

Abstract

Background Chlamydia and gonorrhea notifications are rapidly rising in men who have sex with men (MSM). Currently, there are limited data on the prevalence of chlamydia and gonorrhea across various anatomical sites. Our study aimed to explore the prevalence, association and changing trends of urethral and rectal chlamydia and gonorrhea among MSM in Guangdong Province, China.

Methods We analyzed data among MSM attending sexually transmitted infections (STI) clinics in the Guangdong governmental sentinel network between 2018 and 2022. Chi-square tests were used to compare the difference, Join-point regressions for analyzing changing trends, and multivariate logistic regressions for examining associated factors.

Results We included 4856 men in the analysis. Rectal chlamydia significantly increased from 13.8% to 26.4% over the past 5 years (average annual percentage change [AAPC] 19.2%, 95%CI 1.0–40.6, $p = 0.043$). After adjusting for covariates, chlamydia infection positively associated with main venue used to seek sexual partners (aOR = 2.31, 95%CI 1.17–4.55), having regular sexual partners in the past 6 months (aOR = 3.32, 95%CI 1.95–5.64), receiving HIV counselling and testing services (aOR = 2.94, 95%CI 1.67–5.17), receiving peer education (aOR = 1.80, 95%CI 1.14–2.83), infection with syphilis (aOR = 2.02, 95%CI 1.02–4.01) and infection with gonorrhea (aOR 7.04, 95% CI 3.01–16.48). Gonorrhea infection positively associated with having regular sexual partners in the past 6 months (aOR = 3.48, 95%CI 1.16–10.49), and infection with chlamydia (aOR 7.03, 95% CI 2.99–16.51).

Conclusions

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Introduction

Chlamydia and gonorrhea are the two most pervasive and curable sexually transmitted infections (STI) worldwide. Approximately 82 million new cases of gonorrhea and 129 million cases of chlamydia occurred in 2020 [1]. World Health Organization (WHO) estimated that, in 2016, the global prevalence of chlamydia and gonorrhea in 15-49-year-old men was 2.7% and 0.7%, respectively [2]. Men who have sex with men (MSM) are disproportionately affected by chlamydia and gonorrhea, which contributing substantially to the worldwide infection burden [2]. In China, the prevalence of chlamydia and gonorrhea infections among MSM in 2018 ranged from 13.9 to 22.5%, and 5.3 to 11.0%, respectively [3–5].

Previous studies showed that the prevalence of chlamydia and gonorrhea varied in different anatomical sites among MSM [5]. A literature review reported that the global prevalence among MSM was 2.1-23% for rectal chlamydia, 0-3.6% for pharyngeal chlamydia, 0.2–24% for rectal gonorrhea, and 0.5-16.5% for pharyngeal gonorrhea [6]. Studies conducted among MSM in China [3, 5], Netherlands [7], the United States [8], Germany [9], and Thailand [10, 11] have found that rectal chlamydia and gonorrhea infections were more common than urethral infections and more likely to be asymptomatic [3–14]. Routine screening for rectal chlamydia and gonorrhea

consents, and then invited to a separate and private room to complete a questionnaire with the help of a trained staff. In order to notify the testing results, we collected the phone number of each participant.

Measure

Socio-demographic and behavioral variables

Socio-demographic characteristics included age, marital status, educational level, household registration (Guangdong province/other provinces) and ethnicity. Sexual behavioral variables included the following: any anal sex with men in the past 6 months, consistently condom use during anal sex in the last 6 months, main venue where MSM used to seek sexual partners, any regular sexual partners in the past 6 months, whether received HIV counselling and testing services, and whether received peer education. Consistently condom use was defined as using condoms during every anal sex in the past 6 months. Main venue where MSM used to seek sexual partners including websites, bars, disco, tearooms, bathrooms, parks and so on. Illicit drug use was defined as using any of the following drugs in the past year, including cannabis, heroin, cocaine, crack, ecstasy, amphetamines, poppers, keta-mine and methamphetamine. Testing history included previous testing for chlamydia, gonorrhea, HIV, syphilis, and Hepatitis C virus (HCV) in the past 6 months.

Laboratory testing for STIs

After completing the questionnaire, all participants were instructed to collect urine samples by themselves, while blood and anal swab samples were collected by the staff at each outreach service site. Urine samples were collected for chlamydia and gonorrhea testing, while anal swabs were only collected from those who engaged in receptive anal sex in the past 6 months regardless of using condoms. All urine and anal swabs samples were transported to the Southern Medical University Dermatology Hospital for laboratory testing using the Cobas 4800 CT/NG detection kits (Roche Molecular Systems, Inc. New Jersey, USA). The results of urine tests and anal swabs were returned to each surveillance site in 2 weeks after receiving the samples. All blood samples were analyzed at local STI clinics and tested for HIV using enzyme-linked immunoassay (ELISA, Lizhu Biotech Inc, Zhuhai, China), for syphilis using the rapid plasma reagin test (RPR, Lizhu Biotech Inc, Zhuhai, China) and *Treponema pallidum* particle agglutination test (TPPA, Rongsheng Biotech Inc, Shanghai, China), and for HCV using enzyme-linked immunosorbent assay (ELISA, Wantai Biotech Inc, Beijing, China). In our study, syphilis positive was defined as both RPR and TPPA positive. Positive test results for HIV, syphilis and HCV antibodies were conveyed to MSM via text messages within one week.

Following this, the local outreach team extended referral services to guide MSM in accessing prompt and appropriate treatment. Post-test counselling and appropriate medical care for HIV, STI, and HCV was implemented according to standard STI clinic procedure [24].

Data analysis

To establish a database, questionnaire data and laboratory results in this study were double-entered to Epi-data software (EpiData Association from Denmark) and data consistency check was conducted to deal with data errors, data loss, and data duplication.

The sociodemographic characteristics and sexual behaviors were presented as number and percentage using descriptive analysis by survey year. Chi-square test was used to compare differences of sociodemographic characteristics and sexual behaviors by years. In addition, Join-point regression was used to identify changing trends of chlamydia and gonorrhea prevalence by anatomic sites as well as HIV, syphilis, and HCV from 2018 to 2022. It estimated the average annual percentage change (AAPC) with 95% Confidence interval (CI) in the whole period. Univariate and multivariate logistic regressions were conducted to explore the factors associated with chlamydia and gonorrhea infections among MSM. As participants may repeatedly involve in this active surveillance across different years, we analyzed data only from the most recent survey year (2022) for associated factor analysis to avoid duplicate samples. In the multivariate model, we adjusted for age, legal marital status, highest level of education, household registration, and ethnicity. These adjusted variables were selected based on our previous experience [13, 20, 25, 26]. Significance was defined at p -value ≤ 0.05 . All analyses were conducted on SPSS 25.0, and Join-point regression was conducted on Join-point regression Program, Version 4.9.1.0 (Statistical Research and Applications Branch, National Cancer Institute).

Results

Sociodemographic and sexual behavior characteristics

A total of 4856 men were recruited for this study, including 893 in 2018, 959 in 2019, 1009 in 2020, 1008 in 2021, and 987 in 2022. Most of the men were characterized as being younger than 40 years old (range from 65.3% in 2019 to 72.0% in 2022), unmarried (range from 63% in 2018 to 68.2% in 2022), having a high school degree or above (range from 73.4% in 2019 to 81.7% in 2021), with household registration in Guangdong Province (range from 56.6% in 2022 to 67.3% in 2019). During the past 6 months, most men engaged in anal sex with men (range from 82.5% in 2018 to 93.8% in 2021). About three-fifths of men used condom consistently during the past 6 months (range from 59.8% in 2018 to 81% in 2019). Only

few participants had ever tested for chlamydia (range from 3.6% in 2018 to 11.9% in 2020) and gonorrhea (range from 3.8% in 2018 to 11.4% in 2020). (Table 1)

Trends of chlamydia and gonorrhea prevalence

The prevalence of chlamydia infection among MSM remained stably high between 2018 and 2022, ranging from 8.6 to 9.4% (AAPC -5.4%, 95% CI -10.3 to 24.0, $p=0.375$). The prevalence of urethral infection dropped from 5.5% in 2018 to 3.4% in 2022 (AAPC -9%, 95% CI -37.3-32.1, $p=0.478$), while the co-infection rate at both urethral and rectal sites rose from 2.1% in 2018 to 3.3% in 2022 (AAPC -11.0%, 95% CI -28.7-72.7, $p=0.507$), although neither trend was significant. By contrast, among MSM who provided anal swabs, the infection rate at the rectal site showed a significant increasing trend from 13.8% in 2018 to 26.4% in 2022 (AAPC -19.2%, 95% CI 1.0-40.6, $p=0.043$). (Table 2; Fig. 1)

The prevalence of gonorrhea infection also remained fairly stable between 2018 and 2022, ranging from 3.4 to 2.5% (AAPC -1.0, 95% CI -26.7 to 39.2, $p=0.926$). During the five-year study period, the prevalence of urethral or rectal infections declined from 2.1 to 1.4% (AAPC -2.6%, 95% CI -31.9 to 39.3, $p=0.832$) and from 5.0 to 4.5% (AAPC -0.8%, 95% CI -40.2 to 70.0, $p=0.962$), respectively, but these decreases were not significant. The co-infection rate of urethral and rectal gonorrhea ranged from 0.0 to 1.1% during 2018–2022. (Table 2; Fig. 2)

In the study period, prevalence of HIV, syphilis, and HCV infections among MSM did not change signifi-

Table 1 Sociodemographic and sexual behaviors characteristics of MSMs in Guangdong province, 2018–2022

Characteristic	2018(n/%)	2019(n/%)	2020(n/%)	2021(n/%)	2022(n/%)	P
Total	893	959	1009	1008	987	
Age						
30	242(27.1)	289(30.1)	342(33.9)	381(37.8)	436(44.2)	< 0.001
31–40	343(38.4)	338(35.2)	342(33.9)	322(31.9)	274(27.8)	
41–50	218(24.4)	192(20.0)	193(19.1)	186(18.5)	140(14.2)	
51	90(10.1)	140(14.6)	132(13.1)	119(11.8)	137(13.9)	
Marital status						
Never married	563(63.0)	613(63.9)	645(63.9)	642(63.7)	673(68.2)	0.123
Ever married	330(37.0)	346(36.1)	364(36.1)	366(36.3)	314(31.8)	
Education						
Junior middle school or below	174(19.5)	255(26.6)	187(18.5)	184(18.3)	188(19.0)	< 0.001
High school or above	719(80.5)	704(73.4)	822(81.5)	824(81.7)	799(81.0)	
Household registration						
Guangdong	597(66.9)	645(67.3)	647(64.1)	649(64.4)	558(56.6)	< 0.001
Other provinces	296(33.1)	314(32.7)	362(35.9)	359(35.6)	429(43.5)	
Ethnicity						
Han	869(97.3)	940(98.0)	992(98.3)	966(95.8)	913(92.5)	< 0.001
Others	24(2.7)	19(2.0)	17(1.7)	42(0.9)	74(7.5)	
Main venue used to seek sexual partners						
Websites	-	864(90.1)	840(83.3)	948(94.0)	912(92.4)	< 0.001
Others (bars, disco, tearooms, bathrooms, parks and so on)	-	95(9.9)	169(16.7)	60(6.0)	75(7.6)	
Engaged in anal sex with men in the past 6 months						
No	156(17.5)	59(6.2)	102(10.1)	107(10.6)	68(6.9)	< 0.001
Yes	737(82.5)	900(93.8)	907(89.9)	901(89.4)	919(93.1)	
Consistently used condom during anal sex with men in the past 6 months						
No	284/706(40.2)	171/900(19.0)	201/908(22.1)	271/901(30.1)	350/919(38.1)	< 0.001
Yes	422/706(59.8)	729/900(81.0)	707/908(77.9)	630/901(69.9)	569/919(61.9)	
Had regular sexual partners in the past 6 months						
No	308/742(41.5)	360/702(51.3)	600/1005(59.7)	472/1001(47.2)	409/987(41.4)	< 0.001
Yes	434/742(58.5)	342/702(48.7)	405/1005(40.3)	529/1001(52.8)	578/987(58.6)	
Received HIV counselling and testing services						
No	231(25.9)	58(6.0)	61(6.0)	304(30.2)	365(37.0)	< 0.001
Yes	662(74.1)	901(94.0)	948(94.0)	704(69.8)	622(63.0)	
Received peer education						
No	643/886(72.6)	642/955(67.2)	665/1001(66.4)	205/1008(20.3)	273/987(27.7)	< 0.001
Yes	243/886(27.4)	313/955(32.8)	336/1001(33.6)	803/1008(79.7)	714/987(72.3)	
Illicit drug use						
No	880(98.5)	932(97.2)	993(98.4)	1000(99.2)	980(99.3)	< 0.001
Yes	13(1.5)	27(2.8)	16(1.6)	8(0.8)	7(0.7)	
Ever test for Chlamydia						
No	861(96.4)	884(92.2)	889(88.1)	923(91.6)	925(93.7)	< 0.001
Yes	32(3.6)	75(7.8)	120(11.9)	85(8.4)	62(6.3)	
Ever test for Gonorrhoea						
No	859(96.2)	887(92.5)	894(88.6)	938(93.1)	932(94.4)	< 0.001
Yes	34(3.8)	72(7.5)	115(11.4)	70(6.9)	55(5.6)	

- Not applicable

testing symptomatic patients during this period deferring routine preventive health appointments that include asymptomatic STI screenings [32]. As chlamydia urethritis is generally less severe than gonorrhoea urethritis, less asymptomatic screening during the pandemic probably led to more undiagnosed chlamydia urethritis cases

and subsequently to onward transmission to the rectum. Regular rectal testing targeting sexually active MSM are needed. However, some barriers may impede access to and the uptake of rectal screening services among MSM. Firstly, asymptomatic infections are more prevalent in the rectal site compared to the urethral site, leading to a

healthcare providers should proactively inquire about MSM's sexual history and encourage them to undergo rectal testing, especially for those engaging in anal sexual behaviors [11, 34]. Furthermore, further studies are needed to identify factors that influence the acceptability of rectal testing among MSM and explore innovative methods to enhance its uptake.

Table 3 Factors associated with gonorrhoea and chlamydia infections among MSM in Guangdong Province, 2022. (N = 987)

Characteristic	Chlamydia infection		Gonorrhoea infection	
	Crude OR(95%CI)	Adjusted OR(95%CI)	Crude OR(95%CI)	Adjusted OR(95%CI)
Age(years)				
30	1.00	1.00	1.00	1.00
31–40	0.97(0.59–1.60)	0.99(0.56–1.64)	0.90(0.34–2.43)	0.93(0.33–2.67)
41–50	0.56(0.26–1.21)	0.57(0.23–1.43)	0.30(0.04–2.33)	0.39(0.04–3.69)
51	0.59(0.27–1.27)	0.58(0.22–1.52)	1.97(0.72–5.35)	2.38(0.52–10.98)
Marital status				
Never married	1.00	1.00	1.00	1.00
Ever married	0.73(0.45–1.18)	1.03(0.53–2.0)	1.01(0.43–2.37)	0.82(0.22–3.05)
Education				
Junior high school or below	1.00	1.00	1.00	1.00
High school or above	1.37(0.76–2.47)	1.30(0.68–2.38)	1.75(0.52–5.91)	1.89(0.54–6.69)
Household registration				
Guangdong	1.00	1.00	1.00	1.00
Other provinces	0.99(0.64–1.52)	1.03(0.65–1.65)	1.21(0.55–2.68)	1.07(0.45–2.58)
Ethnicity				
Han	1.00	1.00	1.00	1.00
Others	1.56(0.77–3.15)	1.65(0.79–3.45)	2.42(0.81–7.25)	2.42(0.75–7.76)
Main venue used to seek sexual partners				
Websites	1.00	1.00	1.00	1.00
Others (bars, discos, tearooms, bathrooms, parks and so on)	2.17(1.12–4.21)*	2.31(1.17–4.55)*	1.16(0.27–5.02)	1.20(0.27–5.28)
Engaged in anal sex with men in the past 6 months				
No	1.00	1.00	1.00	1.00
Yes	1.72(0.61–4.83)	1.89(0.67–5.33)	1.83(0.24–13.73)	1.85(0.26–13.93)
Consistently used condom during anal sex with men in the past 6 months				
No	1.00	1.00	1.00	1.00
Yes	0.81(0.52–1.26)	0.80(0.51–1.26)	1.08(0.48–2.44)	0.98(0.43–2.23)
Had regular sexual partners in the past 6 months				
No	1.00	1.00	1.00	1.00
Yes	3.01(1.79–5.07)***	3.32(1.95–5.64)***	3.81(1.30–11.20)*	3.48(1.16–10.49)*
Receiving HIV counselling and testing services				
No	1.00	1.00	1.00	1.00
Yes	2.86(1.66–4.92)***	2.94(1.67–5.17)***	0.88(0.39–2.00)	1.08(0.45–2.59)
Receiving peer education				
No	1.00	1.00	1.00	1.00
Yes	1.85(1.19–2.87)**	1.80(1.14–2.83)*	1.02(0.42–2.47)	1.07(0.43–2.70)
Illicit drug use				
No	1.00	1.00	1.00	1.00
Yes	1.61(0.19–13.48)	1.83(0.21–15.64)	-	-
Ever test for Chlamydia				
No	1.00	1.00	1.00	1.00
Yes	1.46(0.67–3.17)	1.52(0.69–3.33)	1.66(0.22–12.45)	1.93(0.25–14.84)
Ever test for Gonorrhoea				
No	1.00	1.00	1.00	1.00
Yes	1.43(0.63–3.26)	1.50(0.64–3.38)	1.43(0.19–10.77)	1.53(0.20–11.84)
Syphilis infection				
No	1.00	1.00	1.00	1.00
Yes	2.00(1.01–3.82)*	2.02(1.02–4.01)*	2.17(0.80–5.86)	2.45(0.87–6.89)
Chlamydia infection				
No	-	-	1.00	1.00
Yes	-	-	7.04(0.07–16.17)***	7.03(2.99–16.51)***
Gonorrhoea infection				

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