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# Prevalence and associated risk characteristics of HIV infection based on anal sexual role among men who have sex with men: a multi-city cross-sectional study in Western China



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## SUMMARY

**Background:** The HIV prevalence among men who have sex with men (MSM) in Western China is substantial and increasing at an alarming rate. The current HIV infection prevalence among MSM in Western China and its associated risk characteristics were explored by looking at different anal sexual roles separately.

**Methods:** A total 1245 MSM recruited by convenience sampling from multiple sources and areas in the Chongqing and Sichuan region were interviewed using an anonymous self-administered questionnaire with the assistance of investigators and then underwent HIV testing. Multivariate logistic regression was used to identify factors independently associated with HIV infection.

**Results:** Of the 1235 respondents who reported their sexual roles during anal sex with men, the overall HIV antibody positive rate was 21.21% (262/1235). With regard to the different anal sex roles, HIV-positive rates were significantly higher among men who played the '0.5' role (versatile, equal) and '0' role (only bottom or versatile, but mostly bottom) during anal sex with men than among those who played the '1' role (only top or versatile, but mostly top) (26.41% for '0.5' role, 26.20% for '0' role, and 15.19% for '1' role; Chi-square = 22.66,  $p < 0.0001$ ). Statistically significant differences were not found between the '0.5' role and '0' role groups ( $p > 0.05$ ). The '1' role MSM who had an education level lower than senior high school, a rural household registration, and low self-perceived severity status of AIDS, the '0.5' role MSM who had an education level lower than senior high school and had not undergone HIV testing in the recent 1 year, and the '0' role MSM who were retired or unemployed and had been diagnosed with a sexually transmitted disease by a doctor in the recent 6 months were more likely to be HIV-infected.

**Conclusions:** In this study, the HIV prevalence among MSM was alarmingly high. Moreover, the '0.5' and '0' role MSM were found to have a higher risk of infection compared to the '1' role MSM, while respective risk characteristics were not completely the same across the three groups. Along with routine preventive intervention services, more focused and specific interventions are needed to target anal sex role classes separately.

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## 1. Introduction

At present, HIV prevalence remains low in China, but the epidemic is severe in some areas and among certain groups. The Response Progress Report for AIDS Control in China in 2014

indicated that the southwest of China has been the hardest hit, with the number of reported cases accounting for 79.0% of the total number of people living with HIV/AIDS nationwide.<sup>1</sup> Moreover, HIV-positive rates among different groups show different trends, and men who have sex with men (MSM) have shown a marked

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upward trend, with an increase from 0.9% in 2003 to 7.3% in 2013. Regarding the mode of transmission, the number of male homosexual transmissions among newly diagnosed cases each year has shown a consistent upward trend, increasing from 2.5% in 2006 to 21.4% in 2013.

Documents have revealed that the HIV prevalence among MSM in Chongqing and Sichuan, two typical representative regions of Western China, has generally been 10% higher than the level nationwide and is showing a rapidly increasing trend.<sup>2–4</sup> Preference for anal sex roles is an important aspect of identity and culture among MSM and a key factor in sex behavioral patterns.<sup>5</sup> With regard to different anal sex behavioral patterns for men, there are three types of sex role, including being active, being passive, or being versatile, although there are differences in physiology, behavior, and psychology among these three groups.<sup>6,7</sup> The majority of early studies have concentrated on the socio-demographic and behavioral correlates of the risk of HIV infection and have taken the MSM population as a whole into account, largely neglecting the effects of these differences on the number and safety of sexual partners, condom use frequency, HIV testing, treatment of sexually transmitted diseases (STD), etc., which have much to do with the spread of HIV. Further studies on HIV infection risk correlates for subgroup MSM at higher risk in these areas are urgently needed, in order to develop specific and targeted intervention services.

The authors' project group undertook this survey to explore the current HIV prevalence and risk characteristics associated with HIV infection among different anal sex role categories, as an attempt to provide guidance for the design of future specific and targeted intervention services for subpopulations at higher risk among MSM.

## 2. Materials and methods

### 2.1. Study population

From April 2013 to October 2014, 1245 MSM were recruited by peer referral and trained recruiters from gay communities in Chongqing (Chongqing City, Wanzhou District) and Sichuan (cities of Mianyang, Nanchong, Suining, Yibin, and Luzhou), using outreach work and the snowball technique. The inclusion criteria for all participants were (1) age  $\geq 18$  years, (2) biologically male and had been engaged in sex with other biological males, (3) self-reported HIV-negative or with an unknown HIV infection status, and (4) willing to provide informed consent. The exclusion criteria included MSM with severe mental illness, a language barrier, and/or those with a mental deficiency.

### 2.2. Survey approaches

All potential participants received information about the aims of the study, interview process, confidentiality, and anonymity protections. After informed consent was obtained, the men were interviewed by trained investigators using a structured questionnaire consisting of questions on HIV-related demography, behavior, attitude, and mental health status (depression and anxiety state in the recent week). They were then asked to provide a blood sample for HIV testing. In this study, the local dialect was used during the investigations when patients were being interviewed verbally, mainly SiChuan Hua and ChongQing Hua. Moreover, the Self-Rating Anxiety Scale (SAS)<sup>8</sup> and the Center for Epidemiological Studies Depression Scale (CES-D)<sup>9,10</sup> were used to evaluate anxiety and depression in the most recent week according to the self-reported frequency of anxiety and depressive symptoms in the most recent week. All questionnaires were returned on the spot and were checked for logic and integrity. After the survey, the

participants received a certain amount of money in compensation for travel and lost wages, as well as a small gift for their participation (condoms and lubricants). There were two types of survey site: one was a gay community studio and the other was the first affiliated hospital of Chongqing Medical University. The study protocol was reviewed and approved by the Medical Ethics Committee and the review boards of the Chinese Center for Disease Control (CDC) and Chongqing Medical University, China.

### 2.3. Definitions

In this study, the sex role classification was defined based on the participant's response to the question "What is your usual sex position during sexual activities with men?" Five options were provided in this study: only top; versatile, but mostly top; versatile, equal; versatile, but mostly bottom; only bottom. In the descriptive analyses, MSM were divided into three subgroups: (1) '1' role ('only top', or 'versatile, but mostly top'), including men who engaged exclusively or predominantly in insertive anal intercourse with men; (2) '0.5' role ('versatile, equal'), including men who engaged equally in both insertive and receptive anal intercourse with men; (3) '0' role ('only bottom', or 'versatile, but mostly bottom'), including men who engaged exclusively or predominantly in receptive anal intercourse with men.

### 2.4. Testing for HIV infection

Serum specimens were collected and stored at low temperature before laboratory testing. A diagnostic kit for antigen/antibody to HIV (fourth-generation ELISA; Beijing Kewei Clinical Diagnostic Reagent Inc.) was first used for HIV screening. If the result was negative, the subject was reported as HIV-negative. If the fourth-generation ELISA test result was positive, the serum was retested using an HIV1+2 antibody diagnostic kit (colloid se method; origin, Japan). If the result was consistently positive, the subject was reported as HIV-positive. In this study, the results were initially 99% consistently positive.

### 2.5. Statistical methods

Questionnaire responses were double-entered and then checked for accuracy using EpiData 3.1. Data were then analyzed using SAS 9.2. General information was subjected to descriptive statistical analysis. Socio-demographic characteristics, HIV-related behaviors and attitude, and mental state of depression and anxiety were compared among MSM with different anal sexual roles using Pearson's Chi-square test or Fisher's exact test when necessary for univariate analysis. Logistic regression was used to explore important risk factors of HIV infection. Significant socio-demographic variables with  $p < 0.05$  in the univariate analysis, as well as other potential variables associated with HIV infection in this survey, were included in a multivariate logistic regression model. Only variables with  $p < 0.05$  were kept in the last stepwise multivariate model. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) were calculated to evaluate the risk of HIV infection.

## 3. Results

### 3.1. Sex role composition and demographic characteristics

A total of 1245 MSM were recruited; 1235 participants were included in the analysis as 10 did not respond to the question on their sexual role. Of the 1235 MSM respondents, 566 (45.83%) reported themselves as '1' role in anal sex (only top or versatile, but mostly top), 337 (27.29%) reported themselves as '0.5' role in

anal sex (versatile, equal), and 332 (26.88%) reported themselves as '0' role in anal sex (only bottom or versatile, but mostly bottom).

The mean age of the total 1235 respondents was 31.6 years (standard deviation 9.3, range 18–72 years) and the median was 29 years (interquartile range 25–37 years); age in years for roles '1', '0.5', and '0' averaged  $33.2 \pm 9.1$ ,  $31.9 \pm 9.8$ , and  $28.7 \pm 8.2$ , respectively. More than half of the participants (62.66%) had an urban household registration and most (97.41%) were of Han ethnicity. In terms of education, nearly half of the participants (50.69%) had an education level higher than senior high school, 29.96% had a senior high school diploma, and 19.35% had an education level lower than senior high school. The majority of participants (80.45%) were in employment, 8.43% of the participants were retired or unemployed, and 11.11% were students. More than two-thirds of the participants (69.39%) were unmarried, 21.46% were married, and 9.15% were divorced or widowed. In terms of personal monthly average income, the majority of MSM (43.54%) had an income between 1001 and 3000 RMB (lower middle income locally), while MSM with an income between 3001 and 5000 RMB (upper middle income locally) accounted for 29.96%, MSM with an income of 1000 RMB or lower (low income locally) accounted for 17.78%, and MSM with an income over 5000 RMB (high income locally) accounted for 8.72%. With the exception of household registration and race distribution, statistically significant differences were found for age, education level, employment status, marital status, and personal monthly average income composition among these three sexual role groups ( $p < 0.05$ ).

### 3.2. HIV-related attitudes, behaviors, and mental health status

Of the respondents, 91.73% (1131/1233) reported high self-perceived severity of AIDS and 81.90% (1009/1232) reported high self-perceived threat of AIDS to themselves and their family. With regard to self-perceived prevalence of HIV infection among MSM in the city/district/county in which they were living, 57.45% (706/1229) of the respondents thought it to be high. MSM who reported having undergone HIV testing in the recent 1 year accounted for 43.49% (518/1191) and those who had sought free HIV counseling voluntarily accounted for 47.43% (582/1227). Nearly three-quarters (74.66%; 922/1235) reported using condoms every time in the recent 1 month, and the remaining 25.34% (313/1235) did not use condoms every time during anal sex with men.

With regard to the number of partners, 34.25% (423/1235) of the respondents reported having had two or three male sex partners in the recent 6 months and 11.82% (146/1235) reported having had four or more male sex partners. In addition, 43.35% (486/1121) reported having had one or two occasional male sex partners and 13.29% (149/1121) reported having had three or more occasional male sex partners. Approximately a fifth (20.57%; 254/1235) reported having had heterosexual sex. Using a condom every time, sometimes using a condom, and never using condom accounted for 52.36% (555/1060), 35.38% (375/1060), and 12.26% (130/1060), respectively. Men diagnosed with an STD (such as syphilis, genital herpes, genital warts, non-specific urethritis) by a clinician accounted for 8.23% (101/1227). Having had commercial sex was reported by 5.61% (69/1230) of the respondents. The symptom detection rate of anxiety was 32.06% (396/1235) and of depression was 45.59% (563/1235), and the rate of combined anxiety and depression was 27.29% (337/1235). Statistically significant differences were found in heterosexual sex in the recent 6 months, HIV testing in the recent 1 year, and voluntary HIV counseling across these three sexual role groups ( $p < 0.05$ ), while the remaining characteristics did not differ statistically ( $p > 0.05$ ).

**Table 1**  
Rate of HIV antibody positivity among the three sex role groups

Sex role	Number (%)	HIV testing	
		Positive (n)	Percentage (%)
'1'	566 (45.83)	86	15.19
'0.5'	337 (27.29)	89	26.41
'0'	332 (26.88)	87	26.20
Total	1235 (100.00)	262	21.21

### 3.3. HIV antibody positive rate

Of the 1235 participants, there were a total 262 HIV antibody positive cases, accounting for 21.21%; the HIV antibody positive rate was 15.19% (86/566) for the '1' role, 26.41% (89/337) for the '0.5' role, and 26.20% (87/332) for the '0' role. The HIV antibody positive rate differed significantly among these three groups (Chi-square = 22.66,  $p < 0.0001$ ). Compared with the '1' role, both the '0.5' role and the '0' role MSM had higher HIV infection rates (Chi-square = 17.0049,  $p < 0.0001$  and Chi-square = 16.3102,  $p < 0.0001$ , respectively), but a statistically significant difference was not found between the '0.5' role and the '0' role groups ( $p > 0.05$ ) (Table 1).

### 3.4. Univariate and multivariate analysis of HIV infection-related factors based on anal sexual role categories

The HIV infection-related risk factors for the entire study population were firstly taken into consideration using multivariate logistic regression, with HIV infection status (positive or negative) as the dependent variable and socio-demographics and all potential related risk factors as independent variables. The results suggested that the sexual role category was a significant independent risk factor for HIV infection among MSM ('0' role vs. '1' role: aOR 2.975, 95% CI 1.988–4.452; '0.5' role vs. '1' role: aOR 2.624, 95% CI 1.778–3.873) (Table 2).

Following this, in order to further explore the risk factors for these three sexual role groups respectively, the above analysis was repeated for each of the three sexual role classes separately, adopting the Chi-square test for single factor analysis and logistic stepwise regression for multivariable selection.

#### 3.4.1. Risk factors on univariate analysis

Table 3 shows the results of the univariate analysis. This analysis suggested that the following variables were statistically associated with HIV infection: age, household registration, education level, marital status, employment status, self-perceived severity of AIDS, having had heterosexual sex in the recent 6 months, having used a condom every time during anal sex with men in the recent 1 month, and anxiety state in the most recent week for the '1' role ( $p < 0.05$ ); age, education level, number of male sex partners in the recent 6 months for the '0.5' role ( $p < 0.05$ ); employment status, personal average monthly income, condom use frequency during anal sex with men in the recent 6 months, using a condom every time during anal sex with men in the recent 1 month, and depression state in the most recent week for the '0' role ( $p < 0.05$ ). The other factors were found not to be significantly associated with HIV infection ( $p > 0.05$ ) (Table 3).

#### 3.4.2. Risk factors on multivariate analysis

According to the multiple logistic regression analysis, the factors independently associated with HIV infection for the '1' role were education level (college/university or higher vs. junior high or lower: aOR 0.299, 95% CI 0.136–0.658), household registration (rural vs. urban: aOR 2.315, 95% CI 1.262–4.247), and self-perceived AIDS severity (low vs. high: aOR 9.523, 95% CI

**Table 2**  
Factors associated with HIV infection for the entire study population (multivariate analysis)

Variable	$\beta$	SE( $\beta$ )	Wald Chi-square	p-Value	aOR (95% CI)
Education level					
Senior high vs. junior high or lower	-0.4833	0.2186	4.8893	0.0270	0.617 (0.402–0.947)
College/university or higher vs. junior high or lower	-0.9801	0.2123	21.3218	<0.0001	0.375 (0.248–0.569)
Sexual role					
'0.5' vs. '1'	0.9649	0.1986	23.6033	<0.0001	2.624 (1.778–3.873)
'0' vs. '1'	1.0902	0.2057	28.0992	<0.0001	2.975 (1.988–4.452)
Employment status					
Student vs. in employment	-0.9761	0.3410	8.1915	0.0042	0.377 (0.193–0.735)
Retired or unemployed vs. in employment	0.5675	0.2612	4.7207	0.0298	1.764 (1.057–2.943)
Self-perceived AIDS severity					
Moderate vs. high	0.4021	0.2966	1.8377	0.1752	1.495 (0.836–2.673)
Low vs. high	1.4512	0.5177	7.8575	0.0051	4.268 (1.547–11.775)
HIV testing in recent 1 year					
No vs. yes	0.4398	0.1679	6.8596	0.0088	1.552 (1.117–2.157)
Diagnosed with STD by doctors in recent 6 months					
No vs. yes	-0.5863	0.2736	4.5914	0.0321	0.556 (0.325–0.951)

SE, standard error; aOR, adjusted odds ratio; CI, confidence interval; STD, sexually transmitted disease.

2.288–39.627) (Table 4); for the '0.5' role, the factors independently associated with HIV infection included education level (college/university or higher vs. junior high or lower: aOR 0.270, 95% CI 0.139–0.526; senior high vs. junior high or lower: aOR 0.320, 95% CI 0.153–0.666) and having undergone HIV testing in the recent 1 year ('no' vs. 'yes': aOR 1.773, 95% CI 1.008–3.116) (Table 5); for the '0' role, factors independently associated with HIV infection included employment status (being retired/being unemployed vs. being in employment: aOR 3.059, 95% CI 1.055–8.870; student vs. being in employment: aOR 0.378, 95% CI 0.161–0.889) and having been diagnosed with an STD by a doctor in the recent 6 months ('no' vs. 'yes': aOR 0.307, 95% CI 0.106–0.892) (Table 6).

#### 4. Discussion

The rapidly increasing prevalence of HIV indicates that current HIV/AIDS prevention efforts have not yet effectively eased the severe situation of HIV infection among MSM in Western China.

The total HIV-positive rate among MSM in this survey was 21.21%, which is much higher than that for the whole country (7.3%) and also higher than that reported for Kampala, Uganda (13.7%), and closely follows the rate in Bangkok, Thailand for the period 2005–2011 (28.3%).<sup>1,11,12</sup> A cross-sectional study performed in Chongqing each year from 2006 to 2009 showed that the HIV prevalence rates were 10.9%, 12.8%, 10.6%, and 19.1%, respectively, with an increase of 2.3% per year.<sup>13</sup> Moreover, another set of data from five consecutive cross-sectional surveys among MSM in 2006, 2008, 2010, 2012, and 2013 suggested that HIV prevalence increased from 13.0% to 19.7% from 2006 to 2013, with an increase of 1.0% per year.<sup>3</sup> It follows that the HIV prevalence among MSM in Western China is substantially high and climbing at an alarming rate, which indicates the grim situation for HIV prevention and treatment. Areas of high prevalence in this epidemic, like Chongqing and Sichuan, require more focused and specific prevention and intervention services.

The anal sex role plays an independent significant role in HIV infection among MSM, and both the '0' role and '0.5' role have a higher risk of HIV infection compared with the '1' role. The results of the present study found that the HIV antibody positive rate was significantly higher among '0' role and '0.5' role MSM than among '1' role participants. This finding is similar to the observation from a study performed in Lima, Peru (11.8% for activo role, 28.4% for moderno role, and 26.8% for pasivo role).<sup>14</sup> Furthermore, some studies have shown that anal sex roles are closely related to choices of sex partners and protective sexual behaviors, which make a difference to HIV transmission among MSM.<sup>5,15</sup> A study by

Lou et al. took sexual role preference into account, which is quite important in addressing the spread of HIV in some MSM populations, when constructing a mathematical model for HIV transmission among MSM in China.<sup>16</sup>

In the present study, anal sex roles were also found to be significant independent risk factors for HIV infection. Due to the differences in behaviors among different sex roles, the risk of HIV infection is not experienced equally by all MSM and the risk of HIV infection is about 2.6 times higher among MSM who have the '0.5' role and about three times higher among MSM who have the '0' role compared to MSM with the '1' role. Men who engage exclusively or predominantly in receptive anal sex ('0' role) carry a higher biological risk of HIV infection, possibly for the reason that the rectum mucosa is easily damaged during anal sex in the absence of condom use, thus increasing the likelihood of HIV virus passing into their blood. Furthermore, '0' role MSM are often in a submissive position during anal sex.<sup>15,17</sup> This study suggests that men with the '0' role are significantly younger than those who have the '1' role, which may in turn result in a lower awareness or reduced ability in terms of self-protection. They seldom seek HIV-related prevention behaviors and services, such as condom use and HIV testing and counseling.<sup>18</sup> Those engaging equally in both receptive and insertive anal sex ('0.5' role) are significantly more likely to be HIV-infected perhaps because of the role change during anal sex with other '0.5' role MSM.<sup>14</sup> Under such circumstances, they could have more occasional sex partners or engage in unprotected anal sex activities frequently.<sup>5,19</sup> In populations with role versatility, the person who is easily infected through unprotected receptive anal (URA) sex can then efficiently transmit infection through unprotected insertive anal (UIA) sex.<sup>20</sup>

As the 'most-at-risk' populations among MSM, both the '0' role and '0.5' role should probably be treated as a priority for HIV/AIDS prevention and control. The '1' sex role men, being an older population and having a 'dominant' position during intercourse, may well have stronger self-protection awareness and ability.<sup>15,17</sup> Compared with other sex roles, they tend to be more active with regard to HIV testing and counseling and there should be a relatively high rate of condom use during anal sex, thus fewer '1' role MSM are infected with HIV.<sup>18</sup> In terms of HIV-related behaviors, some high-risk behavioral characteristics, such as number of sexual partners and condom use, were found not to make a statistically significant difference across the three sexual role groups in this survey, in contrast to the findings for heterosexual sex behaviors in the recent 6 months and HIV testing and counseling in the recent 1 year.

Risk factors for HIV infection are not completely the same among anal sex roles, which means that more targeted and focused



**Table 3**

Correlation between socio-demographic characteristics, risk behavior, attitude, psychological characteristics, and HIV infection among MSM stratified by sexual role category during anal sex (univariate analysis)

Variable	'1' role (n=566)		'0.5' role (n=337)		'0' role (n=332)	
	HIV-positive % (n/N')	Chi-square	HIV-positive % (n/N')	Chi-square	HIV-positive % (n/N')	Chi-square
Age, years		8.0239 <sup>a</sup>		9.3574 <sup>a</sup>		6.1534
<20	22.22% (2/9)		40.00% (4/10)		7.14% (1/14)	
20–29	10.33% (25/242)		24.28% (42/173)		24.17% (51/211)	
30–39	17.98% (32/178)		19.32% (17/88)		35.14% (26/74)	
≥40	19.71% (27/137)		39.39% (26/66)		27.27% (9/33)	
Household registration <sup>b</sup>		18.6511 <sup>a</sup>		0.6485		2.2924
Urban	10.17% (35/344)		25.12% (52/207)		23.61% (51/216)	
Rural	23.72% (51/215)		29.13% (37/127)		31.30% (36/115)	
Education level		26.6899 <sup>a</sup>		14.2584 <sup>a</sup>		4.6486
Junior high or lower	27.78% (35/126)		43.66% (31/71)		38.10% (16/42)	
Senior high	17.05% (30/176)		24.24% (24/99)		28.42% (27/95)	
College/university or higher	7.95% (21/264)		20.36% (34/167)		22.56% (44/195)	
Employment status <sup>b</sup>		9.6719 <sup>a</sup>		5.8862		9.3927 <sup>a</sup>
In employment	14.76% (71/481)		27.44% (73/266)		27.76% (68/245)	
Student	5.13% (2/39)		9.38% (3/32)		13.64% (9/66)	
Retired or unemployed	28.89% (13/45)		33.33% (13/39)		45.00% (9/20)	
Marital status		10.9574 <sup>a</sup>		5.9317		3.9456
Unmarried	11.43% (40/350)		22.37% (51/228)		24.37% (68/279)	
Married	22.82% (34/149)		34.62% (27/78)		39.47% (15/38)	
Divorced or widowed	17.91% (12/67)		35.48% (11/31)		26.67% (4/15)	
Average monthly income (RMB) <sup>b,c</sup>		3.9029		2.7480		9.0048 <sup>a</sup>
≤1000	18.99% (15/79)		30.00% (18/60)		18.18% (14/77)	
1001–3000	17.46% (44/252)		29.41% (45/153)		34.68% (43/124)	
3001–5000	11.86% (21/177)		21.11% (19/90)		20.62% (20/97)	
>5000	11.54% (6/52)		21.43% (6/28)		30.77% (8/26)	
HIV testing in recent 1 year <sup>b</sup>		2.5357		3.6921		2.6847
Yes	12.60% (33/262)		20.80% (26/125)		21.37% (28/131)	
No	17.50% (49/280)		30.50% (61/200)		29.53% (57/193)	
HIV counseling voluntarily <sup>b</sup>		0.0459		0.0003		0.1560
Yes	15.46% (45/291)		26.45% (41/155)		25.00% (34/136)	
No	14.81% (40/270)		26.37% (48/182)		26.94% (52/193)	
Self-perceived AIDS severity <sup>b</sup>		6.8892 <sup>a</sup>		<i>p</i> = 0.6213 <sup>d</sup>		<i>p</i> = 0.4288 <sup>d</sup>
High	14.17% (73/515)		26.05% (81/311)		25.25% (77/305)	
Moderate	21.05% (8/38)		27.78% (5/18)		36.36% (8/22)	
Low	38.46% (5/13)		37.50% (3/8)		33.33% (1/3)	
Opinion towards the infection rate of HIV among MSM in the city in which they are living <sup>b</sup>		0.7256		0.5547		0.1965
High	14.24% (47/330)		24.29% (43/177)		26.13% (52/199)	
Moderate	17.24% (25/145)		28.04% (30/107)		27.91% (24/86)	
Low	14.61% (13/89)		27.45% (14/51)		24.44% (11/45)	
Self-perceived AIDS threat to themselves and family <sup>b</sup>		0.9402		0.7263		4.0740
High	14.93% (70/469)		25.47% (68/267)		28.21% (77/273)	
Moderate	14.04% (8/57)		29.79% (14/47)		14.29% (5/35)	
Low	20.51% (8/39)		31.82% (7/22)		17.39% (4/23)	
Number of male sex partners in recent 6 months		4.8479		6.6827 <sup>a</sup>		0.1398
≤1	13.53% (41/303)		24.19% (45/186)		25.42% (45/177)	
2–3	14.85% (30/202)		23.85% (26/109)		26.79% (30/112)	
>3	24.59% (15/61)		42.86% (18/42)		27.91% (12/43)	
Number of male occasional sex partners in recent 6 months <sup>b</sup>		2.4445		2.9579		0.7277
None	13.21% (28/212)		29.85% (40/134)		28.57% (40/140)	
1–2	17.37% (41/236)		23.70% (32/135)		24.35% (28/115)	
≥3	20.31% (13/64)		36.59% (15/41)		29.55% (13/44)	
Heterosexual sex in recent 6 months		11.5927 <sup>a</sup>		2.2446		2.8350
Yes	24.11% (34/141)		32.91% (26/79)		38.24% (13/34)	
No	12.24% (52/425)		24.42% (63/258)		24.83% (74/298)	
Condom use frequency during anal sex with men in recent 6 months <sup>b</sup>		2.9991		0.8902		6.6609 <sup>a</sup>
Every time	13.28% (34/256)		26.32% (40/152)		23.13% (34/147)	
Sometimes	17.44% (30/172)		31.73% (33/104)		37.37% (37/99)	
Never	8.33% (4/48)		28.95% (11/38)		22.73% (10/44)	
Condom use during anal sex with men in recent 1 month		4.3984 <sup>a</sup>		1.7758		4.8424 <sup>a</sup>
Every time	13.38% (57/426)		24.61% (63/256)		22.92% (55/240)	
Not every time	20.71% (29/140)		32.10% (26/81)		34.78% (32/92)	
Commercial sex in recent 6 months <sup>b</sup>		1.6717		<i>p</i> = 0.2386 <sup>d</sup>		<i>p</i> = 0.7898 <sup>d</sup>
Yes	22.86% (8/35)		40.00% (6/15)		21.05% (4/19)	
No	14.74% (78/529)		25.94% (83/320)		26.60% (83/312)	
Diagnosed with STD by doctors in recent 6 months <sup>b</sup>		1.3725		2.1959		<i>p</i> = 0.0549 <sup>d</sup>
Yes	20.75% (11/53)		37.93% (11/29)		47.37% (9/19)	

**Table 3** (Continued)

Variable	'1' role (n = 566)		'0.5' role (n = 337)		'0' role (n = 332)	
	HIV-positive % (n/N)	Chi-square	HIV-positive % (n/N)	Chi-square	HIV-positive % (n/N)	Chi-square
No	14.68% (75/511)		25.25% (77/305)		24.84% (77/310)	
Frequency of searching for sex partners online in recent 6 months <sup>b</sup>		0.7258		4.4141		2.3937
Often	20.00% (5/25)		20.00% (2/10)		11.11% (2/18)	
Sometimes	14.63% (42/287)		23.32% (45/193)		28.05% (46/164)	
Never	16.59% (36/217)		33.90% (40/118)		26.52% (35/132)	
Anxiety state in the last week		4.3639 <sup>a</sup>		1.2388		0.3049
Yes	19.89% (35/176)		30.28% (33/109)		24.32% (27/111)	
No	13.08% (51/390)		24.56% (56/228)		27.15% (60/221)	
Depression state in the last week		3.4341		1.4996		5.1514 <sup>a</sup>
Yes	18.33% (46/251)		29.45% (48/163)		20.13% (30/149)	
No	12.70% (40/315)		23.56% (41/174)		31.15% (57/183)	

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

<sup>a</sup>  $p < 0.05$ .

<sup>b</sup> Partially missing data (numbers might not add up to the total because of missing data).

<sup>c</sup> Combined with the average monthly income of the local level, the relative socioeconomic tier of each income can be categorized as follows: low income for  $\leq 1000$ , lower middle income for 1001–3000, upper middle income for 3001–5000, and high income for  $> 5000$ .

<sup>d</sup>  $p$ -Value for Fisher's exact test.

**Table 4**

Factors associated with HIV infection for the '1' role group (multivariate analysis)

Variable	$\beta$	SE( $\beta$ )	Wald Chi-square	$p$ -Value	aOR (95% CI)
Education level					
Senior high vs. junior high or lower	-0.1247	0.3326	0.1407	0.7076	0.883 (0.460–1.694)
College/university or higher vs. junior high or lower	-1.2062	0.4017	9.0162	0.0027	0.299 (0.136–0.658)
Household registration					
Rural vs. urban	0.8395	0.3096	7.3510	0.0067	2.315 (1.262–4.247)
Self-perceived AIDS severity					
Low vs. high	2.2537	0.7275	9.5971	0.0019	9.523 (2.288–39.627)
Moderate vs. high	0.4057	0.4687	0.7495	0.3866	1.500 (0.599–3.759)

SE, standard error; aOR, adjusted odds ratio; CI, confidence interval.

**Table 5**

Factors associated with HIV infection for the '0.5' role group (multivariate analysis)

Variable	$\beta$	SE( $\beta$ )	Wald Chi-square	$p$ -Value	aOR (95% CI)
Education level					
Senior high vs. junior high or lower	-1.1410	0.3745	9.2799	0.0023	0.320 (0.153–0.666)
College/university or higher vs. junior high or lower	-1.3087	0.3400	14.8153	0.0001	0.270 (0.139–0.526)
HIV testing in recent 1 year					
No vs. yes	0.5724	0.2879	3.9533	0.0468	1.773 (1.008–3.116)

SE, standard error; aOR, adjusted odds ratio; CI, confidence interval.

**Table 6**

Factors associated with HIV infection for the '0' role group (multivariate analysis)

Variable	$\beta$	SE( $\beta$ )	Wald Chi-square	$p$ -Value	aOR (95% CI)
Employment status					
Student vs. being in employment	-0.9723	0.4363	4.9660	0.0259	0.378 (0.161–0.889)
Retired or unemployed vs. in employment	1.1182	0.5431	4.2381	0.0395	3.059 (1.055–8.870)
Diagnosed with STD by doctors in recent 6 months					
No vs. yes	-1.1809	0.5443	4.7067	0.0300	0.307 (0.106–0.892)

SE, standard error; aOR, adjusted odds ratio; CI, confidence interval; STD, sexually transmitted disease.

interventions are required for subgroup populations among MSM to suppress infection and the transmission of HIV more effectively.

The multivariate logistic regression analysis stratified by sexual role categories indicated that '1' role men who had an education level lower than senior high school, a rural household registration, and low self-perceived severity of AIDS, '0.5' role men who had an education level lower than senior high school and who had not undergone HIV testing in the recent 1 year, and '0' role men who were retired or unemployed and who had been diagnosed with an

STD by a clinician in the recent 6 months had a higher prevalence of HIV infection.

In terms of attitude towards HIV/AIDS, although most participants thought that HIV infection has serious consequences and that the threat is great to themselves and their family, only half of the participants (57.45%) thought that the prevalence of HIV among MSM in the city/district/county in which they were living was high. This suggests that a considerable proportion of MSM have low infection risk awareness and still lack a full

understanding of the seriousness of HIV infection in the gay community in which they are living, despite the current grim situation of the HIV/AIDS epidemic in these areas. In the future, more community-based education should be conducted on the risk of HIV infection, at an appropriate educational level and in a more sophisticated way, covering the current situation in regard to HIV infection in the community, as well as introducing the behavioral risks related to HIV infection among MSM. In addition, the MSM with the '1' role are dominant during sexual activities, and HIV-related attitudes and preventive actions from MSM in the '1' role largely determine the infection risk for both parties, so their risk perceptions as being keen or weak will directly determine whether or not they use condoms during sexual activities. Therefore, strengthening cognitive behavior interventions for MSM in the '1' role may maximize the benefits of behavioral interventions.

In terms of HIV-related preventive actions, HIV testing and counseling is well described as an effective strategy to reduce the risk of HIV infection.<sup>21</sup> In this survey, the HIV testing rate among MSM in the recent 1 year (43.49%) was found to be close to the survey result for Chongqing during the years 2009–2010 (44.6%),<sup>2</sup> slightly lower than that among MSM nationwide in 2011 (50.4%),<sup>22</sup> but much lower than that in developed countries, such as Australia (60–70%)<sup>23,24</sup> and the USA in 2011 (67%).<sup>25</sup> In particular, among those in the '0.5' role group, only 38.46% had taken an HIV test in the recent 1 year, indicating that a large proportion of men among those infected with HIV were not aware of their status yet and could have continued to spread the HIV virus when engaging in an insertive sexual role in the absence of condom use. Accordingly, more attention should probably be paid to HIV testing among the '0.5' role MSM. A self-perceived low risk of HIV infection may be the main reason for not seeking an HIV test. Other studies have suggested that the principal perceived barriers to testing include the following: fear of knowing a positive result, fear of suffering from discrimination if tested positive, low perceived risk of HIV infection, and not knowing where to take a test. Factors reported to facilitate testing are sympathetic attitudes from health staff, guaranteed confidentiality, having received some form of HIV education recently, having been diagnosed with a sexually transmitted infection in the past 6 months, and serious self-perceived HIV threat, etc.<sup>26–28</sup>

In terms of condom use, the rate of continuous condom use remains low. Only about half of the participants (52.36%) reported using condoms every time during anal sex with men in the recent 6 months; the remaining participants used condoms intermittently or never. It is necessary to continue to improve awareness of the risk of HIV infection among MSM, promoting the habit of consistently using a condom during sexual activity. Furthermore, the use of special condoms for MSM who dislike using common condoms is recommended, in order to improve their acceptability and usage. The use of special condoms for oral sex among MSM is also advocated.

It is well known that STDs can increase the risk of HIV infection, so screening and standardizing the treatment of STDs needs to be addressed as a matter of urgency. As well as expanding the detection of HIV, the provision of convenient, easily available, low cost, and designated and normal services for the diagnosis and treatment of STDs will undoubtedly help to reduce the risk of HIV infection. Greater attention should be paid to screening and standardized treatment of STDs in the future, especially among MSM in the '0' role.

In this study, most of the study population were ethnic Han (97.41%), and the basic statistics from the 6<sup>th</sup> National Population Censuses in 2010<sup>29</sup> indicated that 93.3% of the total population in Chongqing municipality and 93.9% in Sichuan Province are of Han nationality. Although some studies have documented that certain significant ethnic minorities, such as Tibetans, Yi, and Qiang, who

show significant differences in cultural practices to the Han, will subsequently have very different representation in terms of MSM orientation and HIV-1 infection, no such differences were found in the present study; this was because ethnic minorities represented less than 3% of the study population (including Miao, Tujia, Mongolians, Tibetans, Uygur, and Qiang).<sup>30,31</sup>

This study had some limitations that should be noted. First, non-probability sampling was used to recruit participants and about two-thirds of the study population were recruited primarily from Chongqing; this represents a potential bias in terms of the representativeness of the sample. Second, due to the sensitive nature of the investigation, some data concerning HIV-related risk factors, such as the number of sexual partners, might have been missing to a certain extent. This may have reduced the statistical accuracy, rendering the results in terms of the odds ratios less precise than they should be. Third, although the survey was anonymous, all measures involved in the self-reporting were subject to social desirability bias and recall bias. Fourth, the data collected on interpersonal and socio-cultural factors were insufficient, so further studies into how interpersonal and socio-cultural factors may affect the HIV infection risk for the different anal sex roles are warranted.

Despite these limitations, as a large-scale survey, this study indicates that the HIV prevalence among MSM in Western China has risen to an alarming level, calling for more substantial interventions in these highly epidemic areas. As well as routine publicity and education and behavior interventions among MSM as a whole, the 'most-at-risk' populations among MSM should also be screened for priority interventions according to the characteristics of their high-risk behaviors.

As highlighted in this article, further intervention strategies should focus on the role of anal sex practices in HIV transmission. This study identified risks and some associated risk factors for HIV infection among different anal sex role groups and thus has provided some important basic information to further help develop specific prevention and intervention services for subgroup MSM in these highly epidemic areas.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ijid.2016.06.009>.

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