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Community-Based Sexually Transmitted Infection Screening and Increased Detection of Pharyngeal and Urogenital *Chlamydia trachomatis* and *Neisseria gonorrhoeae* Infections in Female Sex Workers in Hong Kong

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Background: Female sex workers (FSWs) are vulnerable to sexually transmitted infections (STIs) and are one of the key populations being infected most by *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections. In Hong Kong, limited data on the burden of chlamydial and gonococcal infections exist because regular screenings are not offered. This study aimed to investigate the prevalence of *C. trachomatis* and *N. gonorrhoeae* in FSWs and to assess predictors associated with unprotected fellatio.

Methods: A cross-sectional study was conducted on 340 FSWs attending a community organization for HIV/STI screening, and a questionnaire addressing sociodemographic and behavioral characteristics was administered to all FSWs.

Results: The prevalence of syphilis infection was 2.1%, and none was tested positive for HIV. The positivity for pharyngeal *C. trachomatis* and *N. gonorrhoeae* was 3.2% and 4.4%, respectively, whereas that for urogenital chlamydial and gonococcal infection was 10.6% and 0.9%, respectively. Of 313 FSWs offering fellatio, having unprotected fellatio with clients was significantly associated with the perceived low risk of contracting STI via fellatio (adjusted odds ratio [OR], 1.88), working in clubs (adjusted OR, 11.14), working on streets (adjusted OR, 3.28), recently started working in the sex industry for 1 year or less (adjusted OR, 3.05), and reporting group sex in the previous year (adjusted OR, 11.03).

Conclusions: The prevalence of HIV and syphilis infection remains low. This study reveals a relatively high prevalence of *N. gonorrhoeae* detected mostly in the pharynx. Offering pharyngeal screening for STI would

facilitate early diagnosis and treatment of gonococcal infection in FSWs in Hong Kong.

Chlamydia trachomatis and *Neisseria gonorrhoeae* are the 2 most common pathogens causing genital tract infections. In the United States, more than 1.4 million cases of chlamydia and 330,000 cases of gonorrhea were reported to the Centers for Disease Control and Prevention in 2012.¹ Because of the job nature with frequent sexual contact with multiple sex partners, female sex workers (FSWs) are still one of the key populations being affected most by these infections. Globally, although there is a rising attention toward sex workers' health and occupational risk of HIV and sexually transmitted infections (STIs) in the past decades that may lead to a general increased awareness on condom use, chlamydial and/or gonococcal infections can take place whenever condom use is sabotaged. A study by Parvez and colleagues² reported that in New York City jails, incarcerated FSWs were more likely to be diagnosed as having chlamydial infection. In China, the prevalence of *C. trachomatis* among FSW could be as high as 32%,³ although the prevalence among the general population was only 2.6%.⁴

With the continuing spread of *C. trachomatis* and *N. gonorrhoeae* infections, the role of orogenital sex as a route of transmission has been a concern. However, because of the belief that oral sex carries a minute HIV risk, most sexual health research and programs focus mostly on vaginal/anal sex.⁵ Nevertheless, unprotected fellatio may contribute to a high proportion of STI. In Asia, previous studies have suggested that up to 22.5% and 4.0% of Japanese FSWs were infected with pharyngeal *C. trachomatis* and *N. gonorrhoeae*, respectively,^{6,7} and 5.2% of FSWs were diagnosed as having pharyngeal *N. gonorrhoeae* in Singapore.⁸

Providing FSWs with accessible sexual health screening and treatment is an important strategy to maintain the health of FSWs and their clients. Nevertheless, stigmatization and criminalization of sex work have forbidden FSWs from getting appropriate medical care. Even in places where government supports are available, FSWs often avoid those services because of the fear of public identification or of being mistreated by authorities.⁹ Moreover, the asymptomatic nature of STI often makes infected individuals unaware of their infection status. Opportunities for prevention and control could have been lost if infections are not diagnosed and treated, which may result in the rapid emergence and spread of antimicrobial-resistant pathogens.

In Hong Kong, sex work itself is not illegal but is heavily restricted by the Crimes Ordinance. Mandatory STI screening for sex workers has been ceased since the early 1930s. Unlike other Southeast Asian countries, FSWs in Hong Kong seldom work in large brothels as operating sex establishments with more

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than 1 sex worker is an offence. The most common form of legal brothel that exists to date is called “1-woman brothel,” where one woman serves her clients in a tiny apartment. Other FSWs provide sex services underground in massage parlors and clubs (night clubs/Japanese-styled hostess clubs) and solicit clients on streets, through a middleman or from the Internet, and some work temporarily and illegally with a short-stay visitor visa. Screening for STI at government clinics is only free for local citizens, and the services are not anonymous. Most of the clinics attendees are presented with symptoms, and it is estimated that these clinics have only captured approximately one-fifth of STI in Hong Kong.¹⁰ Existing data on the burden of pharyngeal and urogenital *C. trachomatis* and *N. gonorrhoeae* are minimal because these infections are not regularly tested. In addition, the detection of pharyngeal *N. gonorrhoeae* by insensitive culture-based method may miss most of the infections^{11,12} and is only performed in symptomatic patients. This study was thus designed to determine the prevalence of pharyngeal and urogenital *C. trachomatis* and *N. gonorrhoeae* infections among FSWs recruited from a community setting in Hong Kong and to predict factors associated with unprotected fellatio.

METHODS

Setting and Study Participants

During the study period, a registered nurse held a weekly screening session in a community-based organization. The organization is one of the largest and oldest service providers offering voluntary counseling and testing for HIV to FSW. Screening sessions were held in the drop-in center of the organization and were conducted during outreach visits. All FSWs approached by the staff were invited to participate and screened for pharyngeal and urogenital *C. trachomatis* and *N. gonorrhoeae* infections. Voluntary HIV and syphilis rapid tests were also performed. Eligibility for participation included FSWs who had offered sex service (vaginal, oral, and/or anal) to other men for money, gift, or equivalent in the preceding 6 months. Exclusion criteria included having received antibiotics treatment within the last 3 weeks and having been participated in the study before. The nurse performed HIV/STI screening tests and provided appropriate pretest and posttest counseling to the sex workers. HIV and syphilis rapid test results were released in 15 minutes, whereas participants were informed with the *C. trachomatis* and *N. gonorrhoeae* screening results in 2 weeks. Participants tested positive for *C. trachomatis* and/or *N. gonorrhoeae* infections were referred to a doctor for follow-up managements.

After providing informed consent, all participants were interviewed by the nurse or organization staff with an anonymous behavioral survey. Study domains included demographic characteristics; HIV/STI testing experiences; history and symptoms of STI; knowledge, awareness, and perceived risk of orogenital transmission of STI; working patterns; and risk behaviors including illicit drug use, sexual practices, and condom use with clients. The study was approved by the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee.

HIV/STI Screening

Screening for HIV infection was performed using the SD Bioline HIV 1/2 3.0 rapid diagnostic test (Standard Diagnostics, Yongin-si, South Korea). Diagnosis of syphilis infection was conducted using the SD Bioline Syphilis 3.0 rapid test (Standard Diagnostics). Nucleic acid amplification test (NAAT) was used for *C. trachomatis* and *N. gonorrhoeae* detection. A 3-mL first-catch urine sample or clinician-obtained endocervical swab was collected for

urogenital screening by using the Aptima Combo 2 Assay (AC2; Hologic Gen-Probe, San Diego, CA). From each participant, 3 pharyngeal swabs were also collected by the nurse in a randomized order. One pharyngeal specimen was collected using Amies charcoal swab (Copan Diagnostics, Murrieta, CA) for *N. gonorrhoeae* culture. Two pharyngeal swabs for NAATs were placed in each of the manufacturers' collection tubes: Aptima swab specimen transport tube for AC2 assay and Roche Cobas collection tube for automated Cobas 4800 *C. trachomatis*/*N. gonorrhoeae* assay (Roche Molecular Systems, Pleasanton, CA). Because both AC2 and Cobas 4800 assays were only approved by the Food and Drug Administration for the detection of *C. trachomatis* and *N. gonorrhoeae* in urine and urogenital samples, any pharyngeal specimen with positive NAAT results was tested by additional NAAT that targets alternate regions to those of the AC2 and Cobas 4800 assays. An alternate monospecific assay of Aptima *C. trachomatis* (Hologic Gen-Probe) or Aptima *N. gonorrhoeae* (Hologic Gen-Probe) was further used for pharyngeal *C. trachomatis* or *N. gonorrhoeae* detection, respectively. Positive pharyngeal *C. trachomatis* case was defined as (1) positive results by both AC2 and Cobas 4800 NAATs or (2) a positive result by AC2 and confirmed by Aptima *C. trachomatis* assay for *C. trachomatis*. Diagnosis of positive pharyngeal *N. gonorrhoeae* infection was defined as (1) a positive result by pharyngeal gonococcal culture, or (2) positive results by both AC2 and Cobas 4800 NAATs, or (3) a positive result by AC2 and confirmed by Aptima *N. gonorrhoeae* assay for *N. gonorrhoeae*.

Statistical Analyses

Participants' demographic characteristics, diseases prevalence, HIV/STI testing experiences, knowledge and risk perception, working patterns, and sexual risk behaviors were described according to their working venue: 1-woman brothels, night/hostess clubs, massage parlors, and streets-based sex workers. To assess differences between FSWs by working venue, categorical variables were analyzed using Pearson χ^2 or Fisher exact tests. Continuous variables were compared using 1-way analysis of variance test.

Univariate and multivariate logistic regression analyses were performed to examine predictors associated with unprotected fellatio with clients in the past 6 months. Demographic factors, knowledge and risk perception, working patterns, sexual risk behaviors, and history of STI were included. Crude and adjusted odds ratio (aOR) with 95% confidence interval (CI) were determined. Factors significantly associated with the outcome variable of unprotected fellatio at $P < 0.05$ in univariate analysis were included in multivariate logistic regression. The multivariate model was constructed using backward stepwise selection method. All data analyses were conducted using IBM SPSS Statistics 21.0 (IBM Inc, Armonk, NY). A P value less than 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

Between April 2012 and August 2013, 818 FSWs were approached and 340 agreed to participate in the community-based HIV/STI screening (participation rate, 41.6%). Among them, 146 were recruited from night/hostess clubs, 72 from 1-woman brothels, 68 from streets, and 54 from massage parlors (Table 1). The participants' mean age was 37 years, with the youngest was from club girls (33.7 years). Most FSWs (79.4%) were local Chinese; the remaining migrants were mostly street-based FSWs. More than two-thirds of participants were ever-married, and less than half (35.0%) reported completing high school education or above.

TABLE 1. Sociodemographic, STI Prevalence, and Behavioral Characteristics of 340 FSWs by Location of Sex Work

	Location of Sex Work										<i>P</i> value for χ^2 test
	Total (n = 340)		OWBs (n = 72)		Clubs (n = 146)		Massage (n = 54)		Streets (n = 68)		
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	
Demographics											
Age, mean (SD), y	37.0	(7.8)	39.1	(6.8)	33.7	(7.5)	37.9	(6.7)	41.4	(7.1)	<0.001*
Having Hong Kong citizenship	270	(79.4)	71	(98.6)	110	(75.3)	54	(100.0)	35	(51.5)	<0.001*
Marital status											
Single	72	(21.2)	10	(13.9)	46	(31.5)	11	(20.4)	5	(7.4)	<0.001
Married	136	(40.0)	23	(31.9)	55	(37.7)	19	(35.2)	39	(57.4)	
Divorced	114	(33.5)	33	(45.8)	38	(26.0)	21	(38.9)	22	(32.4)	
Others	18	(5.3)	6	(8.3)	7	(4.8)	3	(5.6)	2	(2.9)	
High school education or above	119	(35.0)	25	(34.7)	49	(33.6)	21	(38.9)	24	(35.3)	0.885
Prevalence of HIV and STI											
HIV	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	—
Syphilis	7	(2.1)	1	(1.4)	3	(2.1)	2	(3.7)	1	(1.5)	0.801
Chlamydia (pharyngeal and/or urogenital)	44	(12.9)	7	(9.7)	20	(13.7)	8	(14.8)	9	(13.2)	0.787
Gonorrhea (pharyngeal and/or urogenital)	17	(5.0)	3	(4.2)	12	(8.2)	1	(1.9)	1	(1.5)	0.111
Use of screening services											
HIV screening in the last 12 mo	151	(44.4)	33	(45.8)	65	(44.5)	27	(50.0)	26	(38.2)	0.616
STI screening in the last 12 mo	153	(45.0)	35	(48.6)	66	(45.2)	26	(48.1)	26	(38.2)	0.603
Pharyngeal STI screening in the last 12 mo	16	(4.7)	2	(2.8)	12	(8.2)	2	(3.7)	0	(0.0)	0.044
Previous STI and symptoms											
History of STI in the past 6 mo	27	(7.9)	7	(9.7)	12	(8.2)	6	(11.1)	2	(2.9)	0.335
STI symptoms in the past 6 mo	133	(39.1)	25	(34.7)	56	(38.4)	19	(35.2)	33	(48.5)	0.321
Knowledge and risk perception											
Ever heard that STI could be transmitted via oral sex	202	(59.4)	53	(73.6)	86	(58.9)	28	(51.9)	35	(51.5)	0.028
Perceived high risk of contracting STI via oral sex	160	(47.1)	42	(58.3)	66	(45.2)	20	(37.0)	32	(47.1)	0.320
Perceived high risk of contracting HIV compared with non-FSW	204	(60.0)	37	(51.4)	85	(58.2)	35	(64.8)	47	(69.1)	0.151
Working patterns											
Age of first sex work, mean (SD), y	33.0	(7.8)	35.2	(5.8)	29.6	(7.9)	34.0	(6.3)	36.8	(8.1)	<0.001*
Had practiced sex work outside Hong Kong	21	(6.2)	4	(5.6)	6	(4.1)	5	(9.3)	6	(8.8)	0.418
Had worked 5 d or above per week	85	(25.0)	24	(33.3)	28	(19.2)	17	(31.5)	16	(23.5)	0.086
No. clients in last week, mean (SD)	7.4	(11.5)	11.2	(13.9)	3.6	(7.1)	9.9	(13.3)	9.8	(12.4)	<0.001*
Sexual practices with clients in the past 6 mo											
Vaginal sex	315	(92.6)	72	(100.0)	125	(85.6)	52	(96.3)	66	(97.1)	<0.001
Consistent condom use with clients (vaginal sex)	209	(66.3)	59	(81.9)	69	(55.2)	42	(80.8)	39	(59.1)	<0.001
Oral sex	313	(92.1)	70	(97.2)	125	(85.6)	52	(96.3)	66	(97.1)	0.002
Had clients ejaculated in the mouth	103	(32.9)	14	(20.0)	65	(52.0)	15	(28.8)	9	(13.6)	<0.001
Consistent condom use with clients (oral sex)	116	(37.1)	46	(65.7)	19	(15.2)	23	(44.2)	28	(42.4)	<0.001
Anal sex	14	(4.1)	2	(2.8)	7	(4.8)	0	0.0	5	(7.4)	0.202
Consistent condom use with clients (anal sex)	16	(42.9)	1	(50.0)	4	(57.1)	0	0.0	1	(20.0)	0.429

Significant difference with *P* values less 0.05 highlighted in bold.

*Means (age, age of first sex work, and number of clients in the last week) were compared by 1-way analysis of variance test.

OWBs indicates 1-woman brothels.

Use of Services, Working Patterns, and Behavioral Characteristics

Of all FSWs, 44.4% had an HIV test, 45.0% screened for STI, and only a minority (4.7%) had pharyngeal STI screening in the previous year. Having attended sexual health screening for pharyngeal infections was significantly higher among club girls (8.2%; *P* = 0.044). Presence of genital STI symptoms (having abnormal vaginal discharge, growth, ulceration, or pain) in the past 6 months was reported by 133 FSWs (39.1%).

Knowledge of STI infection was significant higher among FSWs working in 1-woman brothels, and 73.6% of them had ever heard that STI could be transmitted via fellatio (*P* = 0.028). Nearly half (47.1%) believed that the risk of getting STI through fellatio was high, and 60.0% believed that they had a higher chance of getting HIV if compared with women who were not working in the sex industry. Difference in age of first sex work was observed,

with the youngest mean age of 29.6 years reported by club girls (*P* < 0.001). In the preceding week, a quarter of FSW worked for 5 days or longer. The mean number of clients was highest among FSWs working in 1-woman brothels (mean, 11.2), whereas club girls had the lowest number of clients in the preceding week (3.6).

In the past 6 months, more than 90% of FSWs had vaginal and/or fellatio with clients. Approximately two-thirds of FSWs consistently used a condom with clients during vaginal sex, whereas consistent condom use rate during oral sex was 37.1%. Only a minority of FSWs (4.1%) reported having had anal sex with clients, and consistent condom use during anal sex was 42.9%.

HIV/STI Prevalence

Of 340 FSWs, seropositivity for HIV infection was not identified and syphilis positivity was 2.1% (95% CI, 0.5–3.6). For the detection of pharyngeal *N. gonorrhoeae*, both AC2 and

Cobas 4800 NAATs were superior to gonococcal culture. The sensitivity of AC2 was 100% for pharyngeal *C. trachomatis* and *N. gonorrhoeae*, whereas the sensitivity of Cobas 4800 for pharyngeal *C. trachomatis* and *N. gonorrhoeae* was 76.0% and 83.3%, respectively. The specificity of AC2 and Cobas 4800 was consistently greater than 99.6% for both pharyngeal *C. trachomatis* and *N. gonorrhoeae* detections. Regardless of anatomical site of infection (either pharyngeal or urogenital), the overall prevalence of *C. trachomatis* and *N. gonorrhoeae* infection was 12.9% (44/340) and 5.0% (17/340), respectively. For pharyngeal infection, 11 FSWs had *C. trachomatis* infection (prevalence, 3.2%; 95% CI, 1.3–5.1) and 15 were infected with *N. gonorrhoeae* (prevalence 4.4%; 95% CI, 2.2–6.6); none of them had pharyngeal *C. trachomatis* and *N. gonorrhoeae* coinfection. Urogenital chlamydial infection was detected in 36 FSWs (prevalence, 10.6%; 95% CI, 7.5–14.2), and 3 were with gonococcal infection (prevalence, 0.9%; 95% CI, –0.1 to 1.9). Coinfection with urogenital *C. trachomatis* and *N. gonorrhoeae* was detected in 2 FSWs (prevalence, 0.6%; 95% CI, –0.2 to 1.4).

The positivity for *C. trachomatis* and *N. gonorrhoeae* infection by anatomical location is shown in Figure 1. Of 44 chlamydial infections identified, 75% (33/44) was exclusively detected in urogenital. Only 3 FSWs (6.8%) had coexisting *C. trachomatis* at pharyngeal and urogenital sites. Of 17 gonococcal infections identified, positivity rate for pharyngeal *N. gonorrhoeae* was higher and 82.4% (14/17) was exclusively detected in the pharynx. Concurrent *N. gonorrhoeae* infection at both anatomical sites was only detected in 1 participant (5.9%).

Predictors Associated With Unprotected Fellatio

Overall, 313 FSWs (92.1%) reported having oral sex with clients in the past 6 months. In univariate analysis (Table 2), an increased risk of engaging in unprotected fellatio was associated with a younger age at first sex work, the perception of a lower chance of contracting STI via fellatio; working in clubs, in massage, and being a street-based FSW; having worked in the sex industry for 1 year or less; and reporting group sex in the previous year. In multivariate analysis, a significant association with unprotected fellatio and with increased odds included the perceived low risk of contracting STI via fellatio (aOR, 1.88; 95% CI, 1.09–3.26; $P = 0.023$), working in clubs (aOR, 11.14; 95% CI, 5.33–23.32; $P < 0.001$) and as street-based worker (aOR, 3.28; 95% CI, 1.55–6.96; $P = 0.002$), having worked in the sex industry for 1 year or less (aOR, 3.05; 95% CI, 1.44–6.44; $P = 0.003$), and reporting group sex in the previous year (aOR, 11.03; 95% CI, 2.35–51.83; $P = 0.002$).

DISCUSSION

Our study reveals that although the prevalence of HIV and syphilis is low, infection of *C. trachomatis* and *N. gonorrhoeae* is not uncommon in FSWs in Hong Kong. Approximately 1 (7.6%) in 13 FSWs has pharyngeal chlamydial/gonococcal infection, and nearly 1 (10.6%) in 10 carries urogenital chlamydial infection. Condom use was significantly predicted by women's working profiles that club girls, street-based FSWs, and those who were newer to the sex industry were significantly more likely to have unprotected sex with clients. Apparently, condom use during oral sex was not a common practice. In this study, only 37.1% of FSWs used condom consistently for fellatio, which was similar to a previous study conducted in Hong Kong a decade ago.¹³ It seems that condom use for fellatio has remained constantly low in the past years. On the contrary, more than half of the FSWs in Singapore, UK, Australia, and Israel had reported consistent condom use for fellatio.^{8,14–16} This low condom use rate may link to the misconception of oral sex as a safe sex among FSWs in Hong

Chlamydia positive (N=44)

Gonorrhoea positive (N=17)

Figure 1. Distribution of *C. trachomatis* and *N. gonorrhoeae* positivity by anatomical site.

Kong, as evidenced by more half of them who did not perceive that the chance of getting STI via oral sex could be high, and some had not even heard about orogenital transmission of STI. Other factors, such as unpleasant taste of condoms and lack of negotiation skills in condom use may also contribute to low condom use rate, although these factors were not explored in this study.¹⁷ With a low condom use rate for fellatio in Hong Kong, orogenital transmission of STI could have perpetuated among FSWs and their clients. It has been shown that an increased condom use rate for fellatio by FSW from less than 50.0% to 97.2% resulted in 3-fold reduction in the incidence of pharyngeal gonorrhea from more than 12 to 4.7 per 1000 person-months.¹⁸ Although the chance of transmitting HIV is comparatively slim via oral sex,⁵ promoting condom use for fellatio would reduce public health burden from other bacterial STI.

Other than individuals' perception, knowledge, preference, and negotiation skills that may be associated with a low condom use, our study supports the notion that condom use is highly affected by environmental-structural factors. Not only for fellatio, but condom use for vaginal sex also varied significantly across different work settings. Female sex workers working in 1-woman brothels and massage parlors reported higher condom use than did those working in clubs and on streets. The effect of working environment on safe sex practice could be mediated through different ways. These include how prevention resources are distributed to different types of sex establishments and how much of these resources are really made accessible for FSWs in the establishments. The importance of managerial support in workplace on FSW's condom use has been highlighted previously. In a study conducted on more than 1300 bar girls in the Philippines, those who worked in establishments where condom use policy exists

TABLE 2. Predicators Associated with Unprotected Fellatio with Clients among 313 FSWs in Hong Kong

	n	(%)	Crude OR	95% CI	P	aOR*	95% CI	P
Demographic indicators								
Age (n = 309), y								
>25	286	92.6	1	—	—	—	—	—
≤25	23	7.4	1.07	(0.44–2.61)	0.879	—	—	—
Marital status								
Single	60	19.2	1	—	—	—	—	—
Married or divorced	253	80.8	0.75	(0.41–1.36)	0.337	—	—	—
Residence status								
Hong Kong resident	254	81.2	1	—	—	—	—	—
Migrant	59	18.8	1.43	(0.78–2.63)	0.249	—	—	—
Education level (n = 289)								
Primary school or below	178	61.6	1	—	—	—	—	—
High school or above	111	38.4	0.68	(0.41–1.10)	0.115	—	—	—
Knowledge and risk perception								
Ever heard that STI could be transmitted via oral sex								
No	117	37.4	1	—	—	—	—	—
Yes	196	62.6	0.77	(0.48–1.25)	0.292	—	—	—
Perceived risk of contracting STI via oral sex (n = 298)								
High chance	150	50.3	1	—	—	—	—	—
Low chance	148	49.7	1.81	(1.21–2.92)	0.015	1.88	(1.09–3.26)	0.023
Perceived risk of contracting HIV compared with non-FSW								
High chance	192	61.3	1	—	—	—	—	—
Low chance	121	38.7	0.79	(0.44–1.26)	0.318	—	—	—
Working patterns								
Location of sex work								
OWBs	70	22.4	1	—	—	—	—	—
Clubs	125	39.9	10.69	(5.34–21.41)	<0.001	11.14	(5.33–23.32)	<0.001
Massage	52	16.6	2.42	(1.56–5.05)	0.019	2.26	(0.98–5.17)	0.055
Streets	66	21.1	2.60	(1.30–5.21)	0.007	3.28	(1.55–6.96)	0.002
Age at first sex work, y								
>25	273	87.2	1	—	—	—	—	—
≤25	40	12.8	2.62	(1.16–5.90)	0.02	1.34	(0.53–3.35)	0.539
Duration in sex work, y								
>1	252	80.5	1	—	—	—	—	—
≤1	61	19.5	2.28	(1.20–4.36)	0.012	3.05	(1.44–6.44)	0.003
No. clients in last 7 d								
≤10	230	73.5	1	—	—	—	—	—
>10	83	26.5	0.61	(0.37–1.01)	0.056	—	—	—
Sexual risk behaviors								
Group sex in previous year								
No	285	91.1	1	—	—	—	—	—
Yes	28	8.9	8.67	(2.02–37.23)	0.004	11.03	(2.35–51.83)	0.002
Alcohol use before sex in previous year								
No	250	79.9	1	—	—	—	—	—
Yes	63	20.1	1.23	(0.68–2.20)	0.494	—	—	—
Recreational drug use before sex in previous year								
No	299	95.5	1	—	—	—	—	—
Yes	14	4.5	2.23	(0.61–8.16)	0.226	—	—	—
History of STI								
Prior STI in the past 6 mo								
No	287	91.7	1	—	—	—	—	—
Yes	26	8.3	1.66	(0.68–4.08)	0.268	—	—	—
Pharyngeal chlamydia and/or gonorrhea infection detected								
No	289	92.3	1	—	—	—	—	—
Yes	24	7.7	2.37	(0.86–6.53)	0.095	—	—	—

Significant difference with *P* values less than 0.05 highlighted in bold.

*Adjusted for perceived risk of contracting STI via oral sex, location of sex work, age at first sex work, duration in sex work, and group sex in previous years.

OWBs indicates 1-woman brothels.

were nearly 3 times more likely to use condom consistently compared with establishments without such policy.¹⁹ On the other hand, unlike club girls and street-based FSWs who usually have

sex with clients at isolated venues, women working in brothels and massage parlors spend a lot of time in the establishments. Therefore, there is a higher chance for them to be approached by

outreach workers. Working in in-door settings may also protect FSWs from clients' violence or police harassment that may hinder condom use²⁰ because peers, pimps, and brothel keepers nearby may offer support when problems arise. Future public health programs and research would need to abandon an individualist perspective to look at condom use among FSWs and to focus on effects of environmental-structural influences.

In Hong Kong, the prevalence of HIV and syphilis in FSW remains low.²¹ This may partly due to FSWs' increasing acceptance of free HIV and syphilis testings²² and a declining epidemic in China among both FSWs²³ and clients.²⁴ Although the positivity for *C. trachomatis*/*N. gonorrhoeae* was not strikingly high in this study, there was still 17.4% (59/340) of FSWs who carried the infections at the pharyngeal or urogenital sites and a markedly increase in the prevalence of urogenital *C. trachomatis* infection (10.6% vs. 4.6%) than previously reported.²¹ In contrast, less than 2% of FSWs working in San Francisco had pharyngeal or urogenital *C. trachomatis*/*N. gonorrhoeae* infections.²⁵ Compared with other studies, the prevalence of urogenital chlamydial and gonococcal infections is comparatively higher among FSWs in China (chlamydia: 14.6%–17.3%, gonorrhea: 5.4%–5.9%).^{26,27} Positive rate of pharyngeal gonorrhea observed in this study is similar to those reported in Singapore and Japan. A study by Wong and Chan⁸ revealed that approximately 5% of FSW in Singapore contracted pharyngeal *N. gonorrhoeae* after a 6-month follow-up period. In Japan, a lower prevalence of pharyngeal gonorrhea was documented in FSWs (4.0%),⁷ whereas in Israel, a much higher prevalence of 9.0% was reported among brothel-based FSWs.¹⁶

This study supports that community-based screening for pharyngeal and urogenital infections could facilitate the detection of STI in asymptomatic FSWs. Moreover, our findings highlight the increasing burden of pharyngeal gonococcal infection among FSW. In our analysis, more than 82% of *N. gonorrhoeae* infections were detected as isolated infection in the pharynx and only 1 case of concomitant urogenital gonococcal infection was identified. Although cases of pharyngeal *N. gonorrhoeae* are mostly asymptomatic, most FSWs would remain at risk for persistent infection if screening is restricted at urogenital site only. In consistent with previous study conducted in Japan, urogenital screening only detect a minority of cases and that pharyngeal *N. gonorrhoeae* infection is more common.⁷ Because regular screening for pharyngeal infections is not available for FSWs, most of the pharyngeal gonorrhea infections would remain undiagnosed and untreated, which serves as an important reservoir for the emergence of antimicrobial-resistant *N. gonorrhoeae*.²⁸ Given that the pharynx is well documented as the source of ongoing transmission of gonococcal infections, our study supports the need of additional screening for pharyngeal infections for FSW, in light of the growing concern of antibiotic-resistant gonococci that has been building up recently.²⁹

There are several limitations of this study. First, our study may be biased in terms of sampling. Female sex workers recruited in this study may be affiliated with the cooperating organization, and thus, they may share similar sexual practices. Moreover, nearly half of FSWs were recruited from clubs. The prolonged recruitment period (16 months) may also affect the estimated prevalence of the diseases. Second, the analysis of condom use was focused solely between FSW and their clients. We did not further examine the sexual behaviors between FSWs and their spouses or other sex partners, despite the fact that 40.0% of the study participants were married. It could be possible that some FSWs contracted the infection through their regular partners. Third, we only evaluated the prevalence for syphilis with an immunochromatographic assay. The sensitivity of the rapid treponemal tests could be

as low as 75% and failed to differentiate recent infection from past infection.³⁰

To conclude, the prevalence of *C. trachomatis*/*N. gonorrhoeae* infections was substantial among FSWs in Hong Kong. In particular, FSWs are at risk for pharyngeal gonococcal infection because of a suboptimal condom use rate and infrequent screening. Our study underscores the importance of pharyngeal STI screening in FSW, which will facilitate rapid diagnosis and treatment, prevent the emergence of antimicrobial-resistant *N. gonorrhoeae*, and reduce the ongoing transmission of STI among FSWs and their sex partners. Therefore, future public health programs will be most effective if the promotion of condom use for fellatio is incorporated, working in different settings is tailored for FSWs, and routine pharyngeal screening for STI is promoted.

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