



# HIV Testing Among Chinese Men Who Have Sex with Men: The Roles of HIV Knowledge, Online Social Life, and Sexual Identity Concerns

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## Abstract

HIV testing is critical for timely care and controlling the HIV epidemic among men who have sex with men (MSM), particularly for regions with increasing infection rates such as China. This study investigated HIV testing and associated demographic, psychosocial, and risk behavior factors among internet-using Chinese MSM ( $n = 332$ ). Most participants received HIV testing before (74.1%), which was associated with more HIV knowledge, online social life, and more frequent condomless anal sex. Among MSM who tested previously ( $n = 246$ ), 48.4% reported regular HIV testing, which was associated with a greater online social life and less sexual identity concerns (internalized homonegativity and concealment motivation). Findings suggest a two-step approach to engage MSM who never tested for HIV and who do not undergo regular testing. Strategies to promote testing should enhance HIV knowledge, sex education, and online MSM community building. Interventions to increase acceptance and positivity of sexual identity are crucial to regular testing.

**Keywords** HIV · Testing behaviors · Men who have sex with men · China · Internet

## Resume

Pruebas del VIH son crítica para cuidado oportuno y controlando la epidemia de VIH entre hombres que tienen sexo con hombres (HSM), particularmente para regiones con tasas de infección en aumento tal como China. Este estudio investigó las pruebas de VIH y la asociada demográfico, psicológicos, y factores de comportamiento de riesgo entre HSH chinos que utilizan internet ( $n = 332$ ). La mayoría de los participantes recibieron pruebas de VIH antes (74.1%), que se asoció con más conocimiento del VIH, vida social en línea, y sexo anal sin condón más frecuente. Entre HSH que probó previamente ( $n = 246$ ), 48.4% reportaron pruebas de VIH regulares, que fue asociado con una mayor vida social en línea y menos preocupaciones de identidad sexual (homonegatividad interiorizada y motivación de ocultamiento). Resultados sugieren un enfoque de dos pasos para engancharse HSM que nunca ha probado para VIH y que no someterse pruebas con regularidad. Estrategias para promover las pruebas debería mejorar VIH conocimiento, educación sexual, y HSM construcción comunitaria en línea. Las intervenciones para aumentar la aceptación y la positividad de la identidad sexual son cruciales para las pruebas regulares.

**Palabras Clave** VIH · Conductas de pruebas · Hombres que tienen sexo con hombres · China · Internet

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## Introduction

HIV prevalence among Chinese men who have sex with men (MSM) has been drastically rising in the past decade: between 2006 and 2014, new HIV infections due to male to male sexual transmission increased from 2.5 to 25.8% [1]. A meta-analysis revealed an increase of HIV prevalence among MSM in China from 1.4% in 2001 to 5.3% in 2009 [2]. The alarmingly high and increasing HIV epidemic in Chinese MSM demands research and prevention efforts.

Key to HIV prevention and care is testing, as it can identify HIV infection, link people to medical and counseling services, and promote antiretroviral therapy treatment that can prevent secondary transmission [3]. The U.S. Centers of Disease Control and Prevention (CDC) recommends that MSM in the U.S. undergo HIV screening annually and suggests that MSM at increased risk of infection (such as those who engage in high sexual risk behaviors) would benefit from more frequent and regular testing every 3–6 months [4]. Testing may be particularly important for Chinese MSM, given the increasing prevalence of HIV as well as the lack of awareness of one's HIV status among many Chinese MSM [5].

Despite globalization and recent economic success, Chinese society remains strong in its family-oriented, Confucian tradition and men are expected to marry a woman and bear children to continue the family lineage [6, 7]. Thus, same-sex behaviors are often stigmatized and MSM largely remain “in-the-closet” and have limited social support [8]. For this reason, the internet has gained popularity for Chinese MSM as a means to socialize and recruit sexual partners. As a platform, the internet might promote social support, information on HIV prevention, along with more access to sex [9]. The internet also provides researchers the advantage of reaching “hidden populations”, particularly MSM who may not be reached through other traditional approaches [9, 10]. Studies outside of China have found that demographic and psychosocial factors associated with HIV testing by internet-using MSM. For instance, a recent meta-analysis on studies among internet-using MSM in the United States found that HIV testing was associated with age over 30 years, college education, use of drugs, and self-identification as gay [11]. A large online survey that included men from 38 European countries found that structural and cultural stigma decreased testing utilization by MSM [12]. A study with MSM in Brazil found that poor HIV knowledge about transmission was associated with never having been tested for HIV [13]. A recent intervention study with online-recruited racial minority MSM in the U.S. found that more online networking was associated with a greater likelihood of HIV testing, suggesting a positive influence of online social life for MSM [14].

Meta-analysis suggests that only less than half Chinese MSM have ever been HIV tested in their lifetime [15]. A few studies have examined factors associated with HIV testing among Chinese MSM in general. A study with young migrant MSM in Beijing found that HIV testing was associated with sexual risk behaviors and a history of sexually transmitted diseases [16]. Non-testers in the study reported barriers related to less perceived risk for HIV infection, fear of stigmatization, inconvenience of testing, and concerns about confidentiality [16]. A recent study in Zhejiang, China with MSM noted that those tested were more likely to be older MSM, with more education, self-reported

as gay, and had received HIV education in the past year [17]. Another recent study in Changsha, China also found HIV testing to be more prevalent among MSM who were older and had been previously diagnosed with a STI [18]. Among MSM living in Chongqing, testing was associated with safe sex behaviors, HIV status discussion with one's partner, and lower level of HIV stigma [19]. However, less is known about testing behaviors among Chinese MSM who are recruited online. One online study with MSM in Shandong and Guangdong Provinces showed the relevance of sensitivity to HIV testing social norms and self-efficacy in testing behaviors [20]. Another study investigated HIV and syphilis testing found that previous engagement in sexual health programmes contributed to testing [21]. One study investigating the method of HIV self-testing with Chinese MSM recruited online found that self-testing correlated with being married, a higher number of male anal sex partners, and being tested for HIV in the past year [22]. In summary, these studies suggest that HIV testing among Chinese MSM is likely to be influenced by demographic and behavioral variables (risk behavior, prior testing), and less is researched regarding the influence of psychosocial factors on testing among Chinese MSM.

Because of the increased use of the internet, more research is needed to examine factors associated with HIV testing among Chinese MSM recruited online. Specifically, more research is needed to examine potential psychosocial factors associated with testing among sexually active, internet-using Chinese MSM. Further, there has been limited research about factors influencing regular testing, despite its importance in promptly identifying infection, which is critical in the midst of an on-going epidemic. So far, HIV testing research with Chinese MSM has focused on demographic and behavioral (e.g., risk behavior) characteristics, and further investigation on the role of psychosocial factors (e.g., HIV knowledge, online networking, and sexual identity stigma) is warranted, given their relevance in non-Chinese MSM populations [12–14].

In China, MSM recruited online were found to be less accepting of their sexual orientation compared to those recruited in-person [23], suggesting that sexual identity-related issues might significantly affect internet-using MSM. The important influence of sexual orientation concerns is in accord with the minority stress theory [24]. For example, internet-using MSM who have strong internalized homophobia and live in concealment of their sexual orientation might avoid testing since it may involve acknowledging, at least psychologically, their sexual behavior with men. Meanwhile, the internet provides a relatively anonymous and private platform for Chinese MSM to connect with others. Chinese MSM often live in heteronormative environments and the internet may allow them to both receive social support and learn about HIV

prevention. Such socialization and learning via the internet could promote HIV testing. Thus, clarification on the roles of sexual identity concerns, engagement in a social life online, and HIV knowledge (a known factor for testing with offline-recruited MSM) among internet-using MSM in China could suggest ways to promote testing in this relatively “hidden” population. In addition, recruitment of MSM online has the advantage of reaching a more geographically diverse sample than face-to-face methods. This research has public health significance because it may provide valuable information for developing online and mobile-based interventions for MSM in China, which is a growing population that may benefit from wide-spread and more regular HIV testing.

As such, there were two main aims of this study. First, we investigated the prevalence of HIV testing behaviors among a sample of sexually active internet-using Chinese MSM. Second, we investigated their demographic, psychosocial, and sexual risk behavior variables associated with HIV testing behaviors.

## Methods

### Procedure

Data in this study is part of a comprehensive study on HIV prevention with Chinese MSM. The study was approved by the Educational and Social/Behavioral Science Institutional Review Board (IRB) at University of Wisconsin-Madison. An anonymous online survey was created using Qualtrics Survey Tool. MSM in China were recruited through ads on WeChat linked websites (a widely used social app in China) and through LGBT (Lesbian, Gay, Bisexual, Transgender) organization websites/apps, which included Beijing LGBT Center, a national non-profit LGBT community and advocacy organization; Blued, an MSM social networking and dating app; PFLAG China, a national non-profit organization formed by LGBT individuals, their parents, friends, and supporters in China; and Guangzhou Zhitong LGBT Center, an LGBT community organization located in Guangzhou, Guangdong Province. Eligibility criteria included (1) being 18 years of age or older, (2) being fluent in the Chinese language, and (3) self-identifying as a man who has sex with men. Interested individuals could learn more about the survey and participate by clicking an anonymous link or scanning a QR code (for phone users). Potential participants were asked to read through the consent form and click their agreement to gain access to the survey. No incentive was provided to participants. Recruitment took place between February 2017 and May 2018.

## Participants

A total of 906 self-identified Chinese MSM enrolled in the study. As there was a lack of drug use behaviors in this sample (only one participant reported drug use in the past 12 months), this research focuses on testing behaviors among sexually active MSM. Among the 649 participants who reported their sex history with male and female partners, only 7.4% ( $n=48$ ) reported sex (oral, vaginal, or anal) with a woman in the past 12 months. Among those reported their sex history with men ( $n=636$ ; oral or anal), the majority reported having had anal sex with a man in the past ( $n=536$ , 84.3%). Of these 536 men, 332 (61%) completed all measures regarding their demographic information, HIV knowledge, sexual identity scale, HIV testing behaviors, and MSM related social life. Therefore, the complete sample of 332 sexually active MSM is the focus of this paper. Detailed demographic information are reported in Results and Table 1.

## Measures

*American Men’s Internet Survey (AMIS)* was translated and adapted to measure Chinese MSM’s HIV testing and risk behaviors. The AMIS is a behavioral health survey developed by PRISM Health [25]. This survey was selected because it was developed to assess MSM who use internet and has been shown to be useful in data collection in large populations. It includes items from the CDC National HIV Behavioral Surveillance Survey (NHBS). It has been used with MSM in United States annually since 2013 and shown to be useful in monitoring behaviors that are critical for effective HIV/STI prevention [26]. Following translation of the survey, we conducted pretesting regarding its cultural relevance with five MSM who live in China and use online platforms (website, apps) to socialize with other MSM. Revisions and adjustments to the translation were made accordingly.

In the AMIS, participants are asked if they have ever been tested for HIV in the past (yes/no), whether they have been tested regularly (every 3–6 months) in the past year (yes/no), and how many HIV tests they have had in the past 2 years. Barriers to testing are assessed with a multiple-choice question for participants who have never been HIV tested and for those who do not test regularly. Examples of the nine barriers include a perceived low risk for HIV infection, fear of confirming one’s HIV infection, and concerns about testing confidentiality (see Table 2). The relevance of these barriers was ensured through our pilot pretesting as well as results of previous qualitative research in China on barriers to testing [27].

Sexual risk items from the AMIS included in analysis were (1) number of sexual partners with whom they engaged

**Table 1** Sociodemographic information of internet-using MSM in China, 2017–2018 ( $n = 332$ )

	<i>N (%)</i>
<i>Sexual orientation</i>	
Gay	274 (83.0)
Heterosexual	0 (0)
Bisexual	32 (9.7)
Pansexual	5 (1.5)
Queer	1 (0.3)
Non-labeled	16 (4.8)
Other	2 (0.6)
<i>Age in years</i>	
18–25	172 (51.8)
26–35	130 (39.2)
36–45	23 (6.9)
> 45	7 (2.1)
<i>Residence</i>	
First tier city	179 (54.2)
Second or third tier city	131 (39.7)
Country or non-city areas	20 (6.0)
<i>Region</i>	
North China (Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia)	133 (40.1)
Northeast China (Liaoning, Jilin, Heilongjiang)	16 (4.8)
East China (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong)	88 (26.5)
South Central China (Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan)	44 (13.3)
Southwest China (Chongqing, Sichuan, Guizhou, Yunnan, Tibet)	23 (6.9)
Northwest China (Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang)	8 (2.4)
HongKong, Macau, or living abroad	20 (6.0)
<i>Highest education completed</i>	
Without high school	15 (4.5)
High school	25 (7.5)
College degree or college certificated	200 (60.2)
Graduate degree or higher	92 (27.7)
<i>Annual income</i>	
Less than \$1800	48 (14.5)
\$1800 to \$5380	75 (22.6)
\$5380 to \$10,800	85 (25.6)
\$10,800 to \$18,000	64 (19.3)
More than \$18,000	60 (18.1)
<i>Marital status</i>	
Single, never married	221 (67.2)
Single, divorced	5 (1.5)
Cohabited	41 (12.5)
In a stable romantic relationship, not cohabited	43 (13.1)
In legal marriage with a woman	18 (5.5)
In legal marriage with a man	1 (0.3)
<i>HIV testing (tested before)</i>	246 (74.1)
<i>Regular testing (yes)</i>	123 (37.0)
<i>HIV status</i>	
HIV-positive	11 (3.5)
HIV-negative	250 (79.9)
Don't know one's status	52 (16.6)

**Table 2** Perceived barriers for HIV testing (more than one may apply)

	Non-testers and non-regular testers ( <i>n</i> = 213) <i>n</i> (%)	Non-testers ( <i>n</i> = 86) <i>n</i> (%)	Non-regular testers ( <i>n</i> = 127) <i>n</i> (%)	$\chi^2$	<i>p</i>
Perceived low likelihood of contracting HIV	93 (43.66)	53 (61.63)	40 (31.49)	17.72	< .001***
Afraid of finding out self as HIV-positive	38 (17.84)	8 (9.30)	30 (23.62)	6.23	.01*
No time	35 (16.43)	14 (16.28)	21 (16.54)	< .001	1
Afraid of others finding out testing results	18 (8.45)	2 (2.33)	16 (12.60)	5.73	.02*
Do not like needles	17 (7.98)	6 (6.98)	11 (8.66)	0.04	.85
Afraid of government obtaining one's information	27 (12.68)	9 (10.47)	18 (14.17)	0.35	.56
Do not know where to do testing	22 (10.33)	12 (13.95)	10 (7.87)	1.44	.23
Do not have money or insurance to do test	8 (3.76)	3 (3.49)	5 (3.94)	< .001	1
Afraid of losing family, job, or housing	13 (6.10)	3 (3.49)	10 (7.87)	1.04	.31
Inconvenient transportation	8 (3.76)	3 (3.49)	5 (3.94)	< .001	1

More than one perceived barrier can be selected by participants. *p* value was calculated using Person's Chi Squared ( $\chi^2$ ) test to compare non-testers (*n* = 86) and non-regular testers (*n* = 127). \**p* < .05, \*\**p* < .01, \*\*\**p* < .001

in condomless anal sex (CAI) with in the past 12 months, (2) whether or not one engaged in CAI with a partner whose HIV status was unknown to the participant, and (3) self-rated percentage of condom use during anal sex with men in the past 12 months.

One item on the AMIS that measures participants' online MSM social life frequency was included in the analysis: participants were asked to rate how often they used the internet to meet or socialize with gay men or other MSM, including social network websites, websites directed toward gay men, dating websites, or the use of mobile social applications (0 = never, 1 = less than once a month, 2 = once a month, 3 = more than once a month, 4 = once a week, 5 = more than once a week, 6 = once a day, 7 = more than once a day). Another item on the AMIS measures participants' "outing" or disclosure of sexual orientation: participants were asked "have you ever told anyone about your sexual attraction or sexual history with men? (yes/no)."

HIV knowledge was measured by the *Brief HIV Knowledge Questionnaire* (HIV-KQ-18; Chinese version) [28]. Participants were asked to select "true" or "false" on 18 statements about HIV. Sample items included "A person can get HIV by sharing a glass of water with someone who has HIV" and "Having sex with more than one partner can increase a person's chance of being infected with HIV." The HIV-KQ-18 has been demonstrated to have good internal consistency and construct validity in various populations including men who have sex with men [29]. The Cronbach's  $\alpha$  in this sample was 0.65, which was lower than previous studies used the HIV-KQ-18 among MSM in other regions (e.g., U.S., Argentina) [30, 31]. A closer look of the internal consistency identified two items on the scale that had the lowest item-total score correlation, including "there is a female condom that can help decrease a woman's chance of

getting HIV (True)" ( $r = .001$ ) and "A person can get HIV from oral sex (True)" ( $r = .03$ ). We included both items in the calculation of the total score because both are indicative of relevant knowledge on HIV transmission risk for this population, and the weak item-scale correlation might suggest a lack of knowledge in the entire sample regarding these two items.

The *Lesbian, Gay, and Bisexual Identity Scale* (LGBIS) [32, 33] measures participants' experiences related to their sexual identity. The LGBIS has eight subscales, of which three subscales related to the process of minority stress were used: (a) concealment motivation (concern with and motivation to protect one's privacy as an LGB person), (b) internalized homonegativity (rejection of one's LGB identity), and (c) acceptance concerns (related to potential interpersonal stigmatization as an LGB person). The LGBIS has been used in Taiwan [34] and has good internal consistency and validity [34]. Cronbach's alphas for concealment motivation, internalized homonegativity, and acceptance concerns in this sample were 0.85, 0.85, and 0.83 respectively, indicating good internal consistency.

## Statistical Analysis

All analyses were conducted in R [35]. Descriptive statistics and independent samples *t* test were calculated and bivariate analyses were conducted to explore the relationships among continuous variables.

Three outcome variables on HIV testing were examined through regression analysis, including (a) whether or not participants had ever been tested for HIV in the past (yes/no), (b) whether participants had been tested for HIV regularly in the past year [every 3–6 months (yes/no)], and (c) the number of times tested for HIV in the past 2 years. Logistic

regression analysis was employed for binary outcome variables (a & b). Because the number of times tested in the past 2 years was positively skewed, log transformation (base 2) was used to reduce skewness and multiple linear regression was used to examine its potential predictors.

For each regression model, demographic, sexual history, HIV knowledge, sexual orientation, and MSM social media use variables were only included as predictors if they were shown to be significantly associated with the three outcomes in t-tests or correlations. As both internalized homonegativity and concealment motivation differed significantly for regular and non-regular testers, and because the two variables highly correlated with each other ( $r=0.41$  [0.32, 0.50],  $p<.001$ ), a sum score was used to avoid multicollinearity and to represent sexual identity related concerns. In logistic regression analyses, adjusted odds ratios and their 95% confidence intervals were calculated.

## Results

### Descriptive Statistics

In this sample of 332 MSM, participants' age ranged from 18 to 50 ( $M=26.4$ ,  $SD=6.6$ ). Among them, most identified as gay men (83.0%). Regarding education level, most participants had an undergraduate or graduate degree (87.9%), which is similar to several previous studies that recruited online samples (> 80% college completers) [9, 22, 36]. Participants resided in 27 different Provinces or Municipal Cities out of the 34 provincial-level divisions in China, and the majority lived in a city area (54.2% live in a first-tier city and 39.7% live in a second or third tier city). Detailed sociodemographic information are presented in Table 1.

Nearly three quarters of the 332 participants reported that they had been tested for HIV in the past (74.1%), and of those, about a third reported regular testing (37.0%). The most frequent barrier to testing reported was a low perceived likelihood of contracting HIV (43.7%; 61.6% among non-testers and 31.5% among non-regular testers). Non-testers reported more structural barriers than non-regular testers such as having no time (16.3%) and not knowing a testing location (14.0%). Additional barriers for non-regular testers included a fear of confirming that one was HIV infected (23.6%), lack of time for testing (16.5%) and concerns about the confidentiality from the government of the testing information (14.2%).

Comparison on demographic and psychosocial characteristics between testers and non-testers, as well as regular and non-regular testers, are presented in Table 3 and 4, respectively. MSM who had been tested for HIV differed from those who had not such that testers were more likely to have completed college (91.1% vs. 79.1%), were older

(26.97 years vs. 24.78), had more HIV knowledge (mean of 15.26 vs.14.41), more frequent use of the internet for their MSM social life ( $M=4.27$  vs. 3.65), and more CAI partners in the past 12 months ( $M=0.81$  partners vs. 0.52).

In comparison to those testing less than every 3–6 months, regular testers reported less internalized homonegativity ( $M=8.87$  compared to 10.19,  $t=-2.49$ ,  $p=.01$ ) and concealment motivation ( $M=11.99$  compared to 13.15,  $t=-2.35$ ,  $p=.02$ ), more frequent online MSM social life ( $M=4.61$  compared to 3.94,  $t=2.17$ ,  $p=.03$ ), and a greater proportion of sexual acts in the past 12 months involved condoms (85.68% on average compared to 77.80%,  $t=2.02$ ,  $p=.04$ ).

Correlations with continuous variables are shown in Table 5. Number of times HIV testing (log transformed) in the past 2 years was positively associated with HIV knowledge ( $r=.13$ ,  $p=.02$ ), online MSM social life ( $r=.15$ ,  $p=.009$ ), and self-rated condom use ( $r=.11$ ,  $p=.048$ ).

### Regression analysis

In a logistic regression accounting for age and education, a history of ever being tested for HIV was significantly associated with greater HIV knowledge ( $OR=1.19$ , 95% $CI=[1.06, 1.35]$ ,  $p=.005$ ), a greater frequency of using the internet for their MSM social life ( $OR=1.13$  [1.01, 1.25],  $p=.03$ ), and a greater number of CAI partners in the past 12 months ( $OR=1.45$  [1.08, 2.01],  $p=.02$ ). For instance, holding other variables at fixed value, there was a 19% increase in the odds of HIV testing for a one-unit increase in HIV knowledge scale total score.

Among those who had been tested for HIV, regular HIV testers were likely to have less sexual identity concerns (sum score of internalized homonegativity and concealment motivation;  $OR=0.94$  [0.90, 0.98],  $p=.006$ ) and a greater internet MSM social life frequency ( $OR=1.16$  [1.03, 1.31],  $p=.01$ ). Other variables including HIV knowledge and proportion of times using a condom use during intercourse in the past 12 months were not associated with regular testing in the logistic regression analysis (Tables 6, 7).

A greater number of HIV tests in the past 2 years was associated with greater HIV knowledge ( $B=0.07$  [0.01, 0.12],  $SE=0.03$ ,  $p=.01$ ) and more frequent use of the internet for MSM social life ( $B=0.06$  [0.02, 0.11],  $SE=0.02$ ,  $p=.006$ ), but was not associated with the proportion of times using a condom during intercourse in the past 12 months.

## Discussion

HIV testing is essential to promptly identify PLWH and engage them in HIV care, particularly for high-risk populations such as MSM. The internet has rapidly grown to be a

**Table 3** Comparison between MSM who tested for HIV before and MSM who did not test

Categorical variables	Tested before (N=246)	Not tested before (N=86)	$\chi^2$	p
	n (%)	n (%)		
<i>Sexual orientation</i>				
Gay	204 (82.93)	70 (81.40)	1.47	.83
Bisexual	22 (8.94)	10 (11.63)		
Pansexual or queer	5 (2.03)	1 (1.16)		
Non-labeled	12 (4.88)	4 (4.65)		
Other	2 (0.8)	0 (0)		
<i>Residence</i>				
First tier city	136 (55.74)	43 (50.0)	3.02	.22
Second or third tier city	91 (37.30)	40 (46.51)		
Country or non-city areas	17 (6.97)	3 (3.49)		
<i>Education</i>				
Without high school	10 (4.07)	5 (5.81)	15.13	.002**
High school	12 (4.88)	13 (15.12)		
College degree or college certificated	149 (60.57)	51 (59.30)		
Graduate degree or higher	75 (30.49)	17 (19.77)		
<i>Annual income</i>				
Less than \$1800	29 (11.79)	19 (22.09)	6.88	.14
\$1800 to \$5380	56 (22.76)	19 (22.09)		
\$5380 to \$10,800	62 (25.20)	23 (26.74)		
\$10,800 to \$18,000	51 (20.73)	13 (15.12)		
More than \$18,000	48 (19.51)	12 (13.95)		
<i>Marital status</i>				
Single, never married	170 (69.39)	51 (60.71)	3.51	.48
Single, divorced	4 (1.63)	1 (1.19)		
Cohabited	29 (11.84)	13 (15.48)		
In a stable romantic relationship	28 (11.43)	15 (17.86)		
In legal marriage with a woman	14 (5.71)	4 (4.76)		
<i>HIV status</i>				
HIV-positive	11 (4.58)	0 (0)	195.32	< .001***
HIV-negative	228 (95.00)	22 (30.14)		
Don't know one's status	1 (0.42)	51 (69.86)		
Outness (out to others)	225 (91.46)	74 (86.05)	1.53	.22
UAI with an unknown status partner in past 12 months	65 (26.42)	13 (15.12)	3.92	.05
<i>Continuous variables</i>				
	M (SD)	M (SD)	t	p
Age	26.97 (6.64)	24.78 (6.38)	2.71	.008**
HIV Knowledge	15.26 (1.99)	14.41 (2.21)	3.16	.002**
Acceptance concerns	11.83 (4.01)	12.23 (2.97)	-0.98	.33
Internalized homonegativity	9.55 (4.18)	9.30 (3.84)	0.51	.61
Concealment motivation	12.59 (3.88)	13.05 (3.32)	-1.05	.29
Online MSM social life	4.27 (2.43)	3.65 (2.51)	1.98	.049*
Number of CAI partners in the past 12 months	0.81 (1.6)	0.52 (0.73)	2.22	.03*
Condom use %	81.59 (30.53)	78.21 (33.47)	0.80	.43

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

**Table 4** Comparison between MSM reported regular testing and non-regular testers ( $n = 246$ )

Categorical variables	Regular testers ( $N = 119$ ) $n$ (%)	Non-regular testers ( $N = 127$ ) $n$ (%)	$\chi^2$	$p$
<i>Sexual orientation</i>				
Gay	98 (82.35)	106 (83.46)	2.37	.67
Bisexual	12 (10.08)	10 (7.87)		
Pansexual or queer	2 (1.68)	3 (2.36)		
Non-labeled	6 (5.04)	6 (4.72)		
Other	0 (0)	2 (1.57)		
<i>Residence</i>				
First tier city	63 (53.39)	73 (57.94)	0.63	.73
Second or third tier city	47 (39.83)	44 (34.92)		
Country or non-city areas	8 (6.78)	9 (7.14)		
<i>Education</i>				
Without high school	4 (3.36)	6 (4.72)	3.81	.28
High school	9 (7.56)	3 (2.36)		
College degree or college certificated	71 (59.66)	78 (61.42)		
Graduate degree or higher	35 (29.41)	40 (31.50)		
<i>Annual income</i>				
Less than \$1800	13 (10.92)	16 (12.60)	1.79	.77
\$1800 to \$5380	28 (23.53)	28 (22.05)		
\$5380 to \$10,800	32 (26.89)	30 (23.62)		
\$10,800 to \$18,000	21 (17.65)	30 (23.62)		
More than \$18,000	25 (21.01)	23 (18.11)		
<i>Marital status</i>				
Single, never married	85 (71.43)	85 (67.46)	1.25	.87
Single, divorced	1 (0.84)	3 (2.38)		
Cohabited	13 (10.92)	16 (12.70)		
In a stable romantic relationship	13 (10.92)	15 (11.90)		
In legal marriage with a woman	7 (5.88)	7 (5.56)		
<i>HIV status</i>				
HIV-positive	5 (3.94)	6 (4.88)	1.01	.60
HIV-negative	112 (88.19)	116 (94.31)		
Don't know one's status	0 (0)	1 (0.81)		
Outness (ever out to others)	111 (93.28)	114 (89.76)	0.57	.45
UAI with unknown status partner in the past 12 months	32 (26.89)	33 (25.98)	0.003	.99
<i>Continuous variables</i>				
	$M$ ( $SD$ )	$M$ ( $SD$ )	$t$	$p$
Age	27.36 (6.83)	26.60 (6.46)	0.90	.37
HIV knowledge	15.45 (1.70)	15.08 (2.22)	1.49	.14
Acceptance concerns	11.60 (4.17)	12.05 (3.86)	-0.88	.38
Internalized homonegativity	8.87 (4.23)	10.19 (4.05)	-2.49	.01*
Concealment motivation	11.99 (4.05)	13.15 (3.64)	-2.35	.02*
Online MSM social life	4.61 (2.43)	3.94 (2.39)	2.17	.03*
Number of CAI partners in the past 12 months	0.92 (6.81)	0.71 (4.83)	1.00	.32
Self-rated condom use %	85.68 (26.33)	77.80 (33.63)	2.02	.04*
Number of testing in past 2 years	3.79 (3.21)	1.48 (1.15)	7.31	< .001***

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$



**Table 5** Bivariate analysis (*n* = 332)

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
1. Age	26.40	6.63	-									
2. Education	3.11	0.72	.22***	-								
3. Income	3.04	1.31	.48***	.31***	-							
4. HIV Knowledge	15.04	2.08	.08	.26***	-.02	-						
5. Acceptance Concerns	11.93	3.77	-0.02	.12*	.001	-.08	-					
6. Internalized Homonegativity	9.49	4.09	.11	-.02	.02	-.11	.39***	-				
7. Concealment Motivation	12.71	3.74	.16**	.20***	.16**	-.08	.63***	.41***	-			
8. Online MSM social life	4.11	2.46	-.02	-.03	-.07	-.06	.07	.08	.08	-		
9. Number of men engaged in UAI in past 12 months	0.73	1.43	.03	-.15**	.002	-.05	.03	.04	-.01	.07	-	
10. Self-rated condom use %	80.74	31.28	-.03	.09	-.001	-.07	.01	-.004	-.02	.21**	-.32***	
11. Number of testing in past 2 years (log 2)	0.77	0.99	.03	-.05	-.01	.13*	.004	-.03	-.08	.15**	.06	.11*

Education and income were calculated as continuous variables in bivariate correlation analysis. Person's product-moment correlation was used for binary variables (outness). \**p* < .05. \*\**p* < .01. \*\*\**p* < .001

popular platform for social networking and dating by Chinese MSM, who live in a largely heteronormative environment. This study is an initial effort to advance our knowledge on the roles of behavioral and psychosocial factors among internet-using MSM, particularly in the importance of an online MSM social life, greater knowledge about HIV, and fewer concerns about one's minority identity. Overall, findings suggest that about three quarters of sexually active MSM reported having been tested for HIV [15], which is higher than some previous findings, although still less than the Joint United Nations Programme on HIV/AIDS' target goal of 90% by 2020. Only half of the MSM reported regular testing. Barriers reported by those who had never been tested were mainly the lack of a perceived risk for HIV and structural issues. The barriers to repeated, regular testing included concerns regarding sexual identity and testing confidentiality.

A unique contribution of the study to the literature lies in its attentiveness to regular testing behaviors, which is an important aspect of behavioral health for this high-risk group. To promote HIV testing among internet-using MSM in China, findings suggest the utility in conceptualizing a two-step approach and effectively identifying two subpopulations: MSM who have never tested for HIV and those who do not undergo regular testing. It is critical to identify appropriate and relevant strategies for testing promotion for these two groups. For those who have never been tested for HIV, it may be most important to provide HIV knowledge such as the modes of HIV transmission and the efficacy of HIV testing. For instance, it is intriguing that among sexually active MSM who never tested in our sample, 30.1% (*n* = 22) self-reported as HIV-negative, which suggests that they believe that they have not acquired HIV despite the lack of HIV testing that would confirm such a perception. Our findings highlight the importance of promoting basic knowledge about HIV transmission, awareness of one's risk, and importance and safety of testing among internet-using MSM who have never been tested for HIV. For example, strategies to encourage initial testing may involve messages such as "one can only know their HIV status by taking a test" and "even with low risk, test for HIV."

More can be done to promote regular testing among MSM in China. It is of concern that only half of MSM had tested regularly and that the frequency of testing was not associated with sexual risk behavior, since regular testing for MSM who engage in high-risk behavior is recommended [4]. After initial testing, barriers of regular testing among internet-using MSM were more psychological and concerned their identity development. This finding supports the theory and empirical literature on the detrimental role of minority stress on health and health behaviors among sexual minorities [24, 37]. Internalized homonegativity may be linked to avoidance or inconsistent engagement in medical care [37, 38]. The

**Table 6** Logistic Regression Analysis on HIV Testing

Variables	<i>B</i>	<i>SE</i>	<i>z</i>	<i>OR</i>	95% <i>CI</i> for <i>OR</i>	<i>p</i>
<i>Model 1</i>						
Ever tested for HIV ( <i>n</i> = 332)						
Intercept	-4.54	1.15	-3.95	0.01	[0.001, 0.10]	< .001
Age	0.04	0.02	1.84	1.04	[1.00, 1.09]	.07
Education	0.38	0.20	1.95	1.46	[1.00, 2.16]	.05
<i>HIV knowledge</i>	0.18	0.06	2.81	1.19	[1.06, 1.35]	.005**
<i>Online MSM social</i>	0.12	0.05	2.23	1.13	[1.01, 1.25]	.03*
<i>Number of CAI partners in past 12 months</i>	0.37	0.16	2.32	1.45	[1.08, 2.01]	.02*
<i>Model 2</i>						
Regular testing ( <i>n</i> = 246)						
Intercept	-1.82	1.36	-1.34	0.16	[0.01, 2.24]	.18
<i>HIV knowledge</i>	0.12	0.07	1.65	1.13	[0.98, 1.30]	.10
<i>Sexual identity concerns</i>	-0.06	0.02	-2.78	0.94	[0.90, 0.98]	.006**
<i>Online MSM social</i>	0.15	0.06	2.47	1.16	[1.03, 1.31]	.01*
% Condom use in past 12 months	0.007	0.005	1.48	1.01	[1.00, 1.02]	.14

Sexual identity concerns were the total score of two subscales of LGBIS that differed for regular and non-regular testers due to their highly correlated nature ( $r = .41, p < .0001$ ), including internalized homophobia and concealment motivation. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

**Table 7** Multiple linear regression on number of testing in the past 2 years

Variables	<i>B</i>	95% <i>CI</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>p</i>
Intercept	-0.70	[-1.57, 0.16]	0.44		-1.60	.11
<i>HIV Knowledge</i>	0.07	[0.01, 0.12]	0.03	0.14	2.52	.01*
<i>Online MSM social</i>	0.06	[0.02, 0.11]	0.02	0.16	2.79	.006**
% Condom use in past 12 months	0.003	[-0.0007, 0.006]	0.002	0.09	1.56	.12

Model  $F(3, 303) = 5.82, R^2 = 0.05$ , model  $p = .0007$ . \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

motivation to conceal one's identity may also lead to individuals not utilizing services due to confidentiality related concerns and fear of stigma and discrimination. Findings on the barriers perceived by non-regular testers complement the aforementioned results, as evidenced by the common endorsement of psychosocial barriers (e.g., fear of positive test result) and confidentiality-related concerns (fear of government learning one's information).

Thus, interventions to promote regular testing should involve stigma reduction in the MSM community as well as efforts by providers and testing agencies to ensure privacy and confidentiality. For instance, enhancing self-acceptance, connection to the LGBT community, and safe, selective disclosure of sexual orientation can facilitate a healthy sexual identity development. Interventions tailored to address minority stress could be beneficial. For example, ESTEEM is a LGBT affirmative care intervention developed by Pachankis and it has been shown to be effective in lowering minority stress and promoting self-acceptance, particularly for those with higher internalized homonegativity at baseline [39]. In addition, beyond stigma on the individual level, intervention programs need to be sensitive to stigma

related to sexuality and HIV within the MSM community and cultural factors as well, given that MSM in China largely conceal their identity and traditional cultural values remain strong [40]. Creative ways to collaboratively work with MSM, local LGBT organizations, online sites/apps, and HIV testing sites may help stigma reduction on several levels. Future interventions may also include education on a realistic outlook on living with HIV as a method of decreasing fear of HIV, which is a frequent barrier to testing. For testing sites, thoroughly explaining confidentiality and establishing credible protection of test seekers' information is important, particularly for a population vulnerable to discrimination.

The internet and dating apps can be used for MSM to connect with others and find sexual partners, which can result in a greater sense of social support. Studies indicated that internet use is associated with higher numbers of sexual partners, and there are mixed results regarding its role in condomless anal sex [9, 41, 42]. In our study, findings reveal that an online MSM social life had a positive role in HIV testing, regular testing, and the frequency of tests, suggesting that the internet may be a promising platform for health promotion and may be serving such a function already. An

online MSM social life may help build a sense of community and establish a priority for HIV testing and sex education, especially in the largely heteronormative environment in China [7]. Data from other countries show the acceptability, feasibility, and effectiveness of online-based prevention intervention efforts with MSM [43–45]. A study in Chengdu, China also suggested good feasibility and acceptance of e-technology based interventions by MSM [46]. An internet-based intervention with MSM living with HIV in China incorporated online counseling with peer educators and it was found to be effective in promoting HIV disclosure and motivating participants' partners to HIV testing [47]. Despite these encouraging findings, there are structural challenges in internet-based stigma reduction work with MSM in China. In particular, content related to LGBT advocacy and activism can be restricted due to state censorship, so interventions need to skillfully navigate the complex socio-political environment and communicate to stakeholders on the roles of identity positivity and internet-based interventions in the health outcomes of MSM [48, 49]. Since MSM in China remain stigmatized, hidden and disconnected from other MSM, any approach to improve testing and reduce risk will need to consider structural barriers, fragmentation of resources, and limitations on social support to best reach MSM and maximize intervention effect.

The study findings should be interpreted in the context of its limitations. First, the sample was recruited online and may only represent a subpopulation of internet-using Chinese MSM. Since the study was posted on LGBT oriented websites and platforms, Chinese MSM who identify as members of the LGBT community may be over-represented and findings may not represent Chinese MSM who identify as heterosexual. Findings may also not be generalizable to lower-income Chinese MSM, Chinese MSM with less education, or Chinese MSM from rural or non-city areas. Second, the survey is self-registered and questions related to one's HIV testing behaviors, sexual risk behaviors, and identity concerns are subject to the impact of social desirability. Third, the cross-sectional survey method of the study limits any interpretation related to causality in associated factors. Fourth, we did not measure other potentially related factors including mental and physical health, peer support, and history of STIs. In addition, although more online MSM social life and HIV knowledge were associated with greater rates of testing, testing could be a method of coping with anxiety. In this study, one participant reported 26 HIV tests in the past 24 months, which could indicate inordinately high anxiety about his risk.

In conclusion, our study highlights the relevance of online socialization, HIV knowledge, and sexual identity concerns in testing behaviors among internet-using MSM in China. To meaningfully increase testing in this population, intervention efforts should use different strategies to promote

initial testing and regular testing behaviors in a community-oriented, culturally responsive fashion [50]. In the age of the internet, online and app-based interventions could greatly promote HIV knowledge, facilitate community building, reduce stigma, and increase testing awareness. Internet-based interventions can be discrete, confidential, and easily accessible. They can help reduce barriers to initial testing by informing MSM of the modes of HIV transmission, increasing risk awareness, and improving confidence for testing. Internet-based interventions can also increase regular, repeated testing by building supportive online communities that will reduce stigma and sexual identity concerns. In addition, HIV testing sites may consider policies and efforts to foster a trusting relationship and credible reputation with the local MSM community. For example, a clear statement on non-discriminative policy and explanation on confidentiality can be beneficial to encourage regular testing. Overall, this study suggests that the internet is a popular platform for MSM in China and it provides initial indications of effective, relevant online-based intervention strategies for testing promotion among Chinese MSM.

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## Compliance with Ethical Standards

**Conflict of interest** None of the authors have any conflicts of interest to report.

**Ethical Approval** All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** All participants provided their consent to the study.

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