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Journal

BMJ Open, 9(1)

ISSN

2044-6055

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Publication Date

2019

DOI

10.1136/bmjopen-2018-021955

Peer reviewed

BMJ Open Trends in HIV prevalence and risk behaviours among men who have sex with men from 2013 to 2017 in Nanjing, China: a consecutive cross-sectional survey

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To cite: Zhu Z, Yan H, Wu S, *et al.* Trends in HIV prevalence and risk behaviours among men who have sex with men from 2013 to 2017 in Nanjing, China: a consecutive cross-sectional survey. *BMJ Open* 2019;**9**:e021955. doi:10.1136/bmjopen-2018-021955

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2018-021955>).

Received 9 February 2018
Revised 22 August 2018
Accepted 8 October 2018



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ABSTRACT

Objective To examine the trends of HIV prevalence, risk behaviours and HIV testing among men who have sex with men (MSM) in Nanjing.

Design Five consecutive cross-sectional surveys.

Setting Nanjing, China.

Primary and secondary outcome measures HIV and syphilis prevalence, HIV testing rate and factors associated with HIV infection; demographic characteristics and behaviours.

Results 649, 669, 577, 633, 503 MSM were recruited from 2013 to 2017. HIV prevalence was 9.9%, 12.3%, 12.5%, 9.8% and 10.1%, respectively. Syphilis prevalence decreased with a range from 10.6% to 5.6%. Risk behaviours like unprotected anal intercourse (UAI) and unprotected vaginal sex in the past 6 months decreased, but multiple sex partners and ever used rush popper rose significantly. MSM tested for HIV in the previous year remained stable from 57.0% to 64.1% ($P=0.633$). Multivariate analysis showed that tested for HIV in the past year was protective factor against HIV infection. MSM who had UAI in the past 6 months, sex role as receptive and dual, diagnosed with sexually transmitted diseases (STDs) in the past year and currently syphilis infected were risk factors for HIV infection.

Conclusions We observed stable high HIV prevalence, a steady HIV testing rate, decreasing syphilis prevalence and UAI among MSM in Nanjing. However, rush popper use rose dramatically. The HIV preventive strategies for MSM including condom promotion, HIV testing expansion and reduction of rush popper use, STDs screening and standardised treatment should be strengthened.

INTRODUCTION

In recent years, a fast-spreading HIV epidemic among men who have sex with men (MSM) presented a new challenge worldwide.^{1 2} In China, MSM transmission has surpassed both injection drug use and blood donors and has become the major HIV transmission route.^{3 4} The overall HIV prevalence, from national MSM sentinel surveillance data,

Strengths and limitations of this study

- The present study is designed to assess the recent HIV prevalence, risk behaviours and HIV testing trends among men who have sex with men (MSM) in Nanjing.
- We analysed and confirmed several factors associated with HIV infection using pooled 5 years' data.
- Rush popper use among Nanjing MSM had a rising trend.
- Snow ball sampling and internet convenience sampling may not yield a representative sample of the general MSM population; these data should be interpreted with caution.
- Face-to-face investigation may under evaluate risk behaviours due to the issue of social desirability.

demonstrated a rising trend from 0.9% in 2003 to 6.3% in 2011.⁵

Nanjing is the capital city of Jiangsu Province, eastern China, with a total population of 8.6million. Consistent with many other metropolitan cities of China, homosexual transmission has become the major route of HIV transmission in Nanjing.⁶ According to the national direct network HIV/AIDS Case Reporting System, the annual proportion of newly reported HIV cases attributed to homosexual transmission rose from 44.3% in 2008 to 63.5% in 2012⁷ and to 71.3% in 2015 in Nanjing. Recent studies have highlighted a higher prevalence of club drugs use among MSM,⁸ and rush popper (inhalant nitrites) is the most popular. Research has documented that rush popper use may increase HIV transmission by increasing engagement in high risk sex behaviours among MSM.⁹

In response to the escalating HIV epidemic among MSM, Nanjing implemented comprehensive prevention strategies over the past

decade. Condom promotion and lubricant distribution were free in MSM popular venues. Almost 40 voluntary HIV testing and counselling sites were established across the city to provide friendly HIV testing service. From 2008 to 2012, under the implementing of China-Bill Melinda Gates Foundation on HIV/AIDS programme and the Global Fund to Fight AIDS programme in Nanjing, a growing number of MSM Community Based Organisations (CBOs) established and provided peer-led HIV rapid testing and referrals to treatment.

In 2013, the Chinese national centre for AIDS/sexually transmitted diseases (STDs) control and prevention launched Expanding HIV Testing and Scale-up Antiretroviral Therapy (ART) Programme in eight cities over the country, Nanjing was one of them. The programme implemented various measures. On one hand, Centers for Disease Control and Prevention (CDC) led health education programmes, HIV testing days, referrals for ART and standardised STDs treatment. On the other hand, CBOs carried out condom and lubricant distribution, behavioural interventions and provision of HIV rapid testing kits. After each test, staff of CDC or CBO provided risk-reduction counselling.

However, it is unknown whether these strategies reduced the HIV prevalence among MSM, and to what extent their risk behaviours were changed. Therefore, we designed and conducted five consecutive cross-sectional surveys from 2013 to 2017, aimed to identify the trends of HIV and syphilis prevalence, risk behaviours and HIV testing among MSM. We also analysed the factors correlated with HIV infection using the pooled 5 years' survey data.

METHODS

Participants

Participants met the following criteria: 16 years of age or older, male, had oral or anal sex with a male in the previous year, could provide written informed consent and were willing to complete the study.

Sampling method and participant recruitment

We employed two methods to recruit participants: snow ball sampling and internet convenience sampling. For snow ball sampling, the participants were recruited from MSM venues such as bars, clubs, saunas, and public restrooms. Initial 'seed' participants were recommended by volunteers of CBOs or staffs of MSM bars. Each initial seed was invited to participate in the study and then asked to invite other person with the same inclusion criteria. We also posted study advertisements on some MSM social platforms and the Nanjing CDC official website, inviting MSM to participate in our study. These recruit processes continued from April to July in each year.

Study procedures

We designated two survey sites in Nanjing. They were VCT clinics in the Nanjing municipal CDC and Qinhuai

district CDC. All interviewers were CDC staff members who were well trained. We screened for duplicate reported telephone numbers and excluded those repeated participants during a same survey year. The survey sites, main interviewers and recruit methods were consistent during the 5 years surveys.

After the qualification screening, every participant signed a consent form before the formal investigation. Face-to-face interviews were used to collect information including demographic characteristics, sexual behaviours in the past 6 months (with males and females), drugs use, STD diagnoses and HIV testing history. No name or identifying information was collected; 5 mL of whole blood was collected for HIV and syphilis test. After testing, we offered HIV risk-reduction counselling for each participant. Confirmed HIV cases were subsequently referred to the designated free ART clinic for treatment, and current syphilis cases were referred to standardised STDs clinics for treatment.

Laboratory testing

Blood samples were screened for HIV-1 antibody with a rapid test (Determine HIV-1/2, Alere Medical, Chiba Prefecture, Japan). Positive samples were retested by an enzyme-linked immunoassay (HIV Ag/Ab ELISA KIT 96T, Zhuhai Livzon Diagnostics, China), ELISA-positive cases were confirmed with a western blot assay (HIV BLOT 2.2, MP, Singapore). Syphilis screening was performed by *Treponema pallidum* particle assay (TPPA) (Alere Medical), and confirmed by the rapid plasma regain test (RPR) (Diagnosis; Shanghai, Kehua, China). TPPA-positive and RPR-positive participants were determined to be currently syphilis infected.

Variable definitions

'Unprotected anal intercourse (UAI)' was defined as inconsistent use of condoms during anal sex with male partners in the past 6 months; 'unprotected vaginal intercourse (UVI)' was defined as inconsistent use of condoms during vaginal sex with female partners in the past 6 months. We defined 'multiple sexual partners' as having had two or more sexual partners in the past 6 months. 'Ever used drugs' were defined as ever used heroin or opium.

Statistical analysis

Data were double entered and checked for accuracy using Epi Data software (V.3.0: Epi Data Association, Odense, Denmark). Descriptive statistics were used to describe participant's demographic characteristics and prevalence rate. Trend tests were performed using χ^2 tests with linear-by-linear analysis. Univariate and multivariate logistic regression analyses were conducted to adjust ORs for potential confounding. Only variables that were significant in univariate analyses at $P < 0.1$ were included in the multivariate logistic regression models. A P value < 0.05 (two-tailed) was considered to be statistically significant.

Table 1 Demographic characteristics among men who have sex with men in Nanjing, 2013–2017

Variables	2013	2014	2015	2016	2017	Linear-by-linear χ^2	P value
Total sample	649	669	577	633	503	–	–
Age group (years)						0.061	0.805
<20	6.0 (39)	4.3 (29)	5.4 (31)	2.0 (18)	3.8 (20)		
20–49	86.0 (558)	84.9 (568)	89.1 (514)	91.0 (557)	89.1 (467)		
≥50	8.0 (52)	10.8 (72)	5.5 (32)	6.0 (37)	7.1 (37)		
Marital status						30.186	<0.001
Single, divorced or widowed	73.3 (476)	74.6 (499)	81.3 (469)	81.5 (516)	84.5 (425)		
Married or live together	26.7 (173)	25.4 (170)	18.7 (108)	18.5 (117)	15.5 (78)		
Han ethnic	97.4 (632)	98.7 (660)	97.9 (565)	98.6 (624)	97.0 (488)	0.074	0.785
Residency (hukou) in Jiangsu	68.4 (444)	71.4 (478)	66.7 (385)	69.0 (437)	67.6 (340)	0.437	0.509
Education						24.910	<0.001
Junior high school and lower	18.0 (117)	13.2 (88)	11.4 (66)	11.8 (75)	9.5 (48)		
Senior high school or skill school	24.3 (158)	22.1 (148)	20.8 (120)	18.5 (117)	21.9 (110)		
College and higher	57.6 (374)	64.7 (433)	67.8 (391)	69.7 (441)	68.6 (345)		
Sex orientation						1.303	0.2524
Homosexual/bisexual	94.1 (611)	93.6 (626)	92.7 (535)	94.8 (600)	95.4 (480)		
Heterosexual/not sure	5.9 (38)	6.4 (43)	7.3 (42)	5.2 (33)	4.6 (23)		

All statistical analyses were conducted using SPSS software (V.20; IBM, Armonk, New York, USA).

Patient involvement

Patients were not involved in setting the research question, the outcome measures, the design or the implementation of the study. No patients were asked to advise on interpretation or writing up of results. No patients were advised on dissemination of the present study and its main results.

RESULTS

Demographic and social characteristics

Demographic characteristics of the participants in the 5-year surveys are presented in [table 1](#). The number of self-reported MSM was 649, 669, 577, 633 and 503, respectively. The composition of the samples and their corresponding characteristics were comparable in the five surveys. The majority of participants were aged 20–49 years, single, Han ethnicity, Jiangsu residents and highly educated. Over 90% of participants were either homosexual or bisexual. Significantly more MSM were single and highly educated.

Trends in HIV prevalence, risk behaviours and HIV testing

The trends of HIV prevalence, sexual behaviours, STD diagnosis and HIV testing rates among MSM are presented in [table 2](#). The HIV prevalence among MSM range from 9.9% to 12.5%, the trend was not significant. There was a decreasing trend of current syphilis prevalence with the range from 10.6% to 5.6%. During the 5 years of the study, some risk behaviours like UAI, vaginal sex and

UVI in the past 6 months showed decreasing trends. On the other hand, the rate of multiple sexual partners and ever used rush popper indicated significantly increasing trends. The behaviours including anal sex, commercial anal sex, ever used drugs, diagnosed with STDs and tested for HIV showed no significant change.

Factors associated with HIV infection

A total of 3031 participants were included. [Table 3](#) presents the results of univariable logistic analyses of factors related to HIV infection among participating MSM. Factors with p values <0.10 in univariable analysis were included in the multivariable model. Because the factors of ‘anal sex’ and ‘UAI’ in the past 6 months were correlated with each other ($r=0.400$, $p<0.001$), ‘anal sex’ was not included in multivariate logistic analysis. ‘Ever used rush popper’ was also excluded from multivariate logistic analysis for missing data in 2013. [Table 4](#) shows the results of multivariate logistic regression analysis. Participants were more likely to be infected with HIV if they had UAI in the past 6 months, sex role as receptive or dual, diagnosed with STDs in the previous year and currently were syphilis infected. Participants tested for HIV in the previous year were less likely to be HIV infected compared with those not tested.

DISCUSSION

Over the five annual cross-sectional surveys, we found that HIV prevalence among MSM in Nanjing remained steady at a high level from 2013 to 2017. This trend is different from the period of 2008 to 2012 when a rapid increase

Table 2 Trends in HIV prevalence, risk behaviours and HIV testing among MSM in Nanjing, 2013–2017

Variables	2013	2014	2015	2016	2017	Linear-by-linear χ^2	P value
	% (n)	% (n)	% (n)	% (n)	% (n)		
HIV infection	9.9 (64)	12.3 (82)	12.5 (72)	9.8 (62)	10.1 (51)	0.181	0.670
Current syphilis infection	6.2 (40)	10.6 (71)	5.9 (34)	4.7 (30)	5.6 (28)	5.043	0.025
Had anal sex, last 6 months	86.1 (559)	81.0 (542)	76.4 (441)	83.6 (529)	80.7 (406)	2.958	0.085
Had UAI, last 6 months	50.7 (329)	42.5 (284)	43.0 (248)	41.2 (261)	41.7 (210)	9.433	0.002
Multiple sex partners, last 6 months	55.6 (361)	49.6 (332)	46.3 (267)	57.3 (363)	62.0 (312)	19.194	<0.001
Had commercial anal sex, last 6 months	2.8 (18)	3.6 (24)	3.1 (18)	5.6 (17)	4.4 (18)	3.397	0.065
Had vaginal sex, last 6 months	22.2 (144)	22.4 (150)	19.2 (111)	19.9 (126)	16.3 (82)	7.034	0.008
Had UVI, last 6 months	14.0 (91)	15.1 (101)	11.6 (67)	13.7 (87)	9.1 (46)	6.791	0.009
Ever used rush popper*	–	12.9 (86)	20.8 (120)	23.1 (146)	21.7 (109)	17.879	<0.001
Ever used drugs	2.0 (13)	0.9 (6)	1.7 (10)	0.9 (6)	1.2 (6)	1.166	0.280
Diagnosed with sexually transmitted disease, last 12 months	6.9 (45)	6.6 (44)	4.7 (27)	8.4 (53)	7.0 (35)	0.333	0.564
Tested for HIV, last 12 months	61.2 (397)	64.1 (429)	57.0 (329)	63.2 (400)	63.4 (319)	0.228	0.633

*The data of 'ever used rush poppers' have not been collected in 2013.

MSM, men who have sex with men; UAI, unprotected anal intercourse; UVI, unprotected vaginal intercourse.

from 6.6% (RDS sampling, 430 sample size)¹⁰ to 13.7% (snow ball sampling, 670 sample size)¹¹ were reported. These surveys were conducted by the same work team and recruited from the same venues. We also observed almost 10% decline in UAI among MSM. These outcomes should be cautiously attributed to the comprehensive prevention programme implementation, especially the supply of risk-reduction counselling after each test. Compared with other cities, HIV prevalence among MSM in Nanjing was much lower than in the southwestern cities of Chongqing (21.2% in 2014)¹² and Kunming (17.0% in 2014).¹³ It was higher than in Beijing¹⁴ (6.1% in 2011) or other countries (eg, 4.4% in India¹⁵ in 2010, 2.5% in the Republic of Cyprus¹⁶ in 2012). However, all of these comparisons should be considered cautiously as there were differences in methodologies used to estimate prevalence. Because HIV continues to spread in Nanjing, interventions should be continued and strengthened.

We found that the HIV testing rate in the previous year remained steady at around 60%, higher than that reported in Chongqing (43.5% in 2014),¹² Beijing (42.6% in 2016)¹⁷ and Guangzhou (53.4% in 2013).¹⁸ It was also higher than the national annual HIV testing rate (50.4% in 2011) among MSM.¹⁹ HIV testing rate among MSM in Nanjing increased from only one in five in 2008 to nearly half in 2012,²⁰ and then to almost two-thirds by 2017. The disclosure of HIV-positive status can have individual health benefits and potentially reduce community spread of HIV through early diagnosis and early initiation of ART.²¹ Our multivariate analysis confirmed that being tested for HIV in the previous year was a protective factor. However, there is still a gap in HIV testing rate among MSM between Nanjing and other areas, like Australia

(80.5%)²² and the USA (67%).²³ We need to continue the expanding test programme further.

It is alarming that rush popper use among MSM in Nanjing rose dramatically from 12.4% to 21.7%, it is just a little bit lower than that reported by Beijing (26.8%)²⁴ or Shenyang (26.3%).²⁵ Rush popper used to be a prescription drug prescribed to relieve angina. Now MSM is used to facilitate sexual intercourse due to its mechanism of relaxing the anal sphincter and dilating capillaries.²⁶ Univariate analysis indicated that rush popper use was associated with a higher rate of HIV infection, which was consistent with other reports.^{24 25 27} Two factors may explain this result. First, rush popper has the effects on sexual behaviours such as promoting sexual desire, reducing sexual inhibition and decreasing physical experiences of pain, which may further prevent users from using condoms. Second, prior research had documented that rush popper use may increase HIV transmission through their engagement in group sex and multiple sex partners.²⁸ Our findings underscore the need for specific intervention programmes to reduce rush popper use.

We analysed the factors associated with HIV infection using the pooled five surveys data. Consistent with other reports,^{12 29} our data confirmed that UAI is an important risk factor for HIV infection. Although there was a declining trend of UAI among MSM, slightly >40% of participants reported using condoms only intermittently or never. It is necessary to improve awareness of the risk of HIV infection among MSM and the need for consistent condom use during sexual activity. In the present study, anal sex role was found to be independent risk factor for HIV infection men who engaged exclusively or partially in receptive anal sex carry a higher risk of HIV infection,

Table 3 Univariate analysis of factors associated with HIV infection among MSM in Nanjing

Factors	HIV infection % (n)	OR (95% CI)	P value
Age group (years)			
<20	6.6 (9)	1.000	
20–49	11.1 (297)	1.785 (0.898 to 3.546)	0.098
≥50	10.9 (25)	1.734 (0.785 to 3.834)	0.174
Residency (hukou)			
Jiangsu	11.1 (231)	1.000	
Others	10.6 (100)	0.947 (0.739 to 1.214)	0.668
Education level			
Junior middle school and lower	15.0 (59)	1.000	
Senior middle school/skill school	12.7 (83)	0.827 (0.577 to 1.185)	0.300
College and higher	9.5 (189)	0.598 (0.436 to 0.819)	0.001
Sex role			
Insertive	7.6 (80)	1.000	
Receptive	13.6 (99)	1.925 (1.410 to 2.628)	0.001
Dual	9.5 (189)	1.695 (1.276 to 2.252)	0.001
Anal sex, last 6 months			
No	9.0 (50)	1.000	
Yes	11.3 (281)	1.290 (0.940 to 1.769)	0.114
Multiple sex partners, last 6 months			
No	10.9 (158)	1.000	
Yes	10.9 (173)	0.996 (0.792 to 1.251)	0.971
Had UAI, last 6 months			
No	7.9 (135)	1.000	
Yes	14.7 (196)	1.999 (1.585 to 2.521)	0.001
Commercial sex, last 6 months			
No	10.9 (319)	1.000	
Yes	12.6 (12)	1.186 (0.640 to 2.197)	0.587
Had vaginal sex, last 6 months			
No	11.2 (272)	1.000	
Yes	9.6 (59)	0.840 (0.625 to 1.130)	0.250
Had UVI, last 6 months			
No	11.0 (272)	1.000	
Yes	9.6 (59)	0.937 (0.663 to 1.304)	0.712
Ever used rush popper			
No	10.0 (192)	1.000	
Yes	16.3 (75)	1.750 (1.311 to 2.336)	0.001
Ever used drugs			
No	10.7 (320)	1.000	
Yes	26.8 (11)	3059 (1.518 to 6.164)	0.002
Diagnosed with STD, last 12 months			
No	10.5 (296)	1.000	
Yes	17.2 (35)	1.771 (1.207 to 2.598)	0.003
Current syphilis infection			
No	10.1 (285)	1.000	
Yes	22.7 (46)	2.614 (1.841 to 3.712)	0.001

Continued

Table 3 Continued

Factors	HIV infection % (n)	OR (95% CI)	P value
Tested for HIV, last 12 months			
No	12.9 (149)	1.000	
Yes	9.7 (182)	0.728 (0.578 to 0.916)	0.007

MSM, men who have sex with men; STD, sexually transmitted disease; UAI, unprotected anal intercourse; UVI, unprotected vaginal intercourse.

possibly because rectal mucosa is easily damaged during receptive anal sex, thus increasing the likelihood of HIV virus passing into their blood.³⁰ Therefore, both the 'receptive' and 'dual' role MSM should probably be considered a priority target for condom promotion.

We observed a declining trend in current syphilis prevalence among MSM during these recent 5 years. Compared

Table 4 Multivariable analysis of factors associated with HIV infection among MSM in Nanjing

Factors	OR (95% CI)	P value
Education level		
Junior middle school and lower	1.000	
Senior middle school/skill school	0.883 (0.610 to 1.278)	0.509
College and higher	0.700 (0.503 to 1.035)	0.501
Sex role		
Insertive	1.000	
Receptive	1.936 (1.409 to 2.660)	0.001
Dual	1.684 (1.261 to 2.249)	0.001
Had UAI, last 6 months		
No	1.000	
Yes	2.046 (1.558 to 2.687)	0.001
Ever used drugs		
No	1.000	
Yes	1.874 (0.997 to 4.120)	0.053
Diagnosed with STD, last 12 months		
No	1.000	
Yes	1.610 (1.077 to 2.407)	0.020
Current syphilis infection		
No	1.000	
Yes	2.219 (1.531 to 3.217)	0.001
Tested for HIV, last 12 months		
No	1.000	
Yes	0.631 (0.437 to 0.912)	0.014

The variables that included in multivariable analysis were below: education level, sex role, had UAI, ever used drugs, diagnosed with STD in last 12 months, current syphilis infection and test for HIV in last 12 months.

MSM, men who have sex with men; STD, sexually transmitted disease; UAI, unprotected anal intercourse.

with previous report,¹¹ current syphilis prevalence was lower than that in 2011 (9.1%) and 2012 (11.5%). This phenomenon is consistent with the report that syphilis infection has declined in China.³⁰ The implementation of the syphilis prevention and control plan by the China's Ministry of Health may have contributed to this decline.³¹ It is well known that STDs that cause ulcers or inflammation greatly increase the efficiency of HIV transmission, by increasing both the infectiousness and the susceptibility to HIV infection.³² The positive association observed between syphilis and HIV can be explained by similar risk behaviours.³³ Thus, anyone presenting with syphilis should be tested for HIV and vice versa.³⁴ Meanwhile, screening and standardising STDs treatment need to be continued to push this trend further.

Several limitations of our study should be noted. First, our participants were recruited from MSM venues, some MSM social platforms and a government internet site. Thus, they may not be representative of MSM who do not go to these venues or visit the website. 'Hidden' MSM may carry higher risk behaviours. Second, it is possible that face-to-face investigation may have underestimated the levels of risk behaviours due to the issue of social desirability. The study was however anonymous; fake names and study serial number were used to match the records. Third, our cross-sectional studies are inherently observational and descriptive; thus, we cannot infer causality.

Overall, our five consecutive surveys were carefully designed, implemented and quality controlled. Under the implementation of comprehensive interventions, we observed stable HIV prevalence, steady HIV testing rate, decreasing UAI and syphilis prevalence. However, an increasing use of rush popper was observed. In response to the high HIV burden among MSM in Nanjing, HIV prevention and intervention messages must be increased about the urgent need for consistent condom use, targeting especially those MSM who engage in any receptive anal intercourse (although condom use is also important for inserters), HIV testing expanded, rush popper use reduced, STD screening increased and more widespread use of standardised treatment implemented.

Acknowledgements The authors are grateful to all the dedicated fieldworkers who took part in the surveys and all MSM participants who accepted the questionnaire investigation and blood sample providing. The authors would also like to thank MSM CBOs including: Nanjing Xingyou Community Based Organization, Nanjing Yeshanteng Bathroom Community Based Organization, Nanjing Bibochi Bathroom Community Based Organization and Nanjing Compass work studio.

Contributors SW, YX, LL, XL were contributed to data collection. WX contributed to laboratory testing, FX contributed to the study design and quality control, ZZ was responsible for data analysis and manuscript writing, HY and RD contributed to manuscript revision. All authors read and approved the final manuscript.

Funding The study was supported by outstanding Medical Academic Leader Programme of Jiangsu Provincial Center for Disease Control and Prevention (grant no. JKRC2011003), Jiangsu Department of Health Programme (grant no. H201330) and Nanjing Field Epidemiology Training Programme (first session).

Competing interests None declared.

Patient consent Not required.

Ethics approval This study was approved by the Ethics Committee of the National Center for AIDS and STD Control, China CDC.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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