	161	13.1	24	14.9	33.8 \pm 3.8 [‡]
Outdoor cruising area	98	8.0	11	11.2	34.1 \pm 3.9 [‡]
Internet or HIV testing sites	642	52.2	60	9.3	39.2 \pm 3.6
Age (years)					
<25	548	44.6	53	9.7	37.8 \pm 4.2
25–34	505	41.1	50	9.9	37.4 \pm 4.4
≥ 35	177	14.3	41	23.2 [‡]	36.1 \pm 4.6 [‡]
Marital status					
Single/separated	1018	82.8	97	9.5	37.7 \pm 4.2
Married or cohabitating	212	17.2	47	22.2 [‡]	35.9 \pm 4.6 [‡]
Residency					
Shandong province	991	80.6	107	10.8	37.4 \pm 4.4
Non-Shandong province	239	19.4	37	15.5	37.6 \pm 4.2
Ethnicity group					
Han	1206	98.0	140	11.6	37.4 \pm 4.4
Others	24	2.0	4	16.7	38.8 \pm 3.5
Occupation					
Student	187	15.2	6	3.2	38.3 \pm 4.3
Commercial service	539	43.8	80	14.8	37.7 \pm 4.2
Farmer	117	9.5	8	6.8	38.9 \pm 4.0
Full time employee	268	21.8	33	22.9 [‡]	37.0 \pm 4.3
Housework and/or unemployed	119	9.7	17	14.3	34.6 \pm 4.3 [‡]
Education					
High school or lower	649	52.8	94	14.5 [†]	36.9 \pm 4.5 [‡]
College or higher	581	47.2	50	8.6	38.0 \pm 4.1
Duration of residence in current location (years)					
≥ 2	815	66.3	97	11.9	37.4 \pm 4.4
<2	415	33.7	47	11.3	37.4 \pm 4.2
Self-identified sexual orientation					
Homosexual	845	68.7	73	8.6	37.6 \pm 4.2
Heterosexual	17	1.4	6	35.3 [‡]	34.6 \pm 4.7 [‡]
Bisexual	323	26.3	61	18.9	36.9 \pm 4.6
Do not know	45	3.7	4	8.9	39.2 \pm 3.1
Being married or cohabitating/ ever had sex with woman in past 6 months					
Homosexual	878	71.4	74	8.4	37.8 \pm 4.3
Bisexual	352	28.6	70	19.9 [‡]	36.6 \pm 4.5 [‡]
<i>Biological outcome</i>					
HIV status					

TABLE 1: Continued.

Variables	Total		Drinking (≥ 3 times/week)		Stigma and discrimination
	N	%	N	%	\pm SD
Negative	1208	98.4	142	11.8	37.4 \pm 4.3
Positive	20	1.6	2	10.0	38.3 \pm 4.4
Syphilis status					
Negative	1144	93.2	130	11.4	37.5 \pm 4.4
Positive	84	6.8	14	16.7	36.4 \pm 4.2*

Total N for each subgroup may not add up to the total due to missing data; P6M: in the past 6 months; * $P < 0.05$; † $P < 0.01$; ‡ $P < 0.001$; NA: not applicable.

strong social pressure [5, 19]. Such social environments may lead MSM to hide their sexual orientation by unwillingly engaging in heterosexual relationships [20]. Many of them continue to be married and maintain sexual relationships with their wives while maintaining concurrent but hidden homosexual relationships. Nearly one-third of MSM are married in China, and an even higher proportion reported having had sex with women [21, 22]. Our previous study showed approximately 40% of MSM being married or ever having had heterosexual behavior in Shandong province [23]. These bisexual and marital relationships have a strong impact on the HIV epidemic from MSM population to general population. Studies from different countries documented the high rate of unprotected sexual behaviors between spouses and/or regular heterosexual partners tends [22, 24, 25]. Therefore, bisexually active men in China could play a critical bridging role in spreading HIV and other STIs from their high-risk male sexual partners to low-risk female partners, for example, their wives [26, 27]. Under social pressure, bisexual MSM may further reinforce the negative attitudes towards PLWHA and worsen drinking behaviors.

While stigma is widely invoked as a major facilitator of the HIV epidemic [28], only few studies have demonstrated an association between stigma and increased risk behavior. This study showed that unprotected male anal sex in the past 6 months and ≥ 2 male sex partners in the past week are independently associated with drinking behavior and more negative attitudes towards PLWHA. Other studies that have demonstrated drinking behaviors will result in multiple sexual partners and unprotected sex [11, 12]. A cross-sectional study of MSM in 5 cities in Jiangsu province showed that heavy alcohol consumption was linked to unprotected anal intercourse (OR = 2.32) compared with nondrinkers or light drinkers [29]. Alcohol consumption may directly impair judgment and cause social disinhibition, resulting in an increased likelihood of unprotected sexual encounters. The other explanation involves a social environment model, in which an association occurs because the social environment of drinking overlaps with an environment that facilitates meeting potential casual sexual partners. Stigma can have significant adverse effects on health and disease transmission by promoting delays in seeking care and reluctance to follow medical advice [28]. One study among Chinese migrants found that persons holding stigmatizing beliefs were more likely to have multiple sexual partners, a commercial sex partner, and a STI [30]. The findings of the present study

suggest that common multiple sex partners and existing sexual network among this group could offer an intervention opportunity to reduce HIV/AIDS-related stigmatizing and discriminatory attitudes and strengthen alcohol use prevention and risk reduction initiatives among MSM.

This study also found that MSM who ever received peer education in the past year were more likely to express lower negative attitudes towards PLWHA. Peer education could relieve their social pressure, persuade MSM to receive HIV counseling and testing, and facilitate early diagnosis, timely prevention, and linkage to care and medical treatment. Ti and Kerr showed that by creating peer-involved HIV testing clinics and pairing physicians with peers, high-risk groups may be more likely to use these services without fear of being discriminated by healthcare workers [31]. By shifting delivery of care from healthcare professionals to peers, or by incorporating peer workers into professionally led services, a reduction in stigma and discrimination in these settings may be achieved. The findings of the present study underline the effect of peer education and the need to deliver conventional HIV/AIDS services directly to MSM to reduce the stigmatization and discrimination among MSM communities.

These studies highlighted the importance of policy considerations for stigma, alcohol use, and its related sexual risk among MSM. This study is not without limitations. First, the stigma scale may provoke socially desirable answers from respondents. Participants may feel embarrassed to openly express stigmatizing and discriminatory attitudes towards PLWHA during face-to-face interviews. This study might therefore underestimate the true levels of negative attitudes and risk behavior. Second, the nature of the cross-sectional study design precluded identification of causal relationships. Third, since this study did not assess the cooccurrence of drinking behavior with inconsistent condom use or multiple sex partners, any inference on the causal relationship between these variables is impossible. Fourth, the variables used to characterize alcohol consumption are not a complete list and may miss some opportunities to capture all true relationships.

Despite its many limitations, this study provides important information for further research and suggests that MSM who experience stigmatizing and discriminatory attitudes towards PLWHA and exhibit patterns of excessive alcohol use may be at higher risk for increased numbers of sexual partners and for bisexual and unprotected sex. Common HIV/AIDS-related stigmatizing and discriminatory attitudes,

TABLE 2: Sex and drug use behavior, stigma and discrimination, alcohol consumption, HIV knowledge, and HIV prevention services among men who have sex with men in Shandong province, China.

Variables	Total		Drinking (≥ 3 times/week)		Stigma and discrimination
	N	%	N	%	\pm SD
<i>Sexual and drug use behaviors</i>					
Age of first sex (years)					
≤ 20	661	53.7	70	10.6	38.0 \pm 4.1
> 20	569	46.3	74	13.0	36.7 \pm 4.6 [‡]
Sex with man in past 6 months					
No	105	8.6	6	5.7	39.4 \pm 3.2
Yes	1123	91.4	138	12.3	37.2 \pm 4.4 [‡]
Number of male sex partners in the past week					
< 2	499	45.7	43	8.6	38.8 \pm 3.9
≥ 2	592	54.3	92	15.5 [†]	35.9 \pm 4.4 [‡]
Condom use during sex with man in the last sex					
Yes	794	70.8	89	11.2	37.6 \pm 4.3
No	327	29.2	48	14.7	36.4 \pm 4.5 [‡]
Condom use during sex with man in past 6 months					
Always	351	31.3	27	7.7	39.1 \pm 3.4
Sometimes or never	770	68.7	111	14.4 [†]	36.4 \pm 4.5 [‡]
Commercial sex with man in past 6 months					
Yes	306	27.2	51	16.7 [†]	35.7 \pm 4.2 [‡]
No	818	72.8	86	10.5	37.8 \pm 4.3
Condom use with paid male partner during the last sex					
No	84	6.8	18	21.4	34.3 \pm 4.4 [‡]
Yes	222	72.5	33	14.9	36.2 \pm 4.0
Condom use with paid male sex partners in past 6 months					
Always	91	29.8	12	13.2	38.4 \pm 3.4
Sometimes or never	214	70.2	38	17.8	34.5 \pm 4.0 [‡]
Sold sex to man in past 6 months					
Yes	264	21.5	43	16.3 [*]	36.1 \pm 4.2 [‡]
No	966	78.5	101	10.5	37.8 \pm 4.3
Condom use in the last time with male partner who sold sex					
No	56	21.4	9	16.1	34.8 \pm 4.3 [‡]
Yes	206	78.6	34	16.5	36.4 \pm 4.1
Condom use in past 6 months with male partners who sold sex					
Always	82	31.1	12	14.6	38.8 \pm 3.2
Sometimes or never	182	68.9	31	17.0	34.9 \pm 4.1 [‡]
Sex with woman in past 6 months					
Yes	287	23.4	61	21.3 [‡]	36.8 \pm 4.5 [†]
No	942	76.6	83	8.8	37.6 \pm 4.3
Condom use with female partners in the last sex act					
Yes	149	52.1	23	15.4	37.7 \pm 4.1
No	137	47.9	37	27.0 [*]	35.9 \pm 4.7 [‡]
Condom use with female partners in past 6 months					
Always	93	32.5	14	15.1	38.4 \pm 3.7
Sometimes or never	193	67.5	46	23.8	36.1 \pm 4.6 [‡]

TABLE 2: Continued.

Variables	Total		Drinking (≥ 3 times/week)		Stigma and discrimination
	N	%	N	%	\pm SD
Drug use					
No	1210	98.9	138	11.4	37.4 \pm 4.4
Yes	13	1.1	6	46.2 [†]	36.9 \pm 3.8
<i>HIV-related prevention services in the past year</i>					
Condom promotion/VCT					
Yes	925	75.2	116	12.5	38.1 \pm 4.1
No	305	24.8	28	9.2	37.2 \pm 4.4 [†]
Received peer education					
Yes	508	41.3	69	13.6	38.7 \pm 4.0
No	722	58.7	75	10.4	36.5 \pm 4.3 [‡]
Had free HIV test in the past year					
Yes	624	50.7	87	13.9 [*]	38.5 \pm 3.9
No	606	49.3	57	9.4	36.3 \pm 4.5 [‡]
<i>Drink ≥ 3 times per week in P6M</i>					
No	1086	88.3	—	—	37.6 \pm 4.2
Yes	144	11.7	—	—	35.4 \pm 5.2 [‡]

TABLE 3: Predictors for stigma and discrimination, alcohol consumption among men who have sex with men in Shandong province, China.

Model 1 predictors for drink (≥ 3 times per week in P6M)	N (%)	OR (95% CI)	AOR (95% CI)
Higher level of stigma and discrimination (continuous)	35.4 \pm 5.2	0.90 (0.86–0.93) [‡]	0.92 (0.87–0.96) [‡]
Unprotected male anal sex in P6M	111 (14.4)	2.0 (1.3–3.1) [†]	1.9 (1.1–3.3) [*]
Bisexual identity/orientation	70 (19.9)	2.7 (1.9–3.8) [‡]	2.2 (1.3–3.9) [†]
Number of male sex partners in the past week ≥ 2	92 (15.5)	2.0 (1.3–2.9) [†]	1.5 (1.0–2.4) [*]
Drug use	6 (46.2)	6.7 (2.2–20.1) [†]	6.7 (2.0–22.3) [†]
High school or lower education level	94 (14.5)	1.7 (1.1–2.5) [†]	1.6 (1.0–2.6) [*]
Model 2 predictors for stigma and discrimination	Mean \pm SD	β (95% CI)	Adjusted β (95% CI)
Drink ≥ 3 times per week in P6M	35.4 \pm 5.2	2.2 (1.5–3.0) [‡]	1.5 (0.8–2.3) [‡]
Unprotected male anal sex in P6M	36.4 \pm 4.5	2.8 (2.2–3.3) [‡]	1.7 (1.1–2.2) [‡]
Bisexual identity/orientation	36.6 \pm 4.5	1.2 (0.6–1.7) [‡]	0.9 (0.4–1.4) [†]
Number of male sex partners in past week ≥ 2	35.9 \pm 4.4	2.9 (2.4–3.4) [‡]	1.9 (1.3–2.4) [‡]
Commercial sex with man in P6M	35.7 \pm 4.2	2.1 (1.5–2.6) [‡]	0.8 (0.2–1.4) [†]
Never received peer education in the past year	36.5 \pm 4.3	2.3 (1.8–2.7) [‡]	1.7 (1.2–2.2) [‡]

Multivariable logistic regression analysis was applied for alcohol consumption (Model 1); multivariable linear regression model was performed for stigma and discrimination (Model 2); P6M: in the past 6 months; OR: odds ratio; 95% CI: confidence interval; AOR: adjusted odds ratio; ^{*} $P < 0.05$; [†] $P < 0.01$; [‡] $P < 0.001$.

drinking behaviors, bisexual identity, and unprotected sex among this group have become emerging challenges in containing the HIV epidemic. The findings of this study highlight the urgent need to develop programs that would target HIV/AIDS-related stigmatizing and discriminatory behavior and strengthen alcohol use prevention and risk reduction strategies among MSM, in the context of rapid social changes that are occurring in China.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Research Article

HIV Prevention Services and Testing Utilization Behaviors among Men Who Have Sex with Men at Elevated Risk for HIV in Chongqing, China

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Objective. To investigate barriers and correlates of the use of HIV prevention services and HIV testing behaviors among men who have sex with men in Chongqing. **Methods.** Three consecutive cross-sectional surveys provided demographic, sexual behavior, HIV/syphilis infection, HIV prevention service, and testing behavior data. **Results.** Of 1239 participants, 15.4% were infected with HIV, incidence was 12.3 per 100 persons/year (95% CI: 9.2–15.3), 38% of the participants reported ever having unprotected insertive anal sex, 40% ever received free condom/lubricants in the past year, and 27.7% ever obtained free sexually transmitted infection examination/treatment in the past year. Multivariable logistic regression revealed that lower levels of HIV/AIDS related stigmatizing/discriminatory attitudes, full-time jobs, and sex debut with men at a younger age were independently associated with use of free condom/lubricants. Large social networks, higher incomes, and sexual debut with men at a younger age were associated with use of any HIV prevention and HIV testing services. Lower levels of stigmatizing/discriminatory attitudes were also associated with HIV testing. Fearing needles and being unaware of the venues for testing were top barriers for testing service utilization. **Conclusion.** It is imperative to address HIV/AIDS related stigmatizing/discriminatory attitudes and other barriers while delivering intervention and testing services.

1. Introduction

In recent years, the HIV epidemic has been rapidly expanding among men who have sex with men (MSM) in China. Male-to-male sexual contact has emerged as one of the major transmission routes for new HIV infections [1–3]. Historically, HIV-1 infection has been largely concentrated among injection drug users and former paid blood and

plasma donors in geographically disparate rural areas in China [4, 5]. However, the rapid increase of HIV-1 prevalence among MSM [6, 7] shows that China may be following the trajectory of other Asian countries where HIV-1 infection is a growing problem among MSM [3, 8–10].

Chongqing is one of the metropolitan cities in China with a rapid expansion of the HIV epidemic among MSM [11]. HIV prevalence among MSM in Chongqing [12] was twice

the rates of 5-6% among MSM from the National Sentinel Surveillance in 2011 [13]. A meta-analysis of HIV studies among MSM in low and middle-income countries estimated that globally MSM have 19.3 times higher odds of being infected with HIV compared to the general population [14]. Among an estimated 780,000 persons living with HIV/AIDS in China, nearly 55% did not know their infection status in 2011 [3]. A recent study in Shanghai reported 28.5% of MSM engaged in sex work (money boys) and 50.5% of non-money boy MSM had never tested for HIV [15]. It is imperative to effectively reach MSM and improve the effectiveness and quality of ongoing intervention prevention services and promotion of HIV testing [16].

HIV prevention services, including the distribution of condoms, HIV testing, and testing and treatment for sexually transmitted infections (STIs), have been documented as effective measures in reducing HIV transmission [17–21]. HIV testing is the entry point to access other interventions and treatment services, while HIV infected individuals who know their infection status have been shown to reduce their risky sexual behavior and lower the risk of onward transmission [17, 19]; moreover timely treatment of HIV infected individuals may reduce community level viral load and prevent HIV transmission at the population level [22, 23].

Though HIV prevention services and HIV testing have been scaled up in China over the past few years, gaps in the use of these services still remain [24–26]. Limited data is available in characterizing barriers and facilitators for the use of these prevention services in different settings or regions [16].

From 2009 to 2013, three consecutive cross-sectional surveys were conducted among MSM in Chongqing using respondent driven sampling (RDS). The objective of this study was to investigate the barriers and correlates of HIV prevention services and testing behaviors among MSM in Chongqing.

2. Methods

2.1. Recruitment of the Participants. Three consecutive cross-sectional surveys were conducted among MSM from September of 2009 to January 2010, September 2010 to January 2011, and September 2011 to January 2012. RDS was utilized to recruit the study participants. The details of the recruitment methods have been reported previously [16]. Participants were eligible if they were male, 18 years age or older, a Chongqing resident, had a history of having sex with another man in the past 12 months (sex can be defined as oral, anal, or mutual masturbation), had a valid study recruitment coupon, never participated in the survey previously, and was able to provide written informed consent. The study was approved by the Committees for Human Research of the National Center for AIDS of the China Center for Disease Control and Prevention, Vanderbilt University and the University of California San Francisco. A computer-assisted, interviewer-administrated questionnaire (CASI) was used to collect information including demographic information and sexual behaviors.

2.2. Measures. After eligibility screening and obtaining informed consent, each participant received a 20–30 minute computer-assisted interview. The questionnaire asked participants about information on demographics, sexual and drug use behaviors, HIV testing history, and stigmatizing and discriminatory attitudes towards people living with HIV/AIDS (PLWHA).

- (1) Demographics and sexual risk behaviors: demographic questions included age, ethnicity, education, marital status, employment, sexual orientation, and Chongqing residence status. Risk behavior measures included ever engaging in unprotected sexual intercourse, disclosure of sexual orientation, and the number of male and female sexual partners in last 6 months.
- (2) HIV prevention and HIV testing services: all participants were asked if they had participated in HIV prevention programs including receiving free condom/lubricants, free STI examination and treatment, and HIV testing. Recent testers were defined as participants who received a test for HIV in the preceding year.
- (3) HIV/AIDS related stigma and discrimination: individual attitudes towards PLWHA were scored by asking participants about their agreement and disagreement (1 = “yes”; 2 = “no”) with 22 statements. The scale was adapted from two pilot investigations conducted in Thailand and Zimbabwe and reported elsewhere [27, 28]. The psychometric measure includes 3 components: shame, blame and social isolation (10 items), discrimination (8 items), and equity (4 items). In our study, we included the first two components in all 3 years (equity section excluded in 2011) and therefore the first two components (18 items) were analyzed in this paper.
- (4) Laboratory testing: HIV infection was screened with enzyme-linked immunosorbent assay (ELISA; Vironostika HIV Uni-Form plus O, bioMerieux, Holland) and confirmed with Western Blot test (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). For HIV positives, The BED IgG-capture ELISA (BED-CEIA, Calypte Biomedical Corporation, Rockville, Maryland) was performed for all HIV-seropositive specimens. Syphilis screening was performed by rapid plasma regain (RPR; Shanghai Rongsheng, Shanghai, China) and confirmed with *Treponema pallidum* particle assay test (TPPA; Fujirebio Inc., Japan).

2.3. Statistical Analyses. We excluded the observations of individuals who participated in more than one round and the first observation for repeated individuals was retained in the final dataset. Since we intend to focus on service utilization analysis rather than the trend of use of these services, we believe aggregating data over three years provides a better picture of service coverage among MSM in Chongqing.

Basic demographic, risk characteristics, HIV prevention service utilization, and HIV testing factors were tabulated.

For HIV/AIDS stigma and discrimination, scores were calculated (reverse coding items asked in the positive) for each observation within the overall scale. The factors associated with HIV prevention service utilization (three models) and recent testing (one model) were assessed with multivariable logistic regression after univariate analysis. Adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) were calculated in the multiple logistic regression analysis using a stepwise method. We calculated odds ratios (OR), 95% CIs and *P* values using bivariate logistic regression for each of these analyses. For multivariable analyses logistic regression was used to calculate adjusted odds ratios, 95% CIs, and *P* values. To adjust the enrollment year's impact to service use or the influence changes in time, we used recruitment year as a variable in each model. Statistical Analysis System (SAS 9.3 for Windows; SAS Institute Inc., NC, USA) software was used for all analyses.

3. Results

3.1. Socio-Demographics of the Study Participants. In total, we removed 163 repeated participants to obtain 1239 unique participants in the final dataset. A total of 510, 485, and 244 participants were retained in each of the three years, respectively (Table 1). The median age of these participants was 23 years old (interquartile (IQR): 21–27 with a range from 18 to 67). Of participants, 69.6% had a college or higher level of educational attainment, nearly two-thirds currently employed with a full time job. In terms of other demographics, 30.0% were college students, more than three-quarters (78.1%) were local residents, and 7.4% reported being married to a woman. In terms of sexual orientation, 70.0% reported their sexual orientation as homosexual, while 23.9% reported being bisexual, and 5.6% being unknown or heterosexual. A quarter (26.3%) of men in this study reported knowing ≥ 10 MSM and nearly 40% reported having an income of <1000 Yuan (CNY) per month.

3.2. Sexual Behaviors. Of participants, 8.5% reported having sex with a female partner in the past six months, 3.6% reported ever seeking sex for money or goods with male partners in the past six months, and 38% reported having unprotected insertive anal sex.

3.3. Prevalence of HIV and Syphilis. Regarding STIs, 4.9% were infected with syphilis and 15.4% with HIV (Table 1). HIV prevalence increased from 11.6% in 2009 to 15.3% in 2010 and 23.8% in 2011. BED-CEIA estimated HIV incidence was 12.3 per 100 persons/year (95% CI: 9.2–15.3), increasing from 7.9 in 2009 to 11.9 in 2010 and 18.2 in 2011 per 100 persons/year. Syphilis prevalence was stable at 4% to 5% across all three recruitment years.

3.4. Score of Stigmatizing and Discriminatory Attitudes Towards HIV/AIDS. The median score of stigmatizing and discriminatory attitude towards HIV/AIDS (stigma score) of all participants was 7.0 (mean = 5.9, IQR: 3–8) (Table 1). The average stigma score for those who received testing in the past

12 months (5.6) was lower than that for those who did not receive HIV testing (<6.0) (*P* = 0.03). The average stigma score for those who received free condom/lubricants in the past 12 months (5.4) was lower than those who did not receive HIV testing (6.6) (*P* < 0.01). The average stigma score for those who received any prevention services in the past 12 months (5.6) is lower than those who did not receive any prevention services (<6.2) (*P* < 0.01).

3.5. Received HIV Prevention and Testing Services. Only forty percent of respondents reported ever receiving condoms and/or lubricants in the past year; less than a third reported always using free condoms and being satisfied with their use, 27.7% reported ever obtained free STI examination or treatment services in the past year, and more than a third never had HIV testing in the past (Table 1). Of the participants who reported where they got free condoms and lubricants, 33.4% were from community based organizations (CBO), followed by family members (20.9%), sex partners (15.4%), and CDC staff (14.5%).

3.6. Factors Independently Associated with Receiving Prevention Services

3.6.1. Factors Correlated with Receiving Free Condoms/ Lubricants. Participants who enrolled in 2009 (AOR = 0.1, 95% CI: 0.1–0.2, versus 2011), having a full time job (AOR = 1.5, 95% CI: 1.1–2.0), sexual debut with men at younger age (AOR = 0.7, 95% CI: 0.5–0.9, 9–29 yrs versus ≤ 18 yrs; AOR = 0.3, 95% CI: 0.2–0.6; ≥ 30 yrs versus ≤ 18 yrs), and lower stigma score (AOR = 0.9, 95% CI: 0.9–1.0, OR value per scale point) were more likely to have ever obtained free condoms/lubricants in the last year Table 2, Model 1.

3.6.2. Factors Correlated with Receiving Free STI Services. Participants who enrolled in 2009 (AOR = 0.5, 95% CI: 0.3–0.8, versus 2011), who had larger social networks (AOR = 1.6, 95% CI: 1.2–2.2), those more likely to receive free STI services, those who had unprotected sex (AOR = 0.7, 95% CI: 0.5–0.9), and those who were HIV positive (AOR = 0.6, 95% CI: 0.4–0.9) were less likely to receive free STI services in the past year Table 2, Model 2.

3.6.3. Factors Correlated with Receiving Any of HIV Prevention Services. Participants who enrolled in 2010 (AOR = 1.6, 95% CI: 1.2–2.1, versus 2009), who had higher income (AOR = 1.5, 95% CI: 1.1–1.9; >1000 Yuan monthly), those with larger social networks (AOR = 1.6, 95% CI: 1.2–2.1), and those with sexual debut with men at a younger age (AOR = 0.7, 95% CI: 0.5–0.9; 9–29 yrs versus ≤ 18 yrs; AOR = 0.4, 95% CI: 0.2–0.6; ≥ 30 yrs versus ≤ 18 yrs) were more likely to have ever received any of the HIV prevention services in the past year Table 2, Model 4.

3.7. Factors Independently Associated with HIV Testing. Having larger social networks (AOR = 1.8, 95% CI: 1.3–2.4) and lower stigma scores (AOR = 0.9, 95% CI: 0.9–1.0), enrolling in 2010, having higher income (AOR = 1.7, 95% CI: 1.2–2.2; >1000 Yuan monthly), and being HIV-seronegative

TABLE 1: Demographics, prevalence of HIV and Syphilis, sexual behaviors, HIV prevention, and testing behaviors among men who have sex with men in Chongqing, China, 2009–2011.

Factors	N*	%		N*	%
Age (years)			Enrollment year		
18–25	836	67.6	2009	510	41.2
26–35	302	24.4	2010	485	39.1
≥36	98	7.9	2011	244	19.7
Mean (Std.)	25 (6.4)		Unprotected anal insertive sex		
Median	23		No	765	61.7
Range (Q1–Q3)	18–65 (21–27)		Yes	474	38.3
Ethnicity			Free condom use in the last year		
Han	1202	97.4	Never use	49	10.8
Others	32	2.6	Sometime use, unsatisfied	53	11.7
Years of education			Sometime use, satisfied	197	43.6
≤9	100	8.1	Always use, unsatisfied	20	4.4
10–12	277	22.4	Always use, satisfied	133	29.4
>12	862	69.6	Male sex patterns		
Marital status			No anal sex	33	2.7
Single	1099	88.9	Definitely insertive	228	18.5
Married	91	7.4	Mainly insertive	152	12.3
Divorced/widowed	46	3.7	Both	453	36.7
Full-time work			Mainly receptive	230	18.6
No	761	61.4	Definitely receptive	140	11.3
Yes	478	38.6	Stigmatized attitudes towards HIV/AIDS		
Permanent Chongqing residence			Mean (Std.)	5.9 (3.4)	
No	271	21.9	Median	7	
Yes	968	78.1	Range (Q1–Q3)	0–18 (3–8)	
Monthly income in last year			HIV infection		
<1000	479	38.7	No	1048	84.6
1000–2999	542	43.7	Yes	191	15.4
3000–4999	151	12.2	Syphilis infection		
≥5000	67	5.4	No	1178	95.1
Sexual orientation			Yes	61	4.9
Homosexual	872	70.6	Received condom/lubricants in P12M		
Bisexual	295	23.9	No	685	60.5
Others ¹	69	5.6	Yes	447	39.5
No. of MSM you know in Chongqing			Ever had an HIV testing		
≤10	913	73.7	No	422	34.1
≥11	326	26.3	Yes	817	65.9
Had sex with women in P6M			Received free STI services		
No	1134	91.5	No	818	72.3
Yes	105	8.5	Yes	314	27.7
Age at first sex with a man (years)			Getting condom from		
≤18	386	31.2	CBO or peers	251	33.4
19–29	789	63.7	family members	157	20.9
≥30	64	5.2	sex partner/s	116	15.4
			CDC staff	109	14.5
			Medical staff	23	3.1

Note: P6M: the past 6 months; P12M: the past 12 months; STI: sexually transmitted infections; CBO: community-based organization; CDC: Center for Disease Control and Prevention. *Numbers might not add to totals due to missing data. ¹Others: heterosexual or unknown sexual orientation.

TABLE 2: Factors associated with HIV prevention service and HIV testing.

Independent factors	OR (95% CI)	AOR (95% CI)
Model 1: Factors associated with having ever received condom/lubricants in P12M		
Enrollment year		
2010 versus 2009	0.9 (0.7–1.2)	0.9 (0.7–1.2)
2011 versus 2009	0.1 (0.0–0.1) [†]	0.1 (0.1–0.2) [†]
Fulltime job versus part time job	1.1 (0.9–1.42)	1.5 (1.1–20) [†]
sex debut age with a man (yrs)		
19–29 versus ≤18	0.6 (0.5–0.8) [†]	0.7 (0.5–0.9) [†]
≥30 versus ≤18	0.3 (0.2–0.6) [†]	0.3 (0.2–0.6) [†]
No. of MSM you know in Chongqing (≥11 versus <11)	3.0 (2.3–4.0) [†]	2.3 (1.7–3.1) [†]
Stigmatizing attitudes towards HIV/AIDS*	0.9 (0.9–0.9) [†]	0.9 (0.9–1.0)*
Model 2: Factors associated with having ever receiving HIV testing in P12M		
Enrollment year		
2010 versus 2009	2.6 (2.0–3.4) [†]	2.9 (2.1–4.0) [†]
2011 versus 2009	0.3 (0.2–0.5) [†]	0.5 (0.3–0.8) [†]
Monthly income in P12M		
1000–2999 versus ≤1000 CNY	1.7 (1.3–2.3) [†]	1.7 (1.2–2.3) [†]
3000–4999 versus ≤1000 CNY	1.3 (0.9–2.0)	1.3 (0.9–2.1)
≥5000 versus ≤1000 CNY	0.6 (0.3–1.3)	0.7 (0.3–1.4)
No. of MSM you know in Chongqing (≥11 versus <11)	2.2 (1.7–2.9) [†]	1.8 (1.3–2.4) [†]
Stigmatizing attitudes towards HIV/AIDS*	0.9 (0.9–1.0)*	0.9 (0.9–1.0)*
HIV positive	0.5 (0.3–0.8) [†]	0.5 (0.3–0.8) [†]
Model 3: Factors associated with having ever received free STI services in P12M		
Enrollment year		
2010 versus 2009	1.3 (0.9–1.7)	1.2 (0.9–1.6)
2011 versus 2009	0.6 (0.4–0.8) [†]	0.5 (0.3–0.8) [†]
No. of MSM you know in Chongqing (≥11 versus <11)	1.8 (1.4–2.4) [†]	1.6 (1.2–2.2) [†]
Unprotected insertive anal sex	0.9 (0.7–1.2)	0.7 (0.5–0.9)*
HIV positive	0.6 (0.4–0.8) [†]	0.6 (0.4–0.9)*
Model 4: Factors associated with having ever received any prevention services in P12M		
Enrollment year		
2010 versus 2009	1.6 (1.3–2.1) [†]	1.6 (1.3–2.1) [†]
2011 versus 2009	0.3 (0.2–0.5) [†]	0.4 (0.3–0.5) [†]
Monthly income		
1000–2999 versus ≤1000 CNY	NA	1.5 (1.1–1.9) [†]
3000–4999 versus ≤1000 CNY	NA	1.3 (0.8–1.9)
≥5000 versus ≤1000 CNY	NA	1.6 (0.9–2.9)
No. of MSM you know in Chongqing (≥11 versus <11)	2.1 (1.6–2.7) [†]	1.6 (1.2–2.1) [†]
Sex debut age with a man (yrs)		
19–9 versus ≤18	0.7 (0.6–0.9) [†]	0.7 (0.5–0.9) [†]
≥30 versus ≤18	0.4 (0.2–0.7) [†]	0.4 (0.2–0.6) [†]

Note: OR: Odd ratio; 95% CI: 95% confidence interval; AOR: adjusted odd ratio; P6M: the past 6 months; P12M: the past 12 months; * $P < 0.05$; [†] $P < 0.01$; NA: not available; all the four models were adjusted with sexual orientation, age, married status, education, employment, sex debut age with men, number of male sex partners, stigmatizing/discriminatory attitudes (consecutive variables), HIV infection status, having multiple male sex partner or not, and anal sex pattern (insertive or receptive).

(AOR = 0.5, 95% CI: 0.3–0.8) were independently associated with receiving a test for HIV in the past year.

3.8. Barriers and Facilitators of HIV Testing. Of participants, 72.1% reported “fearing needles” as the reason for not seeking a test for HIV, 66.1% perceived they were unable to afford treatment once diagnosed as HIV positive, and 61.4% feared

meeting acquaintances at testing sites (61.4%) as reasons for not seeking an HIV test (Figure 1). While nearly two-thirds (60.6%) of respondents perceived no risk for HIV infection, 54.5% feared knowing their HIV serostatus, 54.3% feared to be tested due to discrimination or privacy concerns and 52.1% did not know where to get an HIV test. Regarding facilitators for HIV testing, the majority of respondents

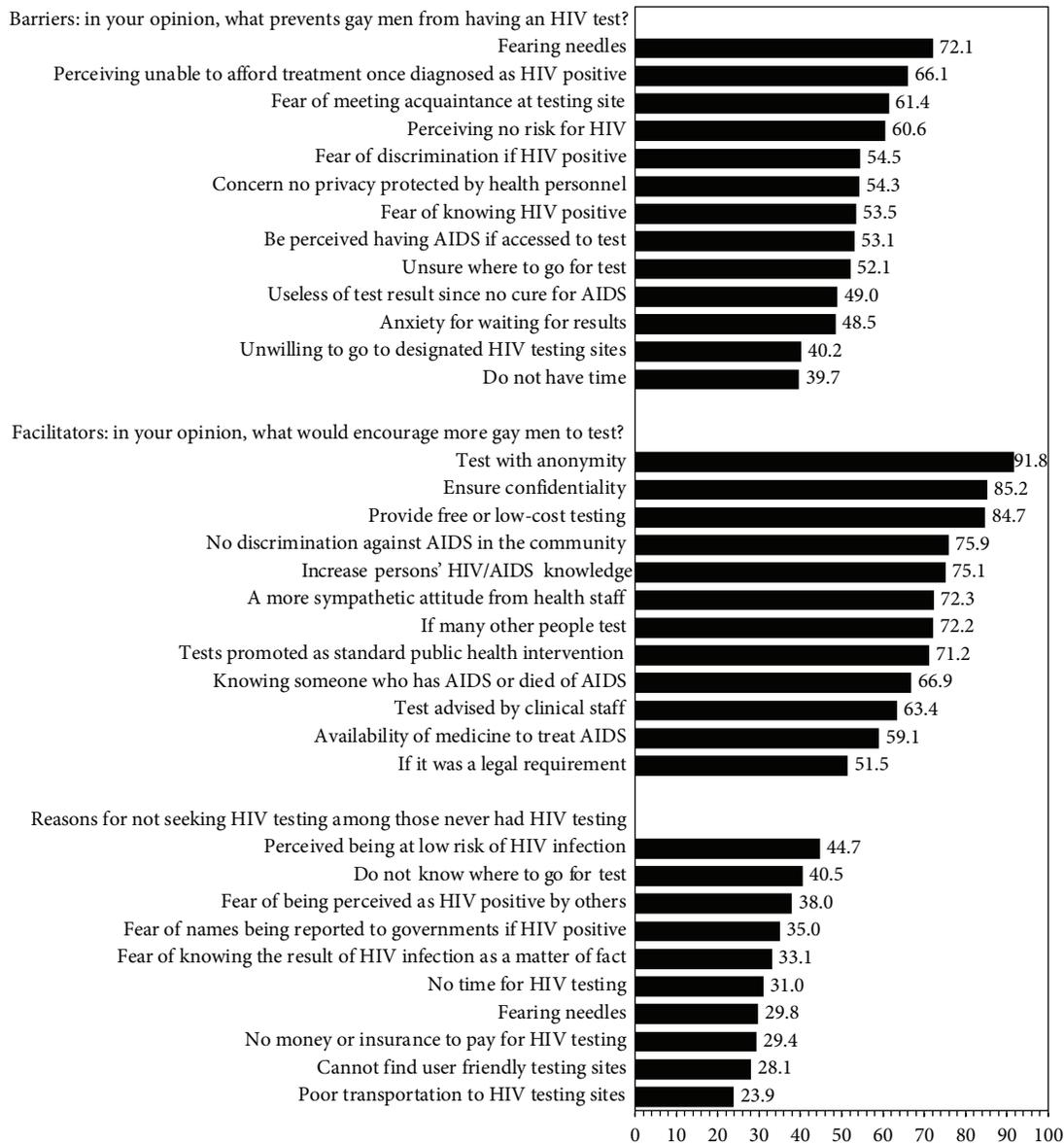


FIGURE 1: Barriers and facilitators for HIV testing and reasons for not seeking HIV testing.

(91.8%) choose “test with anonymity,” assurance of confidentiality (85.2%), “free or low-cost testing” (84.7%), less discrimination (75.9%), HIV/AIDS knowledge awareness, and more sympathetic attitude from health professionals (75.1%), as well as promoting HIV testing as part of standard HIV intervention (71.2%) as reasons to have an HIV test. More than half (66.9%) of respondents believed knowing somebody who had AIDS or died of AIDS might be a facilitator for HIV testing uptake.

4. Discussion

Statistics from the Chinese Ministry of Health and UNAIDS have shown a worrisome trend in the HIV epidemic among MSM in China [3, 10]. Nationally, the proportion of cases

attributed to MSM increased approximately 5-fold from 2.5% in 2006 to 13.7% in 2011 [3]. This suggests that the HIV epidemic is expanding rapidly in this population and that more effective prevention measures are urgently needed. The present study presents a potentially worrying scenario of rapid HIV expansion among MSM in Chongqing, with an alarming HIV prevalence, about 3 times of the national average [12] and a worrisome level of high HIV incidence. Just over half of respondents in Chongqing received at least one HIV prevention service recently, including free condoms/lubricants, free HIV testing, and free STIs examination in the last year. Only a quarter of MSM had a test for HIV recently, while a third had never tested for HIV. This study highlights that HIV/AIDS related stigmatizing and discriminatory attitudes and a variety of barriers must be

addressed in order to improve the delivery of prevention services and to expand HIV testing effectively.

Studies [27, 28] have shown that social stigma and punitive civil environments may lead to delays in seeking HIV and STI testing, and subsequent initiation of antiretroviral therapy [18]. Our previous report suggested that stigma and discriminatory attitudes were associated with not seeking HIV testing [28]. The present study suggests that stigma and discrimination are not only associated with HIV testing but are also associated with HIV prevention services, especially the use of free condom/lubricants. This is consistent with the finding from the barriers and facilitators assessment in present study. More than half of participants listed “fear of meeting acquaintance at testing site,” “fear of discrimination if being HIV positive,” and “perceived to be living with HIV/AIDS if initially take HIV test,” as discrimination and stigma related barriers. A recent qualitative study in China suggested that reducing HIV-related stigma and discrimination can actually increase HIV testing and relevant HIV-service uptake [29].

The present study also found the two main facilitators for HIV testing are “testing with anonymity” followed by “assurance of confidentiality.” This finding is consistent with another study that those recruited via social networks (who benefit developing the supportive relationships from group membership) prefer to maintain their anonymity [30]. Unwillingness to go to an HIV clinic was an additional barrier to testing. Financial assistance, transportation support, and mobile testing vans should be considered to address this situation, for example, conducting HIV testing in community venues frequented by MSM. For persons using clinic-based testing, high quality counseling, and nonjudgmental friendly care and service providers can help clients reduce their fear and concerns and facilitate the linkage of seropositive persons to care. Along with expanded education and social marketing, a welcoming and nonjudgmental environment for HIV testing is needed [31].

The barriers and facilitators assessment revealed that fear of needles was the first perceived barrier against taking an HIV test, followed by fear of cost of testing. This finding supports the use of the rapid oral test (ROT) or other noninvasive HIV testing method for testing promotion. China National Guideline for Detection of HIV/AIDS in 2009 [32] recommended saliva based oral rapid HIV testing for use in clinics or Emergency Department. It is necessary to provide training for the use of ROT in community based organizations (CBO) or in grass-root level health agencies.

More than half of the participants reported one of the barriers to HIV testing as not knowing where to get a test. Another important barrier was the perception of being not able to afford HIV testing and/or treatment. This finding further underscored the gap in promoting HIV testing among MSM [33, 34] and the needs to address various barriers in delivering prevention and HIV testing services.

The age of participants in the present study is younger compared with other reports [29, 35], while one predictor for free condom/lubricants accessibility in last year was sexual debut with men at a younger age. Similarly with Choi's study

[5], the present study found that the younger age of sexual debut with men was associated with larger size of social networks ($r = -0.15$) and larger social networks were associated with the use of HIV prevention services. However, our findings differ with another report that suggests MSM sexual debut predicted more frequently change of sex partners and other risk behaviors [36]. The finding of our study leads us to believe that the larger size of an individual's social network might be an advantage for the use of HIV prevention services. While RDS was used to recruit participants for research [37, 38] it could also be applied as a mechanism to deliver intervention services among Chinese MSM as it has been used among intravenous drug users (IDU) [39, 40]. Younger MSM may be more intensely engaging in dynamic social networks where individuals interact often with large numbers of peers. Along with more intensity in dynamic cyber life via emerging media, Internet based social network, for example, “Weibo” (microblog, a “Facebook” like social network in China), QQ, email, and other “text message” or instant messaging “Apps” via mobile phone/Internet could serve as effective channels to promote education message for intervention services delivering.

MSM in our study who had full time jobs were more likely to receive condoms and/or lubricants, which corroborated with a recent report in Beijing that lack of stable employment and stable income leads to vulnerabilities to STI infection [35]. Our study shows MSM were more likely to utilize the services in 2010 compared to 2009 but less likely to use services in 2011 compared to 2009. The reason might be due to the RDS recruitment. Along with the longer referral chains, persons enrolled later, who were more hidden, may have been less likely to be reached by the prevention programs. Another possible reason for the peak of service utilization appearing in 2010 rather than 2011 could be that the China-Global Fund AIDS Program delayed funds disbursement and made CBO face the funds vacuum for almost 1 year period since 4thquarter of 2010 to quarter 3rd of 2011 [41]. The delay exposed vulnerability in CBOs' sustainability and lack of monetary incentives resulted in their inactivity in HIV prevention service delivery.

Unprotected receptive anal sex among MSM is the sexual behavior with the highest risk for HIV transmission [42–46]. Nondisclosure of HIV status with casual partners has been associated with sexual transmission. Not knowing a partner's HIV status and not communicating HIV status were particularly common in the casual partnerships. Efforts to improve communication skills to disclose HIV status and use condoms with sexual partners might reduce the sexual transmission of HIV among MSM [47, 48]. However, almost half (48.2%) of the men who tested positive for HIV during the survey were unaware of their infection, highlighting the importance of consistent and correct condom use in the prevention of HIV transmission. Therefore, monitoring the prevalence of risky sexual behaviors and identifying HIV infected individuals who do not know their status could provide valuable information for prevention programs, which are critical to reduce sexual transmission of HIV among MSM.

Multifaceted comprehensive interventions should be implemented. Infrastructure and healthy social norm building (e.g., normalizing condom use and routine HIV testing) should be part of the comprehensive approach. Infrastructure building could be considered such as using mobile vans or equipping health professionals and local CBOs serving local MSM community to promote HIV testing. Healthy social norm building can be achieved by diffusing most relevant health information via available and accessible social media like websites or text messages to promote testing in Chinese MSM [31, 49, 50]. The extent of the risk of acquiring HIV in the United States today is largely defined by a person's sexual network rather than his or her individual behaviors [51]. Group intervention with targeting the behaviors and beliefs from community perspective might be promising as an avenue for prevention in China [52]. For example, collaborating with event promoters offers valuable opportunities to provide condoms, lubricants, and HIV/STI testing [53].

We recognized the limitations of this study. First, self-reported information about the sexual behavior and service uptake may lead to recall bias. Second, because the information was collected by interviewers, some behaviors might have been underreported or over reported. For example, participants might have underreported socially undesirable behaviors (e.g., drug uses) or might have overreported socially desirable behaviors, (e.g., condom use or HIV testing). Third, the nature of the cross-sectional study design precluded the ascertainment of casual relationship. Forth, the study sample comprised of almost one-third college students, which raises the concern of the representativeness of the sample [54]. In addition, the inclusion criteria of willingness to provide a blood specimen may have led to potential under participation in the survey thus increasing selection bias. Despite these limitations, we believe that the present study generated valuable information to enhance the effectiveness of HIV prevention programs among the MSM community.

In summary, the present study revealed that an alarming HIV epidemic is occurring among MSM in Chongqing. Various barriers to the use of HIV prevention service and HIV testing among this population still remain. It is imperative to address the stigmatizing/discriminatory attitudes and other barriers while delivering prevention services and promoting HIV testing.

Ethical Approval

The study protocol was approved by institutional review boards of the National Center for HIV/AIDS Control and Prevention, China CDC, the Vanderbilt University, and the University of California San Francisco in the USA.

Consent

Informed patient consent was obtained.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contribution

Dayong Huang, Yifei Hu, and Guohui Wu contributed equally to this work. Dayong Huang, Yifei Hu, and Yujiang Jia conceptualized the paper, did analysis, and drafted the initial version of the paper. Yuhua Ruan and Yan Xiao are the principal investigator of the research. Jiangping Sun, Yuhua Ruan, Yan Xiao and Yujiang Jia, H. F. Raymond, Willi McFarland, and Wei Ma provided guidance on study design implementation, data analysis, and paper writing. Guohui Wu and Rongrong Lu conducted questionnaire interviews. Yujiang Jia, H. F. Raymond, and Jiangping Sun contributed to the revision of the paper. All authors read and approved the final version of the paper.

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Research Article

The Dynamic Trends of HIV Prevalence, Risks, and Prevention among Men Who Have Sex with Men in Chongqing, China

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Objective. This study was to characterize the continuously changing trends of HIV prevalence, risks, sexual behaviors, and testing behaviors among men who have sex with men (MSM) in Chongqing, China. **Methods.** Five consecutive cross-sectional surveys were conducted among MSM in 2006, 2008, 2010, 2012, and 2013. Testing for HIV and syphilis was performed, and HIV risks, sexual behavior, prevention, and HIV testing behavior were collected using the same questionnaire. **Results.** HIV prevalence increased from 13.0% to 19.7% from 2006 to 2013 ($P = 0.004$), with an increase of 1.0% per year. Syphilis prevalence peaked in 2008 with a positive rate of 11.6% and then experienced a sharp drop to 2.8% in 2012 and 2.9% in 2013. Percentage of those who ever received HIV testing in the last year increased from 17.0% to 43.3% ($P < 0.001$); condom use at the last anal intercourse and reported consistent condom use in the last 6 months increased from 51.8% to 71.0% ($P < 0.001$) and from 24.7% to 47.9% ($P < 0.001$), respectively. **Conclusions.** HIV continued to spread among MSM in Chongqing even when a decline in prevalence of syphilis and increase in awareness rate, condom use, and HIV testing seeking behaviors seemed to occur.

1. Introduction

Unprotected sex among men who have sex with men (MSM) is the main route of HIV transmission in many countries and regions that were first affected by the HIV/AIDS epidemic, such as North America, Western Europe, and Australia [1]. Over the past years, HIV infection rate among MSM is on the decline in some cities in the United States [2]. On the contrary, HIV infection rate is increasing obviously among MSM in China [3, 4]. According to the national estimations of the HIV/AIDS epidemic in China, the proportion of HIV/AIDS cases infected via homosexual contact increased from 7.3% in 2005 to 13.0% in 2011 [5, 6]. It was estimated that 29.4% of new HIV infections in 2011 were transmitted via homosexual contact [6]. In 2008, a survey was conducted among 18,101 MSM in 61 cities in China and indicated an overall HIV prevalence of 5.1% among MSM. In some cities, HIV infection rate exceeded 10% among MSM [7, 8]. Chongqing is a city affected most heavily by homosexual transmission. The first HIV infection via homosexual contact

was reported in Chongqing in 2005. Since then, the proportion of new HIV/AIDS cases via homosexual contact has shown a rapid upward trend [9], reaching 22.2% from January to June 2013, which is 0.8% higher for the same period in 2012. Understanding the trends of HIV/AIDS epidemics is crucial to identify priorities, revise strategies, and allocate resources in the response to HIV. In Chongqing, serological and behavioral surveillance has been conducted among MSM since 2006, and sound historical data have been accumulated [10, 11]. This study aims to capture the changes in the trends of the HIV/AIDS epidemic and risk behaviors of the MSM population based on the surveillance data from 2006 to 2013 in Chongqing and provide scientific evidence for the development of strategies and measures in the city's response to HIV.

2. Methods

2.1. Study Population. Men who were at least 18 years of age and had sexual intercourse with at least 1 male during the

TABLE 1: Demographics of Participants among Men Who Have Sex with Men in Chongqing.

Demographics	2006		2008		2010		2012		2013		Total	
	N	n (%)	N	n (%)								
Age (years)												
18–24	561	158 (28.2)	602	322 (53.5)	400	184 (46.0)	390	144 (36.9)	376	153 (40.7)	2329	961 (41.3)
25–34	561	211 (37.6)	602	205 (34.1)	400	172 (43.0)	390	201 (51.5)	376	175 (46.5)	2329	964 (41.4)
≥35	561	192 (34.2)	602	75 (12.5)	400	44 (11.0)	390	45 (11.5)	376	48 (12.8)	2329	404 (17.3)
Marital Status												
Single	561	416 (74.2)	602	516 (85.7)	391	341 (87.2)	390	335 (85.9)	376	320 (85.1)	2320	1928 (83.1)
Married or divorced	561	145 (25.8)	602	86 (14.3)	391	50 (12.8)	390	55 (14.1)	376	46 (14.9)	2320	382 (16.5)
Residence												
Local	561	441 (78.6)	602	373 (62.0)	398	316 (79.4)	390	326 (83.6)	376	319 (84.8)	2327	1775 (76.3)
Non-Local	561	120 (21.4)	602	229 (38.0)	398	82 (20.6)	390	64 (16.5)	376	57 (15.2)	2327	552 (23.7)
Education (years)												
0–9	561	137 (24.5)	602	97 (16.2)	399	14 (3.6)	390	18 (4.6)	376	28 (7.4)	2328	294 (12.6)
10–12	561	198 (35.3)	602	174 (28.8)	399	91 (22.8)	390	49 (12.6)	376	71 (18.9)	2328	583 (25.0)
≥13	561	226 (40.2)	602	331 (55.0)	399	294 (73.7)	390	323 (82.8)	376	277 (73.7)	2328	1451 (62.3)

previous year were eligible to participate in the study, regardless of their residence, history of HIV testing, serostatus, or treatment status.

2.2. Recruitment. Under the guidance of the National Protocol for HIV Sentinel Surveillance, a national MSM sentinel site was established in Chongqing and began operations in 2006. The period of surveillance was from April to June every year. A number of recruitment strategies were adopted, including receiving referrals from nongovernment organizations, adopting the snowball method, and using online recruitment. The numbers of participants were 561, 602, 400, 390, and 376 in 2006, 2008, 2010, 2012, and 2013, respectively.

2.3. Measures. The survey site was located in a STI/HIV clinic of Chongqing CDC. After obtaining informed consent from study subjects, trained investigators administered a questionnaire to collect information on the study subjects' demographic characteristics, homosexual behaviors, heterosexual behaviors, commercial sex, and access to HIV testing and intervention. Blood samples were taken from subjects for HIV and syphilis testing. HIV infection was screened with enzyme-linked immunosorbent assay (ELISA; Zhuhai Livzon Diagnostics Inc., China). Subjects with a positive result in the first test were retested with another ELISA reagent (Beijing Wantai Biological Pharmacy Enterprise Co., Ltd., China). HIV infection was diagnosed if both tests were positive. For syphilis testing, ELISA assay (Zhuhai Livzon Diagnostics Inc., China) and TRUST assay (Shanghai Rongsheng Biological Pharmacy Enterprise Co., Ltd., China) were used, and there would be a confirmed diagnosis if both ELISA and TRUST positive could be diagnosed syphilis positive. However, only ELISA assay was used in 2006 and 2008.

2.4. Statistical Analysis. Data were entered into a web-based electronic database designed by the National HIV Sentinel Surveillance Working Group. Upon completion of data

inputs, data were then exported to the SAS software for statistical analysis (SAS Institute Inc., USA, version 9.3). Demographic characteristics were presented and compared using chi-square test for different rounds of samples. Observed trends in HIV and syphilis prevalence, as well as a number of sexual risk behaviors, were analyzed with chi-square trend test (Cochran-Armitage method). Since the study samples across the study period were different in age proportion, trends were also examined separately for participants aged between 18 and 24 years, 25 and 34 years, and those aged over 45 years. All reported *P* values were examined at a 2-tailed test. *P* < 0.05 was considered as a statistically significant difference.

3. Results

3.1. Study Participants. A total of 2329 MSM were enrolled in the sentinel surveillance surveys: 561 participated in 2006, 602 in 2008, 400 in 2010, 390 in 2012, and 378 in 2013 (Table 1). The mean age (SD) was 31.8 (9.9), 26.0 (6.8), 26.7 (6.9), 27.4 (6.4), and 27.4 (7.0) in 2006, 2008, 2010, 2012, and 2013, respectively. Subjects in 2006 were older than those in other years. Most subjects were single, accounting for 83.1%. 23.7% of subjects were migrants. In 2008, 38.0% of subjects (the highest figure across the years covered by the study) were migrants. 62.3% of subjects have received education for at least 13 years. The education level was obviously higher among subjects surveyed in 2010 than those surveyed before 2010. There are significant differences in demographic characteristics of subjects across the survey years (*P* < 0.001).

3.2. Dynamic Trends of HIV and Syphilis. HIV prevalence among the study participants showed an upward trend and increased from 13.0% to 19.7% from 2006 to 2013 (*P* = 0.004), with an increase of 1.0% per year. After age stratification, HIV prevalence significantly increased from 6.3% to 19.6% among MSM aged 18–24 (*P* < 0.001) and had a modest increase

TABLE 2: Dynamic trends of HIV, Syphilis, and other sexually transmitted diseases among men who have sex with men in Chongqing.

Infections/Diseases	2006		2008		2010		2012		2013		P value*
	N	n (%)	N	n (%)	N	n (%)	N	n (%)	N	n (%)	
HIV	561	73 (13.0)	602	98 (16.3)	400	50 (12.5)	390	76 (19.5)	376	74 (19.7)	0.004
Age (years)											
<25	158	10 (6.3)	322	39 (12.1)	184	22 (12.0)	144	26 (18.1)	153	30 (19.6)	<0.001
25–34	211	29 (13.7)	205	29 (14.1)	172	19 (11.0)	201	36 (17.9)	175	34 (19.4)	0.085
≥35	192	34 (17.7)	75	20 (26.7)	44	9 (20.5)	45	14 (13.1)	48	10 (20.8)	0.18
Syphilis	561	54 (9.6)	602	70 (11.6)	400	25 (6.3)	390	11 (2.8)	376	11 (2.9)	<0.001
Age (years)											
<25	158	6 (3.8)	322	29 (9.0)	184	12 (6.5)	144	3 (2.1)	153	4 (2.6)	0.044
25–34	211	19 (9.0)	205	26 (12.7)	172	9 (5.2)	201	5 (2.5)	175	3 (1.7)	<0.001
≥35	192	29 (15.1)	75	15 (20.0)	44	4 (9.1)	45	3 (6.7)	48	4 (8.3)	0.056
HIV and syphilis coinfection	73	15 (20.5)	98	29 (29.6)	50	7 (6.5)	76	2 (2.1)	74	9 (12.2)	<0.001
Self-report STD diagnosis in the last year	561	112 (20.0)	602	122 (20.3)	400	22 (5.5)	390	11 (2.8)	376	9 (2.4)	<0.001
Age (years)											
<25	158	34 (21.5)	322	58 (18.0)	184	11 (6.0)	144	6 (4.2)	153	3 (2.0)	<0.001
25–34	211	53 (25.1)	205	46 (22.4)	172	7 (4.1)	201	1 (0.5)	175	4 (2.3)	<0.001
≥35	192	25 (13.0)	75	18 (24.0)	44	4 (9.1)	45	4 (8.9)	48	2 (4.2)	0.072
HIV and Other STDs coinfection	73	26 (35.6)	98	24 (24.5)	50	6 (12.0)	76	6 (7.9)	74	1 (1.4)	<0.001

*P values are from Cochran-Armitage trend analysis.

from 13.7% to 19.4% among MSM aged 25–34 ($P = 0.085$). No significant trend was observed among those over 35 years old ($P = 0.18$). However, syphilis prevalence peaked in 2008 with a positive rate of 11.6% and then sharply dropped to 2.9% in 2013. The decreasing trend could be observed in all three age groups and subgroups by HIV infection status. In addition, both HIV infection rate and syphilis infection rate increased by age, with MSM over 35 having the highest HIV/syphilis prevalence in all survey years. HIV positive cases had higher syphilis prevalence compared to HIV negative cases over the study period, except in the year 2012. See Table 2.

3.3. Sexual Behavior and Trends of Reported Condom Use. Percentage of receiving HIV testing in the last year increased from 16.8% to 43.1% ($P < 0.001$). Reported condom use at the last anal intercourse and reported consistent condom use in the last 6 months increased from 51.9% to 71.0% ($P < 0.001$) and from 24.7% to 47.9% ($P < 0.001$), respectively. HIV/AIDS awareness rate rose from 87.0% to 98.0% ($P < 0.001$). The proportion of subjects ever having had sex with women decreased from 33.0% to 8.8%. Just like the rate of condom use with men, the rate of condom use with women was also on the increase. The rate of condom use at last sex increased from 30.8% to 51.5%. The rate of consistent condom use in the past six months increased from 21.6% to 45.5%. See Table 3.

4. Discussion

Despite huge amounts of effort in HIV prevention and control, this analysis has shown that there has been a significant increase in HIV prevalence among MSM population in

Chongqing from 2006 to 2013, coinciding with the general trend in China [4, 12]. This rise in prevalence is mainly due to the rapid increase in HIV infection among MSM individuals aged 18–24 years, which resulted in the fact that all age groups had similar HIV prevalence in 2013 although there was a huge gap (6.3% for 18–24, 13.7% for 25–34, and 17.7% for over 35) in 2006. Previous study indicated that younger MSM are more likely inclined to have multiple sex partners and engage in more complicated sexual networks and older MSM may prefer to have young MSM partners [13]. The sexual intercourse between older MSM with higher HIV prevalence and young MSM could be a contributing factor to the increase of HIV prevalence among young MSM. HIV prevalence among older MSM has stabilized in recent years, as a result of more people having access to ART treatment and decreasing number of MSM dying from AIDS. However, it is also likely that the HIV prevalence may have been overestimated. Firstly, in all rounds of surveys, HIV positive cases were defined as two ELISA positives, which may include some false positives. Secondly, the participants were conveniently sampled. One meta-analysis indicated that the unprotected anal intercourse prevalence was significantly lower in studies that used random or systematic sampling methods compared with studies that used convenience sampling, as more high-risk MSM could have been recruited, resulting in higher estimate of HIV prevalence [14].

Our results suggest that there is a significant increase in condom usage and more MSM are willing to seek HIV testing. This could be partly a result of the numerous MSM intervention projects implemented by the local government, as well as the work of all the MSM nongovernment organizations in Chongqing these years [10]. The positive trend could also be seen in other studies in China [15, 16]. However, the

TABLE 3: HIV testing behavior and condom use among men who have sex with men in Chongqing.

Health behaviors	2006		2008		2010		2012		2013		P value*
	N	n (%)									
Ever received HIV testing in previous year	561	94 (16.8)	602	195 (32.4)	400	198 (49.5)	390	165 (42.3)	376	162 (43.1)	<0.001
Age (years)											
<25	158	29 (18.4)	322	96 (29.8)	184	84 (45.7)	144	58 (40.3)	153	63 (41.2)	<0.001
25–34	211	44 (20.9)	205	79 (38.5)	172	91 (52.9)	201	94 (46.8)	175	81 (46.3)	<0.001
≥35	192	21 (10.9)	75	20 (26.7)	44	23 (52.3)	45	13 (28.9)	48	18 (37.5)	<0.001
Condom use during last sexual intercourse with man	466	242 (51.9)	500	330 (66.0)	375	250 (66.7)	336	231 (68.8)	338	240 (71.0)	<0.001
Age (years)											
<25	135	80 (59.3)	268	175 (65.3)	171	117 (68.4)	124	84 (67.7)	137	98 (71.5)	<0.001
25–34	187	97 (51.9)	172	123 (71.5)	161	108 (67.1)	173	119 (68.8)	154	113 (73.4)	<0.001
≥35	144	65 (45.1)	60	32 (53.3)	43	25 (58.1)	39	28 (71.8)	47	29 (61.7)	0.002
Consistent condom use in the last 6 months with men	466	115 (24.7)	500	185 (37.0)	375	155 (41.3)	336	150 (44.6)	338	162 (47.9)	<0.001
Age (years)											
<25	135	48 (35.6)	268	97 (36.2)	171	75 (43.9)	124	50 (40.3)	137	60 (43.8)	<0.001
25–34	187	45 (24.1)	172	71 (41.3)	161	64 (39.8)	173	82 (47.4)	154	88 (57.1)	<0.001
≥35	144	22 (15.3)	60	17 (28.3)	43	16 (37.2)	39	18 (46.2)	47	14 (29.8)	<0.001
Sex with women	561	185 (33.0)	602	95 (15.8)	400	45 (11.3)	390	45 (11.5)	376	33 (8.8)	<0.001
Condom use during last sexual intercourse with woman	185	57 (30.8)	95	43 (45.3)	45	15 (33.3)	45	22 (48.9)	33	17 (51.5)	0.008
Consistent condom use in the last 6 months with women	185	40 (21.6)	95	38 (40.0)	45	12 (26.7)	45	19 (42.2)	33	15 (45.5)	0.001
Commercial sex with men	561	39 (6.9)	602	51 (8.4)	384	16 (4.0)	376	14 (3.6)	367	9 (2.4)	<0.001
HIV/AIDS awareness rate	561	488 (87.0)	602	522 (86.7)	400	385 (96.3)	390	385 (98.7)	376	368 (98.0)	<0.001

* P values are from Cochran-Armitage trend analysis.

current level of condom usage is still very low and could be a reason for the elevated prevalence. Many countries across the world are struggling to reduce unprotected sexual behavior among MSM [17, 18] and to reduce HIV infection among MSM, additional effort is needed to expand HIV prevention programs, taking into consideration of the biomedical, behavioral, and structural aspects of the epidemic, which could lead to possible improvements in safe sexual behavior, HIV testing seeking and access to care, and subsequently a decline of HIV prevalence in the long run.

There are a few reasons for the discrepancy between HIV prevalence increase and condom use rate. Firstly, prevalence reflects joint action of incidence and mortality. Prevalence might go up when both incidence and mortality go down. In fact, with expansion of ART, the mortality does decrease significantly in recent years in China [19]. In general, population incidence can reflect epidemic trends most directly. The surveillance of incidence, however, has not been implemented widely due to constraints of laboratory capacity, staffing, timing, and resources. Many studies adopted prevalence from continuous cross-sectional surveys to estimate the trends of HIV/AIDS epidemic [20, 21]. Secondly, Sentinel surveillance is grounded on anonymous unlinked survey. The

duplication of the recruitment over the years might have overestimated condom use rate and HIV testing rate.

The analysis indicated a significant decline in syphilis infection rate in Chongqing, which could also be seen in other Chinese cities [22]. Since TRUST reagents were not used for syphilis screening in 2006 and 2008, the use of single ELISA might produce a high proportion of false positive cases. Excluding data from these two years, an obvious decline was still observed for syphilis infection rate after 2010. Additionally, the proportion of subjects self-reporting sexually transmitted diseases in the previous year was also on the decline, consistent with syphilis testing results and coinciding with the self-reported increasing rate of condom use. This indicated that safer sex could be effective in preventing STDs but needed to be confirmed by more data. Results showed that the rate of syphilis infection and self-reported STD was higher among HIV-positive subjects than among HIV-negative subjects, consistent with other studies [23]. The high rate of coinfection justified the necessity of screening in both HIV positive cases and STD patients.

There are several limitations in this analysis. Firstly, the sentinel surveillance relied on convenience-based samples and the participants were recruited through several different

methods in every round. Since the characteristics of samples in each survey showed statistically different results, stratified analysis was performed to minimize the effect of the change in population structure.

Secondly, changes in HIV tests may also influence trends. HIV antibody tests have improved over the years. New generation assays are more accurate and the rate of false-positive results that may skew prevalence becomes lower. Thirdly, Reporting bias due to desirability is more likely to affect the assessment of trend data. Since incidence is the best indicator of HIV trend in a short period, trend analysis based on incidence estimates was strongly recommended for future study.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contribution

Gang Zeng and Liangui Feng contribute to the paper equally on data analysis, interpretation of the findings, and paper drafting.

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Research Article

Alcohol Use among Chinese Men Who Have Sex with Men: An Epidemiological Survey and Meta-Analysis

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The HIV/AIDS epidemic among Chinese men who have sex with men (MSM) has become a significant public health concern. Knowledge of alcohol consumption in this population is limited. In this study, 1,155 Chinese MSM were surveyed to assess alcohol use and its correlates. A meta-analysis was also performed to aggregate pooled prevalence of current alcohol use. MSM who were unmarried (aOR: 1.87; 95% CI: 1.29–2.71) or unemployed/retired (aOR: 2.77; 95% CI: 1.73–4.45) were more likely to drink alcohol more than once per week. MSM who consumed alcohol more than once per week were more likely to use drug ($P < 0.01$), have sex with women ($P < 0.01$), have unprotected insertive ($P = 0.04$) or receptive ($P = 0.03$) anal sex with men, have more than 10 lifetime male sex partners ($P < 0.01$), predominantly practice insertive anal sex ($P < 0.01$), and trade sex for money ($P < 0.01$). Pooled overall alcohol use prevalence was 32%. Pooled prevalence for MSM who drank alcohol more than once per week and who drank alcohol before sex with male partners was 23%. Our findings provide the basis for further exploring the alcohol-HIV association and developing risk reduction interventions.

1. Introduction

HIV transmission is shifting in China from a preponderance of persons who inject drugs to those persons who acquire HIV sexually; homosexual transmission among men who have sex with men (MSM) is of particular concern [1]. The proportion of new HIV cases among Chinese MSM has surged from 0.2% in 2001 to 29.4% in 2011, and the major risk in this population is unprotected anal sex [2–4]. Prospective cohort studies have shown that Chinese MSM who experienced unprotected anal intercourse or had multiple male partners were 3–10 times more likely to encounter HIV

seroconversion than MSM not practicing these risk behaviors [5–8].

Alcohol abuse is a factor in a variety of medical, social, and public health problems. Global evidence suggests that alcohol use is common among MSM, and can be associated with high risk behaviors for HIV and for other sexually transmitted infections (STI), such as unprotected sex, commercial sex, sexual violence, and sex with multiple concurrent partners [9–15].

Due to traditional social norms and booming economic development, alcohol is used commonly among Chinese men, especially those living in rural areas (26.4% among

rural men versus 12.6% among urban men) [16]. Data from the China Chronic Disease and Risk Factor Surveillance study suggests that the prevalence of current drinking was 35.7%, higher among males (55.6%) than females (15.0%) [17]. Knowledge about prevalence of alcohol consumption prevalence and its important correlates among Chinese MSM is limited [18–20]. In this study, we sought to (1) evaluate the association of demographic factors with alcohol use among Chinese MSM; (2) compare risky behaviors among MSM who drank and who did not drink alcohol; and (3) perform a meta-analytic literature review to better estimate the prevalence of alcohol consumption among Chinese MSM with available published studies.

2. Materials and Methods

2.1. Study Design and Population. Our cross-sectional study was conducted among MSM in Beijing, China, during 2010 and 2011. The study design and study population were described in detail elsewhere [37]. In brief, the study participants were recruited from the community through a local gay-oriented community-based organization (CBO) and through referrals from ongoing epidemiological study. The primary objective of the study was to assess the relationship between male circumcision and HIV/HPV risks and a secondary objective was to explore alcohol use among MSM. Each study participant received genital exam on circumcision status, testing of blood and anal and genital swab specimens, and a questionnaire interview. Written informed consent was obtained. This study was approved by the institutional review boards of the National Center for AIDS/STD Control and Prevention of the Chinese Center for Disease Control and Prevention and Vanderbilt University School of Medicine.

2.2. Data Collection. A questionnaire interview collected data on sociodemographic characteristics (e.g., age, ethnicity, marital status, occupation, education, Beijing residence, and duration of living in Beijing), current alcohol drinking status (at least once per week), HIV risk behaviors (e.g., illicit drug use, sexual orientation, number of male or female sex partners and concurrent partners, specific sexual activities and condom use, anal sex role with male partners, commercial sex, and forced sex), and history of STI. Laboratory testing of HIV and syphilis was conducted according to Chinese national protocol.

For the meta-analysis on prevalence of current alcohol use among MSM in China, we searched both English and Chinese publications up to September 15, 2013, mainly in two databases: MEDLINE via PubMed and Wanfang Data, and we also searched Google Scholar for additional publications. The following search strategy was used to identify articles: (“China” OR “Chinese”) AND (“MSM” OR “men who have sex with men” OR “gay” OR “homosexual”) AND (“ethanol” OR “alcohol” OR “alcohols”). We also conduct reviews on the reference list of all eligible articles to identify additional literature relevant to the topic. Articles were considered eligible for inclusion if they were original epidemiologic studies conducted among MSM in China with reported alcohol use prevalence and/or had crucial statistics permitting us to

compute prevalence. Two reviewers (Yu Liu and Han-Zhu Qian) examined relevant abstracts and determined whether they met criteria for inclusion.

2.3. Statistical Analysis. We sought to identify sociodemographic factors associated with alcohol consumption among Chinese MSM. First, we defined alcohol drinkers as someone who drank alcohol at least once per week in the past 4 weeks, and we compared sociodemographic factors between alcohol drinking MSM and nondrinkers in univariate logistic regression analysis. Significant factors were further evaluated by being fitting into multivariable logistic regression model. In each multivariable logistic model, potential confounders were adjusted *a priori* using direct acyclic graph (DAG). Odds ratios (OR) and 95% confidence intervals (CI) were calculated for both univariate and multivariable logistic regressions. We also compared risky behaviors between alcohol drinkers and nondrinkers by using Chi-squared test or a two-tailed Fisher’s exact test.

In meta-analysis, we used three definitions on alcohol consumption: (1) the loose definition on drinking or not drinking alcohol which could mean different frequency and volume in the original papers; (2) ever drinking alcohol before sex; (3) drinking alcohol for at least once a week, which is consistent with that in our epidemiological survey. To account for the potential heterogeneity of studied population in each study reflected by different geographic locations, ethnicity, age group, and so forth, a random-effect model using the DerSimonian and Laird method [38, 39] was used to aggregate effect sizes to estimate the overall pooled prevalence and corresponding 95% CIs. Two separate random-effect models were also used to summarize the prevalence of alcohol consumption before sex with male sexual partners and alcohol use at least once per week. To quantify the heterogeneity of effect sizes over all included studies, I^2 statistics were calculated. Funnel plots were used to graphically examine signal of potential publication bias. Egger tests were performed to test the funnel plot asymmetry.

STATA 12.0 (StataCorp LP, College Station, Texas) was used for all statistical analyses.

3. Results

3.1. Demographics and Alcohol Use among MSM in Beijing. A total of 1,155 MSM provided informed consent to participate in the original study. Fifteen participants had missing information on alcohol drinking; therefore, 1140 (98.7%) participants were included in the analysis. Six percent were non-Han minority ethnics; 27% were married; 53% had ever attended college; 66% had Beijing residency; 59% had lived in Beijing for more than 4 years. Age ranged from 18 to 68 years (median = 30 years). The prevalence of drinking alcohol at least once a week was 23%.

3.2. Sociodemographic Factors Associated with Alcohol Consumption. Univariate analyses suggested the following factors to be associated with alcohol consumption: age, marriage, education, occupation, and sexual orientation. After controlling for age, education, and Beijing residency, being

TABLE 1: Sociodemographic predictors for alcohol drinking among men who have sex with men in Beijing, China (N = 1140).

Sociodemographic factors ^a	Alcohol consumption (N, %)		Crude OR (95% CI)	Adjusted OR (95% CI) ^b
	<once per week (N = 875)	≥once per week (N = 265)		
Age (year)			1.03 (1.01, 1.05)	1.00 (0.98, 1.02)
Median, IQR	30 (26–35)	32 (27–39)		
Ethnicity				
Han Chinese	821 (93.8)	252 (95.1)	Reference	—
Non-Han	54 (6.2)	13 (4.9)	0.78 (0.42, 1.46)	
Marital status				
Currently married	205 (23.4)	105 (39.6)	Reference	Reference
Currently unmarried	670 (76.6)	160 (60.4)	2.14 (1.60, 2.87)	1.87 (1.29, 2.71)
Education (years of schooling)				
College and above (>12)	480 (54.9)	122 (46.0)	Reference	
Senior high school (10–12)	240 (27.5)	85 (32.1)	1.39 (1.01, 1.91)	1.24 (0.90, 1.73)
Junior high school (7–9)	133 (15.2)	48 (18.1)	1.42 (0.97, 2.09)	1.21 (0.81, 1.80)
Primary school (≤6)	21 (2.4)	10 (3.8)	1.87 (0.86, 4.08)	1.43 (0.64, 3.21)
Occupation				
Employed	752 (86.0)	204 (77.0)	Reference	Reference
Unemployed/retired	47 (5.3)	34 (13.2)	2.78 (1.76, 4.42)	2.77 (1.73, 4.45)
Student	44 (5.1)	4 (1.5)	0.86 (0.44, 1.65)	0.84 (0.42, 1.77)
Other	32 (3.6)	22 (8.3)	1.52 (0.86, 2.73)	1.53 (0.90, 2.88)
Beijing residency				
No	292 (33.4)	94 (35.6)	Reference	—
Yes	583 (66.6)	170 (64.4)	0.91 (0.68, 1.21)	
Duration of living in Beijing (years)				
≤4	365 (41.7)	100 (37.7)	Reference	—
>4	510 (58.3)	165 (62.3)	1.18 (0.89, 1.57)	
Sexual orientation				
Homosexual	602 (69.8)	156 (59.3)	Reference	
Heterosexual	9 (1.0)	4 (1.5)	1.71 (0.52, 5.64)	1.60 (0.48, 5.33)
Bisexual	252 (29.2)	103 (39.2)	1.58 (1.18, 2.11)	1.28 (0.93, 1.75)

IQR: interquartile range; OR: odds ratio; CI: confidence interval.

^aSample size may vary due to missing data. ^bAdjusted for age, education, and Beijing residency.

currently unmarried (adjusted OR [aOR]: 1.87; 95% CI: 1.29–2.71) and being unemployed/retired (aOR: 2.77; 95% CI: 1.73–4.45) were significantly associated with drinking alcohol at least once per week (Table 1).

3.3. Comparison of HIV Risk Behaviors between MSM Who Drank and Did Not Drink Alcohol. Alcohol drinking MSM were more likely to use illicit drug use (6.0% versus 1.9%; $P < 0.01$), to have female sexual partners in the past 6 months (61.5% versus 40.7%; $P < 0.01$), to have unprotected insertive (23.2% versus 17.6%; $P = 0.04$) or receptive (26.8% versus 18.3%; $P = 0.03$) anal sex with men in the past 6 months, to have ≥10 lifetime male sex partners (66.8% versus 59.8%; $P = 0.04$), to experience insertive anal sex with male partner in the past 6 months (80.4% versus 63.7%; $P < 0.01$), to predominantly practice insertive anal sex (52.7% versus 41.0%; $P < 0.01$), and to trade sex for money in the

past 12 months (10.2% versus 3.5%; $P < 0.01$). MSM who drank alcohol were less likely to have more than one lifetime female sex partner (70.2% versus 76.2%; $P = 0.04$) and to be HIV (19.8% versus 27.3%; $P = 0.02$) infected or syphilis seropositive (21.2% versus 27.7%; $P = 0.04$) (Table 2).

3.4. Meta-Analysis of Literature on Alcohol Consumption among Chinese MSM. Our search strategy identified 2527 studies; 19 met the inclusion criteria and were included for computing the meta-analytic outcome of alcohol use prevalence (Table 3). All these 19 studies used cross-sectional design, and current alcohol use rates ranged from 16.5% to 79.7%; the pooled prevalence was 32% (effect size: 0.32; 95% CI: 0.25–0.40) (Figure 1). Five studies measured only general alcohol use status (yes versus no) [21, 24, 26, 31, 34]. Seven studies measured ever use of alcohol before sex [22, 23, 32, 35, 36], and the pooled prevalence was 23% (effect size: 0.23; 95%

TABLE 2: Comparison of HIV risky behaviors between alcohol drinking and nondrinking men who have sex with men in Beijing, China (N = 1140).

Risk factors ^a	Alcohol consumption (N, %)		P value
	<once per week	≥once per week	
Illicit drug use			<0.01
No	856 (98.1)	249 (94.0)	
Yes	17 (1.9)	16 (6.0)	
Sexual orientation			<0.01
Homosexual	602 (69.8)	156 (59.3)	
Heterosexual	9 (1.0)	4 (1.5)	
Bisexual	252 (29.2)	103 (39.2)	
Sex with female partner in past 6 months			<0.01
No	519 (59.3)	102 (38.5)	
Yes	356 (40.7)	163 (61.5)	
Condom use with female partner in past 6 months			0.67
Every time	56 (27.5)	31 (30.4)	
Very often	20 (9.8)	6 (5.9)	
Rarely	29 (14.2)	16 (15.7)	
Never	99 (48.5)	49 (48)	
Number of lifetime female sex partners			0.04
<2	208 (23.8)	79 (29.8)	
≥2	667 (76.2)	186 (70.2)	
Oral sex with male partner in past 6 months			0.82
No	147 (16.8)	43 (16.2)	
Yes	726 (83.2)	222 (83.8)	
Condom use during oral sex with male partner in past 6 months			0.49
Every time	69 (9.5)	167 (75.2)	
Very often	36 (5.0)	28 (12.6)	
Rarely	72 (10.0)	7 (3.2)	
Never	546 (75.5)	20 (9.0)	
Insertive anal sex with male partner in past 6 months			<0.01
No	313 (36.3)	52 (19.6)	
Yes	549 (63.7)	213 (80.4)	
Condom use during insertive anal sex with male partner in past 6 months			0.04
Every time	324 (59.5)	117 (55.5)	
Very often	125 (22.9)	45 (21.3)	
Rarely	54 (9.9)	36 (17.0)	
Never	42 (7.7)	13 (6.2)	
Receptive anal sex with male partner in past 6 months			0.94
No	376 (43.6)	114 (43.3)	
Yes	486 (56.4)	149 (56.7)	
Condom use during receptive anal sex with male partner in past 6 months			0.03
Every time	296 (60.8)	74 (49.7)	
Very often	102 (20.9)	35 (23.5)	
Rarely	44 (9.1)	25 (16.8)	
Never	45 (9.2)	15 (10.0)	
Number of lifetime male sex partners			<0.01
<10	352 (40.2)	88 (33.2)	
≥10	523 (59.8)	177 (66.8)	
Anal sexual role with male partner			<0.01
Mainly/definitely receptive	299 (35.4)	59 (23.1)	
Mainly/definitely insertive	346 (41.0)	135 (52.7)	

TABLE 2: Continued.

Risk factors ^a	Alcohol consumption (N, %)		P value
	<once per week	≥once per week	
Versatile ^b	199 (23.6)	62 (24.2)	
Multiple concurrent male partners in past 12 months			0.27
No	807 (93.0)	241 (90.9)	
Yes	61 (7.0)	24 (9.1)	
Traded sex for money in the past 12 months			<0.01
No	839 (96.5)	238 (89.8)	
Yes	30 (3.5)	27 (10.2)	
Forced sex with any male partner			0.08
No	843 (97.0)	251 (94.7)	
Yes	26 (3.0)	14 (5.3)	
Self-reported history of sexually transmitted diseases			0.84
No	588 (69.7)	180 (70.3)	
Yes	256 (30.3)	76 (29.7)	
Syphilis seropositive			0.04
No	633 (72.3)	208 (78.8)	
Yes	242 (27.7)	56 (21.2)	
HIV seropositive			0.02
No	635 (72.7)	211 (80.2)	
Yes	238 (27.3)	52 (19.8)	

^aSample size varies due to missing data.

^bVersatile indicates mixed receptive and insertive anal sex roles.

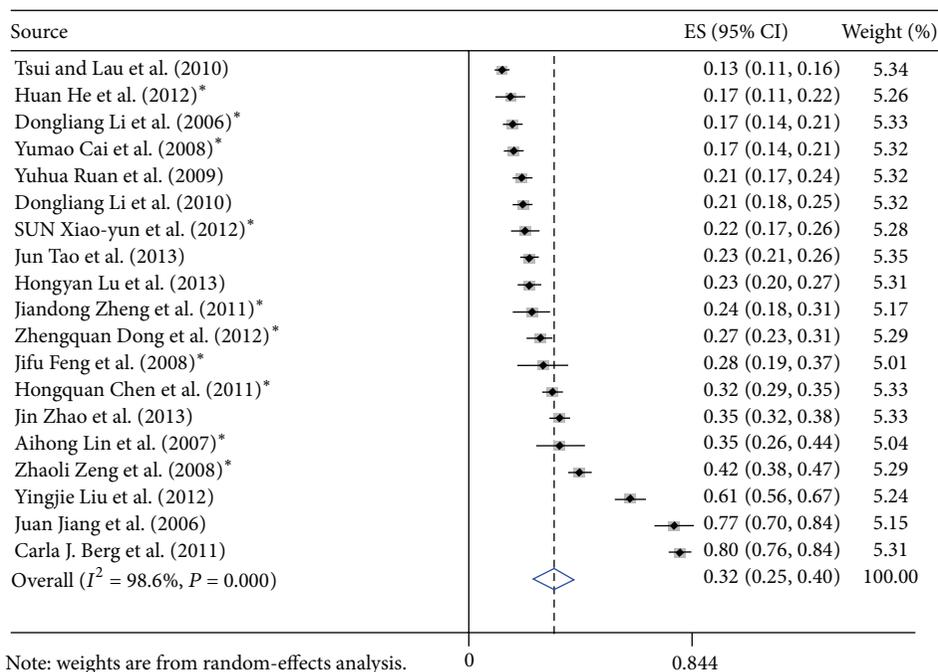


FIGURE 1: Forest plots of studies reporting prevalence of current alcohol consumption among Chinese men who have sex with men.

TABLE 3: Summary of 19 quantitative studies on prevalence of alcohol use among Chinese men who have sex with men.

Source	City	Study design	Total sample size	Study participants Age, median or mean; range	Alcohol measurement and time frame	Alcohol use prevalence (%) (number use alcohol/ analytic sample)
Lu et al. (2013) [18]	Beijing	Cross-sectional	500	Median = 30; N/A	Alcohol use \geq once per week (yes versus no) in the 12 months	23.4 (117/500)
Berg et al. (2011) [21]	Shanghai	Cross-sectional	404	N/A; N/A	General alcohol use (yes versus no) in the past 3 months	79.7 (322/404)
Li et al. (2010) [8]	Beijing	Cross-sectional	507	Median = 26; 18–62	Alcohol use \geq once per week (yes versus no) in the past 3 months	21.1 (107/507)
Tsui and Lau (2010) [22]	Hong Kong	Cross-sectional	566	N/A; 18–60	Alcohol use before sex (yes versus no) in the past 12 months	13.3 (76/566)
Zhao et al. (2013) [23]	Shenzhen, Guangdong province	Cross-sectional	801	Median = 30; 18–62	Alcohol use before sex (yes versus no) in the past 12 months	34.8 (279/801)
Jiang et al. (2006) [24]	Five cities in Zhejiang province: Nanjing, Yangzhou, Suzhou, Wuxi, and Changzhou	Cross-sectional	137	N/A; 18–70	Ever used alcohol (yes versus no)	77.4 (106/137)
Tao et al. (2013) [25]	Beijing	Cross-sectional	1140	Median = 28; N/A	Alcohol use \geq once per week (yes versus no) in the past 4 weeks	23.2 (265/1140)
Liu et al. (2012) [26]	Beijing	Cross-sectional	307	Mean = 23.7; N/A	Alcohol use (yes versus no) in the past 6 months	61.2 (188/307)
Ruan et al. (2009) [19]	Beijing	Cross-sectional	541	Median = 27; 18–62	Alcohol use \geq once per week (yes versus no) in the past 3 months	20.7 (112/541)
Zheng et al. (2011) [27]	Beijing	Cross-sectional	157	Mean = 22.7; 17–32	Alcohol use before sex (yes versus no) in the past 6 months	24.2 (38/157)
Feng et al. (2008) [28]	Taizhou, Zhejiang province	Cross-sectional	95	Mean = 27.9; 18–48	Alcohol use before sex (yes versus no) in the past 1 month	28.4 (27/95)
Chen et al. (2011) [29]	Nine cities: Harbin, Shenyang, Xi'an, Zhengzhou, Shanghai, Nanjing, Wuhan, Chongqing, and Chengdu	Cross-sectional	1470	N/A; N/A	Alcohol use \geq once per week (yes versus no) in the past 12 months	32.0 (463/1447)
Li et al. (2006) [30]	Beijing	Cross-sectional	526	Median = 23; N/A	Alcohol use \geq once per week (yes versus no) in the past 6 months	17.3 (91/526)
Lin et al. (2007) [31]	Shenzhen, Guangdong province	Cross-sectional	114	Mean = 30.5; 21–52	Ever used (yes versus no) alcohol	35.0 (40/114)
He et al. (2012) [32]	Shanghai	Cross-sectional	200	Mean = 36.3; 21–68	Alcohol use before sex (yes versus no) in the past 6 months	16.5 (33/200)

TABLE 3: Continued.

Source	City	Study design	Total sample size	Study participants Age, median or mean; range	Alcohol measurement and time frame	Alcohol use prevalence (%) (number use alcohol/analytic sample)
Xiao-yun et al. (2012) [33]	Beijing	Cross-sectional	304	Mean = 29.8; 18-49	Alcohol use \geq once per week (yes versus no) in the past 4 weeks	21.7 (66/304)
Zeng et al. (2008) [34]	Beijing	Cross-sectional	541	Mean = 28.2; N/A	Alcohol use (yes versus no) in the past 3 months	42.1 (196/466)
Dong et al. (2012) [35]	Huzhou, Zhejiang province	Cross-sectional	410	Mean = 25.5; 15-47	Alcohol use before sex (yes versus no) in the past 6 months	27.1 (111/410)
Cai et al. (2008) [36]	Shenzhen, Guangdong province	Cross-sectional	458	Mean = 27.4; 18-53	Alcohol use before sex (yes versus no) in the past 12 months	17.5 (80/458)

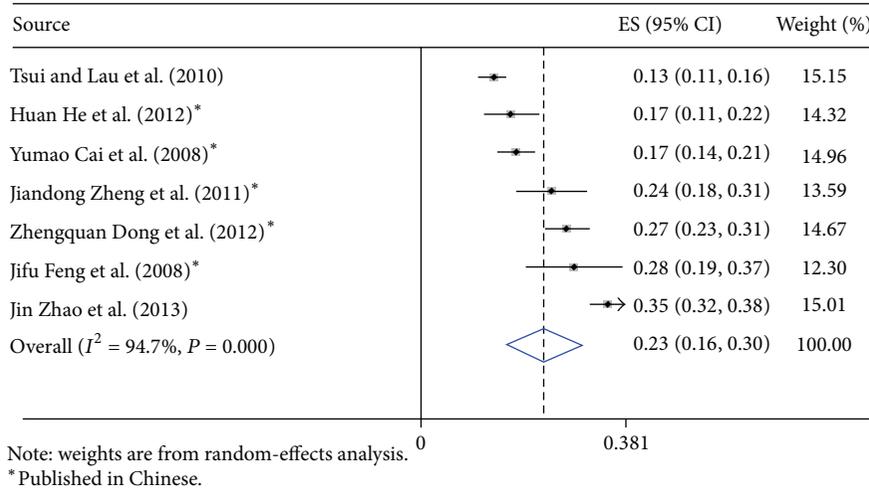


FIGURE 2: Forest plot of studies reporting prevalence of alcohol consumption before sex with male partners among Chinese men who have sex with men.

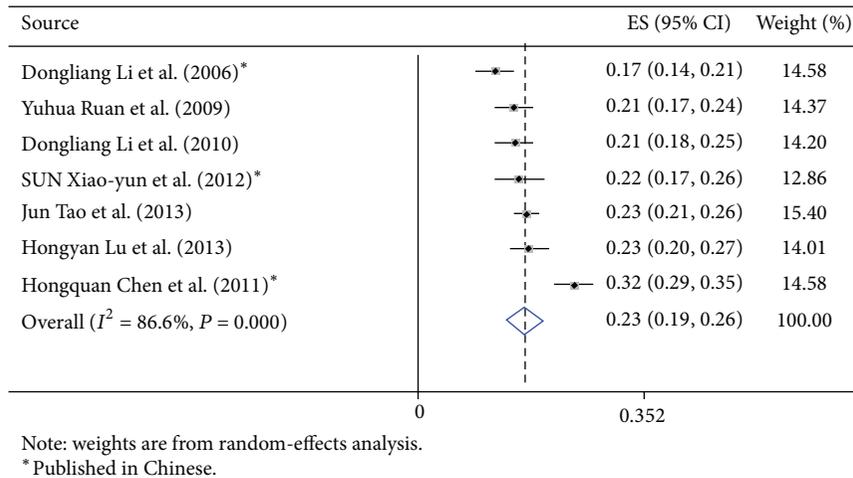


FIGURE 3: Forest plot of studies reporting prevalence of alcohol consumption \geq once a week among Chinese men who have sex with men.

CI: 0.19–0.26) (Figure 2). Seven studies measured alcohol use at least once per week [8, 18, 19, 25, 30, 33], and the pooled prevalence was also 23% (effect size, 0.23; 95% CI, 0.19–0.26) (Figure 3). Large heterogeneity was observed among these studies ($I^2 = 98.6\%$, $P < 0.01$). The funnel plot does not suggest significant publication bias (Egger’s test P value = 0.13).

4. Discussion

In our survey of Chinese MSM living in Beijing, 23% of participants reported alcohol consumption at least once a week, and no association was noted with HIV or syphilis seropositivity. Unmarried and unemployed MSM were more likely to drink alcohol. Alcohol drinking MSM were more likely to report risky behaviors including illicit drug use, larger number of sexual partners, and unprotected sex. Alcohol has been consumed worldwide for a variety of recreational and psychological reasons. Because of its psychogenic

nature and capability of impairing decision making [40], alcohol use has been associated with HIV/STI risk behaviors in both developed and developing countries [13, 14]. MSM may use alcohol for sexual arousal and expectation of casual sex [41]. Our findings are consistent with other studies that a higher frequency of alcohol consumption was associated with a greater likelihood of engaging in unprotected anal intercourse [2, 18, 19, 42, 43]. No association was seen with HIV or syphilis infections per se, suggesting transmission dynamics to be more complex that could be unraveled here.

Understanding of Chinese culture is particularly important in researching alcohol use among MSM [21]. Homosexual relationships are not legal in China and homosexuality is stigmatized in the general public because of traditional taboos and cultural discrimination [44]. Hence, Chinese MSM typically endure social isolation, stress, and low self-esteem; they suffer from psychological syndemics, as reported elsewhere in the world, representing multiple psychological vulnerabilities and related adverse health outcomes [9, 45].

With under one-quarter of Beijing MSM imbibing alcohol at least weekly, our survey found a lower alcohol consumption prevalence than the pooled prevalence among Chinese MSM that we calculated in our literature meta-analysis (32%; 95% CI: 25–40%). However, our findings are consistent with the geographic differences noted for alcohol consumption in the general Chinese population, since men in large cities are less likely to drink alcohol than in rural regions [16].

Our meta-analysis demonstrated that alcohol is often drunk before sex among Chinese MSM (pooled prevalence 23%), a well-known global risk factor for HIV and STIs. A longitudinal study in Rakai, Uganda, found the risk of contracting HIV among participant who used alcohol before sex was increased by 50% [46]. In China, about 30% of men who sought sex from female sex workers reported alcohol drinking before sex, and alcohol use was associated with less condom use and increased HIV/STIs in that context [47]. Since knowledge on factors associated with alcohol use before sex with male partners is scarce among Chinese MSM [48], more work is needed, particularly to assess casual alcohol use from heavy use, since it is the latter that is most commonly associated with high HIV/STI risks [49, 50]. Whether community-based health education may be helpful in raising consciousness about alcohol and higher risk taking among MSM is not known [51, 52].

There are several limitations in our study. First, alcohol consumption was based on self-reporting, and the data may be subjected to recall bias; since our study focused on circumcision, the alcohol use questions were not comprehensive—we did not measure the type and amount of alcohol that MSM consumed in the study [13, 53–58]. Second, the cross-sectional study design did not allow assessing the temporal relationship between alcohol consumption and HIV risk behaviors. Third, the study participants in the epidemiological survey were a convenience sample, including mixed sample from the community (HIV-unknown MSM) and from ongoing study (HIV-infected MSM), so no inference about true drinking prevalence can be justified, but the analysis on the risk factors for alcohol use provided useful information for developing intervention programs. Fourth, the studies included in the meta-analysis for computing pooled prevalence on alcohol drinking at least once per week were mostly conducted in Beijing; thus, the sample representativeness may limit the generalizability of our finding. Finally, there is high heterogeneity on alcohol use among included studies; it could be from within-study variance due to population characteristics and from between-study variances due to geographic variation and different metrics and mechanism of ascertaining alcohol use. However limited information is present to explore these factors and too few findings to warrant further stratified analyses. Despite these limitations, our study presents one of few large studies of investigating alcohol use and its correlates among MSM in China and ours is the first to assess alcohol use prevalence among Chinese MSM with a meta-analysis. Therefore, our study provides useful information for HIV prevention programs targeting this population and can signpost future work and intervention.

In summary, HIV and STI rates are rising among Chinese MSM and alcohol consumption is associated with increased risk-taking behaviors, likely through sexual disinhibition. To better understand the impact of alcohol consumption on sexual behaviors and HIV transmission among MSM, future studies should employ a prospective research design and more refined measures of alcohol use.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Acknowledgments

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Research Article

Associations between Cognitive, Sociocontextual, and Affective Variables and Unprotected Anal Intercourse among Men Who Have Sex with Men—A Comparative Study Conducted in Two Chinese Cities

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Few studies compared HIV-related risk behaviors between cities with different sociocultural environments among men who have sex with men (MSM). This study investigated the prevalence of unprotected anal intercourse (UAI) and associated individual and socio-cultural factors among Chinese MSM in Hong Kong and Shenzhen in Mainland China, which were proximal to each other but experienced different socioeconomic developments. Amongst all the 535 participants, 40.2% had had UAI. Significant factors of UAI among Shenzhen MSM included being able to find someone to share one's sexual orientation, disclosure of sexual orientation to family members, HIV risk perception, and use of alcohol or substances (adjusted OR ranged from 2.37 to 4.91), whilst disclosure of sexual orientation to family members was the only significant factor among Hong Kong MSM (adjusted OR = 1.64). Geographic variations in factors associated with UAI were observed. Future research and interventions need to take this into account.

1. Introduction

HIV prevalence among men who have sex with men (MSM) has been increasing sharply in China [1]. A number of Chinese cities (e.g., Chongqing and Chengdu) reported HIV prevalence among MSM exceeding 10% [2, 3] and HIV incidence higher than 5 per 100 person-years [4]. Moreover, risk behaviors associated with HIV infection such as unprotected anal intercourse (UAI) with different types of sex partners and multiple sex partnership [2, 5–10] are prevalent among MSM in China. Prevalent bisexual behaviors draw the attention that MSM spread HIV to the general female population [7–9].

Risk factors associated with UAI among MSM in China are multidimensional. Such factors include cognitive factors (e.g., HIV-related knowledge, risk perceptions, and perceived condom efficacy in preventing HIV) [10–14], contextual factors (e.g., condom availability and use of alcohol or psychoactive substances) [15, 16], sociocultural factors such as social support and stigma [14, 17], and affective factors such as internalized homophobia [18]. Traditional Chinese culture does not find MSM behaviors acceptable [19]. Many MSM in China had encountered stigma [2, 19]. Effective interventions need to take all these multidimensional factors into account.

This study compared the prevalence of UAI and associated factors among MSM in two cities of China: Hong Kong and Shenzhen. Hong Kong is contiguous to Shenzhen, with travel time of about one hour. Millions of travelers commute daily between the two cities. About 15% of the Hong Kong MSM travel to Shenzhen to seek male sex partners [20]. There is no similar data on how many Shenzhen MSM travel to Hong Kong for the same purpose. Nevertheless, we expect the number to be a large one as it is convenient to do so and Hong Kong is a very popular destination for mainlanders to visit. The two cities have some common grounds to facilitate comparisons. First, the HIV prevalence among MSM is comparable as it was 4.06% in Hong Kong [21] and 2.6% in Shenzhen in 2006 [22]. Second, homosexuality is currently not criminalized in both cities. In contrast, Hong Kong has a longer history of exposure to international interactions. Although discrimination against MSM is still prevalent in Hong Kong [23], the social environment surrounding MSM seems to be more open than that of Shenzhen and the gay community in Hong Kong seems to be better developed than that in Shenzhen. For instance, laws against discrimination based on sexual orientation [24], advocacy groups for gay rights, and public annual activities such as gay movie festivals exist in Hong Kong but not in Shenzhen. In Shenzhen, the only apparent gay community is that of a nongovernmental organization working on HIV prevention.

This study investigated the prevalence of UAI among MSM in Shenzhen and in Hong Kong. Associations between UAI and socioecological factors were identified separately for the Shenzhen and the Hong Kong samples. The results of the present study allow us to understand better risk factors of UAI and facilitate design of effective interventions. Some of such interventions may need to tackle prevalent cross-border risk behaviors [25] and hence may need to target MSM both in Hong Kong and in Shenzhen. The study also contributes to our understanding of degree of homogeneity of risk factors in various cities within a country that have both similarities and differences, reminding researchers of cautions in making generalization to big countries such as China from results that are obtained from a single city. These comparisons provide some insights into how the social environment affects risk behaviors among MSM.

2. Methods

2.1. Study Populations and Sampling. All respondents were Chinese males of age ≥ 18 years old, who self-reported having had anal intercourse with at least one man in the last 12 months and had never been engaged in sex work. Snowball sampling methods were used in the surveys. Respondents were recruited from local gay venues (four gay bars and five saunas in Shenzhen; six gay bars and five saunas in Hong Kong) and gay websites (only for the Hong Kong sample). Prospective respondents were briefed about the details of the study. With informed consent, face-to-face interviews were administered by experienced and well-trained interviewers, who were staff of the Shenzhen Chronic Disease Hospital (Shenzhen sample) or peer fieldworkers in Hong Kong. The

questionnaire was written in Chinese, which is the same for the two samples. The interviews were administered in Mandarin in Shenzhen and Cantonese in Hong Kong, as those are spoken by the two samples, respectively; the contents are however the same and comparability was ensured. Respondents were given about US\$6.4 as a compensation for their time spent in the study. Ethics approval was obtained from the Ethics Committee of the Chinese University of Hong Kong. The response rate was about 70%.

2.2. Measures. The dependent variable of this study was whether having had at least one episode of UAI with the same sex in the last 12 months. There are five blocks of potential factors: (1) background variables including sociodemographics, data on sexual orientation and sexual behaviors, and self-reported STD infection in the last 12 months; (2) cognitive variables including three variables that were related to HIV-related knowledge, perceived chance of contracting HIV in the future (risk perception), perceived efficacy of condom use in preventing HIV transmissions, and perceived discrimination toward MSM; (3) contextual factors including always drink alcohol before having sex and substance use in the last 12 months; (4) social factors including being able to find someone to share feelings about one's sexual orientation and disclosure of his sexual orientation to family members; and (5) affective factors including afraid of others knowing his MSM status, acceptance of his sexual orientation, and perceived negative feelings associated with MSM status (whether the respondent associated his MSM status with worry, shame, social exclusion, family/peer pressure, and fear of contracting HIV). Substance use was assessed by asking whether the participant had used psychiatric substances. A question asked about local residency is defined as having the right of abode in Hong Kong (Hong Kong respondents) and holding a registered residence card (Hukou) for Shenzhen respondents.

2.3. Statistical Analyses. The distributions of the independent variables and the dependent variable were compared by using univariate odds ratios (OR) and 95% confidence intervals (CI). Those sociodemographic variables that were univariately significantly associated with the dependent variable were entered into a multivariate stepwise logistic regression model; significant variables were adjusted for in subsequent analyses. Adjusted OR and respective 95% CI were reported. Multiplicative interactions between the independent variables and the location variable were tested by using multiple logistic regression analyses. SPSS 15.0 was used for data analyses and P value < 0.05 was taken as statistically significant.

3. Results

3.1. Between-City Differences in the Distributions of the Independent Variables. As compared to Hong Kong respondents, Shenzhen respondents were more likely to belong to the age group "25–34," to have a lower education level, to be ever married, to be currently unemployed or not being a student, and to be nonlocals ($P < 0.01$). Shenzhen respondents were

TABLE 1: Comparison of background factors between Shenzhen and Hong Kong respondents.

	All (n = 535) Col%	Shenzhen (n = 102) Col%	Hong Kong (n = 433) Col%	Shenzhen versus Hong Kong	
				ORu ¹ (95% CI)	ORadj ² (95% CI)
<i>Sociodemographics</i>					
Age group					
18–24	35.3	20.2	38.8	1.00	1.00
25–34	53.0	70.7	49.0	2.77 (1.62, 4.74)**	2.35 (1.25, 4.40)**
35–52	11.7	9.1	12.2	1.43 (0.61, 3.32)	0.58 (0.20, 1.70)
Education level					
Junior high and below	6.2	16.0	3.9	1.00	1.00
Senior high	55.2	71.0	51.5	0.34 (0.16, 0.70)**	0.66 (0.28, 1.55)
University and above	38.6	13.0	44.6	0.07 (0.03, 0.17)**	0.11 (0.04, 0.29)**
Marital status					
Never married	95.9	87.9	97.7	1.00	1.00
Ever married (e.g., divorced, widow)	4.1	12.1	2.3	5.83 (2.44, 13.93)**	7.72 (2.34, 25.48)**
Employment					
Full- or part-time	74.6	74.7	74.6	1.00	1.00
Not employed	9.2	23.2	6.0	3.86 (2.09, 7.14)**	3.21 (1.53, 6.75)**
Student	16.2	2.0	19.4	0.10 (0.02, 0.43)**	0.18 (0.04, 0.80)*
Local residence					
No	3.8	12.0	1.8	1.00	1.00
Yes	96.2	88.0	98.2	0.14 (0.05, 0.35)**	0.19 (0.07, 0.58)**
<i>Sexual orientation and sexual behaviors</i>					
UAI with men in the last 12 months					
No	59.8	59.8	59.8	1.00	1.00
Yes, UAI	40.2	40.2	40.2	1.00 (0.64, 1.55)	1.09 (0.64, 1.85)
Number of MSM partners in the last 12 months					
1–3	55.0	50.0	56.1	1.00	1.00
≥4	45.0	50.0	43.9	1.28 (0.83, 1.97)	1.24 (0.74, 2.07)
Had sex with females in the last 12 months					
No	92.5	74.5	96.8	1.00	1.00
Yes	7.5	25.5	3.2	10.24 (5.11, 20.50)**	5.46 (2.33, 12.81)**
Sexual orientation					
Homosexual	77.3	59.4	81.5	1.00	1.00
Bisexual	18.7	33.7	15.2	3.03 (1.85, 4.98)**	2.49 (1.33, 4.65)**
Not sure	3.9	6.9	3.2	2.94 (1.14, 7.59)*	2.40 (0.73, 7.88)
<i>STD infection</i>					
Self-reported STD (last 12 months)					
No	96.0	88.8	97.7	1.00	1.00
Yes	4.0	11.2	2.3	5.35 (2.20, 12.98)**	6.96 (2.35, 20.61)**

** P value < 0.01, * P value < 0.05.

¹Odds ratio of univariate analysis.

²For the analysis of the set of sociodemographic variables, adjusted odds ratios were obtained by applying stepwise multivariate analysis using variables with $P < 0.05$ in the univariate analysis as candidates. Regarding the rest of the tables, adjusted odds ratios were obtained from multivariate analysis adjusted for those sociodemographic variables which were found to be significant in the stepwise multivariate analysis.

also more likely than Hong Kong respondents to have had bisexual behaviors, self-identified as a bisexual person, and self-reported STD infection in the last 12 months ($P < 0.01$; Table 1).

Some conditions seemed to favor Shenzhen respondents, who were more likely than their Hong Kong counterparts to know about the asymptomatic property of HIV transmission (% giving incorrect responses—Shenzhen: 13.7% versus Hong

Kong: 21.7%, adjusted OR = 0.36, $P < 0.01$), less likely to perceive discrimination toward MSM (Shenzhen: 31.7% versus Hong Kong: 61.0%, adjusted OR = 0.37, $P < 0.01$), and less likely to disclose their sexual orientation to none or only some (but not all) family members (Shenzhen: 28.4% versus Hong Kong: 48.5%, adjusted OR = 0.39, $P < 0.01$; Table 2).

Other significant differences between the two cities did not favor Shenzhen respondents, who showed higher likelihood of (1) giving incorrect responses to two of the three HIV-related knowledge questions (adjusted OR = 2.53 and 5.02, resp., $P < 0.01$), (2) afraid of others knowing their MSM status (Shenzhen: 78.4% versus Hong Kong: 61.9%, adjusted OR = 2.85, $P < 0.01$), and (3) giving ≥ 3 affirmative responses to the five perceived negative feelings (worry, shame, social exclusion, family/peer pressure, and afraid of contracting HIV) associated with one's MSM status (Shenzhen: 68.6% versus Hong Kong: 48.4%, adjusted OR = 3.02, $P < 0.01$) whilst lower likelihood of (1) being able to find someone to share feelings about their sexual orientation (Shenzhen: 30.7% versus Hong Kong: 57.6%, adjusted OR = 0.32, $P < 0.01$) and (2) accepting their sexual orientation (Shenzhen: 67.6% versus Hong Kong: 90.0%, adjusted OR = 0.19, $P < 0.01$). The results of the univariate analysis are similar to those of the adjusted analysis and are presented in related tables.

3.2. Factors Associated with UAI among Shenzhen and Hong Kong Respondents. Education level and age group remained significant in the multivariate analysis among the Shenzhen and the Hong Kong respondents (data not tabulated). These two variables were adjusted for when investigating the respective associations between different factors and UAI in the two groups.

Adjusted for the significant background variables, disclosure of one's sexual orientation to family members was the only variable that was significantly associated with UAI in both samples. The association was stronger for Shenzhen respondents as compared to Hong Kong respondents (adjusted OR = 3.66 and 1.64, resp.; P value for the interaction between this variable and the location variable was 0.043; data not tabulated). In similar adjusted analysis, some independent variables were significantly associated with UAI in the Shenzhen sample but not in the Hong Kong sample. Such variables included (1) perceived chance of contracting HIV in the future, (2) always drinking alcohol before having sex, (3) using psychoactive substances, and (4) able to find someone to share feelings about his sexual orientation (Table 3). The interaction terms between the location variable and the aforementioned independent variables, adjusted for relevant sociodemographic variables, were all significant ($P < 0.05$; data not tabulated). No independent variable was significant in the Hong Kong sample but not in the Shenzhen sample in the adjusted analysis. The other factors were nonsignificant in both samples in the adjusted analysis ($P > 0.05$; see Table 3).

4. Discussion

There are both commonality and differences when the two samples were compared. In terms of similarities, the two cities

showed some similar epidemiological data such as prevalence of high risk behaviors (UAI, large number of sex partners, and use of substances and alcohol before having sex with men) and risk perception. Without a deeper look, programmers may erroneously come to the conclusion that similar HIV prevention strategies can be applied to these two cities. The sociocultural contexts are however different in some aspects that may lead to disparities.

Regarding differences, we found that Shenzhen MSM were less likely than Hong Kong MSM to perceive discrimination toward MSM. This observation was made despite the impression that Hong Kong seems to be a more westernized and open society. It is possible that Shenzhen MSM had lower awareness of their rights. For instance, Hong Kong has an antidiscriminatory act to protect the rights of having different sexual orientation and the Equal Opportunities Commission, which is a statutory body to oversee implementation of the antidiscriminatory act. It is possible that an episode that is seen as discriminatory toward MSM among Hong Kong MSM is not seen to be a case among their Shenzhen counterparts. Higher media coverage on discrimination topics in Hong Kong may also account for the difference. The literature on whether perceived discrimination affects UAI is mixed [11, 13, 26] and the association was nonsignificant in our case.

Furthermore, our Shenzhen respondents were less knowledgeable about some HIV-related knowledge items as compared to the Hong Kong respondents; our results show that such knowledge was not associated with UAI. The two samples did not differ in prevalence of perceived efficacy for using condoms to prevent HIV transmission; the variable was also not significantly associated with UAI in both samples. In the literature, the results about associations between HIV-related knowledge or some cognitive factors and UAI have been mixed [27, 28]. In many parts of China, HIV prevention targeting MSM is information-based. Our results suggest that although such campaigns are easy to implement, their effectiveness is not well supported by evidence.

The prevalence of self-reported STD was higher among Shenzhen MSM than among Hong Kong MSM. Surveillance data showed that the prevalence of syphilis among Shenzhen MSM was as high as 20% [22]. There is hence a strong need to integrate HIV and STD prevention targeting MSM in Mainland China, and some reports claimed that the two systems are separated from each other. Self-reported STD history was not associated with UAI; the risk of recurrent STD infections is high. Counseling for STD patients is warranted.

Although the level of risk perception was comparable in the two samples, it was significantly associated with UAI among Shenzhen MSM, but not the Hong Kong sample. Risk perception (perceived susceptibility) is an important component of many health behavioral theories, such as the Health Belief Model [29], and was associated with UAI in some studies though the results were not conclusive [30]. The concept is the foundation of many HIV campaigns targeting MSM—informing them that they are at risk. Our results suggested that the approach would be more effective in Shenzhen than in Hong Kong. The results further bring attention to health behavioral theorists that it is not necessary that similar associations would be observed even in two

TABLE 2: Comparison of cognitive, contextual, social, and affective factors between Shenzhen and Hong Kong respondents.

	All (<i>n</i> = 535) Col%	Shenzhen (<i>n</i> = 102) Col%	Hong Kong (<i>n</i> = 433) Col%	Shenzhen versus Hong Kong	
				ORu ¹ (95% CI)	ORadj ² (95% CI)
<i>Cognitive factors</i>					
HIV-related knowledge					
(i) Infectivity of a healthy-looking HIV-infected person					
Correct	79.8	86.3	78.3	1.00	1.00
Incorrect	20.2	13.7	21.7	0.57 (0.31, 1.05) ⁺	0.36 (0.17, 0.76)**
(ii) Infectivity via kissing with a HIV-infected person					
Correct	59.1	44.1	62.6	1.00	1.00
Incorrect	40.9	55.9	37.4	2.12 (1.37, 3.28)**	2.53 (1.50, 4.27)**
(iii) Detection of HIV one week after infection took place					
Correct	74.4	44.1	81.5	1.00	1.00
Incorrect	25.6	55.9	18.5	5.59 (3.53, 8.85)**	5.02 (2.89, 8.70)**
Perceived chance of contracting HIV in the future					
Extremely low/low	65.2	66.3	64.9	1.00	1.00
Moderate/high/extremely high	34.8	33.7	35.1	0.94 (0.59, 1.48)	0.75 (0.44, 1.28)
Perceived efficacy of condom use for HIV prevention					
Extremely low/low/moderate	14.2	17.8	13.4	1.00	1.00
High/extremely high	85.8	82.2	86.6	0.71 (0.40, 1.27)	1.51 (0.74, 3.06)
Perceived discrimination toward MSM					
No/a little	44.6	68.3	39.0	1.00	1.00
Some/very much	55.4	31.7	61.0	0.30 (0.19, 0.47)**	0.37 (0.21, 0.64)**
<i>Contextual factors (last 12 months)</i>					
Always drink alcohol before having sex					
No	84.7	81.2	85.5	1.00	1.00
Yes	15.3	18.8	14.5	1.36 (0.76, 2.42)	0.72 (0.36, 1.45)
Use of psychotropic substances					
No	84.7	78.6	86.1	1.00	1.00
Yes	15.3	21.4	13.9	1.70 (0.97, 2.95) ⁺	1.19 (0.63, 2.27)
<i>Social factors</i>					
Can find someone to share sexual orientation					
No	27.4	36.6	25.2	1.00	1.00
Yes	52.5	30.7	57.6	0.37 (0.22, 0.62)**	0.32 (0.17, 0.59)**
Do not feel such a need	20.1	32.7	17.1	1.31 (0.75, 2.29)	1.19 (0.60, 2.36)
Disclosure of sexual orientation to family members					
Yes, disclosed to all family members	55.3	71.6	51.5	1.00	1.00
Disclosed to none or only some family members	44.7	28.4	48.5	0.42 (0.26, 0.67)**	0.39 (0.23, 0.67)**

TABLE 2: Continued.

	All (n = 535)	Shenzhen (n = 102)	Hong Kong (n = 433)	Shenzhen versus Hong Kong	
	Col%	Col%	Col%	ORu ¹ (95% CI)	ORadj ² (95% CI)
<i>Affective factors</i>					
Afraid of others knowing his MSM status					
No	35.0	21.6	38.1	1.00	1.00
Yes	65.0	78.4	61.9	2.24 (1.34, 3.73)**	2.85 (1.59, 5.11)**
Accept one's sexual orientation					
No/almost no	14.2	32.4	10.0	1.00	1.00
Yes	85.8	67.6	90.0	0.23 (0.14, 0.39)**	0.19 (0.10, 0.37)**
Perceived negative feelings associated with MSM status [@]					
≤2 kinds of impacts	47.8	31.4	51.6	1.00	1.00
3~5 kinds of impacts	52.2	68.6	48.4	2.33 (1.44, 3.84)**	3.02 (1.76, 5.20)**

**P value < 0.01, *P value < 0.05, and +P value < 0.1.

¹Odds ratio of univariate analysis.

²Odds ratio adjusting for sociodemographic variables significant in the stepwise multivariate analysis in Table 1.

[@]A variable was generated by combining responses to the 5 individual items related to perceived negative feelings associated with one's MSM status (worry, shame, social exclusion, family/peer pressure, and afraid of contracting HIV).

ORs and 95% CIs with $P < 0.05$ were in bold.

societies with some similarities. It is known that theory-based HIV prevention programs are more likely to be effective as compared to nontheory-based ones [31]. However, caution should be given when using these models to guide intervention planning as geographic variations may be substantial. We cannot explain the differential associations and further studies are warranted.

Similarly, the prevalence of using substances or alcohol showed no statistically significant between-city differences but interaction effects were observed—significant associations with UAI were found in Shenzhen but not in Hong Kong. We do not know whether the differential is due to differences in the type and dosage of substances/alcohol used, settings, or ability to control oneself. Again, it cautioned us about generalization of risk factors obtained from a single city to a country, which often occurred in the literature.

Shenzhen MSM showed lower levels of acceptance and sharing, but higher level of fear for disclosure and affective distress associated with their same-sex sexual behaviors and sexual orientation. Although sexual orientation was not associated with UAI in both samples, variables related to sharing and nondisclosure related to sexual orientation were significantly associated with UAI in the Shenzhen but not in the Hong Kong sample. It suggests that it is not sexual orientation that affects risk behaviors, but it is feelings and discomfort attached to the sexual orientation that matter. In Hong Kong, there is more social space for MSM and many celebrities disclose their gay status in public. It may be easier for Hong Kong MSM to come out of the closet and form a clear identity that matches with their sexual orientation. Gay movements are very new in Mainland China. Many MSM in China migrated recently from smaller towns or rural areas to metropolitan areas [32]. To live with a MSM life-style in a new

environment is an adaptation process and confusion might arise. Support groups about the coming out process and counseling services are warranted and should be considered as part of the intervention programs in China.

The study has a number of limitations. The sampling may not be representative and respondent-driven sampling may be a better design. Responses are subject to self-report bias due to social desirability. Response rate was 70%, which is comparable to other similar studies [27, 33, 34]; refusal may be related to time issue, research topic, or other reasons. Gay websites were used for recruitment in Hong Kong but not in Shenzhen as we were not able to contact keepers of websites in Shenzhen; some sampling bias may exist. The sampling excluded male sex workers as they may have different associated factors; such decision should have improved data interpretation but may also limit generalization. The fact that different people were used to interview participants at each site was another limitation, which may cause bias when comparing the differences between sites. The sample sizes of the two groups were different and hence the power for the logistic regression analysis for factors associated with UAI; the large differences in the measures of associations (i.e., adjusted odds ratios) and the significant interaction terms, however, suggest that the difference in power of the two samples would be unable to explain the large between-cities differences. Indicator questions, instead of validated scales, were used in this study, though many of these items have been used in previous studies [20, 27].

In sum, the surveys were comparable as they used the same question items. It shows that sociocontextual variables are potentially important in explaining UAI among MSM in Mainland China. The important findings included that the associations between such variables and UAI could vary

TABLE 3: Factors associated with UAI with men in the last 12 months among the Shenzhen and the Hong Kong respondents.

	UAI in the last 12 months					
	Row %	Shenzhen (<i>n</i> = 102)		Hong Kong (<i>n</i> = 433)		
		ORu ¹ (95% CI)	ORadj ² (95% CI)	Row %	ORu ¹ (95% CI)	ORadj ³ (95% CI)
<i>Cognitive factors</i>						
Perceived chance of contracting HIV in the future						
Extremely low/low	28.4	1.00	1.00	41.3	1.00	1.00
Moderate/high/extremely high	64.7	4.63 (1.92–11.18)**	3.91 (1.57, 9.70)**	38.2	0.88 (0.59, 1.32)	0.90 (0.60, 1.36)
<i>Contextual factors</i>						
Always drink alcohol before having sex						
No	32.1	1.00	1.00	39.2	1.00	1.00
Yes	72.2	5.51 (1.77, 17.16)**	4.91 (1.53, 15.75)**	46.0	1.32 (0.77, 2.27)	1.46 (0.84, 2.52)
Use of psychotropic substances						
No	32.5	1.00	1.00	39.7	1.00	1.00
Yes	66.7	4.16 (1.49, 11.59)**	3.23 (1.09, 9.57)*	43.3	1.16 (0.67, 2.02)	1.18 (0.67, 2.07)
<i>Social factors</i>						
Can find someone to share sexual orientation						
No	29.7	1.00	1.00	41.3	1.00	1.00
Yes	58.1	3.27 (1.20, 8.92)*	4.00 (1.36, 11.73)*	37.8	0.86 (0.54, 1.37)	0.92 (0.58, 1.48)
Do not feel such a need	33.3	1.18 (0.43, 3.25)	1.38 (0.48, 4.01)	45.9	1.21 (0.67, 2.19)	1.33 (0.72, 2.46)
Disclosure of sexual orientation to family members						
Yes, disclosed to all family members	31.5	1.00	1.00	35.0	1.00	1.00
Disclosed to none or only some family members	62.1	3.56 (1.45, 8.73)**	3.66 (1.41, 9.53)**	45.7	1.57 (1.06, 2.30)*	1.64 (1.10, 2.44)*

¹Odds ratio of univariate analysis.

²Odds ratio adjusting for “education level” which is significant in the stepwise multivariate analysis (data not tabulated).

³Odds ratio adjusting for “age group” which is significant in the stepwise multivariate analysis (data not tabulated).

** *P* value < 0.01, * *P* value < 0.05, and † *P* value < 0.1.

Variables considered but not significant in either samples included (1) number of MSM partners, (2) bisexual behaviors in the last 12 months, (3) sexual orientation, (4) self-reported STD infection, (5)–(7) the three items on HIV-related knowledge (“Infectivity via kissing with a HIV-infected person” and “Detection of HIV one week after infection took place” were marginally significant in the Shenzhen sample), (8) perceived efficacy of condom use for HIV prevention, (9) perceived discrimination toward MSM, (10) afraid of others knowing his MSM status (marginally significant in the Shenzhen sample), (11) acceptance of one’s sexual orientation (marginally significant in the Shenzhen sample), and (12) perceived negative feelings associated with MSM status (worry, shame, social exclusion, family/peer pressure, and afraid of contracting HIV) related to one’s sexual orientation.

dramatically between societies, even those which are relatively comparable such as Hong Kong and Shenzhen. It also calls for caution in interpretation of results and applications of behavioral theories. Generalization of research findings should therefore be made carefully. Identification with one’s sexual orientation is potentially a huge problem among MSM in China and counseling services are warranted. More importantly, HIV intervention programs targeting MSM need to be evidence-based and would benefit from sound research support.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of the paper.

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Research Article

Changing the Landscape of the HIV Epidemic among MSM in China: Results from Three Consecutive Respondent-Driven Sampling Surveys from 2009 to 2011

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This study assessed the changes of HIV incidence and its predictors among Beijing's men who have sex with men (MSM). Three consecutive cross-sectional surveys were carried out using a consistent respondent-driven sampling (RDS) approach in 2009, 2010, and 2011, respectively. Structured-questionnaire based interviews were completed with computer-assisted self-administration. Incident infection was examined with BED capture enzyme immunoassay (BED-CEIA). The overall rate of HIV prevalence was 8.0% in the three years (95% confidence interval [CI]: 4.9%–11.2%). The overall rate of BED-CEIA incidence was 7.8/100 person years (PY) (95% CI: 5.5–10.1) with 6.8/100PY (95% CI: 3.4–10.2) in 2009, 11.2/100PY (95% CI: 6.2–16.3) in 2010, and 5.8/100PY (95% CI: 2.4–9.3) in 2011, respectively. Multivariable logistic regression analysis revealed that, compared with HIV-negative MSM, recently infected MSM were more likely to be bisexual (adjusted odds ratio [AOR] = 2.1, 95% CI: 1.1–4.1), live in Beijing ≤ 3 years (AOR = 2.1, 95% CI: 1.2–4.0), and have a negative attitude towards safe sex (AOR = 1.1 per scale point, 95% CI: 1.0–1.1). This study demonstrated a disturbing rise of HIV infections among Beijing's MSM. These findings underscored the urgency of scaling up effective and better-targeted intervention services to stop the rapid spread of the virus.

1. Introduction

Historically, the HIV epidemic in China has been confined to certain high-risk populations such as injection drug users (IDUs) and former blood and plasma donors in geographically disparate rural areas [1–6]. In recent years, the synthesized data suggested that HIV transmission has begun to shift from IDUs to populations at risk through unprotected sex, either through heterosexual contacts or male homosexual sex, accounting for nearly half of all new infections in 2007 [7]. Prevalence of HIV and other sexually

transmitted diseases (STDs), for example, syphilis, is rapidly increasing among MSM in major cities [8–17]. MSM have emerged as a high-risk group for HIV in China. A meta-analysis revealed that the overall HIV prevalence among MSM in China increased substantially from 1.4% during 2001–2003 to 2.3% during 2004–2006 and to 5.3% during 2007–2009 [18]. The sentinel surveillance demonstrated that the overall HIV prevalence among MSM increased from 0.9% in 2003 to 6.3% in 2011 [19].

HIV prevalence is one of the key indicators to describe the disease burden. However, using the prevalence alone is

difficult to capture the dynamic changes of the HIV epidemic, especially in the context of the expansion of antiretroviral treatment along with a spectrum of preventive intervention activities combined with a variety of behavioral, social, and structural factors that affected the spread of the virus. The emerging epidemic among MSM underscores the urgent need for the incidence measurement. Monitoring HIV incidence would pinpoint current dynamics of HIV infection and optimize the resource allocation for prevention activities that would result in the most HIV infections averted, resulting in the lowest HIV transmission rate possible.

There are three main ways to calculate HIV incidence. The “gold standard” method is a prospective cohort study; however, its disadvantages are it is expensive, difficult to maintain retention rate, lack of representative sampling, and the Hawthorne effect which affects a subject’s behavior and may produce a bias conclusion [20, 21]. The second method is the mathematical model based on HIV prevalence data, but that relies on locally appropriate mortality data and survival time distribution [22]. Comparatively, laboratory-based methods for incidence estimation in a single cross-sectional survey have more reliability and attraction [20]. One commercialized and widely used assay to detect and distinguish recent from long-term infections is BED capture enzyme immunoassay (BED-CEIA), which has been applied to different populations worldwide [23–26]. In this study, we assessed the rates of recent HIV infections and its correlates using the BED-CEIA among MSM.

2. Methods

2.1. Study Design, Recruitment, and Instrument. Three consecutive cross-sectional RDS surveys were conducted among Beijing MSM from September to October 2009, from October 2010 to early January 2011, and from September to December 2011, respectively. The criteria for recruiting participants included men who had a valid recruitment coupon or who were selected as a seed, had engaged in homosexual behavior in the past 12 months (sex was defined as oral, anal, or mutual masturbation), currently living or working in Beijing, were at least 18 years old, and were able to provide written, informed consent. Structured questionnaire based interviews were conducted in an HIV voluntary counseling and testing clinic (VCT) located at the Beijing Center for Disease Control and Prevention.

Respondent-driven sampling (RDS) was used to recruit participants for each cycle, of which the details of the sampling method have been previously described [27]. Briefly, each recruitment chain started with 7–10 selected “seeds” that were given three coupons to recruit up to 3 eligible peers from their social network, who in turn were screened, enrolled, interviewed, were asked to refer 3 participants, and so on until both sample size and equilibrium were reached. Seeds were chosen from diverse networks with respect to geography (e.g., bar, bathhouse, park, and internet), demographic characteristics, and subculture, and they should be sociometric stars, articulate, and motivated. There are 7, 10, and 8 seeds in 2009, 2010, and 2011. Repeated seeds were 3, 3, and 2 between 2009 and 2010, between 2009 and 2011, and between 2010 and 2011,

respectively. After signing the informed consent, we used computer-assisted self-administration to collect information on demographic characteristics, HIV risk behaviors, HIV testing history, drug use, access to HIV-related prevention services, and attitudes and perceptions of abilities for safe sex, where the psychosocial scale has been described previously [28]. This was assessed by a 15-item scale asking participants’ self-efficacy in having safe sex (strongly disagree; somewhat disagree; somewhat agree; strongly agree), where the increasing scale score means greater negative attitudes and perceptions of abilities towards safe sex, and the internal reliability was high with a Cronbach’s alpha value of 0.94 in our study. Being a bisexual was defined as someone who was married and/or self-reported to ever have had sex with a woman.

At the completion of the interview, a blood sample was obtained to test for HIV and syphilis. Participants were given 30 RMB for completion of the survey and 20 RMB for recruitment of their peers as monetary incentive. Pre- and postcounseling were offered to all participants and testing results were given within 1 to 3 weeks. At the time of specimen collection, the participant was given an appointment card with the name, telephone number, and email of the counselor, as well as the date, time, and location of their appointment for results counseling. Alternatively, the participant can arrange to contact the trained research staff for their results by telephone. BED results were not provided for participants because the main function of BED assay is to estimate population incidence rather than diagnose recent infection for an individual [20]. Those who were tested positive for HIV or syphilis were referred to appropriate medical and mental health and social support services as needed.

2.2. Laboratory Methods. Blood samples were tested for HIV and syphilis antibodies. HIV enzyme immunoassay (Vironostika HIV Uni-Form plus O, bioMerieux, The Netherlands) was used for HIV screening with a Western blot for confirmation (HIV Blot 2.2 WBTM, Genelabs Diagnostics, Singapore). Syphilis infection was determined using a rapid plasma reagin (RPR) test (Shanghai Rongsheng, China) and confirmed by the *Treponema pallidum* particle assay (TPPA) test (Fujirebio Inc., Japan). The BED IgG-capture ELISA (BED-CEIA, Calypte Biomedical Corporation, Rockville, Maryland) was applied to HIV-positive specimens for the detection of recent HIV seroconversions and estimation of HIV incidence. The basis of the assay is that it measures the ratio of HIV-specific IgG to total IgG, where the proportion slowly rises following seroconversion providing an indicator of disease progression [29]. Samples that had a normalized optical density (OD) less than or equal to the cutoff of 0.8 on the BED assay were classified as recent infections (seroconversion occurring ≤ 153 days), and others were considered as long-term infections. The calculation of HIV incidence followed US CDC’s recommended formulas.

2.3. Statistical Analyses. Statistical analysis was performed using SAS version 9.1, where results with a $P < 0.05$ were considered significant. Of note, MSM who participated in the survey repeatedly were excluded from analysis in order

to estimate the trends of HIV infection accurately. Chi-squared test was applied to compare sample demographic and behavior characteristics across survey years. To explore risk factors associated with recent HIV infection, we compared sociodemographic characteristics and behaviors of recently infected MSM to those of HIV-negative MSM using univariate logistic regression and forward stepwise multivariate logistic regression. Variables that were statistically significant in univariate analysis ($P < 0.05$) were entered into multivariate analysis. Considering the current limitations of RDSAT for conducting regression analyses [30] and the fact that the weighted RDS was performed for three individual years and no different results were found compared with the unweighted analytical method, it was determined that the time gap would have an effect on the sampling population and therefore we did not use weighted RDS analysis for the combined three cycles of data.

The study protocol and informed consent forms were reviewed and approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention (NCAIDS) in China, Vanderbilt University, and the University of California, San Francisco.

3. Results

3.1. Characteristics of Participants. A total of 501, 501, and 502 subjects were recruited in 2009, 2010, and 2011, respectively. Of the 1504 MSM assessed and screened in the three consecutive surveys, 4 participants were excluded due to being younger than 18 years old (1 participant in 2009), reporting no sexual behavior in the past year (1 participant in 2010), and having no valid recruitment card (2 participants in 2011). A total of 1500 eligible participants completed the questionnaire and provided blood samples. In the second cycle, 115 MSM participated in the first cycle repeatedly, and, in the third cycle, 57 participated in the first cycle and 28 participated in the second cycle (12 MSM participated in both the first and second cycle). As noted previously, 188 repeated participants were removed from the final sample for analysis.

Demographic and behavioral characteristics of study participants for each cycle are presented in Table 1. Major variables are different across the 3 cycles without a clear trend. In the subjects, more college or higher education level, employed, and urban MSM were recruited across the survey years. The proportion of MSM who were aware of the HIV status of the most recent male partner increased over the years from 26.4% in 2009 to 37.5% in 2011, and the proportion reporting knowing where to get an HIV test also rose from 94.2% in 2009 to 100.0% in 2011. The proportion reporting having a female sexual partner in the past 6 months decreased from 20.8% in 2009 to 10.8% in 2011, whereas the rates of unprotected sex with male or female partners both remained stably high.

3.2. HIV/Syphilis Prevalence and BED Estimated Incidence. Among 1312 participants, it was determined that 104 were infected with HIV and 1208 were HIV-negative. According to BED results, of the 104 HIV positive MSM, 45 were categorized as recently infected and 59 were long-term

infections. The ratio of incidence infection to overall infection for 3 survey years was 41.7% (15/36), 50% (19/38), and 36.7% (11/30), respectively. The overall rate of BED-CEIA incidence was 7.8/100 person years (PY) (95% confidence interval (CI): 5.5–10.1) with 6.8/100 PY (95% CI: 3.4–10.2) in 2009, 11.2/100 PY (95% CI: 6.2–16.3) in 2010, and 5.8/100 PY (95% CI: 2.4–9.3) in 2011, respectively. Overall, HIV prevalence rose from 7.2% in 2009 to 9.9% in 2010 and dropped to 7.0% again in 2011 yet remaining at a high level, while, at the same time, syphilis prevalence decreased from 22.0% in 2009 to 12.2% in 2010 and 10.5% in 2011.

3.3. Factors Associated with Recent HIV Infection. Table 2 presents the univariate and multivariate logistic analyses of variables associated with recent HIV infection among Beijing MSM. Multivariate logistic regression analyses indicated that compared with HIV-negative MSM, recently infected MSM were significantly more likely to be bisexual (adjusted odds ratio (AOR) = 2.1, 95% CI: 1.1–4.1), live in Beijing ≤ 3 years (AOR = 2.1, 95% CI: 1.2–4.0), and have a negative attitude towards safe sex (AOR = 1.1 per scale point, 95% CI: 1.0–1.1).

4. Discussion

This study revealed the alarmingly high HIV prevalence and incidence rates among Beijing MSM in the past three years. The prevalence is higher than the rates found by previous RDS surveys among Beijing MSM (0.4% in 2004, 4.6% in 2005, and 5.8% in 2006) [31]. The BED-CEIA estimated incidence is much higher than previous rates estimated in either cross-sectional studies in 2005–06 (2.9/PY in 2005, 3.6/PY in 2006) [32] or cohort study in 2007 (2.6/PY) in the same population in Beijing [16], but the rates found in this study are similar to those reported from several cities, such as 7.01%, 7.98%, and 7.8% for Chongqing from 2006 to 2008 [33], 15.43% in 2009 [34], and 7.54% for Jiangsu in 2008 [35]. MSM as a high-risk population in China are facing a severe challenge against HIV infection, and the synthesized data revealed a disturbing expansion in the epidemic among MSM in China. The findings from these three consecutive surveys signals the beginning in changing the landscape of the HIV epidemic in China. HIV transmission has begun to shift from the historically main transmission route, IDU, to populations at risk through unprotected heterosexual contacts or male homosexual sex. The unprotected sex between men has been emerging as a major route of HIV transmission in China like many other nations surrounding China which experienced a resurgence in HIV transmission among MSM [36, 37].

In this study, HIV prevalence and BED-CEIA incidence estimates were very close, and the ratio of incidence infection to overall infection for 3 survey years was between 40% and 50%, which might demonstrate that the recent infection contributes to the main cause of the expanding HIV epidemic; therefore, it is important to identify the characteristics of recently infected MSM.

This study found that recently infected MSM were significantly more likely to be bisexual, and this finding is consistent with the conclusion from a recent meta-analysis, which indicated that bisexual behavior was significantly associated

TABLE 1: Demographic and behavior characteristics of MSM, Beijing, China, 2009–2011.

Variable	2009 (<i>n</i> = 500)		2010 (<i>n</i> = 385)		2011 (<i>n</i> = 427)		<i>P</i>
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Age group in years							
18–25	173	34.6	154	40.0	147	34.4	0.5934
26–35	205	41.0	156	40.5	186	43.6	
36–71	122	24.4	75	19.5	94	22.0	
Education, completed college or more	174	34.8	172	44.7	208	48.7	<0.0001
Married to a woman currently	104	20.8	56	14.6	68	15.9	0.0325
Living with boyfriend	104	20.8	74	19.2	101	23.7	0.2896
Employment status							
Employed	454	90.8	365	94.8	416	97.4	<0.0001
Unemployed	46	9.2	20	5.2	11	2.6	
Residence							
Urban	396	79.2	343	89.1	389	91.5	<0.0001
Rural	104	20.8	42	10.9	36	8.5	
Living three years or fewer in Beijing	221	44.2	168	43.6	184	43.1	0.9440
Mean monthly income (RMB), P12M							
None	58	11.6	41	10.7	30	7.0	<0.0001
<1000	47	9.4	19	4.9	11	2.6	
1000–2999	271	54.2	173	44.9	144	33.7	
3000–4999	80	16.0	64	16.6	137	32.1	
≥5000	44	8.8	88	22.9	105	24.6	
Have health insurance	236	47.2	209	54.3	229	53.6	0.0590
Self-reported sexual orientation							
Homosexual	346	69.2	278	72.2	313	73.3	0.0693
Heterosexual	5	1.0	7	1.8	2	0.5	
Bisexual	147	29.4	93	24.2	109	25.5	
Do not know	2	0.4	7	1.8	3	0.7	
Self-reported preferred role in anal sex with men							
Equally	291	59.4	235	63.3	234	56.0	0.3509
Insertive	133	27.1	91	24.5	124	29.7	
Receptive	66	13.5	45	12.1	60	14.4	
Had male sexual partner, P6M	488	97.6	373	96.9	427	100.0	0.0020
More than five male sex partners, P6M	144	28.8	55	14.3	73	17.1	<0.0001
Type of most recent male partner, P6M							
Regular	309	63.3	205	55.0	267	62.5	0.0281
Casual	179	36.7	168	45.0	160	37.5	
Venues of founding/meeting last male partner, P6M							
Internet/bar/massage/club	306	63.1	274	73.5	300	70.3	0.0033
Bathhouse/sauna/park/public rest room	179	36.9	99	26.5	127	29.7	
Venues of sex with last male partner, P6M							
Residence/bar/club/hotel	428	87.7	341	91.4	370	86.7	0.0894
Bathhouse/sauna/park/public rest room	60	12.3	32	8.6	57	13.4	
Unprotected insertive anal sex with last male partner, P6M	127	36.6	93	38.9	112	40.4	0.6118
Unprotected receptive anal sex with last male partner, P6M	115	40.4	99	50.0	95	42.8	0.1026
Knew the HIV status of most recent male partner	129	26.4	133	35.7	160	37.5	0.0007
Disclosed HIV status to most recent male partner	236	48.4	180	48.3	230	53.9	0.1727

TABLE 1: Continued.

Variable	2009 (<i>n</i> = 500)		2010 (<i>n</i> = 385)		2011 (<i>n</i> = 427)		<i>P</i>
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Bisexual	104	20.8	55	14.3	66	15.5	0.0206
Ever had sex with a woman	283	56.6	181	47.0	207	48.5	0.0075
Had female sexual partner, P6M	104	20.8	49	12.7	46	10.8	<0.0001
Unprotected sex with most recent female partner, P6M	75	72.1	41	85.4	35	76.1	0.2024
Knows where to get HIV test	470	94.2	383	99.5	427	100.0	<0.0001
HIV testing history							
Never tested	166	33.2	148	38.4	93	21.8	
Tested more than one year prior to interview	68	13.6	48	12.5	49	11.5	
Tested within the past year	55	11.0	55	14.3	49	11.5	<0.0001
Tested within the past 6 months	142	28.4	102	26.5	197	46.1	
Tested within the past 3 months	69	13.8	32	8.3	39	9.1	
Received free condoms/lubricant, P12M	436	87.2	267	69.4	330	77.3	<0.0001
Bought condoms, P12M	249	49.8	234	60.8	246	57.6	0.0029
Drug use, P12M	4	0.8	2	0.5	4	0.9	0.7847
Smoking, P12M	217	43.4	154	40.0	153	35.8	0.0640
Level of HIV risk via homosexual contacts for self-perception							
Great	63	12.6	28	7.3	42	9.8	
Moderate	92	18.4	80	20.8	75	17.6	
Small	286	57.2	202	52.6	272	63.7	0.4414
None	59	11.8	74	19.3	38	8.9	
Current test HIV positive	36	7.2	38	9.9	30	7.0	0.2433
Current test syphilis positive	110	22.0	47	12.2	45	10.5	<0.0001

*RMB: renminbi, approximately US \$0.15; P12M: in the past 12 months; P6M: in the past 6 months; chi-squared test was used to compare proportions.

with a 30% increased risk of HIV infection [38]. In the present study, the three-year overall percentage of bisexual MSM and currently married MSM was 17.1% and 17.4%, respectively. The marriage rate was in agreement with the result from a systematic review which reported a national average of 17.0%, higher than most Western developed countries [39]. Chinese MSM suffer from both HIV-related and homosexuality-related stigma [40, 41], where they get married to cover their homosexual orientation, which when combined, these married MSM can be difficult to be reached and intervened. Common bisexual behaviors combined with inconsistent condom use put themselves and their female partner at high risk for HIV exposure. Further research is needed to understand the bridging effect of transmitting HIV from MSM to their female partners.

This study also found that MSM living in Beijing ≤ 3 years compose a risk group of recent HIV infection. Compared with longtime residents, recent migrants may lack HIV-related knowledge, have a low level of HIV infection awareness, and lack information about HIV/AIDS-related healthcare services, such as voluntary counseling and testing, condom distribution programs, and free antiretroviral therapy. Recent migrants are at particular risk for HIV infection; therefore, it is important to improve their access to HIV prevention and treatment services, and further study

is needed to explore the differences between longtime and short-term residents.

Previously published studies among Chinese or foreign MSM indicated that unprotected anal sex was a predictor of recent HIV infection [42, 43], and, although we did not find that relationship in our study, we found that holding a negative attitude towards safe sex practices was associated with recent HIV infection. In the three annual cross-sectional surveys, more than two-thirds of MSM had multiple male sex partners in the past 6 months, and about two-fifths reported unprotected insertive or receptive anal sex in the past 6 months over the period. Given the common multiple sexual partnerships and low rate of condom use in this population, more health education and harm reduction programs are urgently needed to change their low perception of HIV infection risk and increase their confidence in practicing safer sex.

We recognized the limitations of the study. First, the questionnaire involves private and sensitive HIV risk behaviors, so participants may choose to give socially desirable answers instead of true effects, which might introduce information bias. Second, the cross-sectional study design cannot establish the causality between associated factors and recent HIV infection. Third, due to misclassification of long-term HIV infection as recent infection among persons who are on

TABLE 2: Risk factors associated with recent HIV infection among MSM, 2009–2011 (recent HIV infection versus HIV negative, $N = 1253$).

Variable	Recent infection % (N)	OR (95% CI)	P	AOR (95% CI)	P
Age group in years					
18–25	3.5 (16)	1.0			
26–35	3.3 (17)	0.9 (0.5–1.9)	0.8227		
36–71	4.4 (12)	1.2 (0.6–2.7)	0.5706		
Education					
College or above	3.1 (17)	1.0			
High school or less	3.9 (28)	1.3 (0.7–2.3)	0.4575		
Current marital status					
Unmarried	3.1 (32)	1.0			
Married	6.0 (13)	2.0 (1.0–3.9)	0.0386		
Living with boyfriend					
Yes	1.5 (4)	1.0			
No	4.2 (41)	2.9 (1.0–8.1)	0.0453		
Employment status					
Employed	3.7 (44)	1.0			
Unemployed	1.5 (1)	0.4 (0.1–2.9)	0.3600		
Residence					
Urban	3.6 (39)	1.0			
Rural	3.5 (6)	1.0 (0.4–2.3)	0.9219		
Years living in Beijing					
>3	2.5 (18)	1.0		1.0	
≤3	5.0 (27)	2.0 (1.1–3.7)	0.0221	2.1 (1.2–4.0)	0.0153
Mean monthly income (RMB), P12M					
≥1000	3.6 (38)	1.0			
<1000	3.7 (7)	1.0 (0.5–2.3)	0.9523		
Have health insurance					
Yes	3.2 (21)	1.0			
No	4.0 (24)	1.2 (0.7–2.3)	0.4771		
Self-reported sexual orientation					
Others	4.1 (15)	1.0			
Homosexual	3.4 (30)	0.8 (0.4–1.5)	0.5443		
Self-reported preferred role in anal sex with men					
Equally	4.6 (33)	1.0			
Insertive	2.1 (7)	0.4 (0.2–1.0)	0.0487		
Receptive	3.1 (5)	0.7 (0.3–1.7)	0.3875		
No. of male sex partners, P6M					
≤5	3.0 (30)	1.0			
>5	5.9 (15)	2.0 (1.1–3.8)	0.0318		
Type of most recent male partner, P6M					
Regular	3.3 (25)	1.0			
Casual	4.2 (20)	1.3 (0.7–2.3)	0.4473		
Venues of founding/meeting last male partner, P6M					
Internet/bar/massage/club	3.9 (33)	1.0			
Bathhouse/sauna/park/public rest room	3.2 (12)	0.8 (0.4–1.6)	0.5326		
Venues of sex with last male partner, P6M					
Residence/bar/club/hotel	3.3 (36)	1.0			
Bathhouse/sauna/park/public rest room	6.6 (9)	2.1 (1.0–4.4)	0.0553		

TABLE 2: Continued.

Variable	Recent infection % (N)	OR (95% CI)	P	AOR (95% CI)	P
Unprotected insertive anal sex with last male partner, P6M					
No	2.7 (14)	1.0			
Yes	3.8 (12)	1.4 (0.6–3.1)	0.3894		
Unprotected receptive anal sex with last male partner, P6M					
No	4.8 (18)	1.0			
Yes	5.6 (16)	1.2 (0.6–2.3)	0.6490		
Knew the HIV status of most recent male partner					
Yes	3.1 (13)	1.0			
No	3.9 (32)	1.3 (0.7–2.4)	0.4914		
Disclosed HIV status to most recent male partner					
Yes	3.4 (21)	1.0			
No	4.0 (24)	1.2 (0.7–2.2)	0.5677		
Bisexual					
No	3.1 (32)	1.0		1.0	
Yes	6.1 (13)	2.0 (1.1–4.0)	0.0339	2.1 (1.1–4.1)	0.0317
Ever had sex with a woman					
Yes	4.1 (26)	1.0			
No	3.1 (19)	0.7 (0.4–1.4)	0.3445		
Had female sexual partner, P6M					
Yes	3.1 (6)	1.0			
No	3.7 (39)	1.2 (0.5–2.8)	0.7169		
Unprotected sex with most recent female partner, P6M					
No	4.4 (2)	1.0			
Yes	2.8 (4)	0.6 (0.1–3.5)	0.5990		
Received a test for HIV, P12M					
Yes	3.4 (24)	1.0			
No	3.9 (21)	1.2 (0.6–2.1)	0.5916		
Received free condoms/lubricant, P12M					
Yes	3.4 (33)	1.0			
No	4.5 (12)	1.4 (0.7–2.7)	0.3725		
Bought condoms, P12M					
Yes	4.4 (31)	1.0			
No	2.5 (14)	0.6 (0.3–1.1)	0.0768		
Received free STD examination or treatment					
Yes	3.8 (22)	1.0			
No	3.4 (23)	0.9 (0.5–1.7)	0.7632		
Received free VCT					
Yes	3.9 (25)	1.0			
No	3.2 (20)	0.8 (0.4–1.5)	0.4989		
Main resource of knowledge of HIV/AIDS					
Internet	3.4 (16)	1.0			
Friend/relative/sex partner/peer education/TV/newspapers/ doctors/VCT/school education	3.7 (29)	1.1 (0.6–2.0)	0.7657		
Smoking, P12M					
No	3.7 (28)	1.0			
Yes	3.5 (17)	0.9 (0.5–1.7)	0.8265		
Negative attitudes towards safe sex (Cronbach's alpha = 0.94, range = 15–60, median = 20)	na	1.1 (1.0–1.1)	0.0006	1.1 (1.0–1.1)	0.0012

TABLE 2: Continued.

Variable	Recent infection % (N)	OR (95% CI)	P	AOR (95% CI)	P
Current test syphilis positive					
No	3.2 (34)	1.0			
Yes	6.0 (11)	1.9 (1.0–3.9)	0.0639		
Year					
2009	3.1 (15)	1.0			
2010	5.2 (19)	1.7 (0.8–3.4)	0.1351		
2011	2.7 (11)	0.9 (0.4–1.9)	0.7018		

*RMB: renminbi, approximately US \$0.15; P12M: in the past 12 months; P6M: in the past 6 months; OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio; NA: not applicable.

antiretroviral therapy or who have AIDS but with declining antibody levels, the BED assay may overestimate incidence rates [20, 44]. Lastly, although RDS is effective in reaching hard-to-reach populations, it is based on a dual incentive regime; therefore, financial reward may attract more low-income people to participate in the study which may limit the representativeness of the sample [30]. Although there are limitations in our study, it adds to our understanding of the dynamics of HIV infections among Beijing MSM.

This study, together with our previous study findings, demonstrated a disturbing rise of HIV infections among Beijing's MSM. HIV disproportionately affected MSM who were bisexual, short-term Beijing residents, with a negative attitude towards safe sex. These findings underscored the urgency of increasing effective and better-targeted intervention services to stop the rapid spread of the virus, which includes risk reduction education, condom promotion and distribution, encouraging early and frequent HIV testing, and expanding the coverage of HIV prevention measures. These interventions will help curb the spread of HIV infection inside and outside the MSM population.

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors' Contribution

Xuefeng Li performed data retrieval and statistical analyses to prepare and write the initial draft of the paper. Yuhua Ruan and Yan Xiao were the PI of this study and constructed the conceptual framework of the work. Hongyan Lu, Yuejuan Zhao, Dongyan Xia, Yanming Sun, and Xiong He contributed to data collection and survey organization. Yujiang Jia, Catherine Cox, and Yiming Shao provided assistance in the conceptualization of the paper and contributed to revising and editing the final draft of the paper. All authors have read and approved the final version of the paper.

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