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Predictors of Recent HIV Testing Among Chinese Men Who Have Sex with Men: A Barrier Perspective

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Abstract

In China, men who have sex with men (MSM) account for an increasing proportion of new HIV infections. We aim to assess recent HIV testing (in the past 6 months) among Chinese MSM and to identify barriers to testing. A nationwide sample of MSM ($n = 1100$) from mainland China was recruited. Data on sociodemographics, HIV-related risks, perceived barriers to testing, and testing behaviors were collected. Approximately 30% of MSM had recently undergone HIV testing. With regard to testing, almost half endorsed each of three barriers: did not believe themselves to be at HIV risk, had a fear of being diagnosed HIV positive, and feared their privacy would be violated during testing. Five distinct classes of barriers were identified from the responses. The adjusted multivariable logistic regression model demonstrated that the participants in both the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' classes were less likely to undergo testing than those in the ''minimal barrier'' class. Men who were unsure of their HIV status were less likely to undergo testing. Furthermore, participants who had multiple male sexual partners and who engaged in substance use over the preceding 6 months were more likely to undergo testing. Distinct subgroups of testing and HIV status varied within the different barrier classifications. Recent HIV testing rates remain low among MSM in China. Barrier factors associated with testing point to the necessity for preventing and controlling HIV, including increasing the privacy of sites or educating MSM on the importance of testing regularly.

Keywords: HIV testing, barrier factors, latent class analysis, HIV, China, men who have sex with men

Introduction

Globally, men who have sex with men (MSM) continue to be at substantial risk for contracting HIV.[1] Despite decades of efforts, high HIV rates and incidences still exist among MSM in low-, middle-, and high-income countries and regions.[2] Even in many high-income countries, such as the United States of America, the United Kingdom, Canada, and Australia, where resources relating to HIV prevention, treatment, and care services are universally available, HIV epidemics among MSM continue to grow.[3] Meanwhile, in many low- and middle-income regions, including Asia, Africa, Eastern Europe, and Latin America, MSM, to some extent, have less access to HIV-related healthcare and more barriers to testing and HIV care.[4–6] In China, a developing country, there are an estimated 571,000 people currently living with HIV/AIDS.[7] Sexual transmission, especially male-to-male homosexual transmission, has become one of the primary modes of HIV infection in the country in recent years,[8] accounting for almost one-quarter of infected individuals by the end of 2015.[7]

HIV testing is a critical component of HIV diagnosis and for an infected person, represents a fundamental first step to obtaining treatment and care.[9] Early diagnosis and timely initiation of antiretroviral therapy have substantial benefits for such persons, their families, and society in general. For HIV-infected individuals, early diagnosis permits the initiation of highly active antiretroviral treatment, improves health outcomes, results in lower treatment costs, and increases their longevity.[10,11] Furthermore, timely diagnosis promotes the safeguarding of family members and romantic partners with regard to decision making concerning potential marriage and childbearing.[12,13] For society, early diagnosis prevents further HIV transmission and reduces burdens on public medical

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facilities and resources.[14,15] In response to the spread of HIV, the Chinese government has greatly expanded surveillance and intervention efforts among MSM and is providing free antiretroviral treatment to sero-HIV-positive individuals, and these efforts have proven to be effective in decreasing HIV transmission among this population.[16] Despite this, one previous study[17] using data from the national HIV surveillance system found that the HIV testing rate among Chinese MSM in the prior year ranged from 43.2% to 49.0%. Additionally, regular HIV testing is infrequent among Chinese MSM,[18] and in a recent study only 23% of MSM tested for HIV at least once every 6 months,[19] which is lower than United States national guidelines regarding recommended testing frequency.

The main factors for the low rates of regular testing in China include various psychological and structural barriers MSM encounter when they consider testing.[13,18–22] Specifically, discrimination and stigma concerning both homosexuality and HIV,[23] as well as other psychological (e.g., fear of being diagnosed with HIV and the belief that such a diagnosis means certain death), and structural barriers (e.g., uncertainty of testing locations and the fear that privacy will be violated), have resulted in a large proportion of MSM neglecting HIV testing and prevention services.[1] A previous qualitative study of Chinese MSM suggested that gay-related discrimination and stigma are major barriers to HIV testing, mainly because heterosexual marriage and child bearing are greatly valued in traditional Chinese culture.[22] In another study, conducted in Beijing, the three most common testing barriers experienced recently by MSM were determined to be fear of diagnosis, fear of HIV-positive discrimination, and uncertainty of testing locations.[21] Conversely, lower degrees of stigma and discriminatory attitudes toward HIV/AIDS have been determined to result in a positive relationship to HIV testing behaviors for MSM in Beijing.[24]

In terms of methodology, recent studies have used latent class analysis (LCA) to characterize patterns of risk factors for HIV infection and to identify groups that should conduct HIV self-testing.[25,26] For example, one prior study[25] suggested that LCA can reveal the existence of distinct classes containing different characteristics and risk profiles, and that it can also help to identify the highest risk group for HIV infection. LCA is more functional than other forms of analysis because, unlike traditional regression approaches that consider the average effects of factors, LCA simultaneously evaluates the differential effects of multiple factors.[26]

Greater understanding and improved identification of barriers to HIV testing are required to improve the frequency of regular testing, HIV status awareness, diagnosis, timely care, and treatment among individuals with HIV. Furthermore, recognizing these barriers can help identify structural improvements needed related to testing services. However, quantitative research on barriers to HIV testing among Chinese MSM has been limited.[18,24,27–29] Additionally, existing studies have frequently relied on small and/or regional samples. Participants tend to be recruited from clinical facilities, organizations, or from certain districts, meaning they may not be representative of the MSM populations in other Chinese regions. Consequently, the aims of this study are (i) to determine the prevalence of recent HIV testing and barriers to such testing (from psychological and structural perspectives) using a large national sample of MSM in mainland China; (ii) to use the LCA method to evaluate and identify distinct groups of barriers to testing; and (iii) to examine the associations between behavioral characteristics (e.g., number of sexual partners, condom use, engagement in commercial sex, and substance use), barriers to testing, and HIV testing among MSM.

Methods

Design and participants

A cross-sectional online survey was conducted in mainland China between December 2014 and February 2015. Participants were recruited through advertisements placed on social network platforms, similar to research substantially described elsewhere,[30–32] such as gay chat-room websites, the Blued and Zank applications, and QQ groups. Volunteers accessed the survey link supported through Wenjuanxing (a popular and professional Chinese survey website) by clicking on an advertisement. Those who clicked received a description of the study, and consent was assumed if they clicked ''continue'' to provide responses. The initial dataset consisted of 1191 respondents from 30 provinces in China. We excluded duplicate questionnaires based on our checks of the participants' IP addresses.[30] Inclusion criteria were as follows: assigned male gender at birth, self-reported previous experience of sexual intercourse with at least one man (to establish the definition of MSM), at least 16 years of age, and being a resident of mainland China. Ninety-one participants who did not meet these criteria were excluded, leaving a final sample of 1100 MSM from five regions of mainland China (Central, East, South, West, North; presented in Table 1) eligible for analysis. The study was approved by the Ethics Committee of Southwest University, China.

Measures

Sociodemographic variables. Data on basic sociodemographic variables, including gender, age, highest level of education attained, occupation, monthly salary, sexual orientation, and anal sex role behavior[33] (defined as the insertive, receptive, or versatile role that participants may have engaged in when having sex with a partner of the same sex) were also collected.

HIV testing and HIV status. Recent HIV testing was measured by asking participants whether they had been tested for HIV within the previous 6 months. HIV status was assessed by asking participants to report their current HIV status, including HIV negative, unsure of HIV status, and HIV positive.

HIV testing barriers. The barriers we chose to investigate were based on the findings of prior studies[22,34,35]; these were measured using eight items: ''fear of homosexuality-related stigma'', ''fear of HIV-positive discrimination'', ''fear of being diagnosed HIV positive'', ''belief that you are not at HIV risk'', ''belief having HIV means certain death'', ''fear of privacy violation'', ''uncertainty concerning the locations of testing sites'', and ''concerns with regard to testing costs''. The respondents answered ''yes'' or ''no'' to whether or not each item was a concern for them.

Sexual behaviors. Sexual behaviors were assessed by asking participants to report the number of male and female

Table 1. Sociodemographic Characteristics and Recent HIV Testing Among Men Who Have Sex with Men (MSM) in China ($N=1100$)

	Number	*Percentage*
Sociodemographics		
Region		
Central China	256	23.3
East China	208	18.9
South China	125	11.4
West China	427	38.8
North China	84	7.6
Age (Mean, SD)	24.79	6.10
Highest level of education		
≤Senior high school	323	29.4
College or above	777	70.6
Occupation		
Student	350	31.8
Employed	673	61.2
Unemployed	77	7.0
Monthly salary		
<¥2000	405	36.8
¥2000–4000	346	31.5
>¥4000	349	31.7
Sexual orientation		
Gay	739	67.2
Bisexual	239	21.7
Other	122	11.1
Anal sex role		
Receptive preference	681	61.9
Versatile	136	12.4
Insertive preference	283	25.7
HIV testing barriers		
Fear of homosexuality-related stigma (Yes)	287	26.1
Fear of HIV-positive discrimination (Yes)	324	29.5
Belief not at HIV risk (Yes)	537	48.8
Fear of being diagnosed HIV positive (Yes)	471	42.8
Belief HIV means death (Yes)	321	29.2
Fear of privacy violation at testing site (Yes)	492	44.7
Uncertainty of testing site locations (Yes)	279	25.4
Testing cost concerns (Yes)	133	12.1
HIV status		
HIV negative	919	83.5
Unsure	145	13.2
HIV positive	36	3.3
HIV testing history (past 6 months)		
No	724	65.8
Yes	376	34.2

SD, standard deviation.

sexual partners they had over the previous 6 months, and also to report the frequency of general condom use with male and female sex partners, both with regard to receptive and insertive anal intercourse and vaginal intercourse. All of the behaviors were dichotomized to obtain ''yes'' or ''no'' responses. Participants were also asked to report whether they had used a condom during their last sexual encounter (male and female partners, respectively; dichotomized to obtain yes or no responses).

Commercial sex. Commercial sex was measured by asking participants if they had been paid for sex within the previous 6 months, which was defined as exchanging sex for money. This variable was dichotomized to obtain yes or no responses.

Substance use. Substance use was measured by asking participants if they had used alkyl nitrites (''poppers''), methamphetamine (''crystal meth''), sildenafil citrate ''Viagra®'', 3,4-Methylenedioxymethamphetamine (MDMA, ''ecstasy''), ketamine, cocaine or crack cocaine, or marijuana in the previous 6 months. These variables were dichotomized to obtain yes or no responses. To determine binge drinking, participants were asked whether they had five or more drinks of alcohol within a 2-h period at any time within the previous 6 months, as was done in a previous study of MSM.[36]

Statistical analysis

To characterize participants, SPSS 17.0 (Chicago, IL) was used to calculate each sociodemographic characteristic and testing behavior patterns.

To identify classes with comparable patterns of the eight-item HIV-testing barriers, we conducted LCA using Mplus software. Each class is denoted by conditional probabilities for each indicator to categorize people into the smallest possible set of distinct and interpretable latent classes.[37] First, starting with a one-class model, seven models were fit (one to seven classes). Next, model fit was evaluated[38] according to Akaike information criterion (with lower values indicating greater model fit), and the sample-size-adjusted Bayesian information criterion (with lower values indicating greater model fit). The entropy value (range 0–1; with values above 0.8 indicating good model classification), and the adjusted Lo–Mendell–Rubin likelihood ratio test (LMR-LRT) and its p-value were used to compare and determine if the classifications were accurate.[37] The final selected model was examined to estimate the probabilities of membership in each class and the probability of each indicator conditional on class membership.

After the appropriate number of groups was determined, we identified the commonalities of the sociodemographic and behavioral characteristics, along with the subgroups of testing and HIV status for each barrier classification of the best fit latent class model. Meanwhile, Pearson's chi-square test was used to compare the associations between sociodemographic and behavioral characteristics, and subgroups of testing and HIV status with barrier classification.

Univariable and multivariable logistic regression models were then performed to evaluate the associations between behavioral characteristics, testing barriers, and recent HIV testing. Variables with p-value <0.20 in the univariable logistic regression analyses were included within a multivariable logistic regression model and eliminated using a stepwise method until all correlates had a p-value <0.10.

Multinomial logistic regression was performed using the best fit latent class barrier classification as the dependent variable to investigate the association between distinct subgroups of testing and HIV status and barrier classification

after adjusting for potential sociodemographic confounders ($p < 0.20$ in the Pearson's chi-square test), including age, highest level of education attained, monthly salary, sexual orientation, and sex role behavior.

Results

Table 1 presents the participants' sociodemographic characteristics, testing barriers, HIV status, and recent HIV testing data. Almost one-third had undergone HIV testing in the past 6 months ($n = 376$, 34.2%). The mean age was 24.8 years (standard deviation = 6.1); most were employed ($n = 673$, 61.2%) and had college degrees or higher ($n = 777$, 70.6%); the majority self-identified as gay ($n = 739$, 67.2%) or bisexual men ($n = 239$, 21.7%). With regard to testing barriers, almost half of the respondents believed they were not at risk for HIV ($n = 537$, 48.8%), had a fear of being diagnosed HIV positive ($n = 471$, 42.8%), and had a fear that testing would violate their privacy ($n = 492$, 44.7%). Meanwhile, over one-fifth of the participants had a fear of homosexuality-related stigma ($n = 287$, 26.1%), HIV-positive discrimination ($n = 324$, 29.5%), believed that having HIV means certain death ($n = 321$, 29.2%), and were unsure of the locations of testing sites ($n = 279$, 25.4%). Regarding HIV status, 3.3% ($n = 36$) were HIV positive, and 13.2% ($n = 145$) were unsure of their HIV status.

Table 2 presents LCA model fit indicators for the testing barriers. A five-class solution was determined to be more suitable than the two- to four-class solutions, based on its higher entropy values. Furthermore, despite being lower than a six-class solution, the five-class solution's value was moderate, and it had a larger entropy value. Meanwhile, a seven-class solution was excluded because the p-value (0.264) for LMR-LRT was not significant in this regard.

We named the five classes to reflect barrier characteristics (shown in Table 3). Class 1 was labeled ''uncertainty concerning testing sites'' ($n = 204$, 18.5%) because all MSM in this group had reported they were uncertain of the locations of testing sites. Class 2 was labeled ''low risk and privacy violations'' ($n = 112$, 10.2%), because all participants here had reported they believed they were not at risk for HIV and feared that testing would result in privacy violations. Class 3 was labeled ''fear of HIV and dying'' ($n = 77$, 7.0%) because all participants here had reported a fear of being diagnosed HIV positive and believed this would mean certain death. Class 4 was labeled ''low risk'' ($n = 130$, 11.8%) because all MSM here reported believing they were not at risk. Finally, Class 5 was labeled ''minimal barrier'' ($n = 577$, 52.5%).

Table 2. Latent Class Analysis: Model Fit Indices for the 1-, 2-, 3-, 4-, 5-, 6-, and 7-Class Solution for Recent HIV Testing barriers of Men Who Have Sex with Men (MSM) in China ($N = 1100$)

	AIC	*Adjusted BIC*	*Entropy*	*LMR ALRT*	p *Value*
1-Class	10536.88	10551.49	–	–	–
2-Class	10289.40	10320.46	0.58	261.32	<0.001
3-Class	10161.40	10208.90	0.71	143.72	<0.001
4-Class	10065.71	10129.65	0.73	111.91	<0.001
5-Class	9975.77	10056.15	0.87	106.25	<0.001
6-Class	9910.21	10007.03	0.86	82.25	0.015
7-Class	9850.29	9963.55	0.86	76.70	0.264

AIC, Akaike information criterion; adjusted BIC, Sample size adjusted Bayesian information criterion; LMR ALRT, Lo-Mendell-Rubin adjusted likelihood ratio test.

Table 4 presents the results of univariable and multivariable logistic regression models concerning recent HIV testing. In the adjusted multivariable logistic regression model, we found that MSM who had multiple male sex partners [adjusted odds ratio (AOR): 1.99, 95% confidence interval (CI): 1.48–2.69, $p < 0.001$] and who engaged in substance use (AOR: 1.89, 95% CI: 1.41–2.55, $p < 0.001$) over the previous 6 months were significantly more likely to have been recently tested. Meanwhile, compared with MSM in the ''minimal barrier'' group, MSM in the ''uncertainty concerning testing sites'' (AOR: 0.29, 95% CI: 0.19–0.45, $p < 0.001$) and ''low risk and privacy violation'' (AOR: 0.42, 95% CI: 0.26–0.67, $p < 0.001$) groups were found to be significantly less likely to have been recently tested. In addition, in the multivariable model, MSM who were unemployed (AOR: 2.18, 95% CI: 1.22–3.91, $p = 0.009$) and employed (AOR: 1.81, 95% CI: 1.25–2.64, $p = 0.002$), and self-identified as gay (AOR: 1.67, 95% CI: 1.02–2.76, $p = 0.044$) were significantly more likely to have been recently tested. MSM who were unsure of their HIV status were significantly less likely to have been recently tested (AOR: 0.12, 95% CI: 0.07–0.23, $p < 0.001$).

Table 5 presents the results of the adjusted multinomial logistic regression model with latent class barrier classification as the dependent variable after adjusting for potential sociodemographic confounders. MSM who were HIV-negative but had not been tested recently were significantly more likely to be in the ''uncertainty concerning testing sites'' (AOR: 4.22, 95% CI: 2.64–6.75, $p < 0.001$) and ''low risk and privacy violation'' (AOR: 2.39, 95% CI: 1.49–3.83, $p < 0.001$) groups compared with MSM, who were HIV negative and had been recently tested. MSM who were unsure of their HIV status regardless of their recent testing were significantly more likely to be in the ''uncertainty concerning testing sites'' (AOR: 3.78, 95% CI: 2.12–6.71, $p < 0.001$) group, but significantly less likely to be in the ''low risk'' (AOR: 0.42, 95% CI: 0.18–0.99, $p = 0.047$) group compared with MSM who were HIV negative and had been recently tested.

Discussion

Examining a nationwide MSM sample from mainland China, this cross-sectional study found that this population that is typically at high risk for HIV engaged in a relatively low rate of recent HIV testing. The degrees of influence of the most common barriers to testing were also determined, revealing five distinct classes of these barriers. Importantly, significant relationships were found to exist between having multiple male sexual partners and engaging in substance use over the previous 6 months, MSM in the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' barrier classes, and undergoing HIV testing. The subgroups of testing and HIV status varied within the different latent class barrier classifications.

This study's findings imply that only one-third of MSM have been recently tested for HIV. Despite the Chinese government's great efforts to implement HIV interventions and its provision of free testing to citizens through local centers for disease control and prevention,[39] regular HIV testing remains relatively infrequent among this at-risk population. One recent

Table 3. Estimated Sociodemographics and Behavior Characteristics for Latent Class Barrier Classification Variables of Men Who Have Sex with Men (MSM) in China (N=1100)

	Uncertainty concerning testing sites 204 (18.5)	*Low risk and privacy violations 112 (10.2)*	*Fear of HIV and dying 77 (7.0)*	*Low risk 130 (11.8)*	*Minimal barrier 577 (52.5)*	*Chi-square* (p)
Sociodemographics						
Age (in years)						28.07 (<0.001)
≤25	136 (66.7)	43 (38.4)	53 (68.8)	72 (55.4)	336 (58.2)	
>25	68 (33.3)	69 (61.6)	24 (31.2)	58 (44.6)	241 (41.8)	
Educational level						10.07 (0.039)
≤Senior high school	77 (37.7)	27 (24.1)	18 (23.4)	36 (27.7)	165 (28.6)	
College or above	127 (62.3)	85 (75.9)	59 (76.6)	94 (72.3)	412 (71.4)	
Occupation						10.04 (0.262)
Student	76 (37.3)	27 (24.1)	24 (31.2)	44 (33.8)	179 (31.0)	
Employed	110 (53.9)	78 (69.6)	50 (64.9)	76 (58.5)	359 (62.2)	
Unemployed	18 (8.8)	7 (6.3)	3 (3.9)	10 (7.7)	39 (6.8)	
Monthly salary						17.95 (0.022)
<¥2000	83 (40.7)	29 (25.9)	28 (36.4)	54 (41.5)	211 (36.6)	
¥2000–4000	65 (31.9)	33 (29.5)	31 (40.3)	42 (32.3)	175 (30.3)	
>¥4000	56 (27.5)	50 (44.6)	18 (23.4)	34 (26.2)	191 (33.1)	
Sexual orientation						27.73 (0.001)
Gay	133 (65.2)	70 (62.5)	54 (70.1)	86 (66.2)	396 (68.6)	
Bisexual	32 (15.7)	30 (26.8)	11 (14.3)	35 (26.9)	131 (22.7)	
Other	39 (19.1)	12 (10.7)	12 (15.6)	9 (6.9)	50 (8.7)	
Anal sex role						21.38 (0.006)
Receptive preference	122 (59.8)	54 (48.2)	51 (66.2)	80 (61.5)	374 (64.8)	
Versatile	36 (17.6)	13 (11.6)	9 (11.7)	17 (13.1)	61 (10.6)	
Insertive preference	46 (22.5)	45 (40.2)	17 (22.1)	33 (25.4)	142 (24.6)	
Behavior characteristics						
Number of male sexual partners past 6 months						5.39 (0.250)
0–1	99 (48.5)	45 (40.2)	28 (36.4)	52 (40.0)	234 (40.6)	
≥2	105 (51.5)	67 (59.8)	49 (63.6)	78 (60.0)	343 (59.4)	
Number of female sexual partners past 6 months						17.42 (0.002)
0	174 (85.3)	80 (71.4)	72 (93.5)	103 (79.2)	470 (81.5)	
≥1	30 (14.7)	32 (28.6)	5 (6.5)	27 (20.8)	107 (18.5)	
Condomless insertive anal sex with male partners						6.89 (0.142)
No	120 (58.8)	73 (65.2)	50 (64.9)	66 (50.8)	330 (57.2)	
Yes	84 (41.2)	39 (34.8)	27 (35.1)	64 (49.2)	247 (42.8)	
Condomless receptive anal sex with male partners						17.14 (0.002)
No	107 (52.5)	80 (71.4)	49 (63.6)	64 (49.2)	310 (53.7)	
Yes	97 (47.5)	32 (28.6)	28 (36.4)	66 (50.8)	267 (46.3)	
Condomless vaginal sex with female partners						7.90 (0.095)
No	176 (86.3)	88 (78.6)	65 (84.4)	105 (80.8)	449 (77.8)	
Yes	28 (13.7)	24 (21.4)	12 (15.6)	25 (19.2)	128 (22.2)	
Condomless anal sex with last male partner						7.05 (0.133)
No	159 (77.9)	97 (86.6)	69 (89.6)	106 (81.5)	469 (81.3)	
Yes	45 (22.1)	15 (13.4)	8 (10.4)	24 (18.5)	108 (18.7)	
Condomless vaginal sex with last female partner						2.35 (0.672)
No	188 (92.2)	104 (92.9)	73 (94.8)	116 (89.2)	527 (91.3)	
Yes	16 (7.8)	8 (7.1)	4 (5.2)	14 (10.8)	50 (8.7)	
Commercial sex						3.33 (0.504)
No	195 (95.6)	104 (92.9)	71 (92.2)	118 (90.8)	540 (93.6)	
Yes	9 (4.4)	8 (7.1)	6 (7.8)	12 (9.2)	37 (6.4)	

(*continued*)

TABLE 3. (CONTINUED)

	Uncertainty concerning testing sites 204 (18.5)	*Low risk and privacy violations 112 (10.2)*	*Fear of HIV and dying 77 (7.0)*	*Low risk 130 (11.8)*	*Minimal barrier 577 (52.5)*	*Chi-square (p)*
Substance use						18.12 (0.001)
No	164 (80.4)	76 (67.9)	50 (64.9)	87 (66.9)	372 (64.5)	
Yes	40 (19.6)	36 (32.1)	27 (35.1)	43 (33.1)	205 (35.5)	
Binge drinking						0.80 (0.939)
No	117 (57.4)	61 (54.5)	41 (53.2)	69 (53.1)	321 (55.6)	
Yes	87 (42.6)	51 (45.5)	36 (46.8)	61 (46.9)	256 (44.4)	
HIV testing barriers						
Fear of homosexuality-related stigma						-
No	201 (98.5)	112 (100.0)	77 (100.0)	130 (100.0)	293 (50.8)	
Yes	3 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	3 (49.2)	
Fear of HIV-positive discrimination						-
No	204 (100.0)	112 (100.0)	77 (100.0)	130 (100.0)	253 (43.8)	
Yes	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	324 (56.2)	
Belief not at HIV risk						-
No	83 (40.7)	0 (0.0)	77 (100.0)	0 (0.0)	403 (69.8)	
Yes	121 (59.3)	112 (100.0)	0 (0.0)	130 (100.0)	174 (30.2)	
Fear of being diagnosed HIV positive						-
No	161 (78.9)	112 (100.0)	0 (0.0)	46 (35.4)	310 (53.7)	
Yes	43 (21.1)	0 (0.0)	77 (100.0)	84 (64.6)	267 (46.3)	
Belief HIV means death						-
No	185 (90.7)	112 (100.0)	0 (0.0)	88 (67.7)	394 (68.3)	
Yes	19 (9.3)	0 (0.0)	77 (100.0)	42 (32.3)	183 (31.7)	
Fear of privacy violation at testing site						-
No	133 (65.2)	0 (0.0)	77 (100.0)	130 (100.0)	268 (46.4)	
Yes	71 (34.8)	112 (100.0)	0 (0.0)	0 (0.0)	309 (53.6)	
Uncertainty of testing site locations						-
No	0 (0.0)	112 (100.0)	71 (92.2)	130 (100.0)	508 (88.0)	
Yes	204 (100.0)	0 (0.0)	6 (7.8)	0 (0.0)	69 (12.0)	
Testing cost concerns						-
No	170 (83.3)	109 (97.3)	73 (94.8)	111 (85.4)	504 (87.3)	
Yes	34 (16.7)	3 (2.7)	4 (5.2)	19 (14.6)	73 (12.7)	
Subgroups of testing and HIV status						83.83 (<0.001)
HIV negative and have ever tested	26 (12.7)	31 (27.7)	30 (39.0)	42 (32.3)	212 (36.7)	
HIV negative but have never tested	138 (67.6)	75 (67.0)	32 (41.6)	74 (56.9)	259 (44.9)	
HIV unsure whether or not tested	38 (18.6)	5 (4.5)	15 (19.5)	7 (5.4)	80 (13.9)	
HIV positive	2 (1.0)	1 (0.9)	0 (0.0)	7 (5.4)	26 (4.5)	

Values presented are *n* (%).

study[17] analyzed data from MSM in China and found the HIV testing rate in the prior year ranged from ~40% to 50% of participants; other studies have found that recent HIV testing is infrequent among this population,[18] and nearly one-quarter of MSM tested for HIV at least once every 6 months.[19] In the current study, the prevalence of recent testing was found to be low and at rates that were similar to those shown in previous research.[18,19]

Psychological and structural barriers to testing may contribute to the consistently low rates of recent HIV testing among MSM in China.[21,22] In this study, we chose to focus on major barriers documented in previous literature,[22,34,35] and our findings suggest that the three most common barriers are believing oneself to be not at risk for HIV, the fear of being diagnosed HIV positive, and the fear that undergoing testing would violate privacy. Thinking of oneself as being at low risk for HIV has previously been found to be an important factor that inhibits individuals from undergoing HIV testing.[20,24] Meanwhile, almost half of our participants feared being diagnosed with HIV and the violation of their privacy from testing. This is in accordance with a literature review from Europe[40] that showed a considerable proportion of MSM believed that HIV is a fatal condition and testing could draw suspicion from others that one is HIV infected. These latter two barriers are also associated with homosexuality- and HIV-related discrimination and stigma.[22] Homosexuality and HIV/AIDS remain sensitive issues in China.[23] Although same-sex behavior is not illegal, engaging in it can have adverse social and cultural ramifications, such as rejection by family members and prospective employers.[41] Furthermore, rates of HIV-related discrimination and stigma remain high in Chinese society, even though anti-HIV stigma campaigns have been

Table 4. Univariable and Multivariable Models of Recent HIV Testing Among Men Who Have Sex with Men (MSM) in China

	OR (95% CI)	p	*AOR (95% CI)*	p
Sociodemographics				
Age (Ref. ≤25)	1.90 (1.47–2.44)	<0.001	1.36 (0.99–1.88)	0.062
Educational level (Ref. ≤Senior high school)	1.25 (0.95–1.66)	0.112		
Occupation (Ref. Student)				
Employed	2.53 (1.87–3.41)	<0.001	1.81 (1.25–2.64)	0.002
Unemployed	3.00 (1.79–5.04)	<0.001	2.18 (1.22–3.91)	0.009
Monthly salary (Ref. <¥2000)				
¥2000–4000	1.73 (1.26–2.38)	0.001		
>4000	2.60 (1.90–3.54)	<0.001		
Sexual orientation (Ref. Other)				
Gay	2.13 (1.34–3.36)	0.001	1.67 (1.02–2.76)	0.044
Bisexual	1.86 (1.17–3.09)	0.017	1.52 (0.87–2.66)	0.143
Anal sex role (Ref. Insertive preference)				
Versatile	0.74 (0.56–0.99)	0.041		
Receptive preference	0.86 (0.56–1.31)	0.480		
Behavior characteristics				
Number of male sexual partners (Ref. 0–1)	2.40 (1.84–3.15)	<0.001	1.99 (1.48–2.69)	<0.001
Number of female sexual partners (Ref. 0)	1.46 (1.06–1.99)	0.019		
Condomless insertive anal sex with male (Ref. No)	1.17 (0.91–1.50)	0.225		
Condomless receptive anal sex with male (Ref. No)	0.90 (0.70–1.16)	0.407		
Condomless vaginal sex with female (Ref. No)	0.88 (0.64–1.20)	0.409		
Condomless anal sex with last male partner (Ref. No)	0.86 (0.62–1.20)	0.377		
Condomless vaginal sex with last female partner (Ref. No)	0.83 (0.52–1.31)	0.429	0.63 (0.38–1.05)	0.076
Commercial sex (Ref. No)	2.02 (1.25–3.27)	0.004		
Substance use (Ref. No)	2.57 (1.97–3.34)	<0.001	1.89 (1.41–2.55)	<0.001
Binge drinking (Ref. No)	1.04 (0.91–1.17)	0.594		
HIV status				
Unsure (Ref. HIV negative)	0.15 (0.08–0.28)	<0.001	0.12 (0.07–0.23)	<0.001
HIV positive (Ref. HIV negative)	3.00 (1.50–6.00)	0.002	1.96 (0.92–4.15)	0.081
HIV testing barriers (Ref. Minimal barrier)				
Uncertainty concerning testing sites	0.25 (0.16–0.38)	<0.001	0.29 (0.19–0.45)	<0.001
Low risk and privacy violations	0.55 (0.35–0.86)	0.008	0.42 (0.26–0.67)	<0.001
Fear of HIV and dying	0.97 (0.60–1.57)	0.891	1.09 (0.64–1.86)	0.760
Low risk	0.81 (0.55–1.21)	0.302	0.69 (0.45–1.06)	0.090

OR, odds ratio; CI, confidence interval; AOR, adjusted odds ratio.

Table 5. Adjusted Multinomial Model of Latent Class Barrier Classification Among Men Who Have Sex With Men (MSM) in China

	Uncertainty concerning testing sites		*Low risk and privacy violations*		*Fear of HIV and dying*		*Low risk*	
	AOR (95% CI)	p	*AOR (95% CI)*	p	*AOR (95% CI)*	p	*AOR (95% CI)*	p
Sociodemographics								
Age (Ref. ≤25)	0.78 (0.52–1.17)	0.232	2.05 (1.23–3.43)	0.006	0.58 (0.32–1.04)	0.068	1.42 (0.89–2.28)	0.144
Educational level (Ref. ≤Senior high school)	0.70 (0.49–1.00)	0.050	1.19 (0.73–1.93)	0.495	1.52 (0.85–2.69)	0.155	1.00 (0.65–1.55)	0.993
Monthly salary (Ref. <¥2000)								
¥2000–4000	1.11 (0.72–1.72)	0.643	1.06 (0.57–1.97)	0.859	1.62 (0.89–2.98)	0.118	0.86 (0.52–1.45)	0.574
>¥4000	1.08 (0.67– 1.74)	0.760	1.20 (0.64–2.22)	0.574	0.94 (0.46–1.92)	0.868	0.56 (0.32–1.00)	0.048
Sexual orientation (Ref. Other)								
Gay	0.53 (0.33–0.85)	0.009	0.85 (0.43–1.71)	0.655	0.57 (0.28– 1.15)	0.117	1.30 (0.61–2.77)	0.498
Bisexual	0.33 (0.19– 0.60)	<0.001	0.92 (0.43–1.98)	0.829	0.34 (0.14–0.84)	0.019	1.56 (0.69–3.50)	0.283
Anal sex role (Ref. Insertive preference)								
Versatile	1.76 (1.00–3.08)	0.049	0.75 (0.37–1.53)	0.435	1.07 (0.44–2.58)	0.878	1.17 (0.60–2.29)	0.651
Receptive preference	0.81 (0.53–1.25)	0.345	0.55 (0.34–0.90)	0.017	0.92 (0.50–1.72)	0.800	0.89 (0.55–1.44)	0.633
Subgroups of testing and HIV status (Ref. HIV negative and have ever tested)								
HIV negative but have never tested	4.22 (2.64–6.75)	<0.001	2.39 (1.49–3.83)	<0.001	0.81 (0.47–1.40)	0.452	1.42 (0.92–2.19)	0.111
HIV unsure whether or not tested	3.78 (2.12–6.71)	<0.001	0.51 (0.19–1.38)	0.187	1.27 (0.64–2.53)	0.496	0.42 (0.18–0.99)	0.047
HIV positive	0.69 (0.15–3.09)	0.623	0.30 (0.04–2.28)	0.242	—	—	1.41 (0.57–3.50)	0.460

Adjusted for potential sociodemographic confounders, including age, educational level, monthly salary, sexual orientation, and sex role.
AOR, adjusted odds ratio; CI, confidence interval.

implemented.[13,42] Thus, MSM may be reluctant to undergo HIV testing because of the associated discrimination and stigma.

MSM in the ''uncertainty concerning testing sites'' class all reported uncertainty concerning the locations of testing sites and had the lowest rates of recent HIV testing. Meanwhile, MSM in the ''low risk and privacy violation'' class all reported believing themselves to be not at risk and being afraid that testing would violate their privacy. Next, MSM in the ''fear of HIV and dying'' class reported being afraid of being diagnosed HIV positive and that HIV is fatal. MSM in the ''low-risk'' class reported believing themselves to be not at risk, but did not fear privacy violation. Finally, MSM in the ''minimal barrier'' class, which constituted almost half of the participants, reported some, but minimal, barriers to testing and had the highest rates of recent HIV testing.

These five classes had varying degrees of barriers to HIV testing, and the model showed that significant associations exist between certain barrier classes and such testing. Specifically, MSM in the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' classes were found to be significantly less likely to undergo recent HIV testing than MSM in the ''minimal barrier'' class.

Our multivariable regression model showed that individuals who have multiple male sexual partners are significantly more likely to undergo recent HIV testing. This finding is supported by studies conducted among both Myanmar and Chinese MSM.[21,43] The current study also revealed that those who engage in substance use are significantly more likely to have been recently tested for HIV. A possible explanation for this is that, as substance use is an effective method for MSM to overcome feelings of shame and internalized homophobia and to facilitate sexual behaviors,[44] users are more sexually active, and sexually active MSM are naturally more likely to undergo testing. It is not surprising that we found MSM who were unsure of their HIV status were less likely to have been recently tested. In addition, our findings suggest that the employed and unemployed and gay men are significantly more likely to undergo recent HIV testing. The low prevalence of testing among students may be due to insufficient HIV/AIDS knowledge and awareness as a result of inadequate sex education at school.[45] Our findings also support the theory that compared with bisexual and heterosexual men, gay men have more gay friends and are consequently more likely to seek advice from gay communities or HIV organizations, thus being more likely to undergo HIV testing.[46]

By including an adjusted multinomial logistic regression model based upon the latent class barrier classification, our findings have extended previous reports on specific subgroups of MSM regarding their testing barriers. Compared with MSM who were HIV negative and had been recently tested, MSM who were HIV negative but had not tested recently were significantly more likely to be in the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' groups. MSM who were unsure of their HIV status regardless of recent testing were significantly more likely to be in the ''uncertainty concerning testing sites'' group. These results indicate that there is a greater sense of the presence of testing barriers among MSM who were HIV negative, but not recently tested, and MSM who were unsure of their HIV status. These two subgroups of MSM were more likely to be in the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' groups.

Our findings have significant implications for efforts to increase HIV testing in this middle-income country, especially regarding endeavors to remove barriers. First, advertisements for clinical testing sites and facilities could be featured on social media and gay-dating applications, which would provide necessary knowledge and information and also make contributions to improving perceptions of HIV by normalizing it. Second, advertising and offering low-cost self-testing would be a feasible and effective approach to expand HIV testing to MSM in different settings, especially in less economically developed towns and rural areas, because it would protect MSM's privacy and resolve transportation and inconvenience issues with regard to clinical testing sites.[29,47] Additionally, despite the fact that anonymous HIV testing has been in effect in China for several years, confidentiality should be enhanced in testing facilities and clinics to improve the accessibility of testing. Thus, cultural and social shifts to reduce homosexuality and HIV-related discrimination and stigma are essential for increasing the acceptance and protection of gay men, which would indirectly expand HIV testing among MSM. Perhaps this could be done by having well-known people in Chinese society, such as celebrities, model HIV testing behavior. Furthermore, testing could be incorporated into popular media, such as television shows or internet-based, smartphone-based, and text messaging technologies.[48] Finally, HIV testing promotion and testing barrier reduction and cancellation should be targeted to MSM with greater testing barriers, particularly MSM who have never been tested and who are unsure of their HIV status as well as migrant MSM[49] in China.

The study has limitations. First, the data presented are cross-sectional; therefore, causal relationships cannot be determined. Second, the data are Internet based, meaning they may not be generalizable to MSM who do not frequent online MSM communities,[29] those who do not have access to such online recruitment advertisements, and those who can access such surveys but are sensitive to discussing issues such as commercial sex, substance use, and sexual orientation, etc. as a result of cultural practices and social desirability.[50] Nevertheless, given a high proportion of MSM use the Internet to make new friends and find sexual partners,[51] the Internet-based approach is considered an efficient alternative for this population. Third, this study shares a shortcoming common to similar studies (i.e., young MSM are more likely to be recruited than older men). Fourth, we only investigated HIV testing, but further research on testing for other sexually transmitted infections, such as syphilis and condyloma acuminata may also be informative for public health interventions.

Notwithstanding these limitations, as most previous studies contain small and regional samples that may limit the generalizability of the findings to larger areas, this study provides important information on the prevalence rates of recent HIV testing and significant barriers to HIV testing with a nationwide MSM sample in mainland China. Furthermore, LCA was used to explore the degrees of influence of the most common barriers to testing and reveal five distinct classes. Importantly, our results suggest that having multiple sexual partners and engaging in substance use are significantly associated with more frequent HIV testing; furthermore, MSM in the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' classes are significantly less likely to engage in HIV testing than those in the ''minimal barrier''

class. MSM who were HIV negative but had not been tested recently and MSM who were unsure of their HIV status should be especially targeted for HIV testing promotion, as they were more likely to be in the ''uncertainty concerning testing sites'' and ''low risk and privacy violation'' groups. Given the findings of this study, it can be recommended that the prevalence of regular HIV testing in China could be improved by providing enhanced guidance from a barrier perspective, and especially by targeting the MSM community regarding HIV prevention interventions and healthcare services that are easily accessible and with sufficient privacy protections.

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