

Rising HIV Prevalence Among Married and Unmarried Among Men Who Have Sex with Men: Jinan, China

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Abstract We report on two waves of bio-behavioral surveillance of MSM in Jinan, Shandong Province, China. HIV prevalence rose from 0.05% in 2007 to 3.1% in 2008. Differences in the two waves of surveys were noted, particularly with respect to marital status, requiring stratified analysis. In multivariable analysis, unmarried, homosexually identified MSM who do not have female sex partners have a greater than sixfold greater chance of being infected with HIV compared to married, non-homosexually identified MSM who do have female partners. Carefully targeted and population-specific messages will be needed for homosexually identified and non-identified MSM in China.

Keywords Men who have sex with men · China · Asia · HIV · Respondent driven sampling · Surveillance · Marriage

Introduction

Increases in HIV prevalence among men who have sex with men (MSM) have been reported in Beijing and other cities of Asia (Centers for Disease Control and Prevention (CDC) 2006; China Ministry of Health 2008; Gupta et al.

2006; Ma et al. 2007; van Griensven et al. 2005). In 2008, China CDC's National Center for AIDS/STD Control and Prevention (NCAIDS) in conjunction with provincial and local CDCs initiated a 61 city-wide integrated bio-behavioral HIV surveillance system for MSM (Hornby 2009). A sub-set of cities chose to use respondent-driven sampling (RDS) as the recruitment methodology. One city, Jinan, in Shandong Province, had previously implemented bio-behavioral surveillance among MSM using RDS (Ruan et al. 2008). This study provided the 2007 data for the current analysis. The same method was also implemented in Jinan in 2008. This presented the opportunity to assess changes in HIV infection and risk among MSM in Jinan and to evaluate the use of RDS as a tool for routine HIV surveillance.

Tracking the HIV epidemic over time is a main goal of bio-behavioral HIV surveillance. While accuracy is desirable, consistency and repeatability are the mainstays of good sero-surveillance. One method that has increasingly been put forth as being efficient in sampling hard to reach populations while also being repeatable over time is RDS (Heckathorn 1997, 2007; Magnani et al. 2005). In theory, RDS reaches a state of equilibrium after which adjusting for recruitment patterns and social network size allows for unbiased point estimates of characteristics and behaviors of the population. Furthermore, RDS purports to achieve the goal of repeatability on the basis of long-chain of referrals for recruitment being independent of the starting seeds when equilibrium is reached. While many countries around the world have implemented RDS in diverse populations (Johnston et al. 2008a; Malekinejad et al. 2008), at present, few locations have conducted multiple waves of RDS among the same population (Ma et al. 2007). We present here data from two waves of RDS surveys among MSM in Jinan, China.

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Methods

Respondent-driven sampling is a long-chain referral sampling method whose theory and implementation have been described in detail elsewhere (Bozicevic et al. 2008; Heckathorn 1997, 2007; Johnston et al. 2008a; Liu et al. 2009; Malekinejad et al. 2008). In brief, RDS begins with a formative assessment which guides the purposeful selection of initial seed participants who, after completing a behavioral survey and serological testing, are invited to recruit three other MSM from their social networks to initiate chains of referrals to the study. Referrals are recorded to enable the link-dependent RDS adjustments during analysis. Key demographic variables are monitored over the course of recruitment to determine when the crude sample has reached equilibrium; that is, the composition of the sample becomes stable in relation to key variables. When both sample size and equilibrium are reached, sampling stops. Analyses are first conducted using Respondent Driven Sampling Analysis Tool (RDSAT v6) where adjustments are made for each individual's network size and recruitment patterns. Univariate adjusted point estimates and 95% confidence intervals in each of the two waves of surveys were produced in RDSAT. Additionally, RDSAT produces individual weights for any variable of interest to be exported for use in common statistical software packages used for analyzing complex survey data to conduct bivariate and multivariate logistic regression analyses. We did not create a unified set of weights for combining the two waves of RDS surveys under the rationale that the separation in time would preclude the theoretical recruitment and sampling of individuals from the same target population. Current recommendations are that only the outcome variable of interest's individualized weights be created, exported and subsequently used in logistic regression analyses (Heckathorn 2007; Johnston et al. 2008b).

Participants were surveyed by the same trained interviewers using structured questionnaires during both waves of RDS. Measures common to each were used for the present analysis. HIV testing was conducted following standard local laboratory protocols and did not change between the two waves of RDS. All participants received risk reduction counseling and information education and condom (IEC) materials. All participants testing positive for HIV or syphilis were reported and referred for care and treatment.

Participants for both waves of the study were men who reported having sex with other men in the past 12 months, currently living or working in Jinan, were in possession of a valid recruitment coupon received from a previous study participant, and were over 17 years old. The age cutoff was set by the local IRB and the national HIV/AIDS control program.

We first compared key demographic characteristics of the crude and adjusted point estimates of the two studies. Because of the marked increase in both the crude and adjusted proportion of men reporting being married, we then stratified key demographic, risk and outcome variables by marital status within each year and compared 95% confidence intervals (95% CI) to assess trends over time. When point estimates differed and 95% CIs had total non-overlap we interpreted this as indicating that there was a significant difference between the 2 years. When the 95% CIs of the two estimates excluded the point estimate of the other, we interpreted this as being suggestive of a significant difference between the 2 years. Thus, we drew inference on differences in population estimates when the RDSAT adjusted confidence intervals show no or minimal overlap.

Using only the 2008 data we conducted bivariate and multivariate logistic regression analyses to identify correlates of HIV infection using the RDSAT exported weights in SAS (version 9.1). Demographic and risk behavior variables associated with HIV infection at $P < 0.1$ were included in a multivariate model, along with age to adjust for confounding.

Results

The two studies were conducted in Jinan in 2007 (March–July) and 2008 (April–June). Nine and five seeds were used in each round, respectively. In 2007, 13 individuals were approached to be seeds and nine were selected representing diversity with respect to educational attainment, occupation, income and marital status (eight unmarried, one married). In 2008, out of a pool of 25 members of an MSM volunteer group, five seeds were screened and selected. The five seeds included four who identified as homosexual and one identifying as bisexual, four were unmarried and one married. Coupon return rates were 30.5% in 2007 and 38.3% in 2008. In 2007, 428 men were recruited and in 2008, 500 men were recruited, exceeding and meeting their planned sample sizes, respectively. Equilibria were reached on the key variables tracked during recruitment (marital status, education, income) in both years. Only 51 men reported participating in both survey waves.

In 2007, the sample was predominantly over 25 years old (crude 49.2%, adjusted 61.5%) (Table 1). In 2008, the proportion over 25 was 53% crude and 56.4% adjusted. In terms of marital status, in the 2007 sample a majority was single never-married (crude 74.6%, adjusted 73.3%) while only a small proportion were married to a woman (crude 16.1%, adjusted 17.5%). In 2008, the proportion single never-married was 70% (crude) and 66.6% (adjusted) while married men were 25.6% (crude) and 28.5%

Table 1 Crude and adjusted characteristics and sexual identity, MSM: Jinan, China, 2007 and 2008

Variable	2007		2008	
	Crude % (n)	Adjusted % (95% CI)	Crude % (n)	Adjusted % (95% CI)
Age				
≤25 years	40.3 (170)	38.5 (32.7–45.2)	47.0 (232)	43.6 (37.9–49.8)
>25 years	59.2 (258)	61.5 (54.8–67.3)	53.0 (263)	56.4 (50.2–62.1)
Current marital status				
Single, never married	74.6 (318)	73.3 (68–79.1)	70.0 (346)	66.6 (60.4–72.9)
Married (to a woman)	16.1 (69)	17.5 (12.5–22.1)	25.6 (127)	28.5 (22.7–34.5)
Divorced	8.2 (36)	7.9 (5.3–10.9)	4.4 (22)	5.0 (3.0–7.1)
Jinan hukou ^a	44.9 (190)	42.3 (36.1–47.9)	39.6 (195)	38.0 (33.3–42.9)
Has children	18.3 (79)	20.1 (14.9–25.0)	26.4 (131)	27.3 (21.9–32.7)
Lives with				
Alone	39.4 (172)	41.5 (35.5–46.2)	34.0 (169)	33.3 (28.3–37.5)
Friend	22.9 (98)	25.5 (20.9–31.0)	26.2 (129)	26.6 (21.8–31.3)
Parents	4.7 (20)	5.3 (3.4–8.2)	10.2 (50)	9.9 (7.1–12.9)
Spouse	8.7 (37)	8.5 (5–11.9)	17.2 (85)	20.2 (15.6–25.0)
Boyfriend	10.8 (45)	7.0 (4.7–9.7)	10.4 (52)	8.3 (6.0–11.2)
Sexual orientation				
Homosexual	69.9 (299)	65.4 (59.4–71.5)	54.4 (268)	46.4 (41.4–51.6)
Bisexual	22.2 (95)	26.5 (21–32.3)	37.0 (184)	41.5 (36.3–47.0)
Questioning	6.2 (27)	5.5 (3.4–7.6)	8.6 (43)	12.1 (8.4–15.5)
Educational attainment				
Jr. High school or less	44.9 (196)	51.7 (45.2–58.4)	28.4 (142)	28.3 (26.3–33.8)
High school	32.0 (140)	30.8 (25.7–35.7)	27.4 (137)	24.0 (20.3–27.6)
Technical school or higher	23.1 (101)	17.5 (12.5–23.1)	44.2 (221)	47.8 (41.6–53.8)

^a Registered Jinan resident

(adjusted). Having Jinan hukou (official residency) was similar in both waves in crude and adjusted estimates (about 40%). Between 2007 and 2008 the proportion of men reporting having children increased (18.3–26.4% crude and 20.1–27.3% adjusted, respectively). Similarly, the proportion reporting living with a spouse (female) increased between 2007 and 2008 (8.7–17.2% crude and 8.5–20.2% adjusted, respectively). Moreover, the proportion reporting homosexual as their sexual identity decreased from 2007 to 2008 (69.9–54.4% crude and 65.4–46.4%, adjusted, respectively).

Overall, HIV prevalence rose from 0.05% (95% CI 0.1–1.0%) in 2007 to 3.1% (95% CI 1.3–5.1) in 2008. While overall syphilis prevalence decreased slightly over the same period, 3.5% (95% CI 1.8–5.4) to 2.9% (95% CI 1.7–4.5) in 2007 and 2008, respectively. Due to the changing composition of the sample in marital status and the effects of marital status on other risk estimates, further results are stratified by marital status. Table 2 shows RDS adjusted point estimates for biological outcomes and risk behaviors for each wave of MSM surveys with each measure stratified by married versus unmarried. HIV prevalence among

unmarried MSM rose from 0.5% (95% CI, 0–1.1%) in 2007 to 3.4% (95% CI, 1.3–5.8%) in 2008. Among married MSM, HIV prevalence also rose from 0% in 2007 to 2.7% (95% CI, 0.2–5.7%) in 2008. When stratified by marital status, a parallel rise was detected in syphilis prevalence. In 2007, 3.2% (95% CI, 1.4–5.7%) of unmarried men had evidence of past syphilis infection rising to 7.2% (95% CI, 4.7–9.8%) in 2008. Among married men, syphilis prevalence rose from 4.8% (95% CI, 1.2–9.8%) in 2007 to 6.6% (95% CI, 2.6–10.8%) in 2008, although in this sub-group confidence intervals overlap point estimates.

The numbers of partners among both married and unmarried MSM remained similar from year to year (also Table 2). Reported unprotected anal intercourse (UAI) decreased between 2007 and 2008 among both unmarried men and married men. Among unmarried men 66.1% (95% CI, 60.2–71.5%) reported UAI in 2007 compared to 36.8% (95% CI, 32.0–41.8%) in 2008; among married men UAI decreased from 40.8% (95% CI, 27.7–55.0%) in 2007 to 26.5% (95% CI, 17.7–35.3%) in 2008. For both groups there was also a decrease in the proportion who had sex with female partners in a 6-month period. Among

Table 2 Biological outcomes and risk behaviors and among MSM: Jinan, China, 2007 and 2008

Variable	Adjusted % (95% CI)	
	2007	2008
HIV-seropositive		
Unmarried	0.5 (0–1.1)	3.4 (1.3–5.8)
Married	0 (0–0)	2.7 (0.2–5.7)
Syphilis-seropositive		
Unmarried	3.2 (1.4–5.7)	7.2 (4.7–9.8)
Married	4.8 (1.2–9.8)	6.6 (2.6–10.8)
Number of sex partners in past year		
1		
Unmarried	14.1 (10.2–20.1)	14.5 (10.6–20.8)
Married	19.7 (10.1–30.5)	22.3 (12.4–30.3)
2+		
Unmarried	85.9 (79.9–89.8)	85.8 (79.2–89.4)
Married	80.3 (69.6–89.9)	77.7 (69.7–87.6)
Any unprotected male anal sex, 6 months		
Unmarried	66.1 (60.2–71.5)	36.8 (32.0–41.8)
Married	40.8 (27.7–55.0)	26.5 (17.7–35.3)
Sex with female partner, 6 months		
Unmarried	21.5 (16.9–26.8)	17.3 (13.5–21.6)
Married	97.7 (93.9–100.0)	78.1 (71.3–83.6)
Reports female sex partner and UAI with males, 6 months		
Unmarried	12.1 (8.6–15.7)	8.2 (5.4–11.5)
Married	38.1 (25.6–52.1)	44.9 (35.8–53.2)
Self-reported history of STD, ever		
Unmarried	9.6 (6.4–12.7)	10.2 (6.7–13.8)
Married	13.5 (4.6–22.3)	7.5 (3.9–11.7)
Ever used illicit drugs		
Unmarried	2.4 (0.5–4.6)	0.1 (0–0.1)
Married	1.0 (0–2.4)	0.3 (0–0.5)

unmarried men 21.5% (95% CI, 16.9–26.8%) had sex with women in 2007 compared to 17.3% (95% CI, 13.5–21.6%) in 2008; among married men the corresponding estimates were 97.7% (95% CI, 93.9–100.0%) in 2007 and 78.1% (95% CI, 71.3–83.6%) in 2008.

In Table 3 we report the bivariate associations between demographic and risk variables and HIV infection among MSM in Jinan from the 2008 RDS survey. MSM without Jinan hukou had a higher HIV prevalence (4.3, 95% CI, 1.2–7.3) than those with Jinan hukou (1.1, 95% CI, 0–2.8%). MSM with female sex partners had lower HIV prevalence (0.6, 95% CI, 0–1.7%) compared to those had only male partners (4.3, 95% CI, 1.4–7.3%). Ever having a STD was associated with a higher HIV prevalence (8.6, 95% CI, 0–19.1%) compared to never (2.5, 95% CI, 0.6–4.4). Having receptive anal sex (4.9, 95% CI 1.6–8.1%)

Table 3 Adjusted prevalence of HIV by characteristics among men who have sex with men, Jinan, China, 2008

Variable	Prevalence of HIV infection		
	Percent	95% CI	χ^2
Age			
≤25 years	2.1	0–4.7	1.1
>25 years	3.8	0.9–6.7	
Married			
Yes	3.2	0–7.0	0.003
No	3.1	0.7–5.4	
Has Jinan hukou			
Yes	1.1	0–2.8	4.1 [†]
No	4.3	1.2–7.3	
Educational attainment			
None	0	–	7.4
Elementary school	0	–	
Junior middle school	0	–	
High school	5.4	0–11.0	
College and above	3.8	0.7–6.9	
Number of sex partners in past year			
1	2.9	0–8.5	1.67
2	1.4	0–3.9	
3–9	3.7	0.5–7.1	
10+	3.9	0–8.5	
Any unprotected male anal sex past 6 months			
Yes	5.9	2.1–9.6	14.3 [†]
No	0	–	
Lives with spouse			
Yes	3.6	0–8.3	0.49
No	3.0	0.8–5.2	
Sex with female partner, 6 months			
Yes	0.6	0–1.7	5.4 [†]
No	4.3	1.4–7.3	
Self-reported history of STD, ever			
Yes	8.6	0–19.1	5.2 [†]
No	2.5	0.6–4.4	
Had receptive anal sex past 6 months			
Yes	4.9	1.6–8.1	6.04 [†]
No	1.0	0–3.0	
Had insertive anal sex past 6 months			
Yes	2.4	0.06–4.8	1.2
No	4.2	0.6–7.8	
Sexual orientation			
Homosexual	5.9	1.9–9.9	12.3 [†]
Bisexual	0.6	0–1.6	
Questioning	0	–	
Sells sex to men			
Yes	0	–	1.4
No	3.4	1.2–5.5	

[†] $P < 0.1$

Table 4 Correlates of HIV infection, men who have sex with men, Jinan, China, 2008

Variable	β	AOR ^a	(95% CI)	χ^2 ^b	<i>P</i> value
Not having Jinan hukou	1.5186	4.6	0.8–25.1	3.0	0.08
Homosexual identity	2.3993	11.0	1.6–77.9	5.8	0.02
STD ever	1.0139	2.8	0.7–10.3	2.3	0.1
Receptive anal sex ever	1.8997	6.7	1.2–35.9	4.9	0.03
Only male partners past 6 months	2.6607	14.3	0.9–213.9	3.7	0.05
Living with spouse	2.3461	10.4	0.7–166.1	2.8	0.09
Married	0.8570	2.4	0.2–29.2	0.4	0.5
Age (each increasing year)	0.0229	1.0	0.9–1.1	0.4	0.5

^a Adjusted for other variables listed

^b Wald chi square

and identifying as homosexual (5.9, 95% CI, 1.9–9.9%) were associated with higher HIV prevalence.

For multivariate analysis, we included the above variables with non- or minimal overlap of their 95% CI; that is, not having Jinan hukou, homosexual identity, and history of STD, receptive anal sex, and only male sex partners in the past 6 months. Being married, living with spouse, and age were retained in the model to adjust for confounding. In multivariate logistic regression (Table 4), HIV infection was significantly associated at $P < 0.05$ with identifying as gay (AOR 11.0, 95% CI, 1.6–77.9, χ^2 , 5.8), ever having receptive anal intercourse (AOR 6.7, 95% CI 1.2–35.9, χ^2 , 4.9), and having only male sex partners in the past 6 months (AOR 14.3, 95% CI 0.9–213.9, χ^2 , 3.7) in the full model. Not having Jinan hukou, history of STD, and living with a spouse had borderline significant positive associations with HIV, while married and age were not significant but confounded the other associations in the model.

To further assess the relationships between HIV infection and sexual identity, bisexual behavior, marital status, and the potential bridge of infection from MSM to their female partners, we compared two divergent patterns. Using the β coefficients from the final, full multivariate model, we estimate that an unmarried, homosexual identified man who does not have female partners has a 6.4-fold odds of HIV infection compared to a non-homosexual identified, married man with female sexual partners.

Discussion

Samples of MSM were successfully recruited through RDS over two waves of bio-behavioral surveys using the same protocol, by the same team, at the same site, 1 year apart, in the same city of Jinan, China. Stratified analyzes indicate that HIV and syphilis prevalence has risen among both unmarried and married MSM in Jinan from 2007 to 2008, following similar rises in HIV or STI in other cities of China in recent years (Guo et al. 2008; Ma et al. 2007). The primary conclusions of this study are therefore cause for

public health concern and add to the growing body of evidence of emerging HIV epidemics among MSM in Asia. Further examination shows that homosexual identified men without female partners are at several-fold higher risk than non-homosexually identified married men who have female partners and who live with their spouse.

While overall numbers of partners appears to have remained stable among both married and unmarried MSM, having female partners and UAI appear to have declined. The latter finding is perplexing in the face of rising HIV prevalence; however, it is possible that with overall number of partners staying level and STI increasing the reported decrease in UAI may not have enough effect to reduce new HIV infections. Increases in risk for HIV infection may also occur if a decrease in less risky female partners is met with an increase in riskier male partners, a possibility supported by the multivariate model in 2008 and the changes in the sample from 2007. It is also possible that there have been changes in the way MSM respond to these questions given the interval marks a period of increased attention on the issue of HIV among MSM in Jinan and in China as a whole (Hornby 2009). We also recognize that the measures of sexual behavior may not be sensitive enough to capture changes in exposures to different types of partners and partners likely to be infected with HIV.

There are also challenges and limitations in our analysis. Differences in the crude sample, in particular marital status, suggests that reproducibility of multiple rounds of RDS surveys among a specific population may be harder to achieve than first thought. Despite no logistical changes from 2007 to 2008, including interviews being conducted in the same transportation accessible location and to our knowledge with no other conditions (e.g., rapid immigration of married MSM in a year's time) changing, the two samples were markedly different in terms of marital status, which in turn affected key correlates of HIV infection. One implementation change from year to year that may have contributed to the samples' compositions was having a different set of initial seed subjects. This suggests that careful seed selection or exact replication of seed selection

may be needed to ensure the reproducibility of RDS surveys. This also suggests that simply reaching equilibrium in key variables may not be sufficient to achieve a reproducible sample. Moreover, these differences required that further analyzes be stratified upon the variable that differed, in this case marital status, thus reducing power within each stratum and making analyzes more complex when using RDSAT. As a method of surveillance, RDS has seen rapid proliferation around the world. As yet, however, few places have completed more than one wave of surveys. We anticipate that as more locations conduct repeated survey rounds, issues around the reproducibility of RDS will become more evident and different analytic approaches may be developed.

Despite these limitations, our data suggest a growing HIV epidemic, particularly among unmarried MSM in Jinan. Moreover, these data suggest that the role married MSM might play in bridging HIV infection to their female partners may be more complex than simply being a function of being married and having female partners. More detailed research on the topic of married MSM in China and their female partners is needed. Meanwhile, very different approaches to reaching and delivering prevention programs for married and unmarried MSM will be needed in China.

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