HIV testing and risks of sexual behavior among HIV-negative men who have sex with men in Ningbo, China

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Abstract

Background: The human immunodeficiency virus (HIV) testing had been confirmed as a preventive strategy for HIV control. The testing rate and risk behavior of HIV-negative men who have sex with men (MSM) are still unclear. The aim of this study was to examine the factors associated with HIV testing, and high-risk behavior among HIV-negative MSM in Ningbo, China. **Methods:** This cross-sectional study was conducted between July 2016 and June 2017. Using snowball sampling to recruit MSM. Participants were recruited from Blued (an app for the gay community), QQ/Wechat groups, voluntary counseling and testing clinics, baths, bars, and other types of venues. Before the interview, all participants had HIV testing. MSM were included if their result of HIV screening test were negative. Face-to-face questionnaires were conducted mainly focused on HIV testing in the past year and high-risk behavior in the past 3 months. **Results:** In total, 988 MSM were included, 57.1% (564/988) of participants had HIV testing in the past year. The proportion of high-risk sexual behavior was 49.9%. Factors associated with HIV testing were bisexual orientation (adjusted odds ratio [AOR] 0.57, 95% confidence interval [CI] 0.42–0.78), drug use to adjust psychological abnormalities (AOR 1.39, 95 CI 1.04–1.85), and receiving HIV interventions (AOR 4.03, 95 CI 3.00–5.42). Being married (AOR 1.72, 95% CI 1.15–2.58), bisexual orientation (AOR 2.13, 95% CI 1.54–2.95), and receiving HIV interventions (AOR 1.65, 95% CI 1.25–2.20) were risk factors for high-risk sexual behavior, while college degree or above (AOR 0.52, 95% CI 0.35–0.77) were the protective factor. **Conclusion:** We revealed low rate of HIV testing and high rate of risk sexual behavior among HIV-negative MSM in Ningbo. HIV transmission factors are widespread, but the proportion of 90% diagnosed for HIV are still a huge challenge in this population. Attention should be given to married, using substances or bisexual HIV-negative MSM, and HIV intervention should be strengthened to promote HIV testing and reduce risk behavior.

Background

In 2014, UNAIDS proposed the vision of “ending acquired immune deficiency syndrome (AIDS) in 2030” and proposed to achieve “three 90%” prevention and treatment goals in 2020 [1]. These targets include 90% of people living with HIV being aware of their HIV infection, 90% of those receiving antiretroviral treatment (ART), and 90% of people on ART having successful suppression of viral load. In 2017, China also used the “three 90%” as the work target of the “13th Five-Year Plan of Action for China's Containment and Prevention of AIDS” [2]. At present, treatment as a prevention strategy had been confirmed [3-4], the last two 90% target would not difficult to implement, but the first 90% target face enormous challenges. HIV testing had been confirmed as a key HIV prevention strategy. HIV early detection can not only expand treatment for people who lived with HIV/AIDS (PLWHA), but also strengthen intervention for people who tested HIV [5], reducing the proportion of high-risk behaviors and risk of HIV infection among uninfected people [6]. According to the estimated epidemic situation in Zhejiang Province in 2016 [7] the proportion of PLWHA being diagnosed at the end of 2016 was only 71.31%, and the diagnosed rate among MSM cases was 62.03%, which was lower than the diagnosed rate of people who acquired HIV through heterosexual contact, injecting drug use or mother-to-child transmission.

The HIV infection rate of MSM population is growing rapidly in China due to multiple sexual partners and high-risk sexual behaviors, MSM are the important populations of HIV infection and transmission in China [8-9]. In Western countries, the HIV prevalence rate and estimated morbidity rate of young MSM are also high, and it is also a key population of HIV transmission [10]. Globally, even in countries or regions with high HIV prevalence, the HIV testing rate of MSM population is still low (1.6%-41.7%) [11], and the annual HIV testing rate among MSM in China was also low (44.6%-69.0%) [12-14]. The key work is to promote HIV testing and reduce high-risk behavior in MSM population to finally realize the goal of the first 90% target.

In 2015, WHO recommended AIDS treatment as a prevention strategy [15]. In 2016, China began to implement the “treatment as prevention” strategy [16]. HIV-positive people will be targeted intervened and arranged for treated after HIV confirmation, thus their contagiousness will be greatly reduced [3, 17]. Relevant studies had shown that HIV-positive people will change their high-risk behaviors after confirmation [18-20], some studies shown that compared with HIV-negative people, PLWHA were more likely to develop unprotected anal sex behavior (UAI) [21-22]. Otherwise other studies suggested that a small number of HIV-negative MSM may significantly increase community-level HIV transmission because of reduced willingness to HIV testing [23].

As the susceptible population for HIV, there is a lack of data on the AIDS-related behavior among HIV-negative MSM. Although HIV testing is increasingly popular among MSM, little is known about the patterns of behavior of HIV-negative MSM. Therefore, we conducted a survey among HIV-negative MSM from July 2016 to June 2017 to describe the patterns of behavior and to examine the factors associated with HIV testing and risk behavior in Ningbo, China.

Methods

Design

This was a cross-sectional study conducted in Ningbo City, China, between July 1, 2016, and June 30, 2017.

Sampling methods

We used snowball sampling methods to recruit respondents; MSM were recruited from Blued (an app for the gay community), QQ/Wechat groups, voluntary counseling and testing clinics, bathrooms, bars, and other types of venues. After the informed consent, the venous blood test was first performed, and the subjects with positive HIV screening test were excluded and an anonymous questionnaire was

conducted. Without knowledge of the rate of HIV testing among HIV-negative MSM in Ningbo, we referred to studies conducted in other regions of China to determine the sample size. These studies showed that the HIV testing rate ranged from 50% to 60%. P -values <0.05 and $\beta=0.1$ were considered statistically significant. Thus, the estimated minimum sample size required for this study was 514. The sample size was calculated online (<http://powerandsamplesize.com>).

Study participants

We included MSM who met the following criteria: 1) at least 18 years of age; 2) anal sex with men in the last 3 months; 3) HIV negative or unknown and 4) providing informed consent to participate in the study. MSM were excluded from the study if their results of one or both screening tests were positive (These MSM were informed positive of the screening test and included in the HIV/AIDS follow-up management system); were impaired and could not clearly understand and answer the questions from the investigation questionnaire because of excessive alcohol consumption, poisoning, or other causes, or because they had a mental illness or mental retardation; did not fully understand the process of informed consent or did not give informed consent; did not agree to accept the questionnaire survey and/or serological survey; and refused to take part in the study for any other reasons.

Questionnaire and data collection

A face-to-face questionnaire survey was conducted, which included questions about socio-demographic characteristics like age, marital status, education, income, sexual orientation, registered residence and living time in Ningbo, sexual behavior, sexual partner networks in the past 3 months, history of HIV testing, and history of counseling. After the interview, all the participants were tested for HIV, free of charge. All questionnaires were completed by investigator of unified professional trained at county or district CDCs in Ningbo.

HIV Testing

A venous blood specimen (5 mL) was drawn from each participant following the interview. The HIV screening test was performed using an enzyme-linked immunosorbent assay (ELISA; Anti-HIV ELISA Kit, Zhuhai Livzon Diagnostics Inc., China), and if the result was positive, the specimen was retested using the same ELISA kit as well as another ELISA kit (Anti-HIV ELISA Kit, Beijing Wantai Biological Pharmacy Enterprise Co. Ltd., China).

Dependent variable definition

HIV testing were defined that MSM had tested HIV in the past year. High-risk sexual behavior meant that MSM have sexual behavior without condom use in the past 3 months, MSM had sexual behavior with condom use or had not sexual defined as no high-risk behavior.

Statistical analysis

Data were entered into EpiData version 3.1 (<http://www.epidata.dk/>) via double entry. After the data were cleaned and verified, statistical analysis was performed using SPSS version 23.0. For descriptive analyses, categorical variables are presented as frequencies and proportions, and continuous variables are presented as medians and interquartile ranges (IQR). Differences in the general demographic characteristics were calculated using Student's *t*-tests, chi-squared (χ^2) tests, Fisher's exact test, and Kruskal-Wallis tests. We determined the mean (standard deviation [SD]) and median (IQR) differences. Factors from univariate analysis with *P*-values <0.10 and/or those previously shown to be associated with the differences in socio-demographic characteristics were included in the multivariate regression models, which were used to calculate adjusted odds ratios (AOR) and their 95% confidence intervals (CI). The primary outcomes of interest were the HIV testing in the past 12 months, bisexual orientation, drug use to adjust psychological abnormalities and underwent HIV interventions in the past 3 months. *P*-values <0.05 and $\beta=0.1$ were considered statistically significant.

Ethical considerations

The study was approved by the ethical review board of Ningbo Municipal Center for Disease Control and Prevention. Participants were not harmed by their participation in the study and their data remained confidential. Written informed consent was signed by all participants during the survey. The charge for HIV testing were all free. Participants with positive results for the HIV testing were informed and counseled by the staff of local county or district CDCs and received the necessary referral services. This informing and counseling was provided at the same location as the interviews.

Results

In total, 988 HIV-negative MSM were recruited to conduct the survey, 2 MSM were excluded because of their screening tests were positive. The median age of respondents was 29.8±8.4 years. Moreover, 602(60.9%) MSM were single and 346 (35.0%) were married, 978 (99.0%) were of Han nationality, 398 (40.3%) had college degree or above, and 480 (50.5%) had an income above 4000 Yuan (RMB). The majority of MSM were homosexual (n=609, 61.6%) or bisexual (n=313, 31.7%), were registered residents

of Zhejiang province (n=528, 53.4%), were recruited through internet (n=529, 53.5%), and were living in Ningbo for over 24 months (n=724, 73.3%, Table 1).

Of the 988 recruited MSM, 57.1% (564/988) had tested HIV in the past year. The proportion of high-risk sexual behavior was 49.9%, of which 153 (15.5%) had heterosexual high-risk sexual behavior, and 432 (43.7%) have homosexual high-risk behavior, 57 (5.8%) people had anal unprotected sex after drinking alcohol, 8 (0.8%) had anal sex without condom after using drugs, 20 (2.0%) had group anal sex in recent 3 month. Furthermore, 31 (3.1%) had been diagnosed with sexually transmitted diseases (STD) in the last 3 months, and 430 (43.5%) had received HIV interventions in the past 3 months. The awareness rate of AIDS knowledge was 91.7% (906/988); 896 (90.7%) people believed that the current HIV epidemic situation was not serious, and 441 (44.6%) people used drug to adjust psychological abnormalities (Table 2).

There were significant differences in the age ($P=0.016$), sample source ($P=0.014$), income ($P=0.005$), and sexual orientation ($P=0.008$) between HIV-negative MSM who had HIV testing in the past year and those who had not. There were no significant differences in the other demographic characteristics investigated ($P>0.05$).

Among AIDS-related knowledge and behavioral variables, There were significant differences in the cognition of HIV epidemic among MSM ($P<0.001$), drug use to adjust psychological abnormalities ($P<0.001$), diagnosed with sexually transmitted diseases in the last 3 months ($P=0.020$), and receiving HIV interventions in the past 3 months ($P<0.001$) between HIV-negative MSM who had HIV testing in the past year and those who had not. There were no significant differences in the other behavioral characteristics investigated ($P>0.05$).

Univariate analysis showed that bisexual orientation (odds ratio [OR] 0.65, 95% CI 0.50–0.86), drug use to adjust psychological abnormalities in the past week (OR 1.88, 95% CI 1.45–2.44), and receiving HIV interventions in the past 3 months (OR 4.44, 95% CI 3.35–5.87) were associated with HIV testing in the past year (Table 3).

Multivariate logistic regression analysis showed that bisexual orientation (AOR 0.57, 95% CI 0.42–0.78), drug use to adjust psychological abnormalities (AOR 1.39, 95 CI 1.04–1.85), and receiving HIV

interventions in the past 3 months (AOR 4.03, 95% CI 3.00–5.42) were factors associated with HIV testing in the past year (Table 3).

Univariate analysis showed that being married (OR 2.16, 95% CI 1.65–2.83), college degree or above (OR 0.47, 95% CI 0.32–0.65), bisexual orientation (OR 2.46, 95% CI 1.86–3.26), and receiving HIV interventions in the past 3 months (OR 1.54, 95% CI 1.20–2.0) were associated with high-risk sexual behavior in the past 3 months (Table 4).

Multivariate logistic regression analysis also confirmed that being married (AOR 1.72, 95% CI 1.15–2.58), having bisexual orientation (AOR 2.13, 95% CI 1.54–2.95), and receiving HIV interventions in the past 3 months (AOR 1.65, 95% CI 1.25–2.20) were risk factors for high-risk sexual behavior in the past 3 months. In addition, it also showed that college degree or above (AOR 0.52, 95% CI 0.35–0.77) were protective factor for high-risk sexual behavior in the past 3 months (Table 4).

Discussion

Our study revealed that the HIV-negative MSM population had a low rate of HIV testing, which poses a major challenge to achieving 90% HIV-infected patients diagnosed in 2020. At the same time, HIV-negative MSM had widespread high-risk sexual behaviors, including group sex and sexual intercourse after drinking or after drug use. There would be still a large risk of HIV new-infection in this population. Since there is a certain proportion of heterosexual high-risk sexual behavior and a high married rate among this population, bisexual or married MSM would be the key population for HIV prevention and control in the future among HIV-negative MSM.

Plus two MSM who were excluded from the survey, the HIV testing rate was found only 57.0%(564/990) in the last year, which was similar to the results of the RDS (respondent-driven sampling) survey among MSM conducted by LI R et al in Hangzhou (56.8%) [24], but lower than the proportion of detection reported by the United States in 2013 (67.0%) [25]. This could be because of previous low HIV intervention coverage (43.5%), and work to promote testing for MSM sexual partner or self-testing intervention had not been carried out in large areas. We found that the HIV detection of bisexual MSM was insufficient, compared with homosexual MSM. It is necessary to carry out measures to promote HIV detection among HIV-negative MSM, such as sexual partner promotion test or HIV self-testing [26]. It was also found that there were a group of MSM (44.6%) suffering from psychological abnormalities, and using substances to adjust psychological abnormalities. Besides the basic traditional HIV high-risk sexual behavior interventions, joint interventions with psychological counseling and detection consciousness should be strengthened to improve mental health of this population [27].

We found the awareness rate of AIDS knowledge (91.7%) among HIV-negative MSM was high, but the proportion of high-risk behavior in the past three months was as high as 49.9%, which was lower than that rate of Lin He and others surveyed in Hangzhou in 2015-2016 [28]. Moreover, the proportion of high-risk homosexual behavior (43.7%) was also lower than the results of US surveys [26, 29]. Above all, it showed that the local HIV-negative MSM had a more common high-risk behavior, which was similar to some previous research results [30, 31]. We also found that the proportion of high-risk behaviors of bisexual sex was higher than that of homosexuality (AOR=2.130), but the detection consciousness was insufficient (50.5%) and the proportion of marriage was higher (35%), which was similar to the results of previous investigations in China and abroad [32-34], which suggested that bisexual/married MSM had risk of infection and transmission of HIV. Thus, the intervention of high-risk behavior and HIV testing promotion for married or bisexual MSM should be strengthened. The results also suggested that HIV intervention was a contributing factor to HIV testing and high-risk sexual behavior. If the intervention effect was good during HIV testing, the proportion of high-risk behavior may should be reduced. However, the proportion of high-risk behaviors among those with high HIV detection was also higher (59.8%). This might be because of that those MSM tested HIV due to having high-risk sexual behavior, and it may also indicated the effect of intervention in HIV testing was not satisfactory. Then, what we can do is still to improve the quality of behavioral interventions when giving HIV testing service. Since our study can't verify the causal relationship between HIV testing and high-risk behavior, in order to further improve the effectiveness of HIV testing and intervention work, it is necessary to carry out relevant investigations in the later stage.

Our study had several limitations. Firstly, this was a cross-sectional study; therefore, the causal factors associated with HIV testing and high-risk sexual behavior could not be determined. Moreover, it could not be determined whether HIV testing after high-risk sexual activity or inadequate intervention in HIV testing that leads to subsequent high-risk behaviors. Secondly, we did not use probabilistic sampling; instead, we used snowball sampling to recruit MSM. Although the MSM were recruited from a variety of settings, we could not determine the rate of HIV testing and high-risk behavior for all MSM in Ningbo. Lastly, some items of the questionnaire contain some information with a large time span or sensitive information, therefore, some participants might not have reported their privacy behavior. Therefore, the information bias was inevitable.

Conclusions

We noted low rate of HIV testing, high proportion of high-risk sexual behaviors and higher rates of marriage/homosexuality among HIV-negative MSM in Ningbo. The HIV testing was associated with bisexual orientation, drug use to adjust psychological abnormalities; Being married, having bisexual orientation or having lower educational level tended to have high-risk sexual behavior among HIV-

negative MSM. We suggest that attention should be given to married, using substances or bisexual HIV-negative MSM, and HIV intervention should be strengthened during HIV testing to promote HIV testing and reduce high-risk sexual behavior.

Abbreviations

AOR, adjusted odds ratio; CI, confidence interval; IQR, interquartile range; HIV, human immunodeficiency virus; AIDS, acquired immune deficiency syndrome; MSM, men who have sex with men; STD, sexually transmitted disease; χ^2 , chi squared test

Declarations

Consent to publish

Not applicable

Availability of data and materials

The raw data will be provided upon request by Haibo Jiang,

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Competing interests

The authors have declared that they have no competing interests.

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Authors' contributions

LH and HJ conceived of the study design and coordinated the conduct of this research in the field. HJ performed the statistical analysis and drafted the manuscript. LH and JJ reviewed and revised the

manuscript. HH and HD design the research and interpretation of data, HH, XG and HS contributed to acquisition of data in the survey in Ningbo. All of the authors read and approved the final manuscript.

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Ethical considerations

The study was approved by the ethical review board of Ningbo Municipal Center for Disease Control and Prevention. Written informed consent was provided by all participants prior to completion of the survey. All the participants signed the informed consent.

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Tables

Table 1. Socio-demographic characteristics of HIV-negative men who have sex with men who had HIV testing in the past year in Ningbo, China (N=988)

Variables	N (%)	HIV testing		c2	P
		Yes	No		
Age				8.290	0.016
<30	573(58.0)	318(55.5)	255(44.5)		
30-50	389(39.4)	237(60.9)	152(39.1)		
50-	26(2.6)	9(34.6)	17(65.4)		
Marital status				2.514	0.285
Single	602(60.9)	336(55.8)	266(44.2)		
Married	346(35.0)	208(60.1)	138(39.9)		
Divorced/widowed	40(4.0)	20(50.0)	20(50.0)		
Ethnicity				-	0.752
Han	978(99.0)	559(57.2)	419(42.8)		
Minority	10(1.0)	5(50.0)	5(50.0)		
Education				2.871	0.238
Junior high school and below	276(27.9)	169(61.2)	107(38.8)		
High school and junior college	314(31.8)	177(56.4)	137(43.6)		
College degree or above	398(40.3)	218(54.8)	180(45.2)		
Income RMB yuan				10.665	0.005
<3000	169(17.8)	83(49.1)	86(50.9)		
3000-3999	301(31.7)	193(64.1)	108(35.9)		
4000-	480(50.5)	269(56.0)	211(44.0)		
Sexual orientation				9.673	0.008
Homosexual	609(61.6)	371(60.9)	238(39.1)		
Bisexual	313(31.7)	158(50.5)	155(49.5)		
Heterosexual/uncertain	66(6.7)	35(53.0)	31(47.0)		
Registered residence				4.337	0.114
Zhejiang	528(53.4)	292(55.3)	236(44.7)		
Other provinces	460(46.6)	272(59.1)	188(40.9)		
Living time in Ningbo (M)				3.910	0.142
<3	169(17.1)	108(63.9)	61(36.1)		
3-24	95(9.6)	52(54.7)	43(45.3)		
24-	724(73.3)	404(55.8)	320(44.2)		
Sample source				6.009	0.014
Online recruitment	529(53.5)	321(60.7)	208(39.3)		
Not online recruitment	459(46.5)	243(52.9)	216(47.1)		

Table 2. Cognitive and Behavioral characteristics of HIV-negative men who have sex with men who had HIV testing in the past year in Ningbo, China (N=988)

Variables	N (%)	HIV testing		c2	P
		Yes	No		
AIDS awareness				0.429	0.513
No	82(8.3)	44(53.7)	38(46.3)		
Yes	906(91.7)	520(57.4)	386(42.6)		
Cognition of AIDS epidemic among MSM				22.439	<0.001
Nothing serious	285(28.8)	34(37.0)	58(63.0)		
General	611(61.8)	345(56.5)	266(43.5)		
Serious	92(9.3)	185(64.9)	100(35.1)		
drug use to adjust psychological abnormalities				23.204	<0.001
No	547(55.4)	275(50.3)	272(49.7)		
Yes	441(44.6)	289(65.5)	152(34.5)		
High-risk sexual behavior*				3.044	0.081
No	495(50.1)	269(54.3)	226(45.7)		
Yes	493(49.9)	295(59.8)	198(40.2)		
Alcohol use before condomless anal sex				1.541	0.215
No	927(94.2)	524(56.5)	403(43.5)		
Yes	57(5.8)	37(64.9)	20(35.1)		
drug use before condomless anal sex				-	0.478
No	975(99.2)	554(56.8)	421(43.2)		
Yes	8(0.8)	6(75.0)	2(25.0)		
Group anal sex				0.036	0.849
No	968(98.0)	553(57.1)	415(42.9)		
Yes	20(2.0)	11(55.0)	9(45.0)		
Diagnosed with STD in the last three months				5.424	0.020
No	956(96.9)	539(56.4)	417(43.6)		
Yes	31(3.1)	24(77.4)	7(22.6)		
Receiving AIDS interventions				117.29	<0.001
No	558(56.5)	235(42.3)	320(57.7)		
Yes	430(43.5)	329(76.5)	101(23.5)		

* High-risk sexual behavior meant that MSM have sexual behavior without condom use in the past 3 months, MSM had sexual behavior with condom use or had not sexual defined as no high-risk behavior.

Table 3. Factors associated with the HIV testing in the past year among HIV-negative men who have sex with men in Ningbo, China (N=988)

Variables	Number of HIV testing % (n/N)	Univariate OR(95%CI)	Multivariate AOR(95%CI)
Sexual orientation			
Homosexual	371(60.9)	1.00	1.00
Bisexual	158(50.5)	0.65(0.50-0.86)	0.57(0.42-0.78)
Heterosexual/uncertain	35(53.0)	0.72(0.44-1.21)	0.65(0.37-1.15)
drug use to adjust psychological abnormalities			
No	275(50.3)	1.00	1.00
Yes	289(65.5)	1.88(1.45-2.44)	1.39(1.04-1.85)
Receiving AIDS interventions			
No	235(42.3)	1.00	1.00
Yes	329(76.5)	4.44(3.35-5.87)	4.03(3.00-5.42)

Table 4. Factors associated with high-risk sexual behavior among HIV-negative men who have sex with men in Ningbo, China (N=988)

Variables	Number of high-risk sexual behavior % [n/N]	Univariate OR(95%CI)	Multivariate AOR(95%CI)
Marital status			
Single	260(43.2)	1.00	1.00
Married	215(62.1)	2.16(1.65-2.83)	1.72(1.15-2.58)
Divorced/widowed	18(45.0)	1.08(0.57-2.05)	1.18(0.57-2.46)
Education			
Junior high school and below	167(60.5)	1.00	1.00
High school and junior college	159(50.6)	0.67(0.48-0.93)	0.68(0.47-0.97)
College degree or above	167(42.0)	0.47(0.32-0.65)	0.52(0.35-0.77)
Sexual orientation			
Homosexual	261(42.9)	1.00	1.00
Bisexual	203(64.9)	2.46(1.86-3.26)	2.13(1.54-2.95)
Heterosexual/uncertain	29(43.9)	1.05(0.63-1.74)	1.01 (0.58-1.78)
Receiving HIV interventions			
No	252(45.2)	1.00	1.00
Yes	241(56.0)	1.54(1.20-1.99)	1.65(1.25-2.20)