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Original Article

Prevalence and risk factors of HIV and syphilis, and knowledge and risk behaviors related to HIV/AIDS among men who have sex with men in Chongqing, China

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Abstract

High HIV prevalence and incidence burdens have been reported in men who have sex with men (MSM) in Chongqing, China. We aimed to estimate the prevalence of HIV and other sexually transmitted infections (STIs), to appraise the knowledge and risk behaviors related to HIV/AIDS among MSM, and to analyze the possible causes of deviation between behavior and knowledge to make better strategies. We recruited 617 MSM from February to July in 2008 by using a respondent-driven sampling (RDS) method in Chongqing, China. Through the collection of questionnaire-based data and biological testing results from all objects, we launched a cross-sectional survey. STATA/SE was used for data analysis by frequency, ANOVA, rank sum test and logistic regression models. MSM with syphilis (OR=4.16, 95%CI: 2.35-7.33, $P<0.0001$) were more likely to be HIV infected. Being a company employee (OR=3.64, 95%CI: 1.22-10.08, $P<0.0001$) and having bought male for sex (OR=3.52, 95%CI: 1.10-11.32, $P<0.034$) were associated with a higher probability of syphilis. MSM with younger age, higher education and greater monthly income had a higher mean knowledge score. MSM who had HIV testing had a higher mean knowledge score than those who never had. Students, venues for finding sex partners by Internet and homosexuals in MSM had a higher mean knowledge score compared to other occupations, venues for finding sex partners and sexual orientation. There is an urgent need for delivery of barrier and biomedical interventions with coordinated behavioral and structural strategies to improve the effect of HIV interventions among MSM.

Keywords: HIV/AIDS, men who have sex with men, Chongqing, China

Introduction

High HIV prevalence and incidence burdens have been reported in men who have sex with men (MSM) all over the world[1]. MSM always play a key role in the global HIV epidemic[2]. In high-income countries, MSM continued to account for a large percentage (61%) of new HIV infections in the United States

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in 2009[3]. HIV infections in MSM have been increasing at an alarming annual rate of 8% since 2001[4]. Various studies during the past decade have assessed the severity of the HIV epidemic in MSM in low-income and middle-income countries[5-6]. Prevalence of HIV among MSM in developing Asian countries was high and increasing, such as 9.0% in Indonesia and 14.7% in India[5]. Studies in Thailand showed that HIV prevalence among MSM increased rapidly form 17.3% in 2003 to 30.8% in 2007[7].

In mainland China, the proportion of HIV cases attributed to MSM has increased rapidly[8-9]. By 2007, the major groups infected with HIV were injection drug users (IDUs; 38.5%), former blood donors (FBD; 19.3%) and promiscuous heterosexuals (17.8%)[10]. In 2009, sexual transmission, including both heterosexual and homosexual transmission, has become the main pattern of HIV infection, accounting for more than 70% of the estimated new infections in China[11]. In recent years, the prevalence of HIV among MSM, which varies geographically, has increased rapidly in China. In Chengdu, rates went from 10.4% in 2006 to 12.5% in 2007[12]. In Beijing, it increased from 0.4% to 5.8% in 2 years form 2004[13].

Chongqing is located in the upper Yangtze River, being the youngest and largest municipality directly under the Central government's administration. With the development of society and economy, Chongqing plays an important part in the development tactics for western China[14-15]. Since the first HIV infection was reported among MSM in Chongqing in 2004, research among MSM in Chongqing has documented rising levels of HIV from 10.9% in 2006 to 12.8% in 2007[16]. However, surveillance among the high-risk MSM population is particularly limited. In addition, there are finite scientific data describing the knowledge and risky sexual behaviors related to HIV/AIDS among MSM in China.

Therefore, we aimed to estimate the prevalence of HIV infection and other sexually transmitted infections (STIs), to appraise the knowledge and risk behaviors related to HIV/AIDS among MSM, and to analyze the possible causes of deviation between behavior and knowledge in Chongqing, China, as well as to make better strategies from the aspects of knowledge and behavioral intervention to control the spread of HIV in MSM.

Patients and methods

Study population and procedures

We conducted the study form February 2008 to July 2008 in Chongqing, China. The target population was MSM aged 18 years or older with a valid recruitment coupon (excluding seeds), who had taken part in oral or anal sex with other men in the past years. Participants were recruited using a respondent-driven sampling (RDS) approach. According to our previous experience, MSM were most likely to gather in bars, bathhouses, parks and some particular websites, and there were estimated about 15,000 MSM living in Chongqing[17]. After considering demographic characteristics and subgroup memberships, active social network, and motivation to recruit peers, 5 MSM were selected randomly as initial seeds during formative research through focus group discussion. Each seed was compensated with 30 Chinese Yuan (approximately 4.4 US dollars) or a gift or a prepaid phone card of equivalent value after he was interviewed. He was also provided with 3 recruitment coupons for 3 other MSM peers from his social networks to initiate chains of referrals to the study. For each of recruited MSM who afterwards finished the study interview, the seed was also given 20 Yuan (approximately 3.0 US dollars). The process went round and round until the predefined sampling size was met.

Questionnaires and biological sampling

All participants were interviewed by structured and anonymous questionnaires after informed agreement. All the face-to-face interviews were conducted in a separate and private room of the district clinic. The survey questionnaire includes demographics, recruitment connections, social network size, sexual orientation, recent sexual behavior, commercial sex, number of partners, condom use, drug use, self-reported STI history, previous HIV testing behaviors, HIV knowledge and coverage of HIV prevention services.

The questionnaire content about HIV/AIDS knowledge is detailed in ***Supplementary Table 1***. Knowledge of AIDS was assessed using a mean score developed from eight questions listed in ***Supplementary Table 1*** regarding HIV transmission and concepts. One point was given for each correct answer and 0 point for each incorrect or unanswered question.

Venous blood samples (5 mL) were collected to test for HIV, syphilis and HCV. Plasma HIV antibodies were tested by ELISA (Acon Biotech, Hangzhou, Zhejiang, China), and positive results were verified by Western blotting assay (Genelabs Diagnostics, Singapore). Syphilis seropositivity was determined using a rapid plasma reagin test (RPR; Beijing Wan Tai Biologic Pharmacy, Beijing, China) and a passive particle agglutination test (TPPA; Livzon Pharmaceutical Group, Fuzhou, Fujian, China). Counseling treatments were offered to all cases with confirmed syphilis testing results. The presence of HCV antibody was tested by ELISA. All

laboratory results were approved and checked by the Chongqing HIV Test Certificate Centre Laboratory and the Chongqing Center for Disease Control and Prevention Laboratory.

Statistical analysis

Questionnaire-based data and biological testing results were recorded, double checked using EpiData software (EpiData for Windows: the EpiData Association Odense, Denmark). Descriptive analyses were made to represent the demographics, prevalence of HIV, syphilis and HCV, HIV/AIDS knowledge, and behavior characteristics. Specific data were depicted and analyzed by frequency, ANOVA, rank sum test and logistic regression models. Each statistical indicator has many within groups, and the analysis results were all obtained by ANOVA. If the result was statistically significant ($P < 0.05$), we explained the variation within groups after S-N-K or LSD-t test. Univariate analysis was done to calculate odds ratios (OR) and their 95% confidence intervals (CI). Variables at the level of $P<0.1$ in the univariate analyses were included in the multivariate logistic regression model, determining adjusted odds ratio (AOR) and their 95%CI after adjusting for the effects of some possible confounding or background variables. Such adjustments compensate for potential bias arising from different personal social network sizes and respondents' homophily (recruitment of participants often occurred within certain groups)[18]. Variables with $P<0.05$ were retained in the final multivariate logistic model. Statistical significance of univariate logistic regression analysis of risk behaviors among different score groups of MSM was defined by $P<0.2$. Missing values were treated as separate categories for clarity, but otherwise received no special treatment; rather, all regression models were run using complete cases. Statistical analyses were conducted using STATA/SE V11.2 (StataCorp LP, College Station, TX, USA).

Ethical review

The survey protocol was approved by Chongqing Center for Disease Control and Prevention. The interview was taken in a private room in Chongqing CDC. Oral or written informed consent was obtained

Table 1 **Demographic and baseline characteristics of MSM in Chongqing, China, 2008**

Characteristics	Subjects (%)	HIV, n	Prevalence (95% CI)	Unadjusted OR(95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age (years)							
	487(78.93)	67	13.76(10.51-17.04)	1		1	
≥30	130(21.07)	33	25.38(16.43-33.67)	2.18(1.26-3.57)	0.01	0.91(0.48-1.98)	0.79
Marital status							
	528(85.58)	72	13.63(10.71-16.68)	1		1	
Ever married	89(14.42)	28	31.52(14.38-53.91)	2.40(1.54-5.67)	0.03	2.78(0.82-6.03)	0.11
Ethnicity							
	602(97.57)	97	16.11(13.23-19.16)	1			
Non-Han Chinese	15(2.43)	3	20.00(0.00-42.91)	1.30(0.36-4.70)	0.69		
Highest education							
College or above	343(55.59)	42	12.24(8.83-15.76)	1			
Senior high	177(28.69)	38	21.47(15.42-27.67)	1.96(1.21-3.17)	0.01	1.25(0.61-2.58)	0.54
Junior high	97(15.72)	20	20.62(12.48-28.83)	1.86(1.03-3.35)	0.04	0.71(0.33-1.51)	0.37
Household registration							
	480(77.80)	76	15.83(12.61-19.12)	1			
Non-local resident	137(22.20)	24	17.52(11.13-24.05)	1.13(0.68-1.87)	0.64		
Monthly income(RMB)							
≥1,000	245(39.71)	40	16.33(11.72-21.01)	1			
1,001-2,000	185(29.98)	36	19.46(13.72-25.26)	1.24(0.75-2.04)	0.40		
2,001-3,000	105(17.01)	14	13.33(6.78-19.92)	0.79(0.41-1.52)	0.48		
>3,000	82(13.29)	10	12.20(5.01-19.47)	0.71(0.34-1.50)	0.37		
Occupation							

Continued

Table 1 **Demographic and baseline characteristics of MSM in Chongqing, China, 2008 (continued)**

Characteristics	Subjects (%)	HIV, n	Prevalence (95% CI)	Unadjusted OR(95% CI)	*P*	Adjusted OR(95% CI)	*P*
Student	142(23.01)	17	11.97(6.67-17.48)	1			
Commercial services	110(17.83)	22	20.00(12.43-27.69)	0.79(0.36-1.77)	0.57	0.93(0.47-4.88)	0.31
Company employee	113(18.31)	11	9.73(4.28-15.34)	2.27(1.28-6.90)	0.02	1.67(0.54-4.03)	0.38
Canting and food industry	39(6.32)	11	28.20(13.45-43.09)	1.84(0.92-3.66)	0.08	1.47(0.81-2.67)	0.21
Housework or unemployed	48(7.78)	12	25.00(12.30-37.72)	0.81(0.62-3.14)	0.36	0.90(0.47-4.26)	0.37
Others	165(26.74)	27	16.37(10.73-22.16)	0.91(0.34-0.89)	0.01	0.72(0.87-1.45)	0.11
Orientation							
Heterosexual and bisexual	217(35.17)	34	15.67(10.81-20.58)	1			
Homosexual	379(61.43)	63	16.62(12.94-20.48)	1.07(0.68-1.69)	0.76		
Syphilis infection							
	545(88.33)	71	13.03(10.21-15.98)	1			
Positive	72(11.67)	29	40.28(28.71-51.97)	4.50(2.64-7.67)	<0.001	4.16(2.35-7.33)	<0.001
HCV infection							
	591(95.79)	96	16.24(13.31-19.26)	1			
Positive	26(4.21)	4	15.38(0.55-30.20)	0.94(0.32-2.78)	0.91		
VCT							
	419(67.91)	63	15.04(11.62-18.57)	1			
Yes	198(32.09)	37	18.69(13.26-24.21)	1.30(0.83-2.03)	0.25		
STD symptoms in the preceding year							
	490(79.42)	75	15.31(12.13-18.54)	1			
Yes	127(20.58)	25	19.69(12.72-26.76)	1.35(0.82-2.24)	0.23		
Venues for finding sex partners							
Bars/tea houses/ dance halls	95(15.40)	16	16.84(9.23-24.54)	1			
Public bathhouses/ saunas	26(4.21)	6	23.08(5.72-40.47)	1.48(0.51-4.27)	0.47		
Parks/public toilet	21(3.40)	2	9.52(0.00-23.20)	0.52(0.11-2.46)	0.41		
Internet sites	406(65.80)	62	15.27(11.82-18.87)	0.89(0.49-1.62)	0.70		
Other	69(11.18)	14	20.29(10.66-30.03)	1.26(0.57-2.78)	0.57		
Buy male sex							
	496(80.39)	78	15.73(0.00-37.90)	1			
Yes	17(2.76)	3	17.65(10.78-25.87)	1.11(0.31-3.94)	0.87		
Sell sex to a male							
	464(75.20)	78	16.81(13.42-20.24)	1			
Yes	49(7.94)	3	6.12(0.00-13.16)	0.32(0.10-1.04)	0.06	0.32(0.09-1.12)	0.08
Number of male sex partners							
0	104(16.86)	19	18.27(10.72-25.85)	1			
1	202(32.74)	33	16.34(11.23-21.50)	1.08(0.60-1.95)	0.79		
2-10	271(43.92)	45	16.61(12.18-21.19)	0.69(0.33-1.44)	0.33		
>10	28(4.54)	3	10.71(0.00-22.94)	1.45(0.80-2.65)	0.22		
Consistent condom use with male partners							
Never	61(9.89)	8	13.11(4.43-21.87)	1			
Occasionally	261(42.30)	43	16.48(11.91-21.07)	1.00(0.60-1.71)	0.98		
Every time	191(30.95)	30	15.71(10.56-20.90)	0.95(0.54-1.68)	0.87		
Number of female sex partners							
0	517(83.79)	82	15.86(12.76-19.07)	1			
1	72(11.67)	13	18.06(9.04-27.28)	1.14(0.60-2.18)	0.68		
>2	25(4.05)	3	12.00(0.00-25.74)	0.71(0.21-2.42)	0.58		

Note: HCV: hepatitis C virus; HIV: human immunodeficiency virus; MSM: men who have sex with men; OR: odds ratios; VCT:

from every participant. Every step was taken to ensure the privacy and confidentiality of all participants, who were also provided individual risk reduction counseling in the survey.

Results

Demographic characteristics

A total of 617 MSM participated in this survey. As shown in ***Table 1***, most participants were young (78.9% aged <30 years), never married (85.6%), Han Chinese (97.6%), highly educated (55.6% had a college education or above), local residents (77.8%), had incomes below 1,000 RMB per month (39.7%), and were homosexual (61.4%). The majorities of the participants had not been tested (67.9%) over 1 year and did not have sexually transmitted disease (STD) symptoms (79.4%) in the past years. Data analysis also demonstrated that the largest proportion of the subjects (65.8%) sought out sexual partners from the Internet.

Prevalence and risk factors

As shown in ***Table 2***, the prevalence of HIV, syphilis and HCV was 16.2% (100/617), 11.7% (72/617) and 4.2% (26/617), respectively. The prevalence of co-infection of HIV and syphilis and co-infection of HIV and HCV was 4.7% (29/617) and 0.6% (4/617), respectively.

The results of univariate and multivariate analysis of risk factors related to HIV and syphilis are shown in ***Table 1*** and ***Table 3***, respectively. According to the logistic multivariate analysis, syphilis-positive participants (OR = 4.16, 95%CI: 2.35-7.33, $P<0.0001$) were more likely to have an HIV infection. As also shown in ***Table 3***, being a company employee (OR = 3.64, 95%CI: 1.22-10.08, $P<0.0001$) and having bought sex service from a male partner (OR = 3.52, 95%CI: 1.10-11.32, $P = 0.034$) were associated with a higher probability of syphilis positivity.

Knowledge and risk behaviors related to HIV/AIDS

Regarding the 3 transmission routes of HIV, many participants gave different answers. A total of 95.3% selected mostly "blood transmission (Q2 and Q3)"; the second most frequent answer was "mother to child (Q6)" with 94.5%, and "sexual transmission (Q4 and 5)" was selected by 81.7%. Participants were significantly more likely to disprove (88.8%) than approve (11.2%) the misconception that HIV could be transmitted by dining together with HIV carriers or with patients with AIDS (Q7). When asked if HIV can be transmitted *via* a mosquito bite (Q8), more than 60% of the participants chose the correct transmission route. The mean knowledge score about HIV/AIDS and the results of ANOVA and rank sum test are shown in ***Table 4***. All the background factors, including age, education, occupation, income, venues for finding sexual partners, HIV testing, and sexual orientation, showed a statistical significance for mean knowledge score. According to the results of rank sum test, MSM with younger age, higher education and more monthly income had a higher mean knowledge score. MSM who had HIV testing had a higher mean knowledge score than those who never had. When the results were all obtained by ANOVA in multigroup analysis, we used Student-Newman-Keuls (S-N-K) or least significant difference (LSD)-t test to explain variation within groups. All the results had statistical significance ($P<0.05$). MSM with different levels of occupation, venues for finding sex partners and sexual orientation had different mean knowledge scores related to HIV/AIDS. Students, venues for finding sex partners by the Internet and homosexuality in MSM had a higher mean knowledge score compared to other occupations and sexual orientation.

MSM were divided into 3 groups according to the different scores. The first group had a score of less than 6, who poorly mastered the knowledge. The second group had a score of 6 or 7, who had better grasp of the knowledge. The third group had a score of 8, who had a comprehensive understanding of the knowledge. Some risk behaviors, such as age at first sexual behavior with male, anal intercourse with a male sex partner in the past 6 months, never using condom during male intercourse in the past 6 months, and using a condom for intercourse with a female, had important significance in statistics. Details are shown in ***Table 5***.

Discussion

The prevalence of HIV among MSM has skyrocketed in the past few years in Chongqing, China. Our study found a very high HIV prevalence (16.2%), which is higher than that of other large and cosmopolitan cites in China. For instance, the

Table 2 **Prevalence of HIV, syphilis and HCV among 617 MSM in Chongqing, China, 2008**

	Positive number	Infection rate(95% CI)
HIV	100	16.2(13.2-19.1)
Syphilis	72	11.7(9.1-14.2)
HCV	26	4.2(2.6-5.8)
HIV and Syphilis	29	4.7(3.0-6.4)
HIV and HCV	4	0.6(0.01-1.3)
Syphilis and HCV	6	1.0(0.2-1.7)

Table 3 **Prevalence and risk factors of syphilis for MSM in Chongqing, China, 2008**

Characteristics	Syphilis, n(%)	Prevalence (95%CI)	Unadjusted OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age(years)						
	48(66.67)	9.86(7.51-12.93)	1			
≥30	24(33.33)	18.46(11.70-27.34)	2.36(1.22-4.36)	0.03	1.63(0.84-5.13)	0.11
Marital status						
	55(76.39)	10.42(7.88-13.09)	1			
Ever married	17(23.61)	19.10(5.43-31.35)	2.54(0.46-7.39)	0.18		
Ethnicity						
	71(98.61)	11.79(9.23-14.47)	1			
Non-Han Chinese	1(1.39)	6.67(0.00-21.01)	0.53(0.07-4.12)	0.55		
Highest education						
College or above	36(50.00)	10.50(7.28-13.89)	1			
Senior high	21(29.17)	11.86(7.14-16.70)	1.15(0.64-2.03)	0.64		
Junior high	15(20.83)	15.46(8.13-22.87)	1.56(0.81-2.99)	0.18		
Household registration						
Local resident	59(81.94)	12.29(9.32-15.26)	1			
Non-local resident	13(18.06)	9.49(4.50-14.54)	0.75(0.40-1.41)	0.37		
Monthly income(RMB)						
≤1,000	24(33.33)	9.80(6.03-13.58)	1			
1,001-2,000	26(36.11)	14.05(9.08-19.11)	1.51(0.83-2.72)	0.18		
2,001-3,000	16(22.22)	15.24(8.26-22.20)	1.66(0.84-3.26)	0.15		
>3,000	6(8.33)	7.31(1.62-13.17)	0.73(0.29-1.85)	0.50		
Occupation						
Student	9(12.50)	6.34(2.33-10.40)	1			
Commercial services	11(15.28)	10.00(4.38-15.71)	1.92(0.79-4.67)	0.15	2.04(0.62-3.19)	0.09
Company employee	13(18.06)	11.50(5.50-17.56)	5.32(1.48-16.12)	<0.001	3.64(1.22-10.08)	<0.001
Canting and food industry	12(16.67)	30.77(15.63-45.90)	0.87(0.42-5.48)	0.64	0.91(0.31-4.87)	0.21
Housework or unemployed	4(5.56)	8.33(0.24-16.42)	2.39(1.07-5.36)	0.03	1.48(0.82-2.67)	0.19
Others	23(31.94)	13.94(8.60-19.38)	0.72(0.41-0.99)	0.04	0.84(0.62-1.36)	0.12
Orientation						
Heterosexual and Bisexual	25(34.72)	11.52(7.26-15.82)	1			
Homosexual	47(65.28)	12.40(9.18-15.71)	1.09(0.65-1.82)	0.75		
Venues for finding sex partners						
Bars/tea houses/dance halls	13(18.06)	13.68(6.63-20.70)	1			
Public bathhouses/saunas	4(5.56)	15.38(0.56-30.21)	1.15(0.34-3.87)	0.83		
Parks/public toilet	2(2.78)	9.52(0.00-23.23)	0.66(0.14-3.19)	0.61		
Internet sites	44(61.11)	10.84(7.89-13.92)	0.77(0.39-1.49)	0.43		
Others	9(12.50)	13.04(4.90-21.23)	0.95(0.38-2.36)	0.91		
Buy male sex						
	60(83.33)	12.10(9.23-15.07)	1			
Yes	5(6.94)	29.41(5.31-53.65)	3.31(1.13-9.70)	0.03	3.52(1.10-11.32)	0.03
Sell sex to a male						
	62(86.11)	6.12(0.00-13.14)	1			
Yes	3(4.17)	6.12(0.00-13.14)	0.47(0.14-1.56)	0.22		
Number of male sex partners						
0	7(9.72)	6.73(1.87-11.63)	1			
1	26(36.11)	12.87(8.21-17.50)	1.99(0.87-4.56)	0.10		
2-10	34(47.22)	12.55(5.60-20.04)	1.96(0.81-4.87)	0.14		
>10	4(5.56)	14.29(0.56-28.13)	2.25(0.63-8.09)	0.21		

Continued

Table 3 **Prevalence and risk factors of syphilis for MSM in Chongqing, China, 2008 (continued)**

Characteristics	Syphilis, n(%)	Prevalence (95%CI)	Unadjusted OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Consistent condom use with male partners						
Never	7(9.72)	11.48(3.21-19.75)	1			
Occasionally	35(48.61)	13.41(9.23-17.68)	1.67(0.87-3.21)	0.12		
Every time	23(31.94)	12.04(7.41-16.74)	1.48(0.73-2.97)	0.28		
Number of female sex partners						
0	56(77.78)	10.83(8.13-13.51)	1			
1	10(13.89)	13.89(5.73-22.13)	1.28(0.62-2.64)	0.50		
≥2	4(5.56)	16.00(0.62-31.46)	1.52(0.50-4.57)	0.46		

prevalence of HIV among MSM was 13.1% in Henan province in 2010[19], 9.9% in Beijing in 2010[20], 9.5% in Harbin city in 2011[21], 8.9% in Chengdu city in 2008[22] and 7.1% in Suzhou city in 2008[23]. The prevalence was also higher than 10.9% in 2006 and 12.8% in 2007 in Chongqing[16], and is consistent with the results of similar studies in Chongqing afterwards: 11.6% in 2009, 15.4% in 2010 and 19.2% in 2011[24]. Therefore, the rapidly rising trend should be given more attention.

Males are a key population for HIV infection, not only due to that they often have a high number of sex partners and active unprotected intercourse[25], but also because they can play both the inserted and receptive roles during intercourse, which could boost the risk of transmission[26]. More importantly, based on Chinese traditional culture, MSM are a hidden population who are generally unwilling to reveal their sexual orientation[27]. For the sake of dealing with parental and societal pressure, many MSM get married with women, and in this way, may act as a bridge for HIV transmission to the general population[28]. The significant proportions of MSM who are young, have multiple sexual partners, use stimulants or alcohol with sex and buy or sell sex have a crucial role in the rise of the prevalence of HIV infection[29].

Through ***Table 1***, men who have sex with both men and women had a lower rate of HIV infection than men who only report having sex with men, which is consistent with some data[30]. They might be less likely to embark in receptive anal intercourse than men who are special male sex partners[30-33]. Individual MSM who engage in both receptive and inserted anal sex were more susceptible to HIV seroconversion, and they can be infected through receptive sex and then transmit the virus through inserted sex, than MSM who only have inserted anal sex[34-35]. With regard to heterosexual MSM, the transmission probabilities of HIV from women to men might be lower owing to receptive and inserted roles being biologically predestined, which

Table 4 **Mean knowledge score by social-demographic characteristics of MSM in Chongqing, China, 2008**

	Subjects (%)	Means±Std	*P*
Age (years)			0.02
<30	487(78.93)	7.04±0.12	
≥30	130(20.07)	6.53±0.28	
Married status			0.62
Never married	528(85.58)	7.10±0.05	
Ever married	89(14.42)	7.05±0.45	
Highest education			<0.001
Junior high	97(15.72)	6.04±0.18	
Senior high	177(28.69)	6.93±0.09	
College or above	343(55.59)	7.45±0.05	
Occupation			<0.001
Student	142(23.01)	7.46±0.07	
Commercial services	110(17.83)	7.06±0.11	
Company employee	113(18.31)	7.34±0.09	
Canting and food industry	39(6.32)	6.26±0.27	
Housework or unemployed	48(7.78)	6.73±0.22	
Others	165(26.74)	6.88±0.11	
Monthly income, RMB			0.04
≤1000	245(39.71)	6.97±0.09	
1,001-2,000	185(29.98)	7.01±0.09	
2,001-3,000	105(17.01)	7.34±0.11	
>3,000	82(13.29)	7.41±0.09	
Venues for finding sex partners			<0.001
Bars/tea houses/ dance halls	95(15.40)	6.49±0.16	
Public bathhouses/ saunas	26(4.21)	6.54±0.26	
Parks/public toilet	21(3.40)	5.90±0.50	
Internet	406(65.80)	7.36±0.05	
Other	69(11.18)	6.80±0.18	
HIV testing			<0.001
Tested	167(27.07)	7.45±0.07	
Never tested	450(72.93)	6.94±0.06	
Sexual orientation			0.01
Homosexual	379(61.43)	7.20±0.06	
Heterosexual	7(1.13)	5.71±0.68	
Bisexual	210(34.04)	6.93±0.09	

Table 5 **Results of univariate logistic regression analysis of risk behaviors among different score groups of MSM**

Risk Behaviors		Score		
		<6	6–7	8
Age having initial sexual behaviour with a male	OR(95%CI)	1	1.74 (0.98–3.09)	1.59 (0.90–2.80)
	P		0.06	0.11
Having anal intercourse with a male sex partners in the past 6 month	OR(95%CI)	1	2.33 (1.20–4.50)	2.30 (1.20–4.39)
	P		0.01	0.01
Having anal intercourse with multiple male sex partners	OR(95%CI)	1	1.46 (0.81–2.63)	1.64 (0.92–2.93)
	P		0.21	0.09
Never used a condom in the last anal intercourse	OR(95%CI)	1	1.34 (0.67–2.67)	1.70 (0.86–3.36)
	P		0.42	0.13
Never used a condom in every time male intercourse	OR(95%CI)	1	6.25 (0.83–47.03)	7.13 (0.96–53.19)
	P		0.08	0.06
Never used a condom every time	OR(95%CI)	1		1.56 (0.82–2.95)
	P			0.17

can be cut down further with male circumcision,[36-38] owing to biologically predestined receptive and inserted roles.

The great majority of MSM had a favorable comprehensive knowledge of some aspects of the transmission of HIV; however, they still harbored some misconceptions that HIV/AIDS can be transmitted *via* eating together with HIV carriers or patients with AIDS, or through mosquito bites. MSM in China had a general level of knowledge about HIV/AIDS[39-43]. Condom use is a highly effective measure to prevent HIV transmission[44-45]. However, the frequency and coverage of condom use is not satisfactory and cannot fully prevent the spread of HIV. The use of antiretroviral therapy (ART) can reduce the plasma viral load by up to 6 orders of magnitude[46] and several studies have confirmed the efficacious action of ART on transmission[47-49]. However, due to some reasons, such as stigma or discrimination from the society, abuse by the family or peers and internalized shame and guilt or denial from themselves, they were unwilling to expose themselves or to receive ART. Knowledge related to HIV/AIDS is important for increasing the frequency of condom use and accepting ART at early stages.

The high awareness of HIV/AIDS knowledge and the low proportion of protective sexual behavior happened simultaneously and presented the divergence of knowledge and behavior[50]. A plausible reason is that some MSM have utilized harm reduction strategies-seroadaptive practices, including serosorting and strategic positioning, to reduce the risk of HIV acquisition transmission based on knowledge of self and partners' serostatus[51]. The process of serosorting is used, by which individuals agree to have unprotected anal intercourse with only those partners who are seroconcordant[52]. However, the underlying premise of this approach is that men are absolutely honest and have accurate knowledge of their HIV status. Therefore, the effectiveness of this strategy is determined by the disclosure and knowledge of serostatus among MSM. Strategic positioning refers to choosing sex acts when they report unprotected anal sex that take serostatuses into consideration, such that HIV-positive men tending to be receptive partners and the HIV-negative men tending to be inserted partners[53]. Inherent problem in this approach, nevertheless, is the potential for strategic positioning to fail. The approach assumed that men have cultivated very distinct comprehension about HIV risks and different levels of relative risks. However, seroadaptive practices do not protect against other STIs, and these risk behaviors might have given rise to epidemics of STIs instead of HIV/AIDS among MSM. Advisedly, avoidance of condoms or barebacking[54-57] is also a concern. They are deliberately seeking anal sex without condoms for increasing sexual pleasure, as a result of raising added anxiety with regard to transmission of HIV and other STI. Consequently, behavioral interventions might be more prompt and effective for reducing HIV transmission in MSM than some other interventions. If maximum effect is to be achieved, behavioral interventions should not only be committed to reduce a variety of risk behaviors such as unprotected anal intercourse, having multiple sex partners, inconsistent condom use, alcohol or drugs use and discontinuous antiretroviral treatment, and need to perform for a long-term basis.

Many prevention strategies with a strong evidence base have already been adopted, such as educational, and behavioral methods and proper use of condoms and ART[58-59]. However, around the world, these proven prevention strategies, whether unidimensional or in combination, are accessible to only a small percentage

of people who would obtain a benefit from their implementation[59]. Therefore, increased service coverage is needed to be warranted. What is more important, that comprehensive HIV intervention measures must be involved in many aspects, for instance behavioral interventions, biomedical and barrier interventions, community interventions, vaccination and diagnosis and treatment of STIs. Only the combinational use of various interventions can effectively reduce HIV infection and spread.

There were some potential limitations in this study. Firstly, our cross-sectional survey is inherently observational and descriptive, and as a result, causal conclusions cannot be drawn. Secondly, the representativeness of the sample is limited. Although the survey was designed with full consideration of concealment and accessibility of the target population, it was difficult to achieve a representative sample results in practice. Thirdly, the behavioral data were collected through self-reports and therefore were subject to self-reporting bias. In addition, due to the independent variables were self-constructed, there may be some risk factors failed to display. Fourthly, that knowledge was meant to cover multiple issues and topics related to HIV/AIDS was taken into account when we designed the questionnaires. Participants who did not score highly on the entire knowledge may still have a good grasp of their individual exposure risk. Fifthly, due to missing data of non-responders during the investigation, we cannot calculate the response rate and analyze the difference between responders and non-responders.

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