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Factors associated with HIV and syphilis co-infection among men who have sex with men in seven Chinese cities

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Abstract

HIV-syphilis co-infection is often cited as a major reason behind recent resurgence in syphilis prevalence among men who have sex with men (MSM) in China. Most published literatures explore factors associated with either HIV or syphilis, but not their co-infection. We analyzed data from a cross-sectional survey on MSM in seven Chinese cities. Snowball sampling was used to recruit participants for the survey. Socio-demographic and behavioral predictors for HIV-syphilis mono/co-infection were examined using ordinal logistic regression. Factor scores were used to summarize; 1) HIV related knowledge, and 2) access to HIV preventive services. Prevalence of HIV, syphilis, and their co-infection, among 2936 self-identified MSM, were 7.7%, 14.3%, and 2.6%, respectively. In the adjusted analysis, the significant positive correlates of poorer diagnoses (co-infection vs mono- & no infection or co- & mono-infection vs no infection) were −30 to 39 years and ≥40 years age, education up to senior high school, unprotected anal intercourse (UAI), recent STD symptoms, incorrect knowledge about routes of transmission, and access to preventive or counselling/testing services for HIV. For effective control of this dual epidemic, integrated HIV and syphilis surveillance and targeted intervention strategies for Chinese MSM are need of the hour.

Keywords

HIV; syphilis; coinfection; homosexual; epidemiology

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Conflict of interest
Authors declare no conflict of interest.

Introduction

As has been widely reported, men who have sex with men (MSM) in China have been witnessing a rising epidemic of HIV and syphilis infection.[1–3] While the overall prevalence of HIV in Chinese population stands at a modest 0.05–0.06%[4], the reported prevalence among MSM ranges from an estimated 3.5%(north-west and south-central China) to 13.2% (south-west China) and has been showing an increasing trend.[2, 3, 5] Additionally, syphilis infection has also been rising over the past two decades, after being close to eradication in 1960s.[1, 6] Co-infection of syphilis with HIV among MSM is expected to have played an important role in this resurgence.[1] The positive association observed between syphilis and HIV among MSM, can be explained by biological plausibility and similar risk behaviors associated with both infections.[7, 8] Most studies report the determinants of either HIV or syphilis in a selected sample population from specific urban cities in China at a specific time, but very few studies have reported on co-infection.[1]

In the literature, a wide array of demographic, behavioral and societal factors, have been identified that predict acquisition of syphilis or HIV among MSM in China. These factors include but are not limited to old age, poor education, multiple sex partners, engaging in commercial sex, unprotected anal intercourse(UAI), being infected with other sexually transmitted diseases(STDs).[9, 10] Although most of the published literatures accept the role of knowledge about disease, many of them either fail to adjust for them or use some surrogate measures, while estimating associations between disease and the predictors.[2, 9, 10] Behavioral interventions have been an integral part of the measures adopted by China in the past decade to halt the HIV epidemic.[11, 12] These interventions have been supported by efforts to improve knowledge about HIV and other STDs and scaling up of HIV related services.[13] Thus, knowledge about HIV and uptake of HIV preventive services should be taken into account while estimating predictors of not only HIV but also syphilis, as these diseases share many predictors.[1]

Quite a few studies have reported the risk factors of HIV and syphilis infection among MSM in various cities of China.[14–18] The findings from these studies often vary widely, which may suggest differences in geographic, socio-economic and risk behavioral factor distribution between different cities. Among these studies, however, few report co-infections of HIV and syphilis, and even fewer explore the factors associated with co-infections. We analyzed survey data from seven Chinese cities to determine the factors associated with co-infection of HIV and syphilis among MSM.

Methods

Study sample

This analysis used cross-sectional survey data from seven Chinese cities, namely Nanjing, Chongqing, Jinan, Haerbin, Guangzhou, Suzhou and Yangzhou. The data was collected in 2008 as part of a nation-wide survey[3] on Men Who Have Sex with Men (MSM), conducted by Chinese Center for Disease Control and Prevention (CDC). The initial plan was to employ “Respondent-driven sampling (RDS)”[19] in five cities (Nanjing, Chongqing, Jinan, Haerbin, and Guangzhou), and “Snowball sampling”[20] in rest two cities for participant

recruitment. However, owing to operational difficulties, “Snowball sampling” was used in all seven cities. Briefly, a set of initial participants (seeds) were enlisted, in consultation with non-governmental organizations, who were then asked to recruit other MSM in their network(s) for behavioral evaluation and serological testing, using uniquely numbered coupons to allow tracking of the recruitment process. This process continued in an expanding format, with respondents obtained in one wave being asked to recruit others in the next wave, until desired sample size was reached.

To be eligible for the study, the participants needed to be male, at least 18 years old, having had oral and/or anal sex with men during the past 12 months and willing to provide consent for HIV and syphilis testing. The data collection procedure was anonymous and names (or other identifying information) of the participants were not recorded. Blood specimens collected (following counselling and consent) from participants were tested immediately for HIV and active syphilis using rapid testing kits and waiting participants were informed about test results. In case a participant had inconclusive test result(s), he was asked to return to obtain his result(s) from confirmatory tests. (See online supplementary information for details about diagnostic tests used). As a token of appreciation for their participation, respondents were provided a package containing lubricant and condoms (worth ~US$ 5). Further, a sum of approximately US$ 1.6 (per new recruit) was paid to participants who successfully recruited other MSM from their social networks. Study procedures were carried on at local STD clinics run by provincial CDCs.

Measures

Demographic and socioeconomic variables—Demographic and socioeconomic measures included in the analysis were age, education level, monthly income, ethnicity, marital status, and city of residence. Education was measured by highest level of education obtained, categorized into less than junior high school, junior high school, senior high school, and junior college or higher. Since Chinese population is predominantly Han, we used two categories for ethnicity, Han and others. City of survey was used as a surrogate for participant’s city of residence.

Risk behavioral variables—Following risk behavioral characteristics were included in analysis: venue of meeting partners, sexual orientation, age at first insertive intercourse, gender of first partner, condom use during last anal sex, number of different male partners in past six months, reported UAI in past six months, symptoms of sexually transmitted diseases (STD) in past year, paying for and/or selling anal sex to men in past six months. Sexual orientation was determined by what a respondent perceived himself to be, and not what his actual behavior suggested. UAI was defined as never or only occasionally using a condom during anal intercourse in the past six months with all male partners. Number of different male partners was categorized into having five or less male partners in past six months and more than five different partners.

Factors representing knowledge and access to HIV related services—In our analysis, we used two separate sets of factors, created using factor analysis, - 1) to determine knowledge and attitude of participants regarding HIV, and 2) to evaluate access to various

services provided under HIV prevention programs. There were eight possible responses, each coded as a discrete variable, determining a participant's knowledge about HIV. Access to HIV related services were represented by six other variables (for the complete list of knowledge and access to care variables, see online supplementary information).

To reduce the problem of dimensionality caused by large number of variables representing knowledge and access to HIV related services and to find specific constructs, we created factor scores from those variables. Factor analysis with principal component extraction and varimax rotation method was employed (factor loading ≥0.50) to extract knowledge and access to prevention factors. We used orthogonal (varimax) rotation because it could make interpretation simpler and also could maintain independence of the factors.[21] The results extracted from factor analysis represented two underlying factors (based on loading of specific items) for knowledge about HIV, namely "Correct/helpful knowledge about routes of transmission" and "Incorrect knowledge about routes of transmission". In the domain of access to HIV services, the two extracted factors were interpreted as follows, "Receiving HIV/STD preventive services" and "Access to HIV/STD testing and counseling". We based our selection of the number of factors on interpretability of factors, instead of selecting them mechanically on the basis of 'Eigenvalues' or 'Scree plots'.[22]

Outcome measures—The outcome in our analysis comprised of two components: testing positive for 1) syphilis, and 2) HIV.

For assessment of determinants of syphilis and HIV co-infection, we created a combined outcome variable having three levels (for easier interpretation these categories were classified as good, poor and poorest diagnoses) –

- **i.** Co-infection (positive for both HIV & syphilis) – poorest diagnoses
- **ii.** Mono-infection (either HIV or syphilis) – poor diagnoses
- **iii.** No infection (neither HIV nor syphilis) – good (baseline) diagnoses

Statistical analysis

Descriptive analysis of our data included determination of prevalences and distribution of socio-demographic and risk behavioral characteristics. There were 2958 observations in total. We deleted the observations which had missing values for any of the following variables: age, marital status, ethnicity, education level, income, venue for meeting partners, age at sexual debut and size of MSM network. Following these deletions, we were left with 2936 observations. For some variables missing observations were generated by 'skip-pattern' in the questionnaire because of negative response to some prior questions (e.g. if the participant did not engage in certain activity, then he was not asked the following questions about that activity). To account for such automatically generated missing values, we created distinct missing value categories for sexual orientation, number of male partners in past six months, STD symptoms in past year, engaging in commercial sex in past six months and unprotected anal intercourse in past six months.

Bivariate associations of demographic and risk-behavioral characteristics were tested, using simple logistic regression, with syphilis and HIV positive status. Frequencies (and proportions) in each category of different predictor variables were cross-tabulated with syphilis and HIV. Similarly, distribution of predictors and bivariate associations were also assessed with the combined outcome variable having the following categories - co-infection (HIV & syphilis), mono-infection (HIV or syphilis) and no infection.

We implemented multiple ordinal logistic regression to determine predictors of HIV-syphilis co-infection and find the adjusted associations. We reviewed published literature to select the following independent variables for our analysis: age, educational level, reported sexual orientation, venue for meeting partners, age at sexual debut, UAI in past six months, history of STD symptoms in past year, paying for sex with other men in past six months, number of male partners in past six months, as well as factors (from factor analysis) representing knowledge about HIV/STD and access to HIV related services. The observed associations were further adjusted for ethnicity, marital status, monthly income, city of survey. The ordinal model was built on the assumption that the categories of combined outcome variable i.e. co-infection, mono-infection and no infection followed a natural ordering (from good to poorest diagnoses) and fulfilled the proportional odds criteria. The score test (multivariate model) for proportional odds hypothesis yielded a p-value of 0.55, suggesting that ordinal model was reasonable.

All analyses were carried out using SAS statistical software version 9.3.

Results

For our analysis, we used interview and laboratory data of 2936 participants from the seven Chinese cities (for city specific prevalences, see online supplementary table S1). Table 1 depicts socioeconomic, demographic, and behavioral characteristics of the study participants. Majority of the participants were 20–29 years old (57.6%), unmarried (73.1%) and of Han ethnicity (97.6%). About half of the participants attended at least junior college (47.7%) and more than half identified themselves as homosexual (55.0%). Seventy percent and 61%, respectively, reported having sexual debut (with either male or female) after 18 years and a male as their first sexual partner. Internet (54.5%) was the preferred mean of finding a partner for majority of MSM. About two-third respondents (66.1%) reported using condom at the time of last anal intercourse but a much lesser proportion (47.8%) used condom every time (no UAI) during the past six months. Distributions of HIV and syphilis prevalence by socio-demographic and behavioral characteristics, along with odds ratios and p-values from bivariate associations, are presented in online supplementary table S2.

Analyses of HIV-syphilis co-infection reveal that approximately 2.6% participants were infected with both HIV and syphilis, whereas 16.9% had either HIV or syphilis [Table 2]. In the unadjusted analysis, among socio-demographic factors, the significant positive predictors of poorer diagnoses (co-infection vs mono- & no infection or co- & mono-infection vs no infection) were age groups above 30 years, education up to junior or senior high school, being legally married and being divorced/widowed. Additionally, meeting partners at entertainment venues such as pub/disco/tearoom/club or in traditional meeting

places such as spa/bathhouses/body massage parlors, reporting UAI, having recent STDs, reportedly having more than five male partners in past six months, having incorrect knowledge about routes of transmission and having access to any kind of HIV preventive services were associated with higher odds of a poorer diagnosis. Reporting no income, being resident of Nanjing/ Jinan and reportedly selling sex to men in the previous six months were significant negative predictors of poorer diagnoses (positive predictors of better diagnoses).

The independent predictors associated with poorer diagnoses (co-infection) and the respective adjusted odds ratios from multivariate ordinal logistic regression are depicted in table 3. Two age categories 30 to 39 years and ≥40 years were respectively associated with 57% and 92% increased odds of having a poorer diagnoses compared to 20–29 years age group, whereas those aged ≤19 years had 50% lower odds of having poorer diagnoses or co-infection compared to 20–29 year age group. Participants educated up to senior high school had 51% higher odds of having a poorer diagnosis than those who went to junior college or higher. Among the risk behaviors, participants reporting UAI and recent STD symptoms were 39% and 36% more likely to have a poorer diagnosis compared to those without UAI and STD, respectively. Each unit increase in incorrect knowledge about routes of transmission of HIV, as determined by respective factor score, was associated with 11% increased odds of poorer diagnoses. However, correct knowledge, although found to be protective against co-infection, did not reach levels of statistical significance. Access to both type of HIV related services - preventive services (such as receiving condom, lubricant, reading materials etc.) and counseling/testing services - were significant positive predictors of being diagnosed with co-infection. Each unit increase in factor score denoting access to preventive services was associated with 15% increased odds of poorer diagnoses, whereas 14% increased odds was associated with each unit increase in the factor score representing access to HIV counseling/testing services.

Discussion

This study on men who have sex with men provide information on prevalences of HIV, syphilis and their co-infection in seven Chinese cities, along with demographic and behavioral factors associated with co-infection of these two STDs.

The overall prevalence of HIV, syphilis, and co-infection among MSM in the seven studied cities were 7.7%, 14.3%, and 2.6%, respectively. Prevalences of HIV and syphilis were higher than the nationwide (61 cities) prevalence obtained from China National MSM survey (4.9% and 11.8%).[3] Co-infection prevalence was commensurate with the findings of a meta-analysis based on 13 eligible studies (2.7%),[1] however, it was higher than the cumulative prevalence in the MSM survey (1.5%).[3]

As per the biological plausibility UAI and recent STD symptoms were found to be potential risk factors for co-infection, corroborating previous reports from China.[23] We did not detect a significant association of co-infection with having higher number of male partners. Reverse causation can be a potential reason for this, as an MSM may reduce frequency of his sexual contact if he is having any symptomatic STD, suffering from poorer health

(owing to presence of simultaneous infections), and/or after being diagnosed with either disease.

Adjusting for other predictors, correct knowledge about routes of transmission of HIV was not a significant protective factor for co-infection. This finding can be due to the fact that the overall knowledge of the study participants were quite high (about 80% participants correctly answered six or more of the eight questions related to the knowledge about routes of transmission of HIV). Since the overall knowledge was high, discrimination of knowledge between HIV or syphilis sero-positive and sero-negative participants was probably low, leading to lack of power to detect a significant association.[24] Incorrect knowledge, as expected, was associated with increased odds of co-infection. However, contrary to expectation, access to HIV preventive services and access to HIV/ STD testing and counseling services were positively associated with co-infection. Again, reverse causation can be a possible explanation for these findings, as participants having symptomatic sexually transmitted diseases in a single cross-sectional time frame are likely to avail/access preventive and treatment services.

Being observational in nature, this study suffered from quite a few limitations. First, because of our cross-sectional design, lack of temporality prevents us from drawing any causal inferences. The time orders of predictors were often unclear – e.g. whether access to preventive services affected disease prevalence or the other way round. Secondly, the fact that most of our data were self-reported raises concern about social desirability bias that, in turn, may lead to severe exposure misclassification. Moreover, selection bias (which can arise from low response/participation rates) can also be a potential threat to validity. Response rates, measured by proportion of returned coupons out of total coupons distributed during recruitment of MSM, were quite low across all the study sites (for example, it was only 33.3% in Nanjing).[25]

To minimize chances of variation in quality of collected data across the study sites, a uniform protocol was followed at every site, and all study personnel were trained together by the same program. Further, HIV and syphilis results were declared to the participants only after completion of their interviews, reducing the probability of obtaining ‘expected’ answers from participants who were aware about their disease status. Therefore, we expect any misclassification of exposure in this study, if present, to be non-differential. Still, we do not rule out possibility of differential misclassification, because some participants might have had symptomatic disease or were aware of their disease status before they participated in the study.

Despite the above limitations, our study had quite a few strengths. Use of snowball sampling gave us access to sufficient number and a relatively comprehensive pool of participants from this hard-to-reach population. We further enhanced our sample size by aggregating data from different cities, which allowed for simultaneous adjustment of multiple potential confounders. We used factor analysis to create scores for disease related knowledge and access to preventive services, enabling us to summarize their effect on syphilis and HIV prevalence in an efficient way.

Our study findings reiterate the fact that Chinese MSM are at high risk of syphilis and HIV infection (and their co-infection) and there is an urgent need for intervention targeted towards this population. Literature review reveals that being infected with syphilis increases risk of acquiring HIV. Moreover, an active T pallidum infection worsens the biological parameters associated with HIV – leading to lowering of treatment response and predisposing the infected towards AIDS.[26, 27] Concentrated epidemic of HIV and syphilis among this highly vulnerable group calls for a convergent surveillance strategy – vide recommendations of Karumudi et al. – anyone presenting with syphilis should be tested for HIV and vice versa.[28] Additionally, behavioral components, such as reduction in UAI, should constitute an integral part of the intervention measures. Spreading awareness about these STDs can be a crucial prevention tool, as well. Finally, most studies on MSM have utilized data arising from cross-sectional surveys, thereby severely restricting the ability to make causal inference about different predictors of STDs. To overcome such limitation, a large-scale longitudinal study could be planned to further explore variables associated with HIV, syphilis and other STDs among MSM.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Message

This study measured the HIV and syphilis co-infection as well as the factors correlated with this co-infection.

Table 1

Sociodemographic and risk behavior characteristics of participating MSM, China National MSM Survey (n=2936), 2008

Characteritics	Total[1]	
	n	%
Age group (Years)		
19 yrs or less	176	6.0
20–29 yrs	1690	57.6
30–39 yrs	603	20.5
40 yrs& above	467	15.9
Highest education level		
Less than junior high school	68	2.3
Junior high school	538	18.3
Senior high school	930	31.7
Junior college or higher	1400	47.7
Ethnicity		
Han	2864	97.6
Others	72	2.5
Marital status		
Single	2146	73.1
Married	615	21.0
Living with significant other	24	0.8
Divorced/widowed	151	5.1
Monthly income		
No income	464	15.8
=<1000 RMB	468	15.9
1001–2000 RMB	929	31.6
2001–3000 RMB	557	19.0
3001–4000 RMB	299	10.2
>4000 RMB	219	7.5
Sexual orientation		
Homosexual	1615	55.0
Bisexual/ heterosexual	1166	39.7
Missing/refused	155	5.3
City of survey		
Nanjing	428	14.6
Suzhou	275	9.4
Yangzhou	299	10.2
Chongqing	614	20.9
Guangzhou	369	12.6
Haerbin	451	15.4
Jinan	500	17.0

Characteritics	**Total**[1]	
	n	**%**
Usual meeting place with patner		
Pub, Disco, Tearoom, or Club	434	14.8
Spa, bathhouse, sauna, foot or body massage parlor	360	12.3
Park, Public Restroom, or Public Lawn	318	10.8
Internet	1601	54.5
Other	223	7.6
Age at sexual debut		
Sexual debut after 18 yrs	2064	70.3
Sexual debut at or before 18 yrs	872	29.7
Gender of first partner		
Male	1781	60.7
Female	1155	39.3
Condom use during last anal sex with male partner with in past 6 months[1]		
Yes	1646	66.1
No	849	33.9
Unprotected anal intercourse in past 6 months[1]		
Yes	1435	48.9
No	1399	47.7
Missing/refused	102	3.5
STD symptoms in past year		
Yes	404	13.8
No	1757	59.8
Missing/refused	775	26.4
Paid for sex with a man in past 6 months[2]		
Yes	147	5.0
No	2454	83.6
Missing/refused	335	11.4
Sold sex to a man in past 6 months[2]		
Yes	260	8.9
No	2341	79.7
Missing/refused	335	11.4
Number of male partners in past 6 months		
5 or less	2095	71.4
More than 5	508	17.3
Missing/refused	333	11.3
Tested positive for HIV[3]		
Positive	227	7.7
Negative	2709	92.3
Tested positive for Syphilis[4]		

Characteritics	Total[1]	
	n	%
Positive	419	14.3
Negative	2517	85.7
Tested positive for HCV[5]		
Positive	41	1.4
Negative	2894	98.6
Indeterminate	1	0.0

[1] Values and percentages may not sum to total or 100% due to missing and rounded numbers.

[2] Among the included subjects, 441 reported not engaging in anal sex in past 6 months

[3] Western blot positive.

[4] Simultanously positive on both RPR and TPPA.

[5] RIBA positive

Table 2

Distribution and bivariate associations with predictors (from ordinal logistic regression) of syphilis and HIV co-/ mono-/ no infection, China National MSM Survey (n=2936), 2008

	HIV and syphilis combined(%)[1]			Crude OR	*95% CI*
Characteristics	**Co-infection**	**Mono infection**	**No infection**		
Total	75 (2.6)	496 (16.9)	2365 (80.6)	----	----
Age group (Years)					
19 years or less	3 (1.7)	17 (9.7)	156 (88.6)	0.66	0.41, 1.07
20 – 29	30 (1.8)	247 (14.6)	1413 (83.6)	----	----
30 – 39	25 (4.2)	119 (19.7)	459 (76.1)	1.63	**1.3, 2.04**
40 years and above	17 (3.6)	113 (24.2)	337 (72.2)	1.97	**1.55, 2.5**
Highest education level					
Less than junior high school	1 (1.5)	12 (17.7)	55 (80.9)	1.3	0.7, 2.42
Junior high school	22 (4.1)	100 (18.6)	416 (77.3)	1.65	**1.29, 2.12**
Senior high school	29 (3.1))	193 (20.8)	708 (76.1)	1.74	**1.41, 2.15**
Junior college or higher	23 (1.6)	191 (13.6)	1186 (84.7)	----	----
Ethnicity					
Han	73 (2.6)	481 (16.8)	2310 (80.7)	----	----
Others	2 (2.8)	15 (20.8)	55 (76.4)	1.28	0.74, 2.22
Marital status					
Single	49 (2.3)	323 (15.1)	1774 (82.7)	----	----
Married	16 (2.6)	133 (21.6)	466 (75.8)	1.51	**1.21, 1.87**
Living with significant other	1 (4.2)	4 (16.7)	19 (79.2)	1.28	0.48, 3.41
Divorced/widowed	9 (6.0)	36 (23.8)	106 (70.2)	2.07	**1.44, 2.97**
Monthly income					
No income	7 (1.5)	48 (10.3)	409 (88.2)	0.5	**0.36, 0.69**
=<1000 RMB	21 (4.5)	90 (19.2)	357 (76.3)	1.17	0.9, 1.52
1001–2000 RMB	19 (2.1)	180 (19.4)	730 (78.6)	----	----
2001–3000 RMB	17 (3.1)	92 (16.5)	448 (80.4)	0.91	0.7, 1.18

	HIV and syphilis combined(%)[1]			Crude OR	*95% CI*
Characteristics	**Co-infection**	**Mono infection**	**No infection**		
3001–4000 RMB	5 (1.7)	50 (16.7)	244 (81.6)	0.83	0.59, 1.15
>4000 RMB	6 (2.7)	36 (16.4)	177 (80.8)	0.88	0.61, 1.28
Sexual orientation					
Homosexual	50 (3.1)	274 (17)	1291 (80)	----	----
Bi/heterosexual	23 (2)	205 (17.6)	938 (80.5)	0.96	0.79, 1.16
City of survey					
Nanjing	4 (0.9)	60 (14)	364 (85.1)	0.51	**0.37, 0.71**
Suzhou	7 (2.6)	48 (17.5)	220 (80)	0.74	0.52, 1.04
Yangzhou	10 (3.3)	67 (22.4)	222 (74.3)	1.02	0.75, 1.4
Chongqing	30 (4.9)	123 (20)	294 (75.1)	----	----
Guangzhou	9 (2.4)	66 (17.9)	294 (79.7)	0.75	0.55, 1.03
Haerbin	12 (2.7)	87 (19.3)	352 (78.1)	0.83	0.62, 1.1
Jinan	3 (0.6)	45 (9)	452 (90.4)	0.31	**0.22, 0.44**
Partner meeting venue					
Pub, disco, tearoom, or club	16 (3.7)	79 (18.2)	339 (78.1)	1.4	**1.08, 1.81**
Spa, bathhouse, sauna, foot or body massage parlor	12 (3.3)	94 (26.1)	254 (70.6)	2.03	**1.56, 2.64**
Park, public restroom, or public lawn	8 (2.4)	49 (15.4)	261 (82.1)	1.08	0.79, 1.48
Internet	34 (2.1)	236 (14.7)	1331 (83.1)	----	----
Other	5 (2.2)	38 (17)	180 (80.7)	1.17	0.82, 1.68
Age at sexual debut					
Sexual debut after 18 yrs	47 (2.3)	353 (17.1)	1664 (80.6)	----	----
Sexual debut at or before 18 yrs	28 (3.2)	143 (16.4)	701 (80.4)	1.026	0.84, 1.25
Gender of first partner					
Male	45 (2.5)	281 (15.8)	1455 (81.7)	0.84	0.06
Female	30 (2.6)	215 (18.6)	910 (78.8)	----	----
Condom use during last anal sex with male partner with in past 6 months					
Yes	46 (2.8)	271 (16.5)	1329 (80.7)	----	----
No	23 (2.7)	149 (17.6)	677 (79.7)	1.06	0.86, 1.31

	HIV and syphilis combined(%)[1]			Crude OR	*95% CI*
Characteristics	**Co-infection**	**Mono infection**	**No infection**		
Unprotected anal intercourse in past 6 months					
Yes	47 (3.3)	259 (18.1)	1129 (3.3)	1.26	**1.94, 1.51**
No	28 (2)	222 (15.9)	1149 (82.1)	----	----
STD symptoms in past year					
Yes	16 (4)	92 (22.8)	296 (73.3)	1.42	**1.11, 1.82**
No	49 (2.8)	311 (17.7)	1397 (79.5)	----	----
Paid for sex with a man in past 6 months					
Yes	6 (4.1)	27 (18.4)	114 (77.6)	1.25	0.84, 1.87
No	63 (2.6)	402 (16.4)	1989 (81.1)	----	----
Sold sex to a man in past 6 months					
Yes	9 (3.5)	26 (10)	225 (86.5)	0.65	**0.45, 0.93**
No	60 (2.6)	403 (17.2)	1878 (80.2)	----	----
Number of male partners in past 6 months					
5 or less	52 (2.5)	330 (15.8)	1713 (81.8)	----	----
More than 5	17 (3.4)	98 (19.3)	393 (77.4)	1.32	**1.04, 1.66**
Tested positive for HCV					
Positive	2 (4.9)	8 (19.5)	31 (75.6)	1.37	0.67, 2.79
Negative	73 (2.5)	488 (16.9)	2333 (80.6)	----	----
Correct knowledge about routes of transmission of HIV[2]				0.93	0.86, 1.01
False knowledge about routes of transmission of HIV[2]				1.09	**1.01, 1.19**
Access to HIV preventive services[2]				1.17	**1.06, 1.27**
Access to HIV/ STD testing and counseling services[2]				1.12	**1.02, 1.22**

[1] Values and percentages may not sum to total or 100% due to missing and rounded numbers.

[2] Factors created from factor analysis.

Table 3

Predictors of Syphilis and HIV co-infection (compared to mono and no infection) from ordinal logistic regression, among men who have sex with men, China National MSM Survey (n=2936), 2008.

	Adjusted Odds Ratio[1,2]	
Variables	**OR**	***95% CI***
Age group (Years)		
19 yrs or less	0.5	**0.3, 0.84**
20–29 yrs	----	----
30–39 yrs	1.57	**1.18, 2.07**
40 yrs & above	1.92	**1.37, 2.7**
Highest education level		
Less than junior high school	1.01	0.51, 2.03
Junior high school	1.25	0.91, 1.72
Senior high school	1.51	**1.18, 1.92**
Junior college or higher	----	----
Sexual orientation		
Homosexual	----	----
Bisexual/ heterosexual	0.82	0.67, 1.01
Partner meeting venue		
Pub, Disco, Tearoom, or Club	1.03	0.77, 1.39
Spa, bathhouse, sauna, foot or body massage parlor	1.25	0.91, 1.72
Park, Public Restroom, or Public Lawn	0.74	0.51, 1.08
Internet	----	----
Other	0.91	0.62, 1.34
Age at sexual debut		
Sexual debut after 18 yrs	----	----
Sexual debut at or before 18 yrs	1.07	0.85, 1.33
Unprotected anal intercourse in past 6 mths[3]		
Yes	1.39	**1.12, 1.73**
No	----	----
STD symptoms in past year		
Yes	1.36	**1.05, 1.77**
No	----	----
Paid for sex with a man in past 6 months		
Yes	1.23	0.8, 1.89
No	----	----
Number of male partners in past 6 months		
5 or less	----	----
More than 5	1.14	0.88, 1.48
Correct knowledge about routes of transmission of HIV[4]	0.94	0.85, 1.03
False knowledge about routes of transmission of HIV[4]	1.11	**1.01, 1.23**

	Adjusted Odds Ratio[1,2]	
Variables	**OR**	***95% CI***
Access to HIV preventive services[4]	1.15	**1.04, 1.27**
Access to HIV/ STD testing and counseling services[4]	1.14	**1.03, 1.25**

[1] Adjusted OR values were generated by the simultaneous entry of covariates in an ordinal logistic regression model with proportional odds assumption; Pearson Goodness-of-Fit Test X^2 = 5198.47(DF=5689), p=1.00. Score test for proportional odds assumption: p=0.6285

[2] In addition to the covariates listed above, estimates were also adjusted for marital status, ethnicity, monthly income and city of survey.

[3] Among the study participants, 445 did not engage in anal sex in past 6 months

[4] Factors created from factor analysis.

Significant associations ($P \leq 0.05$) in bold.