

## Factors Associated with Unprotected Anal Intercourse Among Men Who Have Sex with Men: Results from a Respondent Driven Sampling Survey in Nanjing, China, 2008

Weiming Tang · Xiping Huan · Tanmay Mahapatra ·  
Songyuan Tang · Jianjun Li · Hongjing Yan ·  
Gengfeng Fu · Haitao Yang · Jinkou Zhao · Roger Detels

Published online: 20 January 2013  
© Springer Science+Business Media New York 2013

**Abstract** Unprotected anal intercourse (UAI) is a well-documented risk factor for acquiring HIV, but not well-studied in China. We studied demographic and behavioral correlates for UAI among men who have sex with men (MSM) in a respondent-driven-sampling (RDS) survey in Nanjing, China. Four hundred and thirty MSM (including ten seeds) participated in this study, rendering an adjusted rate of UAI as 62.3 % (95 % CI 56.4–68.4 %). Adjusted HIV and syphilis prevalence rates were 6.6 % (95 % CI 3.0–10.4) and 12.6 % (95 % CI 8.1–18.3), respectively. HIV- and syphilis-positive cases were more likely to have engaged in UAI. Being unwilling to use condoms, meeting partners in non-conventional venues, having multiple male sex-partners in the past 6 months, having sex with regular and casual male partners in the past 6 months, and consumption of alcohol before sex were all positively

associated with UAI. Based on the observed high prevalence of UAI among MSM in Nanjing, we can conclude that implementation of strategies to motivate MSM with high-risk behaviors to use condoms is urgently required in Nanjing.

**Resumen** Examinamos los factores asociados con sexo anal sin protección entre hombres que tienen sexo con hombres en Nanjing, China. Sexo anal sin protección es un factor riesgoso muy bien documentado por adquirir la infección del VIH, pero no ha sido muy bien estudiado en China. Datos sobre el sexo anal sin protección, información demográfica y de comportamiento de hombres que tienen sexo con hombres fue colectada en un muestreo dirigido por los participantes en Nanjing, China. Un análisis dirigido a los participantes fue usado para generar promedios ponderados de sexo anal sin protección y SPSS para llevar a cabo el análisis de regresión logística para factores asociados con sexo anal sin protección. Se estudio un total de 430 participantes (incluyendo 10 semillas), arrojando un promedio ajustado de sexo anal sin protección de 62.3 % (95 % intervalo de confianza 56.4–68.4 %). La práctica de sexo anal sin protección fue significativamente más frecuente entre casos positivos de VIH y sífilis, con tasas de prevalencia de VIH y sífilis de 6.6 % (95 % intervalo de confianza 3.0–10.4) y 12.6 % (95 % intervalo de confianza 8.1–18.3) respectivamente. El consumo de alcohol antes de tener sexo, conocer parejas en lugares que no sean lugares de encuentro convencional, haberse divorciado o envidado, tener mas de una pareja sexual en los últimos seis mese y tener relaciones sexuales con parejas ocasionales en los últimos seis meses fue positivamente asociado a tener sexo anal sin protección. En conclusión, existe una alta prevalencia de sexo anal sin protección entre hombre que tienen sexo con hombres en Nanjing y es un determinante

---

Weiming Tang and Xiping Huan contributed equally to the study.

---

W. Tang · T. Mahapatra · S. Tang · R. Detels (✉)  
Department of Epidemiology, UCLA Fielding School of Public Health, University of California, Los Angeles, 71-267 CHS, S. 650 Charles Young Drive, Los Angeles, CA 90095-1772, USA  
e-mail: detels@ucla.edu

X. Huan · H. Yan · G. Fu · H. Yang  
Jiangsu Provincial Centre for Disease Control and Prevention, Nanjing, Jiangsu, China

J. Li  
Department of Epidemiology and Biostatistics, School of Public Health, Nanjing Medical University, Nanjing, Jiangsu, China

J. Zhao (✉)  
Monitoring and Evaluation Unit, The Global Fund to Fight AIDS, Tuberculosis and Malaria, Cheminde Blandonnet 8, 1214 Vernier, Geneva, Switzerland  
e-mail: jinkou.zhao@theglobalfund.org

significativo del riesgo de VIH. Programas de prevención y estrategias deben ser implementadas urgentemente, como motivación para usar condones a las personas que tienen múltiples parejas sexuales y distribución gratuita de condones en los spas, casas de baño, saunas, salones de masaje, y otros lugares de encuentro convencional.

**Keywords** Unprotected anal intercourse (UAI) · HIV · Respondent-driven sampling (RDS) · Men who have sex with men (MSM) · Sexually transmitted diseases (STDs) · China

**Palabras Claves** Sexo anal sin protección · VIH · Muestro dirigido por los participantes · Hombres que tienen sexo con hombres · Infecciones transmitidas sexualmente · China

## Introduction

In China, the nature of the HIV epidemic has shifted from being primarily driven by drug injection to now occurring through sexual transmission. It was estimated in 2009 that 32.5 % of new HIV infections were attributable to male-to-male sex, an increase from 12.2 % since 2007 [1, 2]. In recent years, China has experienced a rapid increase in HIV prevalence among MSM in urban areas, reaching alarmingly high levels in some cities. The prevalence increased in Shenzhen from 0.9 % in 2002 to 2.7 % in 2005 [3], and from 0.4 % in 2004 to 6.5 % in 2007 in Beijing [4, 5]. In Chongqing, the first large sample survey revealed that HIV prevalence was 10.4 % in 2006, which increased to 16.7 % in 2008 [6, 7].

Numerous studies in various regions of the world, including China, have indicated that unprotected anal intercourse (UAI) is a major risk factor for acquiring HIV infection. Anal intercourse increases the risk of HIV transmission due to injuries to the thin anal and rectal mucosa, which is lined by a large number of HIV target cells (immune cells, including CD4+ cells). Anal intercourse without a condom is more likely to cause trauma, and since there is no barrier, the probability of transmission of the virus is further increased [8–11]. Several studies have revealed that 26.0–93.6 % of reported anal intercourse worldwide is unprotected [12–15]; however, very few studies have investigated the factors associated with UAI in China [4, 16–18].

HIV among MSM in Nanjing is a growing public health concern. In 2008, HIV incidence reached 5.12 per 100 person years in Nanjing [19]. It was estimated in 2009 that there were 25,000 MSM living in Nanjing within a total population of 7.8 million [20]. There is evidence indicating that a high proportion of MSM practice UAI [21], and that UAI

may be the driving factor for increased HIV prevalence among MSM in China, as reported in Jinan and Chengdu [14, 22]. The combination of a large population of MSM and a high rate of UAI may result in an HIV epidemic among MSM. Hence, understanding the factors associated with UAI may aid in designing effective intervention programs to reduce UAI, which in turn can reduce HIV transmission among MSM and their partners. Earlier studies used convenience samples from different venues in different populations of MSM, so comparisons or extrapolation of those results beyond the study population may not be feasible. We therefore wanted to study the factors associated with UAI among a diverse MSM population for input on formulating effective prevention methods and programs.

## Methods

To examine the factors associated with UAI, an integrated behavioral and serologic survey was conducted among MSM in Nanjing, China, using a respondent-driven sampling (RDS) method for recruitment.

### Study Design and Sampling Methods

RDS was used to recruit men who were later screened for eligibility by the research team prior to being interviewed. Eligibility criteria were having had oral and/or anal sex with at least one male during the past 12 months, being 18 years or older, and not having participated in a similar survey within the past 3 months. RDS is a variant of chain-referral methodology based on social connection networks [23, 24]. Briefly, RDS begins with a set of initial participants who are selected as “seeds” for an expanding chain of referrals, with respondents from each link in the chain or wave referring respondents who form subsequent “waves” [25]. In this study, ten seeds were recommended by non-government organizations in Nanjing that provide outreach for the MSM community (in bars, bathhouses/spas, restrooms, parks, and the internet). The original seeds were diverse in terms of income, age, occupation, and cruising areas (the places where MSM usually look for casual sex partners). After being interviewed, participants were given lubricant and two condoms (approximately \$US 4.80 value). Each participant was also asked to recruit up to three other MSM of their acquaintance, using a numbered coupon to be presented to the research team. For each person recruited (up to three), the referring participant received a prepaid phone card (approximately \$US 4.80 value). Six key demographic variables were used to monitor equilibrium, including official residency status (“hukou”, the residency permit system in China), educational level, marital status, syphilis status, sexual orientation, and

cruising areas. All of the interviews and biological sampling took place at the sexually transmitted disease (STD) clinic of the Jiangsu Province Center for Disease Control and Prevention (CDC) in Nanjing.

### Behavioral Measures

Face-to-face interviews were carried out to collect information from the population. In this study, UAI was defined as never or only occasionally using a condom during anal intercourse in the past 6 months with all male partners. Cruising areas/venues were categorized as typical venues for finding partners (pubs, bathhouses, massage parlors, parks, internet) or non-conventional venues such as college campuses or being introduced by friends. Typical venues were further subclassified into:(a) pubs, discos, tearooms or clubs;(b) spas, bathhouses, saunas or massage parlors;(c) parks, public restrooms or other public areas; and(d) internet. Multiple male sexual partners was defined as more than two within the past 6 months.

Regular sexual partners were defined as those having a steady sexual relationship during the past 6 months, while casual sexual partners were defined as those with whom a participant had sex once or occasionally during the past 6 months. Having sex with regular male sexual partners in the past 6 months (vs. those who did not) was the variable used to indicate recent sexual activity with men, and having sex with casual male sexual partners in the past 6 months (vs. those who did not) was used to indicate sexual risk behavior. To determine whether participants were willing to use condoms, they were asked: “If condoms could prevent HIV transmission, would you use condoms when having sex?” Assessment of recent sexual activity of the participants was based on information about having multiple male sexual partners, receptive anal sex, sex with regular or casual male sexual partners, and consumption of alcohol before sex with their last male partner during the past 6 months.

In this study, assessment of knowledge regarding HIV was based on answers to basic questions related to HIV, and coverage of HIV preventive services was defined as the proportion of the study population who received at least one of the six intervention services (condoms, lubricant, peer education, STD diagnosis or treatment, HIV counseling or testing, and AIDS/STD-related materials/pamphlets) in the past year.

Information was collected regarding selection of partners, characteristics of the population, their knowledge about HIV, attitudes regarding HIV preventive services, recent sexual behavior, recreational drug use, and STD-related symptoms and signs. STD-related symptoms and signs included burning sensation during urination, genital discharge, and ulcer/sores on penis/anus.

### Serologic Measures

Before being interviewed, 5.0 ml of blood was drawn from each consenting participant for HIV and syphilis testing. Initial screening of the subjects for the presence of HIV antibodies was done using a rapid test (Acon Biotech Co. Ltd; lot number 200803973/WB). Positive results were confirmed by Western blot (HIVBLOT 2.2, Genelabs Diagnostics, Singapore; lot number AE8039). Subjects were screened for syphilis antibodies with the rapid plasma reagin test (RPR) (Beijing Wantai Biological Pharmacy Enterprise Co. Ltd; lot number N20080404) and confirmed by treponema pallidum particle agglutination assay (TPPA; Livzon Group Reagent Factory; lot number VN80803). Syphilis positivity was defined as “current” when both TPPA and RPR were positive.

### Statistical Methods

Data were double-entered using EpiData 3.0. Before analysis, data were cleaned by logic checking. We used the respondent driven sampling analysis tool (RDSAT) version 5.6 (available free online, <http://www.respondentdriven-sampling.org>) to calculate the population adjusted point estimate and 95 % confidence intervals. While analyzing the total distribution of the recruits, RDSAT automatically dropped the seeds. RDS uses network information to account for potential sources of bias in the sample, and provides mathematical methods for adjusting estimates based on these biases. The weighted adjustment was based on the inverse of social network size (i.e., since the larger a social network, the greater the likelihood that someone might be recruited by other participants in his social network; therefore, the larger the network, the less weighted the participant) and recruitment patterns. After individualized weighting, weights of UAI (outcome variable) were exported from RDSAT, and the weighted information for UAI was used as the dependent variable while conducting weighted conventional logistic regression) using SPSS version 13.0. Independent variables were official residency status, HIV knowledge, coverage of HIV preventive services, recent sexual behavior, recreational drug use, and STD-related symptoms and signs. We first used logistic regression to obtain the crude association between different variables and UAI (odds ratio, 95 % confidence intervals). Finally, we performed multivariate analysis to obtain the adjusted association between different variables and UAI (by adjusting age, marital status, and residency, which have *P* values of less than 0.2 when checking the association of those variables with UAI).

Signed informed consent was obtained from each of the participants prior to interview and blood collection. The survey protocol was developed and approved by the

Institutional Review Board of the National Center for AIDS/STD Prevention and Control (NCAIDS), China CDC.

## Results

The survey was conducted in May and June of 2008. Of the initial ten seeds, nine produced at least one wave of recruitment, with the longest chain reaching 14 waves and recruiting 88 participants (including the seed); the shortest chain recruited three participants (including the seed).

Of the 1,289 coupons distributed, 427 (33.1 %) were returned. Seven (0.5 %) of the referrals were ineligible, with one person being younger than 18 years and 6 participants reporting no oral or anal sex with males during the past 12 months. The initial ten seeds led to recruitment of a total of 420 participants who completed both the serological and behavioral components, resulting in a total sample of 430 participants recruited in 14 weeks (including the ten seeds).

Demographic characteristics of participants are presented in Table 1. One-fifth (20.9 %; 95 % CI 14.9–26.1) of the study population included in the adjusted analyses had been tested for HIV in the past year, and coverage of HIV intervention programs was 62.6 % (95 % CI 57.2, 69.9). The crude HIV and syphilis prevalence rates were 4.6 and 11.6 %, and the adjusted rates were 6.6 % (95 % CI 3.0–10.4) and 12.6 % (95 % CI 8.1–18.3), respectively. Univariate analysis (Table 2) indicated that the likelihood of engaging in UAI was significantly higher (OR = 2.3, 95 % CI 1.1–4.8) among participating MSM aged 30–39 years than those 20 years or younger, and among those living in cities in Jiangsu Province other than Nanjing (OR = 2.5, 95 % CI 1.5–4.1). Having more HIV-related knowledge appeared to be related to being less likely to engage in UAI, although it was not statistically significant (OR = 0.4, 95 % CI 0.1–1.0).

Lack of willingness to use condoms (OR = 3.4, 95 % CI 2.1–5.5) was a significant factor for being more likely to engage in UAI. Meeting with partners at spas, bathhouses, saunas, and massage parlors (OR = 2.3, 95 % CI 1.2–4.2) or non-conventional cruising venues (OR = 5.9, 95 % CI 1.8–19.0) was associated with higher odds of UAI with reference to those meeting partners in other venues such as pubs, discos, tearooms, or clubs. In addition, having multiple male sexual partners in the past 6 months (OR = 2.6, 95 % CI 1.7–4.1), being the receptive partner during anal sex (OR = 2.0, 95 % CI 1.6–2.4), having sex with regular male partners in the past 6 months (OR = 2.7, 95 % CI 2.0–3.8), having sex with casual male partners in the past 6 months (OR = 2.0, 95 % CI 1.6–2.4), and consuming alcohol before having sex with last male partner

(OR = 4.6, 95 % CI 3.3–6.6) were all positively associated with UAI. UAI was significantly associated with both HIV (OR = 4.0, 95 % CI 1.3–12.2) and syphilis (OR = 3.8, 95 % CI 1.89–7.6) sero-positivity in the unadjusted models.

After adjusting for age, residency, and marital status, lack of willingness to use condoms, meeting partners in non-conventional venues (OR = 6.5, 95 % CI 1.9–22.4), having multiple male sexual partners during the past 6 months (OR = 2.6, 95 % CI 1.3–4.9), being the receptive partner during anal sex (OR 2.0, 95 % CI 1.6–2.5), having sex with regular (OR = 2.7, 95 % CI 1.8–3.8) and casual male partners (OR = 4.3, 95 % CI 2.9–6.3) in the past 6 months, consumption of alcohol before having sex with last male partner (OR = 5.2, 95 % CI 3.5–7.6), and being sero-positive for syphilis were all significantly associated with UAI.

## Discussion

This study provided evidence regarding the prevalence of UAI and the strength of association of demographic factors and sexual behaviors with UAI in Nanjing. Two-thirds (62.3 %) of the study population reported engaging in UAI. This estimate is lower than in two previous surveys in Nanjing [26, 27]. We also found that the rate of UAI in Nanjing was higher than in other cities in China that had been similarly surveyed [4, 5, 13]. This high rate of UAI might have significantly contributed to the spread of HIV infection among MSM in Nanjing [28]. Based on our results, it is urgent to implement strategies to scale up condom promotion among MSM in Nanjing and to educate them about the benefits of condom use to prevent HIV transmission.

Although nearly two-thirds (62.6 %) of the study population had accessed HIV prevention/intervention programs, only 20.9 % of the participants had been tested for HIV during the past year, which is a source of serious concern. This probably indicates that the awareness programs need to be specifically targeted towards increasing motivation for MSM in Nanjing to get tested for HIV.

Our results revealed that MSM who were not official residents of Nanjing were more likely to engage in UAI, as were non-residents in another study conducted in Jinan [14]. This finding emphasizes the need to strengthen prevention programs for migrant and non-resident MSM.

Even though not statistically significant, having more knowledge about HIV appeared to be a factor for being less likely to engage in UAI in both the crude and adjusted models. Also, both the crude and adjusted results showed that lack of willingness to use condoms was a significant factor for being more likely to engage in UAI. These two

**Table 1** Demographic characteristics of MSM in Nanjing, China, 2008 (*N* = 430)

	Sample ( <i>n</i> )	Crude (%)	Adjusted % (95 % CI)
Age (years)			
18–19	10	3.2	4.3 (1.2–7.5)
20–29	198	63.5	55.3 (44.2–63.2)
30–39	61	19.6	22.9 (17.2–31.5)
40–49	33	10.6	12.9 (7.5–20.2)
50 or older	10	3.2	4.7 (0.9–10.7)
Marital status			
Single	328	76.3	64.5 (56.5–72.5)
Married	81	18.8	27.7 (20.8–34.9)
Divorced or widowed	21	4.9	7.9 (3.8–12)
Occupation			
Student	124	28.9	18.5 (12.0–22.2)
Worker	22	5.0	8.4 (5.0–15.0)
Staff	89	20.7	26.7 (20.3–32.5)
Teacher	12	2.8	2.3 (1.0–4.3)
Commercial attendant	66	15.4	16.5 (13.2–24.6)
Education level			
Illiterate	1	0.2	0.2 (0.0–0.5)
Elementary school	5	1.2	0.8 (0.1–1.9)
Junior high school	38	8.8	15.6 (9.1–21.1)
Senior high school or technical secondary school	99	23.0	25.5 (20.4–31.4)
Junior college or higher	287	66.7	57.9 (51.3–66.3)
Residency (hukou)			
Nanjing	251	58.4	48 (41.6–54.6)
Other cities in Jiangsu	92	21.4	26.6 (20.0–32.6)
Other provinces	87	20.2	25.5 (19.7–31.5)
Monthly income (RMB ~6.3 = \$US1)			
≤1000	137	31.8	25.3 (16.4–54.5)
1001–2000	103	24.0	25.9 (19.9–31.3)
2001–3000	86	20.0	21.8 (17.2–28.7)
3001–4000	49	11.4	12.1 (8.2–15.9)
>4000	55	12.8	15 (10.5–19.6)
Tested for HIV in the past year			
Yes	107	24.9	20.9 (14.9–26.1)
No	323	75.1	79.1 (73.9–85.1)
Coverage of HIV intervention			
Covered	306	71.2	62.6 (57.2–69.9)
Not covered	124	28.8	37.4 (30.1–42.8)
HIV-positive	20	4.6	6.6 (3.0–10.4)
Syphilis-positive	50	11.6	12.6 (8.1–18.3)

results indicate that continuous educational programs should be implemented immediately, specifically to increase knowledge about HIV among MSM and motivating them to use condoms.

Unlike the findings of a previous study [29], we found that meeting partners in non-conventional venues (such as

college campuses, being introduced by friends) was associated with higher likelihood of engaging in UAI compared to meeting partners in typical venues (pubs, discos, tea-rooms, clubs). This could be because MSM were more likely to trust MSM in their own social networks. Thus, it seems important to understand the network dynamics of

**Table 2** Crude and adjusted analyses of factors associated with UAI among MSM in Nanjing, China, 2008 ( $N = 430$ )

Variables	Basic model (crude)		Adjusted model <sup>a</sup>	
	OR (95 % CI)	<i>P</i> value	OR (95 % CI)	<i>P</i> value
Age (years)				<0.01*
18–19	Ref.			
20–29	1.4 (0.7–2.7)	0.3		
30–39	2.3 (1.1–4.8)	0.02*		
40–49	0.8 (0.4–1.8)	0.6		
50 or older	6.4 (1.0–42.0)	0.06		
Residency (hukou)		<0.1*		
Nanjing	Ref.			
Other cities in Jiangsu Province	2.5 (1.5–4.1)	<.01*		
Other provinces	1.3 (0.8–2.0)	0.3		
Marital status		<0.01*		
Single	Ref.			
Married	1.0 (0.7–1.6)	0.9		
Divorced or widowed	2.5 (1.0–6.30)	0.06		
HIV knowledge	0.4 (0.1–1.0)	0.06	0.4 (0.1–1.2)	0.1
Did not use condom when knowing it can prevent HIV transmission	3.4 (2.1–5.5)	<0.01*	3.0 (1.8–5.1)	<0.01*
Venues for meeting sex partners		<0.01*		<0.01*
Conventional venues				
Pubs, discos, tearooms, clubs	Ref.		Ref.	
Spas, bathhouses, saunas, massage parlors	2.3 (1.2–4.2)	0.01*	2.0 (1.0–4.1)	0.6
Parks, public restrooms, other public areas	0.4 (0.2–1.3)	0.1	0.4 (0.1–1.2)	0.1
Internet	1.6 (0.9–2.8)	0.1	1.8 (1.0–3.2)	0.06
Non-conventional venues (college campus, introduced by friends, etc.)	5.9 (1.8–19.0)	<0.01*	6.5 (1.9–22.4)	0.03*
Multiple sexual partners in the past 6 months (more than 2 vs. 2 or less)	2.6 (1.7–4.1)	<0.01*	2.6 (1.3–4.9)	0.04*
Receptive anal sex	2.0 (1.6–2.4)	<0.01*	2.0 (1.6–2.5)	<0.01*
Sex with regular sexual partners in past 6 months	2.7 (2.0–3.8)	<0.01*	2.7 (1.8–3.8)	<0.01*
Sex with casual sexual partners in past 6 months	3.7 (2.6–5.3)	<0.01*	4.3 (2.9–6.3)	<0.01*
Consumed alcohol before sex with last male partner	4.6 (3.3–6.6)	<0.01*	5.2 (3.5–7.6)	<0.01*
HIV-positive	4.0 (1.3–12.2)	0.01*	2.9 (0.9–9.5)	0.09
Syphilis-positive	3.8 (1.9–7.6)	<0.01*	3.3 (1.6–7.0)	<0.01*

UAI was defined as never or only occasionally using a condom during anal sex in the past 6 months with all male partners

\* Significant differences between groups

<sup>a</sup> Adjusted for age (18–19, 20–29, 30–39, 40–49, 50+), marital status (single, married, divorced, widowed), residency (Nanjing, other cities in Jiangsu Province, other provinces)

MSM in Nanjing for effective roll-out of condom promotion programs to reduce UAI.

Both crude and adjusted results indicated that being the receptive partner and having multiple sexual partners in the past 6 months were associated with higher odds for UAI. These results were similar to the results from a study in Jinan [14], but differed from a survey conducted in Ecuador [30]. Results of both unadjusted and adjusted models indicated that having recent (past 6 months) sexual activity with regular and casual partners was associated with higher odds of UAI, which is similar to the findings of most other

studies [8, 10, 12]. Based on these observations, it is imperative that MSM with high risk behaviors need to be reached by programs to increased their knowledge about preventing HIV and motivating them to use condoms.

Our results corroborate earlier studies indicating that consuming alcohol before having sex is an independent risk factor for UAI among MSM [31–33]. Thus, behavioral surveillance programs to reduce substance abuse need to be combined with HIV prevention and condom promotion programs for efficient reduction of UAI and HIV risk among MSM in Nanjing.

Our study indicated that being sero-positive for HIV or syphilis is associated with higher risk of UAI, possibly due to MSM with high-risk sexual behavior (i.e., UAI) being more likely to become infected. This is of concern, since HIV- or syphilis-positive MSM are more likely to engage in UAI, thereby increasing transmission of those infections. Based on our results, modification of existing prevention strategies may be needed to control the HIV epidemic among MSM in Nanjing, specifically targeting the MSM who are not official residents of Nanjing, know less about HIV, meet partners in places other than typical cruising venues, are generally receptive partners, have multiple partners, have sex with regular and casual partners, consume alcohol before sex and, are syphilis- positive.

Our study had certain limitations. Only 427 (33.1 %) of the 1289 coupons distributed were returned, but this is consistent with other published RDS surveys [34, 35]. The large disparities in the sizes of the referral chains might have limited the representativeness and generalizability of the study results. Also, as is common in many other behavioral surveys, information, desirability, and recall biases probably existed. It was likely that responses differed between MSM and heterosexual interviewers, especially if the interviewer was attractive. This study was conducted at the STD clinic of the local CDC, which might have also introduced selection bias, because those who were willing to go to the clinic to participate might differ from those who were not. To minimize the bias, four specially trained interviewers conducted the face-to-face interviews according to an identical protocol, including two MSM peer interviewers. Two quality checkers were appointed to check each and every questionnaire carefully after each interview. If any logistic errors were detected, the interviewees had the opportunity to correct them before leaving.

The strengths of the study include its use of RDS to access members of this otherwise hard-to-reach population, its demographically diverse sample, and its use of biological markers of HIV risk (HIV and syphilis infection).

Based on our data, we conclude that UAI is significantly contributing to HIV risk among MSM in Nanjing, and there is an urgent need to develop prevention programs and strategies targeting factors associated with UAI at the present stage of the HIV epidemic among MSM in Nanjing. Tailored intervention methods and strategies to increase motivation for condom use, especially by those who have high-risk sexual behavior, to increase free condom distribution at spas, bathhouses, saunas, massage parlors, and other non-conventional cruising venues, to provide education about reducing alcohol consumption among MSM, and local prevention programs that target non-resident MSM of Nanjing should be implemented immediately to deal with the high prevalence of UAI, in order to control the HIV epidemic in this population.

**Acknowledgments** This study was financially supported by Jiangsu Provincial Technologies Research Program (BE2009685), Jiangsu Province's Outstanding Medical Academic Leader Program (RC2011087, 2011086) and the Bill & Melinda Gates Foundation.

## References

1. Wang N, Wang L, Wu ZY, et al. Estimating the number of people living with HIV/AIDS in China; 2003–09. *Intl J Epidemiol*. 2010;39(ii):21–8.
2. State Council AIDS Working Committee Office UN Theme Group on AIDS in China. A Joint Assessment of HIV/AIDS Prevention, Treatment and Care in China; 2007.
3. Zeng HF, Qin YM, Ye BY, et al. Survey of infectious status of HIV/STD in male homosexuals in Shenzhen city. *J China Trop Med*. 2006;6(Suppl 9):1686–8.
4. Ma XY, Zhang QY, He X, et al. Trends in prevalence of HIV, syphilis, hepatitis C, hepatitis B and sexual risk behavior among men who have sex with men: results of 3 consecutive respondent-driven sampling surveys in Beijing, 2004 through 2006. *J Acquir Immune Defic Syndr*. 2007;45:581–7.
5. Lu HY, Ma XY, Liu YC, et al. A survey of HIV/STDs prevalence in 200 MSM and related factors in Beijing. *Chin J AIDS STD*. 2008;14(5):467–70.
6. Feng LG, Ding XB, Lu RR, et al. High HIV prevalence detected in 2006 and 2007 among men who have sex with men in China's largest municipality: an alarming epidemic in Chongqing. *China. J Acquir Immune Defic Syndr*. 2009;52(1):79–85.
7. Ouyang L, Feng LG, Ding XB, et al. A respondent-driven sampling survey on HIV and risk factors among men who have sex with men in Chongqing. *Chin J Epidemiol*. 2010;30(10):1001–4.
8. Clark JL, Konda KA, Segura ER, et al. Risk factors for the spread of HIV and other sexually transmitted infections among HIV-infected men who have sex with men in Lima. *Peru. Sex Transm Infect*. 2008;84(6):449–54.
9. Van Kesteren NMC, Harm JH, Gerjo K, et al. Sexual risk behavior among HIV-positive men who have sex with men: a literature review. *Patient Educ Couns*. 2007;65:5–20.
10. Williamson LM, Flowers P, Knussenb C, et al. HIV testing trends among gay men in Scotland, UK (1996–2005): implications for HIV testing policies and prevention. *Sex Transm Infect*. 2009; 85(7):550–4.
11. Jiang J, Yang P, Wang QQ, et al. Knowledge manual of male reproductive health and disease prevention. Shanghai: Shanghai Science and Technology Publishing House; 2008. p. 5.
12. Van Kesteren MCN, Hoppers JH, Van Empelen P, et al. Sexual decision-making in HIV-positive men who have sex with men: how moral concerns and sexual motives guide intended condom use with steady and casual sex partners. *Arch Sex Behav*. 2007;36:437–49.
13. Houston E, McKirnan JD. Intimate partner abuse among gay and bisexual men: risk correlates and health outcomes. *J Urban Health*. 2007;84(Suppl 5):681–90.
14. Li A, Varangrat A, Wimonasate W, et al. Sexual behavior and risk factors for HIV infection among homosexual and bisexual men in Thailand. *AIDS Behav*. 2009;13(2):318–27.
15. Kendall C, Kerr RFSL, Gondim CR, et al. An empirical comparison of respondent-driven sampling, time location sampling, and snowball sampling for behavioral surveillance in men who have sex with men, Fortaleza, Brazil. *AIDS Behav*. 2008;12(Suppl4):97–104.
16. Elam G, Macdonald N, Hickson FCI, et al. Risky sexual behavior in context: qualitative results from an investigation into risk

- factors for seroconversion among gay men who test for HIV. *Sex Transm Infect.* 2008;84:473–7.
17. Grov C, Parsons TJ, Bimbi DS. Sexual risk behavior and venues for meeting sex partners: an intercept survey of gay and bisexual men in LA and NYC. *AIDS Behav.* 2007;11:915–26.
  18. Jin F, Prestage GP, Mao L, et al. Incidence and risk factors for urethral and anal gonorrhoea and chlamydia in a cohort of HIV-negative homosexual men: the Health in Men Study. *Sex Transm Infect.* 2007;83:113–9.
  19. Yang HT, Hao C, Huan XP. HIV incidence and associated factors in a cohort of men who have sex with men in Nanjing, China. *Sex Transm Dis.* 2010;37(4):208–13.
  20. Yan HJ, Tang WM, Zhang M, et al. Combination of multiplier method with qualitative interview to estimate the population size of men who have sex with men in a city of Jiangsu. *Chin J AIDS STD.* 2010;16(1):29–31.
  21. Crepaz N, Marks G, Liau A, et al. Prevalence of unprotected anal intercourse among HIV-diagnosed MSM in the United States: a meta-analysis. *AIDS.* 2009;23(13):1617–29.
  22. Feng Y, Wu Z, Detels R, et al. HIV/STD prevalence among MSM in Chengdu, China and associated risk factors for HIV infection. *J Acquir Immune Defic Syndr.* 2010;53(Suppl 1):S74–80.
  23. Heckathorn D. Respondent driven sampling: a new approach to the study of hidden populations. *Soc Probl.* 1997;44(2):174–99.
  24. Heckathorn D. Respondent driven sampling II: deriving valid population estimates from chain-referral samples of hidden populations. *Soc Probl.* 2002;49(1):11–34.
  25. United States Department of Health and Human Services, Centers for Disease Control and Prevention, Global AIDS Program Surveillance Team, in collaboration with Tulane University. Behavioral surveillance: introduction to respondent driven sampling participant manual. USA:2007;183-5.
  26. Cao G, Guan WH, Wu XG, et al. Study on infection rate of HIV/syphilis among men who have sex with men in a balneary. *Acta Univers Med Nanjing (Nat Sci).* 2007;27(6):637–40.
  27. Cao NX, Zhang JP, Xia Q, et al. Study on HIV/STD infections among men who have sex with men in selected cities of Jiangsu Province. *Chin J AIDS STD.* 2006;12(2):123–6.
  28. Tang WM, Yan HJ, Liu XY, et al. The factors associated with HIV infection among men who had sex with men in Nanjing, Suzhou, and Yangzhou: a 1:4 matched case control study. *Chin J Epidemiol.* 2009;30(5):448–51.
  29. Xia Q, Tholandi M, Osmond DH, et al. The effect of venue sampling on estimates of HIV prevalence and sexual risk behaviors in men who have sex with men. *Sex Transm Dis.* 2006;33(9):545–50.
  30. Gutiérrez JP, Molina- Yopez D, Morrison K, et al. Correlates of condom use in a sample of MSM in Ecuador Juan-Pablo. *BMC Pub Hlth.* 2006;12(6):152–59.
  31. Platt L, Wall M, Rhodes T, et al. Methods to recruit hard-to-reach groups: comparing two chain referral sampling methods of recruiting injecting drug users across nine studies in Russia and Estonia. *J Urban Health.* 2006;83(Suppl 7):39–53.
  32. Celentano DD, Valleroy LA, Sifakis F, et al. Associations between substance use and sexual risk among very young men who have sex with men. *Sex Transm Dis.* 2006;33(4):265–71.
  33. Johnston GL, Sabin K, Hien TM, et al. Assessment of respondent driven sampling for recruiting female sex workers in two Vietnamese cities: reaching the unseen sex worker. *J Urban Health.* 2005;83(Suppl 7):16–28.
  34. Johnston LG, Khanam R, Reza M, et al. The effectiveness of respondent driven sampling for recruiting males who have sex with males in Dhaka, Bangladesh. *AIDS Behav.* 2008;12:294–304.
  35. He Q, Wang Y, Lin P, et al. High prevalence of risk behavior concurrent with links to other high-risk populations: a potentially explosive HIV epidemic among men who have sex with men in Guangzhou, China. *Sex Transm Infect.* 2009;85:383–90.