Prevalence and risk factors of asymptomatic *Neisseria gonorrhoeae* and *Chlamydia trachomatis* infections in Shenzhen, China.

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Abstract

Objective

The aim of this study was to investigate the prevalence and proportion of laboratory-confirmed urethral *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG) infections that were asymptomatic among individuals presenting to different clinics in Shenzhen and the risk factors related to STI infections in this population.

Methods

In a cross-sectional study, 8,309 eligible individuals were invited to participate in a questionnaire interview, and urine specimens were collected for identification of CT and NG infections. Corresponding outcomes were analyzed by Chi-square test and multivariate logistic regression.

Results

Among 7070 participants who completed the questionnaire and provided the urine specimen, 2871 were asymptomatic and included in our analyses: 1120 (39.0%) males and 1751 (61.0%) females. The prevalence of NG and CT was 0.9% and 6.2% among males reporting no symptoms, and 0.4% and 7.9% among females reporting no symptoms, respectively. The proportion of asymptomatic urethral CT among males with urethral CT was 28.3%; for females, it was 34.2%. For asymptomatic males with urethral NG/CT, 3 independent risk factors were identified: (1) males under the age of 30 (OR, 1.75; 95% CI, 1.07-2.84); (2) being employed in the commercial service work (2.69; 1.33-5.45); and (3) being recruited through the urological department (2.18; 1.24-3.83). For asymptomatic females with urethral NG/CT, 2 independent risk factors were identified: (1) females under the age of 30 (OR, 1.80; 95% CI, 1.25-2.58); and (2) being recruited through the dermatological department (2.83; 1.46-5.46).

Conclusion

A substantial prevalence of asymptomatic CT infections was found among males and females presenting to clinics in Shenzhen. The significant correlation between asymptomatic CT infection and these risk factors could help identify high-risk populations and guide screening.

Background

Chlamydia trachomatis (CT) and *Neisseria gonorrhoeae* (NG) are the first and second common bacterial sexually transmitted infections (STIs), accounting for about 36.6% and 21.8% of global new STIs in 2012, respectively.¹ CT and NG usually colonize and infect the human reproductive tract; if untreated or treated improperly, they can lead to severe complications such as penile stricture and epididymitis in males, pelvic inflammatory disease and endometritis in females, and eventually lead to infertility in both genders. Furthermore, NG and CT infections are also risk factors associated with the transmission and

infection of HIV.² In the US, medical costs for gonorrhea and chlamydia are estimated at \$162.1 and \$516.7 million, respectively.³

However, due to differences in the distribution of risk factors, the prevalence and burden of STIs varies widely around the world. Shenzhen is a newly developed city with the floating population accounting for about 87% of the total population,⁴ which makes it very likely to be a hotbed of high incidence of STIs. The latest molecular epidemiological study on genital NG and CT infections conducted by Zhang et al⁵ in Shenzhen in 2009 showed that the prevalence of CT and NG among participants presenting to clinics was 17.7% and 9.7%, respectively. The prevalence of CT and NG observed in this study was considerably higher than that found in the Chinese Health and Family Life Survey where the overall prevalence of CT and NG infections was 2.6% and 0.08% in females, and 2.1% and 0.02% in males, respectively.⁶ Therefore, Shenzhen may be the best place to study the risk factors associated with STIs and evidence-based interventions for reducing the burden of STIs in Shenzhen may be more cost-effective. However, Zhang and colleagues' study lacks important information, such as the prevalence and proportion of asymptomatic cases and risk factors for asymptomatic infection. It has been recognized that NG or CT infections are often asymptomatic. This nature will undoubtedly further facilitate the spread of gonorrhea and chlamydia, because people with gonorrhea/chlamydia but no symptoms are less likely to seek any treatment. In addition, knowledge of the burden and risk factors of asymptomatic STIs may have implications for syndromic management which is the primary of care for the detection and treatment of suspected STI infections in resource-limited settings.^{7,8} At present, the effectiveness of syndromic management on reduction of the prevalence of STI infections is unsatisfactory.⁹⁻¹¹ The reason is not only because of its poor sensitivity, but more importantly, most STI infections such as CT and NG are asymptomatic.

Here we investigate the prevalence and proportion of laboratory-confirmed urethral CT and/or NG infections that were asymptomatic among individuals presenting to clinics in Shenzhen and the risk factors related to STI infections in this population. Given the limited health resources, there is currently no guidelines for chlamydia and gonorrhea screening in China. The findings from this study may help us to ensure proper resource allocation and develop intervention activities.

Methods

Sampling methods and recruitment

Participants in our study were recruited from 15th April 2018 to 16th May 2018 by using the stratified purposive sampling method. First, we selected 6 of the 10 administrative districts in Shenzhen based on the numbers of NG- and CT-positive reported in 2017. Then in each district we included four hospitals with the highest number of reported cases for conducting the study, except for one district with only one hospital. Finally, a total of 21 general hospitals/maternal and child health hospitals including 49 departments (including department of dermatology, department of urology and department of obstetrics

and gynecology) in 6 administrative districts were selected as study sites to include in this study. The first 15 eligible individuals who arrived at each department were invited to participate for questionnaire interview and urine collection. The criteria for eligible participants were: (1) age ≥ 16 years; (2) having ever engaged in sexual intercourse; and (3) no antibiotic use in the last 2 weeks. The study protocol was provided by the Ethics Committee of Shenzhen Center for Chronic Disease Control. And all participants provided written informed consent.

Data collection

A non-anonymous questionnaire was designed by correspondent, with a total of 45 questions, which were conducted in Chinese only. Data were obtained on: socio-demographic characteristics (including age, gender, children, residency, local residence time, marital status, education, living arrangements status, insurance and occupation), sexual orientation, risky sexual behaviors, history of STI test, history of STI infection, STI-related knowledge/attitude and symptom presentations. After completing the questionnaire, each eligible participant was invited to donate urine specimen for CT and NG tests.

Specimen collection and laboratory testing

15–30 ml urine specimens were collected using the Cobas®urine specimen collection kit (Roche P/N 05170486190). The specimens were temporarily stored at 4°C in local laboratories for up to 10 days before being transported to a central laboratory for testing. At the central laboratory, we used the MagNA Pure 96 System (Roche, Switzerland) to extract and purify DNA from urine specimens by automated magnetism nucleic acid isolation method. Then, polymerase chain reaction (PCR) was performed using DNA extracted from urine specimens for testing CT and NG. Laboratory testing of CT and NG was performed based on standard procedures. Positive PCR results were confirmed as corresponding NG or CT infections.

Statistical analyses

Descriptive analysis (Stratified by Sex) was conducted to describe frequencies and percentages of key variables, and to calculate the prevalence of asymptomatic gonorrhea or chlamydia. Statistical differences between asymptomatic NG or CT patients and non-patients for the categorical variables were assessed using Chi-square test and Fisher exact test as appropriate. The significance level was set at a p-value < 0.05 . Then, univariate logistic regressions were used to select appropriate variables for the multivariate logistic regression models. Those variables with p-value < 0.2 were included in the multivariate analyses to further examine the association between males/females with asymptomatic urethral NG and/or CT, and potential risk factors. Adjusted odds ratios (AORs) and their corresponding 95% confidence interval (CI) were calculated to measure the correlation strength. P-values < 0.05 were considered statistically significant. All analysis above were performed using SPSS 19.0.

Results

Prevalence and proportion of asymptomatic NG and/or CT infections

Between April 2018 and May 2018, 8,309 eligible individuals were invited to participate in this study. Of these, 7070 participants completed the questionnaire and provided the urine specimen for the molecular detection of NG and CT, so the survey response rate was 85.1%. In total, 769 (10.9%) participants screened positive for STIs (NG, CT, or both): 182 (2.6%) participants were positive for NG, 648 (9.2%) for CT, and 61 (0.8%) were co-infected with NG/CT. By symptomatology, urogenital NG was detected in 165 of 4199 symptomatic participants (3.9%) and in 17 of 2871 asymptomatic participants (0.6%); urogenital CT was detected in 441 of 4199 symptomatic participants (10.5%) and in 207 of 2871 asymptomatic participants (7.2%). The proportion of participants without symptoms was 2871/7070 (40.6%): 1120 (39.0%) males and 1751 (61.0%) females. Among males reporting no symptoms, the prevalence of NG and CT was 0.9% and 6.2%, respectively. Among females reporting no symptoms, the prevalence of NG and CT was 0.4% and 7.9%, respectively (Fig. 1). The proportion of asymptomatic urethral NG among males with urethral NG was 7.2%; for females, it was 16.3%. The proportion of asymptomatic urethral CT among males with urethral CT was 28.3%; for females, it was 34.2% (Table 1).

Table 1

Sexually Transmitted Infections (STIs) Detected Stratified by Sex and Presence of STI Symptoms

STIs Detected Among Male, No. (%)			STIs Detected Among Female, No. (%)	
Type of STI	Total	Asymptomatic	Total	Asymptomatic
Gonorrhea	139 (36.3)	10 (7.2)	43 (9.6)	7 (16.3)
Chlamydia	244 (63.7)	69 (28.3)	404 (90.4)	138 (34.2)
Total	383 (100)	79 (20.6)	447 (100)	145 (32.4)

Characteristics of asymptomatic male participants

Of 1120 asymptomatic male participants included in this analysis, 60.0% were more than 30 years old; 54.1% had no children; 58.1% lived with their spouse; 73.7% were immigrants (unregistered residents of Shenzhen); 92.6% lived in Shenzhen for more than one year; 29.8% were workers and 50.9% had education at the senior high school level or higher (Table 2).

Table 2
Characteristics of asymptomatic male participants in Shenzhen, China

Asymptomatic Male Participants					
Variables		No. Total (%) N = 1120	No. Negative cases (%) N = 1046	No. Positive cases (%) N = 74	P value
Age, y	≤ 30	448 (40.0)	408 (39.0)	40 (54.1)	0.011
	> 30	672 (60.0)	638 (61.0)	34 (45.9)	
Children	NO	606 (54.1)	568 (54.3)	38 (51.4)	0.788
	Yes	510 (45.5)	476 (45.5)	34 (45.9)	
Living arrangements status	Living alone	144 (12.9)	136 (13.0)	8 (10.8)	0.078
	Living with spouse	651 (58.1)	615 (58.8)	36 (48.6)	
Residence status	Local residents	295 (26.3)	279 (26.7)	16 (21.6)	0.340
	Migrants	825 (73.7)	767 (73.3)	58 (78.4)	
Local residence time	0–12 months	83 (7.4)	77 (7.4)	6 (8.1)	0.813
	Over 1 year	1037 (92.6)	969 (92.6)	68 (91.9)	
Occupation	Staff	330 (29.5)	318 (30.4)	12 (16.2)	0.013
	Commercial services	304 (27.1)	276 (26.4)	28 (37.8)	
	Housework or unemployed	12 (1.1)	11 (1.0)	1 (1.4)	
	Worker	334 (29.8)	316 (30.2)	18 (24.3)	
Highest educational level	Lower than senior high school	550 (49.1)	508 (48.6)	42 (56.8)	0.175

Asymptomatic Male Participants					
	Senior high school and above	570 (50.9)	538 (51.4)	32 (43.2)	
Clinical settings	Dermatological department	362 (32.3)	344 (32.9)	18 (24.3)	< 0.001
	Urological department	536 (47.9)	486 (46.5)	50 (67.6)	
	Family planning department	220 (19.6)	215 (20.6)	5 (6.8)	
Insurance	Private/Medicaid	724 (64.6)	682 (65.2)	42 (56.8)	0.144
	Uninsured	396 (35.4)	364 (34.8)	32 (43.2)	
Sex with anonymous partner last 3 months	Yes	554 (49.5)	511 (48.9)	43 (58.1)	0.126
	No	566 (50.5)	535 (51.1)	31 (41.9)	
History of STI infection	No	980 (87.5)	916 (87.6)	64 (86.5)	0.361
	Yes	63 (5.7)	57 (5.4)	6 (8.1)	
History of STI test	No	1021 (91.2)	952 (91.0)	69 (93.2)	0.515
	Yes	99 (8.8)	94 (9.0)	5 (6.8)	
STI-related knowledge	Low	869 (77.6)	813 (77.7)	56 (75.7)	0.683
	High	251 (22.4)	233 (22.3)	18 (24.3)	
Partner notification	No	92 (8.2)	86 (8.2)	6 (8.1)	0.933
	Yes	1007 (89.9)	939 (89.8)	68 (91.9)	

Because of the low prevalence of NG in our study, we decided to integrate the number of cases of NG and CT for final analyses. Overall, the prevalence of STIs among males reporting no symptoms was 74/1120 (6.6%). When compared with asymptomatic males not infected with STIs, there were more asymptomatic males infected with STIs aged less than 30 years (54.1% vs 39.0%), being employed in commercial

service work (37.8% vs 26.4%) and being recruited through the urological department (67.6% vs 46.5%) (Table 2).

Factors associated with asymptomatic NG and/or CT infections among male participants

Based on the univariate linear regression results, the following variables: age, occupation, highest educational level, clinical settings, insurance and sex with anonymous partner last 3 months were selected for the multivariate analysis. Risk factors associated with urethral STIs among male participants with having no symptoms included males aged less than 30 years (OR, 1.75; 95% CI, 1.07–2.84), being employed in commercial service work (2.69; 1.33–5.45) and being recruited through urological department (vs dermatological department, 2.18; 1.24–3.83) (Table 3).

Table 3
Factors associated with asymptomatic NG and/or CT infections among male participants

Variables	Univariate analysis		Multivariate analysis	
	OR (95%CI)	P value	aOR (95%CI)	P value
Age, y				
> 30	1		1	
≤ 30	1.84 (1.15–2.96)	0.012	1.745 (1.07–2.84)	0.025
Occupation				
Staff	1		1	
Commercial services	2.69 (1.34–5.39)	0.005	2.69 (1.33–5.45)	0.006
Housework or unemployed	2.41 (0.29–20.21)	0.418	—	—
Worker	1.51 (0.72–3.19)	0.280	—	—
Highest educational level				
Lower than senior high school	1		1	
Senior high school and above	0.72 (0.45–1.16)	0.175	0.95 (0.74–1.21)	0.672
Clinical settings				
Dermatological department	1		1	
Urological department	1.97 (1.13–3.43)	0.017	2.18 (1.24–3.83)	0.007
Family planning department	0.44 (0.164–1.22)	0.144	0.50 (0.18–1.38)	0.179
Insurance				
Private/Medicaid	1		1	
Uninsured	1.43 (0.89–2.30)	0.144	0.96 (0.55–1.66)	0.874
Sex with anonymous partner last 3 months				
Yes	1		1	
No	0.69 (0.43–1.11)	0.126	0.85 (0.51–1.42)	0.526

Characteristics of asymptomatic female participants

Of 1751 asymptomatic female participants included in this analysis, 59.0% were more than 30 years old; 64.4% had children; 75.7% lived with their spouse; 70.0% were immigrants (unregistered residents of Shenzhen); 90.6% lived in Shenzhen for more than one year; 28.1% were staffs and 70.5% had education at the senior high school level or higher (Table 4).

Table 4
Characteristics of asymptomatic female participants

Asymptomatic Female Participants					
Variables		No. Total (%) N = 1751	No. Negative cases (%) N = 1609	No. Positive cases (%) N = 142	P value
Age, y	≤ 30	718 (41.0)	638 (39.7)	80 (56.3)	< 0.001
	> 30	1033 (59.0)	971 (60.3)	62 (43.7)	
Children	NO	609 (34.8)	546 (33.9)	63 (44.4)	0.026
	Yes	1128 (64.4)	1051 (65.3)	77 (54.2)	
Living arrangements status	Living alone	114 (6.5)	104 (6.5)	10 (7.0)	0.250
	Living with spouse	1325 (75.7)	1245 (77.4)	80 (56.3)	
Residence status	Local residents	525 (30.0)	498 (41.0)	27 (19.0)	0.003
	Migrants	1226 (70.0)	1111 (69.0)	115 (81.0)	
Local residence time	0–12 months	165 (9.4)	147 (9.1)	18 (12.7)	0.166
	Over 1 year	1586 (90.6)	1462 (90.9)	124 (87.3)	
Occupation	Staff	492 (28.1)	460 (28.6)	32 (22.5)	0.013
	Commercial services	336 (19.2)	299 (18.6)	37 (26.1)	
	Housework or unemployed	375 (21.4)	349 (21.7)	26 (18.3)	
	Worker	279 (15.9)	247 (15.4)	32 (22.5)	
Highest educational level	Lower than senior high school	516 (29.5)	465 (28.9)	51 (35.9)	0.320

Asymptomatic Female Participants					
	Senior high school and above	1235 (70.5)	1144 (71.1)	91 (64.1)	
Clinical settings	dermatological department	75 (4.3)	62 (3.9)	13 (9.2)	0.026
	gynecological department	1367 (78.1)	1258 (78.2)	109 (76.8)	
	Family planning department	276 (15.8)	259 (16.1)	17 (12.0)	
Insurance	Private/Medicaid	1140 (65.1)	1060 (65.9)	80 (56.3)	0.022
	Uninsured	611 (34.9)	549 (34.1)	62 (43.7)	
Sex with anonymous partner last 3 months	Yes	463 (26.4)	422 (26.2)	41 (28.9)	0.493
	No	1288 (73.6)	1187 (73.8)	101 (71.1)	
History of STI infection	No	1497 (85.5)	1374 (85.4)	123 (86.6)	0.871
	Yes	76 (4.3)	71 (4.4)	5 (35.5)	
History of STI test	No	1599 (91.3)	1463 (90.9)	136 (95.8)	0.049
	Yes	152 (8.7)	146 (9.1)	6 (4.2)	
STI-related knowledge	Low	1407 (80.4)	1282 (79.7)	125 (88.0)	0.016
	High	344 (19.6)	327 (20.3)	17 (12.0)	
Partner notification	No	88 (5.0)	77 (4.8)	11 (7.7)	0.165
	Yes	1594 (91.0)	1466 (91.1)	128 (90.1)	

Overall, the prevalence of STIs among females reporting no symptoms was 142/1751 (8.1%). When compared with asymptomatic females not infected with STIs, there were more asymptomatic females infected with STIs aged less than 30 years (56.3% vs 39.7%), who had no children (44.4% vs 33.9%), who were migrants (81.0% vs 69.0), and uninsured (43.7% vs 34.1%). In addition, most females with STIs were

employed in commercial service work (26.1% vs 18.6%), recruited through dermatological department (9.2% vs 3.9%), having no history of STI testing (95.8% vs 90.9%) and having low STI-related knowledge (88.0% vs 79.7%) (Table 4).

Factors associated with asymptomatic NG and/or CT infections among female participants

Based on the univariate linear regression results, the following variables: age, children, residence status, local residence time, occupation, clinical settings, insurance, history of STI test, STI-related knowledge and partner notification were selected for the multivariate analysis. Risk factors associated with urethral STIs among female participants with having no symptoms included females aged less than 30 years (OR, 1.80; 95% CI, 1.25–2.58) and being recruited through the dermatological department (vs gynecological department, 2.83; 1.46–5.46) (Table 5).

Table 5

Factors associated with asymptomatic NG and/or CT infections among female participants

Variables	Univariate analysis		Multivariate analysis	
	OR (95%CI)	P value	aOR (95%CI)	P value
Age, y				
> 30	1		1	
≤ 30	1.96 (1.39–2.78)	0.000	1.80 (1.25–2.58)	0.001
Children				
NO	1		1	
Yes	0.64 (0.45–0.90)	0.011	0.77 (0.50–1.19)	0.238
Residence status				
Local residents	1		1	
Migrants	1.91 (1.24–2.94)	0.003	1.48 (0.93–2.34)	0.100
Local residence time				
0–12 months	1		1	
Over 1 year	0.83 (0.64–1.08)	0.168	0.91 (0.69–1.19)	0.494
Occupation				
Staff	1			
Commercial services	1.78 (1.08–2.92)	0.023	1.48 (0.88–2.48)	0.140
Housework or unemployed	1.07 (0.63–1.83)	0.802	—	—
Worker	1.86 (1.11–3.11)	0.018	1.50 (0.87–2.57)	0.141
Clinical settings				
Gynecological department	1		1	
Dermatological department	2.42 (1.29–4.54)	0.006	2.83 (1.46–5.46)	0.002
Family planning department	0.76 (0.45–1.29)	0.303	—	—
Insurance				
Private/Medicaid	1		1	
Uninsured	1.50 (1.06–2.12)	0.023	1.07 (0.72–1.60)	0.730
History of STI test				

Variables	Univariate analysis		Multivariate analysis	
	OR (95%CI)	P value	aOR (95%CI)	P value
No	1		1	
Yes	0.44 (0.19–1.02)	0.055	0.53 (0.23–1.26)	0.154
STI-related knowledge				
Low	1		1	
High	0.53 (0.32–0.90)	0.018	0.59 (0.34–1.02)	0.058
Partner notification				
No	1		1	
Yes	0.59 (0.34–1.02)	0.057	0.76 (0.39–1.51)	0.436

Discussion

In this clinic-based multi-site cross-sectional study, we determined both the prevalence and proportion of laboratory-confirmed urethral CT and/or NG infections that were asymptomatic among subjects presenting to clinics in Shenzhen, China. Overall, the prevalence of asymptomatic NG infection was low, but a high prevalence of CT infection was observed among males and females who have no symptoms. In addition, we found that about a third of the CT infections among males or females with urethral CT were asymptomatic. For asymptomatic males with urethral STIs, we identified 3 independent predictors: (1) males under the age of 30; (2) being employed in the commercial service work; and (3) being recruited through the urological department (vs dermatological department). For asymptomatic females with urethral STIs, 2 independent predictors were identified: (1) females under the age of 30; and (2) being recruited through the dermatological department (vs gynecological department).

The overall prevalence of CT and NG observed in this study was 9.2% and 2.6% respectively, which is lower than that of Zhang et al⁵ in 2009 in the similar population in Shenzhen but still significantly higher than the national level.⁶ Currently, the cause of the decline in the prevalence of NG and CT is not clear, but these two diseases (especially CT) are still serious public health problems in Shenzhen. A systematic review suggests that if the prevalence of CT ranged from 3.1–10.0%, the screening for CT infectious is cost-effective.¹² Our findings indicated that a regular and comprehensive CT screening is warranted in Shenzhen.

We observed from this study that the proportion of asymptomatic urethral NG and CT was 7.2% and 28.3% among males, and 16.3% and 34.2% among females, respectively. The proportion of asymptomatic NG and CT has been widely reported, but results vary widely around the world, ranging from 8–87%.^{13–16} The disparities in proportions of asymptomatic participants with or without STIs may

be attributable to the different laboratory methods employed, the distribution of risk factors and the composition of the studied population. Given that a third of the CT infections are asymptomatic, passive screening (i.e., screening for patients who come to see a doctor) is not enough in Shenzhen. We need to identify risk factors for asymptomatic STI patients and implement targeted screening across the population.

The mechanism for why some people who infected with CT or NG are asymptomatic remains uncertain; it is possibly related to a low-level bacterial load.¹⁷ Our epidemiological study have shown that participants (both males and females) under the age of 30 are associated with higher odds of a asymptomatic STI positive screening result. This is similar to the findings from other previous studies which investigated the risk factors for the overall prevalence of NG or CT.¹⁸⁻²² Some potential explanations for impact of age on prevalence of STI might be: first, youth usually accompanied with strong sexual desire, resulting in frequent sexual activity; second, due to lack of sexual safety awareness, youth are more likely to engage in risky sexual behaviors. In view of this, some developed countries have launched STI screening programs for young adults.^{19,23,24} Our findings suggest that attention should also be paid to asymptomatic STIs during the screening process.

Another noteworthy finding was that the prevalence of asymptomatic urogenital STIs was significantly higher in male participants who were recruited through the urological department than that of male participants who were recruited through the dermatological department. In the past, screening STI services conducted by local government were always carried out with the dermatological department as the core place. However, our finding indicates that the urological department may be a better site to provide opportunistic screening for STIs to male patients. So far, although most developed countries have implemented opportunistic screening services for STIs, the effectiveness of these services on reduction of the prevalence of STI infections is unsatisfactory.^{19,25,26} Our results may provide room for improvement of STI screening. In addition to screening sites, low uptake rates of STI screening may also be one of the factors hindering screening effectiveness. According to a study from the US, approximately 37.9% females reported ever receiving a CT testing.²⁷ In China, Wu et al²⁸ found that less than one-third of males had participated in a NG or CT testing. Surprisingly, we observed that the screening intention was significantly lower in male participants who were recruited through the dermatological department than that of male participants who were recruited through the urological department (Figure S1). People with a higher willingness to screen are more inclined to go to the urological department, which further supported the placement of screening sites for males in the urological department.

Our study has some limitations. First, our study was limited to clinics where participants who had urethral symptoms and who were at particularly high-risk of infection were more likely to go to the clinics for treatment. It is possible that the prevalence of NG and/or CT infections among participants without symptoms in the community will be overestimated. Thus, caution should be used when generalizing our findings to the community in Shenzhen. Second, the participants of the study were recruited by using convenient sampling method and the sampling period was only 1 month, which may also lead to a

potential selection bias. Third, we limited the detection to urogenital specimens only, so extragenital infections were not captured. However, given that the high-risk population with rectal or oropharyngeal infection (such as MSM and sex workers) included in our study was rare, our data on prevalence of NG and/or CT infection were reliable. Finally, as with other cross-sectional studies, reporting bias, recall bias and limitation in making causal inferences should be considered.

Conclusion

In conclusion, a substantial prevalence of asymptomatic CT infections was found among males and females presenting to clinics in Shenzhen. The significant correlation between asymptomatic CT infection and age as well as clinical setting could help identify high-risk populations and guide resource allocations and screening. Future studies should investigate people's willingness to screen and the effectiveness of screening strategies on these high-risk populations.

Abbreviations

Chlamydia trachomatis (CT); Neisseria gonorrhoeae (NG); sexually transmitted infections (STIs); Confidence interval (CI); Adjusted odds ratios (AORs)

Declarations

Competing interests

The authors declare that they have no conflict of interest.

Funding statement

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Ethics approval and consent to participate

Ethical approval was provided by Shenzhen Center for Chronic Disease Control. Written informed consent was obtained from all the participants.

Consent for publish

Not Applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author's contributions

Conceptualization: K-KC, Y-MC and WY Data curation: X-TL and S-XC Investigation: H-YZ, M-MW, C-LZ and J-BY Writing: S-XC and K-KC. All co-authors approved the final manuscript and agree to be accountable for all aspects of the work.

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Additional File

Figure S1: Impact of different clinical settings on screening intention

Figures

Figure 1

Prevalence of asymptomatic Gonorrhea and Chlamydia infections by Gender

Supplementary Files

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