Correlates of Chlamydia and Gonorrhea Infection among Female Sex Workers: The Untold Story of Jiangsu, China

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Abstract

Objective(s): To estimate the prevalence of sexually transmitted infections (STIs) among female sex workers (FSWs) in the Jiangsu Province, China and measure the association of Chlamydia trachomatis (CT) and Neisseria gonorrhoeae (NG) infections with their potential correlates.

Design: A cross-sectional study on a representative sample of FSWs in Yangzhou and Changzhou cities of Jiangsu was conducted.

Methods: 185 sex-work venues in Yangzhou and 174 in Changzhou were selected by stratified random sampling. 2972 FSWs (1108 in Yangzhou and 1864 in Changzhou), aged 15 years or more, who agreed to participate and provided blood sample for HIV and syphilis testing were interviewed in these venues. Cervical specimens from 849 randomly chosen participants were then tested for CT and NG.

Results: Proportions of young, school-educated, currently married FSWs who were living alone, migrated from other provinces and engaged in unprotected vaginal intercourse in past 3 months (UVI) were relatively high. Prevalence of HIV, syphilis, CT and NG were 0.20%, 4.88%, 14.61% and 5.42% respectively. Younger age, living alone or with persons other than partners/family members, engaging in UVI and having other STIs seemed to be associated with higher risk of CT or NG infection. Being divorced/widowed and working in middle/low-level venues were identified as additional risk factors for NG.

Conclusions: Based on a representative sample, this initial effort to identify the correlates of CT/NG infections among FSWs of Jiangsu revealed that focused interventions targeting high-risk FSWs are urgently required for controlling STI epidemics in Yangzhou and Changzhou where substantial number of STI cases were identified.

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Introduction

At the end of the year 2011, the estimated number of People Living With HIV/AIDS (PLWHA) was about 780,000 in China with a national HIV prevalence of 0.058% [1]. Among these HIV patients, 46.3% (2011 estimates, increased from 44.3% in 2009) were found to be infected through heterosexual route [1]. Since 2005, heterosexual contact had become the dominant HIV transmission route in this country [2]. Female Sex Workers (FSWs) played an important role in this HIV epidemic [3] owing to their increased propensity of having unprotected sex and concurrent partners [4]. In China, the number of females involved in this trade had reached 10 million in 2003 which generated serious public health concerns in terms of magnitude of the impact of their role in HIV epidemic [4]. According to the recent reports from sentinel surveillance sites, HIV prevalence among FSWs exceeded 1% in Yunnan, Xinjiang, Guangxi, Sichuan and Guizhou provinces/autonomous regions during 2011 [1].

Besides HIV/AIDS, public health concerns of this country also include epidemics of Sexually Transmitted Infections (STIs) caused by Treponema pallidum (syphilis), Chlamydia trachomatis (CT) and Neisseria gonorrhoeae (NG) while it has also been well established that the presence of any of these infections potentially increases the risk of acquisition of HIV by manifolds [5]. A report...
published in 2010 revealed that the expanding syphilis epidemic was very much likely to worsen the HIV scenario in China [6]. While 9% of Chinese males were found to be engaged in commercial sex, the bridging role of FSWs between high-risk and general population seemed to play a significant role in the upsurge of STI epidemic here [7]. A review of studies conducted between 1996–2010 involving FSWs in different regions across the country revealed the range of prevalence of active syphilis being 0.8–12.5% (median = 6.9%), chlamydia being 3.9–38.6% (median = 25.7%) and gonorrhea being 2.0–65.4% (median = 16.4%) [7]. Another study conducted in 8 cities of China between June and September 2009 reported CT and NG prevalence among FSWs to be as high as 5.91% and 17.30% respectively [3].

Like other regions, in the coastal province of Jiangsu in eastern China concentrated epidemics of HIV and other STIs among FSWs are some of the main public health challenges [8,9,10]. The percentage positivity of syphilis, CT, NG and HIV were reported to be 8.4%, 14.7%, 5.4% and 0.3% respectively among the FSWs participating in a cross-sectional study using convenience sampling [11]. However, to the best of our knowledge, no study has ever evaluated the correlates of CT and NG infections among FSWs in this province while published evidences regarding current epidemiological situation of syphilis, CT, NG and HIV among FSWs in Jiangsu are also scanty. Thus, all the intervention programs implemented so far among FSWs in this province were based on the experiences from successful strategies followed in other regions. Moreover, the available data regarding these epidemics in Jiangsu till date was mostly based on passive surveillances and thus was very much likely to suffer from miss/under reporting, under-recognition of diseases and huge variation in the quality of reporting systems [12]. Paucity of evidences regarding the HIV/STI burden and their correlates among FSWs of Jiangsu thus called for a comprehensive survey to understand the dynamics of HIV and STI epidemic in this population in order to identify the gaps and guide the policy-makers in designing intervention programs specifically targeted towards bridging them to control these epidemics among FSWs in Jiangsu.

Hence the objectives of this study were to estimate the prevalence of HIV and STIs among FSWs in the Jiangsu Province and to measure the association of CT and NG infections with their potential correlates.

Methods

Recruitment

This cross-sectional study was conducted in two cities (Yangzhou and Changzhou) in the Jiangsu province, between June and September 2009 as a part of the baseline survey for a huge integrated project (Mega Project). The Mega Projects were conducted by the China Ministry of Science and Technology (MOST) and Ministry of Health (MOH) to address the most important public health issues in China. The objective of this Mega Project was to identify and establish cohorts of high-HIV risk subpopulations (including FSWs) for the evaluation of the impact of expanded STI care on new HIV infection rate among those high-risk groups. In this project, to recruit a representative sample of FSWs, commercial sex work sites/venues were mapped and categorized according to the average socio-economic condition of the clients visiting each study site [3,13].

Based on the available information regarding prevalence of syphilis (4.4% in 2008) among FSWs in Jiangsu [14], required sample size was calculated to be 1616, assuming an α level (two-sided) of 0.05 and a relative precision of 1%. Following the recommendations of Furstenberg et al [15], to have a sample with stable variance by recruiting at least 5 FSWs from each commercial sex-work venue, 340 venues (targeting a sample size of 1700) were required to be selected (at least 170 in each city). Exhaustive lists of venues were thus prepared for both the cities. Following the methods used by other contemporary researchers, the venues where FSWs usually met their clients were classified into three subgroups: high, middle and low-level venues [3]. High-level venues referred to karaoke bars and hotels, middle-level included hair salons/barber shops, massage parlors, foot-bathing shops, roadside shops, guesthouses and roadside restaurants while low-level consisted of streets and other public outdoor places. To have a representative sample, with the help of stratified random selection procedure for selecting venues using probability proportional to size sampling, 185 venues (39 high, 99 middle and 47 low-level) in Yangzhou and 174 venues (35 high, 92 middle and 47 low-level) in Changzhou were selected. FSWs present at the time of survey in each of the selected sites were recruited if they met the eligibility criteria. To meet the inclusion criteria, the participants had to be: (1) biologically female; (2) involved in providing commercial sex in sex-work venues or rented apartments for money or goods during the previous three months; (3) aged 15 years or more and (4) willing to participate by providing informed consent. Participants who met the following criteria were excluded: (1) medical reasons or intoxication preventing from active participation; (2) currently or previously (during past 3 months) enrolled in any HIV behavioral intervention trial. All potential participants who declined to participate or otherwise did not participate were eligible for treatment and were not disadvantaged in any other way by not participating in the study.

Structured Interview

After the assessment of eligibility, written informed consents were collected from eligible subjects regarding participation in the study, collection of blood for free HIV and syphilis testing and cervical swab for free NG and CT testing.

A face-to-face interview using an interviewer-administered, pre-tested, structured questionnaire was conducted for each participant to collect information on demographics and recent sexual behaviors.

The demographic information included age (less than 20/20–29/30–39/40 and above), ethnicity (Han/others), education level (illiterate/elementary school/junior high school/senior high school/college and higher), marital status (never married/married/divorced or widowed), living status (with none/regular partner/causal partner/family members/others) and residency (official residency (Hukou) of the cities under study/Jiangsu province/other provinces).

Recent sexual behaviors were assessed by collecting information (yes/no) on: condom use during the last intercourse with clients and unprotected vaginal intercourse (UVI) which was defined as non-consistent use of condom during the previous three months while being engaged in commercial vaginal intercourse.

Laboratory Tests

Five ml of venous blood was collected from each participant for HIV and syphilis testing. HIV antibodies were screened using a rapid test (Acon Biotech Co., Ltd) and positive samples were re-tested by ELISA (Lizvon Pharmaceutical Group Co., Guangzhou, China). Blood samples positive for both tests were then subjected to Western Blot (HIVBLOT 2.2, Genelabs Diagnostics, Singapore) for confirmation of diagnosis. Syphilis antibodies were screened using ELISA (Wantai Biopharmacy Co., Ltd) and positive results were confirmed with Tiphueine Red Unheated Serum Test [TRUST: A Qualitative and Quantitative Card Test]
for the Serologic Detection of Syphilis (Wantai Biopharmacy Co., Ltd.). Western Blot positive participants were defined as HIV positive while persons positive for both ELISA and TRUST were defined as Syphilis positive.

The approximate sample size required for CT was 918 (using available information for Jiangsu) [14] and for NG it was 731 (using parameters from a contemporary study [16] in another province as for Jiangsu it was not available), assuming an \( \alpha \) level (two-sided) of 0.05 and a relative precision of 2%. Thus to enhance the cost-effectiveness while maintaining an average sample size we planned to select a random subsample of all recruited subjects, using blocking (through randomized block numbers equal for both cities) to have a comparable number for both cities through balanced recruitment and 849 subjects were selected in the process (414 in Yangzhou and 435 in Changzhou). Cervical specimens of the selected subjects were evaluated at the National STD Reference Laboratory at Nanjing for NG and CT testing by using Polymerase Chain Reaction (PCR: Roche Amplicor assay, Roche Diagnostic Systems, Indianapolis, IN).

Table 1. Demographics, sexual behavior and syphilis prevalence among recruited FSWs in the Yangzhou and Changzhou cities of Jiangsu, China (N = 2972).

| Variables | Categories | Tested for CT/NG | Not tested for CT/NG | Overall |
|-----------|------------|------------------|----------------------|---------|
|           | n         | % 95%CI          | n % 95%CI            | n %    |
| Age       | Less than 20 | 107 12.63 10.39,14.87 | 316 14.92 13.40,16.43 | 423 14.27 |
|           | 20-29      | 454 53.60 50.24,56.97 | 1125 53.10 50.99,55.24 | 1579 53.25 |
|           | 30-39      | 238 28.10 25.07,31.13 | 540 25.50 23.64,27.35 | 778 26.24 |
|           | 40 and above | 48 5.67 4.11,7.12 | 137 6.47 4.52,7.52 | 185 6.24 |
| Ethnicity | Han        | 822 97.97 97.02,98.93 | 2072 98.67 98.18,99.16 | 2894 98.47 |
|           | Others     | 17 2.03 1.07,2.98 | 28 1.33 0.84,1.82 | 45 1.53 |
| Education | Illiterate | 8 0.94 0.29,1.60 | 36 1.70 1.15,2.25 | 44 1.48 |
|           | Elementary school | 103 12.15 9.94,14.35 | 317 14.98 13.46,16.50 | 420 14.17 |
|           | Junior High school | 592 69.81 66.72,72.90 | 1295 61.20 59.12,63.28 | 1887 63.66 |
|           | Senior high school | 133 15.68 13.23,18.14 | 429 20.27 18.56,21.99 | 562 18.96 |
|           | College and higher | 12 1.42 0.62,2.21 | 39 1.84 1.27,2.42 | 51 1.72 |
| Marital status | Never Married | 382 45.53 42.15,48.91 | 1000 47.33 45.20,49.46 | 1382 46.82 |
|           | Married     | 434 51.73 48.34,55.12 | 1052 47.99 45.65,51.92 | 1486 50.34 |
|           | Divorced    | 20 2.38 2.00,2.76 | 12 0.60 0.34,0.96 | 32 1.23 |
| Living with | Widowed     | 3 0.36 0.00,0.76 | 3 0.14 0.00,0.30 | 6 0.20 |
|           | None        | 259 30.80 27.63,33.92 | 688 32.90 30.89,34.92 | 947 32.30 |
|           | Regular partner | 263 31.27 28.13,34.41 | 599 26.65 24.37,28.93 | 862 29.40 |
|           | Casual partner | 79 9.39 7.42,11.37 | 177 8.46 7.27,9.66 | 256 8.73 |
|           | Family members | 29 3.45 2.41,4.48 | 110 5.26 4.30,6.22 | 139 4.74 |
|           | Others      | 211 25.09 22.52,28.02 | 517 24.73 22.87,26.58 | 728 24.83 |
| Resident of (Hukou) | Cities under study | 190 22.51 19.69,25.34 | 452 21.29 19.55,23.03 | 642 21.64 |
|           | Jiangsu Province | 160 18.96 16.31,21.61 | 476 22.42 20.64,21.40 | 636 21.44 |
|           | Other Provinces | 494 58.53 55.20,61.86 | 1195 56.29 54.18,58.40 | 1689 56.93 |
| City      | Yangzhou   | 414 37.36 34.51,40.22 | 694 62.64 59.78,65.49 | 1108 37.28 |
|           | Changzhou  | 435 33.44 31.25,35.63 | 1429 66.56 64.74,68.38 | 1864 62.72 |
| Venue types | High level | 346 40.75 37.44,44.96 | 814 59.25 55.86,62.64 | 1160 39.03 |
|           | Middle level | 369 43.46 40.80,46.91 | 1006 56.54 53.70,60.38 | 1375 46.27 |
|           | Low level   | 134 15.78 13.33,18.24 | 303 84.22 76.78,91.66 | 437 14.70 |
| During last sex with client | Condom used | 620 81.79 79.04,84.55 | 1527 18.21 16.45,20.03 | 2147 81.54 |
|           | Condom not used | 138 18.21 15.45,20.96 | 348 81.86 78.04,85.62 | 486 18.46 |
| Used any kind of illicit drug in the past year | Yes | 5 0.59 0.07,1.11 | 6 0.28 0.06,0.51 | 11 0.37 |
|           | No         | 840 99.41 98.89,99.93 | 2112 99.72 99.49,99.94 | 2952 99.63 |
| UVI       | Yes        | 320 43.53 39.94,47.13 | 804 56.47 52.86,60.06 | 1124 44.44 |
|           | No         | 415 56.46 52.87,60.06 | 996 43.54 39.96,47.13 | 1411 55.66 |
| Syphilis  | Negative   | 803 94.82 93.32,96.31 | 2022 95.24 94.33,96.15 | 2827 95.12 |
|           | Positive   | 44 5.18 3.69,6.68 | 101 4.76 3.85,5.66 | 145 4.88 |

N: Total number of recruited FSWs.

n: Number of FSWs in each subcategories.

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Participants who were HIV positive were referred to the National HIV Care and Treatment Program and STI (syphilis, CT or NG) positives were referred to designated clinics or disease control centers for counseling, treatment and follow up.

Data Analysis
Data was double-entered using the software EpiData 3.0 [17] and multiple logic checks were used to ensure the data quality. SAS version 9.1 [18] was used for all statistical analyses. Descriptive analyses were conducted to determine the distribution of the demographic factors, sexual behaviors and to calculate the prevalence proportions [with 95% confidence intervals (95%CI)] of HIV and other STIs. In addition, to assess the strength and direction of the association between CT/NG infection and their potential correlates, simple logistic regressions were performed for univariate analysis [Odds ratio (OR) and 95%CI] and stepwise backward model selection method was used next for the multivariate analysis [variables having OR for at least one category with a p-value of less than 0.2 were included in the adjusted model] using multiple logistic regression.

Ethics Statement
The study process and content, as well as the consent procedures, were approved by the Ethics Committee of Jiangsu Provincial Center for Disease Prevention and Control (JSCDC). Signed informed consent was obtained from each participant prior to the interviews, blood collection and cervical swab collection. The ethics committee were notified that some participants were under 18 years and majority (98.5%) belonged to the Han race. Approximately 80% attended junior high school or less, 50% were currently married, 29% were living with their regular partners (family members) had much higher odds of being CT positive (OR = 2.40, 95% CI: 1.05–5.49) compared to those living alone. Recruited FSWs who were not the official residents of the cities under study, tended to have higher chances of CT infection (OR = 1.61, 95% CI: 0.87–2.98; AOR = 1.54, 95% CI: 0.73–3.28 for the residents of other cities in Jiangsu and OR = 1.53, 95% CI: 0.92–2.56; AOR = 1.25, 95% CI: 0.64–2.45 for the residents of other provinces) compared to the official residents of Changzhou and Yangzhou but these results also lacked power. (Table 3)

Table 3

### Correlates of CT infection

Both univariate and multivariate analyses indicated that compared to the 20–29 years age group, recruited FSWs aged 30–39 years were less likely to suffer from CT infection (unadjusted Odds Ratio: OR = 0.49, 95% CI: 0.30–0.82 while adjusted Odds Ratio: AOR = 0.52, 95% CI: 0.27–0.98). The youngest age group (aged less than 20 years) seemed to have highest odds of CT acquisition (OR = 1.39, 95% CI: 0.62–2.35; AOR = 1.50, 95% CI: 0.82–3.06) although the result lacked statistical power. Compared to those who attended junior high school, participants who attended senior high school (OR = 0.42, 95% CI: 0.27–0.67; AOR = 0.40, 95% CI: 0.23–0.70) had lower odds of having CT infection while FSWs having elementary school level education did show a lower likelihood of being CT positive (OR = 0.48, 95% CI: 0.24–0.96) in the unadjusted model. Univariate analysis also found that FSWs living with regular partners were less likely to acquire CT (OR = 0.50, 95% CI: 0.30–0.84) while those living with others (other than partners or family members) had much higher odds of being CT positive (OR = 2.40, 95% CI: 1.05–5.49) compared to those living alone. Recruited FSWs who were not the official residents of the cities under study, tended to have higher chances of CT infection (OR = 1.61, 95% CI: 0.87–2.98; AOR = 1.54, 95% CI: 0.73–3.28 for the residents of other cities in Jiangsu and OR = 1.53, 95% CI: 0.92–2.56; AOR = 1.25, 95% CI: 0.64–2.45 for the residents of other provinces) compared to the official residents of Changzhou and Yangzhou but these results also lacked power. (Table 3)

Being engaged in UVI was associated with higher odds of acquiring CT (AOR = 1.78, 95% CI: 1.10–2.87) after adjusting for other variables while similar indication was also there in the unadjusted analysis that lacked power (OR = 1.44, 95% CI: 0.98–2.11). Having syphils seemed to be positively associated with having CT (OR = 2.04, 95% CI: 1.00–4.16; AOR = 1.81, 95% CI: 0.83–3.96) while being positive for NG was strongly associated with CT infection (OR = 3.08, 95% CI: 1.61–5.89; AOR = 2.72, 95% CI: 1.29–5.76) in both unadjusted and adjusted models.

### Correlates of NG infection

Han ethnicity (OR = 2.42, 95% CI: 0.54–10.90; ref: others), college or higher level of education (OR = 3.63, 95% CI: 0.66–19.83; AOR = 7.15, 95% CI: 0.88–58.39; ref: senior high school level), being married (OR = 1.73, 95% CI: 0.91–3.30; AOR = 1.84, 95% CI: 0.75–4.53; ref: never married) and working in low-level sex-work venues (OR = 2.19, 95% CI: 0.89–5.24; AOR = 2.26, 95% CI: 0.77–6.62; ref: high-level) seemed to indicate higher likelihood of having NG but neither results were statistically significant. Univariate analyses revealed that, divorced/widowed FSWs (OR = 4.44, 95% CI: 1.17–16.79) and those who were selected from middle-level sex-work venues (OR = 2.31, 95% CI: 1.12–4.75; ref: high-level) had higher odds of being infected with NG. Subjects living with family members (OR = 0.34, 95% CI: 0.14–0.87; AOR = 0.35, 95% CI: 0.13–0.93; ref: living alone) and working in venues at Changzhou (OR = 0.25, 95% CI: 0.12–0.50; AOR = 0.13, 95% CI: 0.06–0.30; ref: Yangzhou) were less likely to be NG positive in both unadjusted and adjusted analyses. Engaging in UVI (OR = 2.05, 95% CI: 1.13–3.73; AOR = 1.96, 95% CI: 0.92–4.18) and being positive for Syphilis (OR = 3.02, 95% CI: 1.21–7.56; AOR = 4.70, 95% CI: 1.58–13.98) or CT (OR = 3.08, 95% CI: 1.61–5.39; AOR = 2.76, 95% CI: 1.32–5.81) were associated with higher likelihood of NG positivity (Table 4).
Discussion

In this comprehensive survey involving a representative sample of FSWs in two cities of Jiangsu province of China, the prevalence of STIs like CT (14.61%), NG (5.42%) syphilis (4.88%) and HIV (0.20%) were measured.

The observed proportions for CT and NG were lower than the findings from studies conducted among FSWs in Kaiyuan city in 2006 and 2008 [16,19], Guangzhou [20] and Gejiu [21]. Compared to a previous observation in Shenzhen, the prevalence of CT was higher while for NG it was much lower [22]. Syphilis prevalence measured in this study was similar to that in Sichuan province [23], lower than the observations in southwestern China [24]and India [25], but higher than some European countries [26,27]. Being one of the first investigations on burden of syphilis, CT and NG in Jiangsu based on a representative sample recruited through a multistage sampling frame involving probability sampling of commercial sex work venues, the observed proportions may be considered as realistic pictures of these STI epidemics in this province necessitating urgent target-oriented disease control programs among FSWs. While the differences in the observed burden might have resulted from differences in sampling techniques across the studies, the probability of having different epidemic situations in the source population of FSWs in respective areas should also be borne in mind.

Although only six FSWs were found to be positive for HIV in this study, keeping in mind the fact that the risk of HIV acquisition increases manifold in presence of STIs like CT, NG and syphilis [28,29,30], considerable number of identified cases of these STIs among FSWs in Jiangsu probably indicated towards the worrisome potential for inducing upsurge of HIV epidemic in this population. Additionally, by increasing immune activation of host cells and secretion of cytokines, these STIs may enhance viral replication among HIV patients, resulting in accelerated progression to AIDS [30].

Recruited FSWs were mostly young (93.8% were aged less than 40 years) and educated up to high-school level (only 1.7% had college-level or higher education). Lack of awareness may translate this lower educational attainment into increased risk of acquisition of STIs including HIV [31] due to greater likelihood of engaging in risky sexual behaviors [32,33]. Potential for being engaged in high-risk sexual behaviors might also be high in this population as 46.8% of them were never married and 34.1% were living with regular partners or family members [34]. A previous study evidenced that FSWs in China are highly mobile with turnover rate across venues being once in 3–4 months [4]. In our study, only 21.6% FSWs were the official residents of the city from where they were recruited, probably indicating that majority of this population was migrated and thus more likely to have risky sexual behaviors. Hence roll out of disease control programs to them seemed difficult [35]. 81.5% of the participants used condom during their last sex with clients but 44.3% did not use condom consistently for the past three months. Considering the evidences from contemporary scientific literature, these demographic and sexual behavioral patterns among FSWs of Jiangsu were likely to emphasize the vulnerability of this population regarding acquisition of HIV and other STIs [36,37].

While estimating the magnitude and direction of association between CT/NG infections and their potential correlates, younger FSWs seemed to be more vulnerable for CT acquisition. This finding corroborated with observations from other studies [3,19] and might be explained by the potential lack of awareness and access regarding STI control programs among younger FSWs along with their increased risk for getting exposed to other possible contributors like sexual violence and increased number of sexual acts. We didn’t find any consistent pattern of association between education and risk of acquiring CT or NG. Compared to the FSWs who were never married, divorced or widowed were much more likely to have NG infection. Similar observation had also been reported in other countries [38]. Lack of social and economic support might have compelled divorced or widowed women of lower socio-economic tier to get involved in this trade and exposed to sexual violence resulting in higher risk of STI acquisition. Social isolation and sexual deprivation might also be the reasons behind their vulnerability for unprotected sex and high risk sexual behaviors. These explanations may also support our observation that FSWs living with family members, regular or casual partners were less likely to acquire CT or NG compared to those who lived alone or with others.

Participants who used to work at middle or low-level commercial sex work venues had much higher risk of contracting NG infection compared to those in high-level venues. These

Table 2. Prevalence of HIV, Syphilis, CT and NG among FSWs in Jiangsu, China.

| Disease       | Yangzhou                  | Changzhou                  | Overall                  |
|---------------|---------------------------|----------------------------|--------------------------|
|               | N | %     | 95%CI | n  | %     | 95%CI | n  | %     | 95%CI |
| HIV (N = 2972)| N | %     | 95%CI | n  | %     | 95%CI | n  | %     | 95%CI |
| Positive      | 0 | 0.00  | –     | 6  | 0.32  | 0.13, 0.74 | 6  | 0.20  | 0.08, 0.46 |
| Negative      | 1108 | 100.00 | –     | 1858 | 99.68  | 99.26, 99.87 | 2966 | 99.80  | 99.54, 99.92 |
| Syphilis (N = 2972)| N | %     | 95%CI | n  | %     | 95%CI | n  | %     | 95%CI |
| Positive      | 31 | 2.80  | 1.82, 3.77 | 114 | 6.12  | 5.03, 7.20 | 145 | 4.88  | 4.15, 5.73 |
| Negative      | 1077 | 97.20 | 96.23, 98.17 | 1750 | 93.88  | 92.80, 94.97 | 2827 | 95.12  | 94.27, 95.85 |
| CT (N = 849)  | N | %     | 95%CI | n  | %     | 95%CI | n  | %     | 95%CI |
| Positive      | 55 | 13.29 | 10.00, 16.57 | 69  | 15.86 | 12.42, 19.31 | 124 | 14.61 | 12.33, 17.20 |
| Negative      | 359 | 86.71 | 83.43, 90.00 | 366 | 84.14 | 80.69, 87.58 | 725 | 85.39 | 82.80, 87.67 |
| NG (N = 849)  | N | %     | 95%CI | n  | %     | 95%CI | n  | %     | 95%CI |
| Positive      | 36 | 8.70  | 5.97, 11.42 | 10  | 2.30  | 0.88, 3.71 | 46  | 5.42  | 4.04, 7.22 |
| Negative      | 377 | 91.30 | 88.58, 94.03 | 425 | 97.70 | 96.29, 99.12 | 803 | 94.58 | 92.78, 95.96 |

N: Total number of FSWs tested for the corresponding diseases.

n: Number of FSWs in each subcategories.

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findings corroborated with observations from several other studies [3,19,24,39]. FSWs in the middle or lower-level venues probably had poor awareness and less social safety, hence were more vulnerable to sexual violence, unprotected sex and risky behaviors including serving more clients compared to their counterparts in high-level venues [40].

Official residency of other cities/provinces seemed to be associated with higher risk of CT infection compared to the residents of Yangzhou and Changzhou, among FSWs sampled from these two cities. Thus migrating from other areas for sex work was probably associated with increased risk of STI acquisition in this population [34], which may well result in worsening of the HIV and STI epidemic situations in Jiangsu Province.

Alike others [16,20], our results also indicated that UVI was an important risk factor for acquisition of CT or NG among FSWs. These findings probably emphasized on the urgent need for condom promotion in commercial sex work venues of Yangzhou and Changzhou.

### Table 3. Associations of demographic factors, sexual behavior and other STIs with CT infection among selected FSWs in the Yangzhou and Changzhou cities of Jiangsu, China (N = 849).

| Variables                        | Unadjusted OR(95%CI) | p value | Adjusted OR(95%CI) | P value |
|----------------------------------|----------------------|---------|---------------------|---------|
| **Age**                          |                      |         |                     |         |
| Less than 20                     | 1.39(0.82,2.35)      | 0.22    | 1.58(0.82,3.06)     | 0.17    |
| 20–29                            | Reference            |         | Reference           |         |
| 30–39                            | 0.49(0.30,0.82)      | 0.01*   | 0.52(0.27,0.98)     | 0.04*   |
| 40 and above                     | 0.59(0.23,1.54)      | 0.28    | 0.62(0.21,1.87)     | 0.40    |
| **Ethnicity**                    |                      |         |                     |         |
| Others                           | Reference            |         |                    |         |
| Han                              | 0.78(0.18,3.45)      | 0.74    |                     |         |
| **Education**                    |                      |         |                     |         |
| Illiterate                       | 1.02(0.20,5.30)      | 0.98    | 1.52(0.25,9.17)     | 0.64    |
| Elementary school                | 0.48(0.24,0.96)      | 0.04*   | 0.72(0.32,1.60)     | 0.42    |
| Junior High school               | Reference            |         | Reference           |         |
| Senior high school               | 0.42(0.27,0.67)      | <0.001* | 0.40(0.23,0.70)     | 0.001*  |
| College and higher               | 1.02(0.26,3.99)      | 0.98    | 0.60(0.11,3.26)     | 0.55    |
| **Marital status**               |                      |         |                     |         |
| Never Married                    | Reference            |         | Reference           |         |
| Married                          | 0.70(0.48,1.04)      | 0.08    | 1.44(0.73,2.82)     | 0.29    |
| Divorced/Widowed                 | 0.54(0.12,2.38)      | 0.41    | 0.91(0.17,4.79)     | 0.91    |
| **Living with**                  |                      |         |                     |         |
| None                             | Reference            |         | Reference           |         |
| Regular partner                  | 0.50(0.30,0.84)      | 0.01*   | 0.63(0.33,1.23)     | 0.18    |
| Casual partner                   | 0.66(0.32,1.38)      | 0.27    | 0.52(0.22,1.24)     | 0.14    |
| Family members                   | 0.76(0.46,1.24)      | 0.27    | 0.76(0.40,1.48)     | 0.62    |
| Others                           | 2.40(1.05,5.49)      | 0.04*   | 2.30(0.85,6.22)     | 0.10    |
| **Resident of (Hukou)**          |                      |         |                     |         |
| Cities under study               | Reference            |         | Reference           |         |
| Jiangsu Province                 | 1.61(0.87,2.98)      | 0.14    | 1.54(0.73,3.28)     | 0.26    |
| Other Provinces                  | 1.53(0.92,2.56)      | 0.10    | 1.25(0.64,2.45)     | 0.51    |
| **City**                         |                      |         |                     |         |
| Yangzhou                         | Reference            |         | #                   |         |
| Changzhou                        | 1.23(0.84,1.80)      | 0.29    |                     |         |
| **Venue types**                  |                      |         |                     |         |
| High level                       | Reference            |         | Reference           |         |
| Middle level                     | 1.38(0.91,2.08)      | 0.13    | 1.25(0.72,2.17)     | 0.43    |
| Low level                        | 0.91(0.49,1.67)      | 0.75    | 0.74(0.31,1.76)     | 0.49    |
| **During last sex with client**  |                      |         |                     |         |
| Condom used                      | Reference            |         | #                   |         |
| Condom not used                  | 1.04(0.62,1.75)      | 0.88    |                     |         |
| **UVI**                          |                      |         |                     |         |
| No                               | Reference            |         | Reference           |         |
| Yes                              | 1.44(0.98,2.11)      | 0.06    | 1.78(1.10,2.87)     | 0.02*   |
| **Syphilis**                     |                      |         |                     |         |
| Negative                         | Reference            |         | Reference           |         |
| Positive                         | 2.04(1.00,4.16)      | 0.05    | 1.81(0.83,3.96)     | 0.14    |
| **NG**                           |                      |         |                     |         |
| Negative                         | Reference            |         | Reference           |         |
| Positive                         | 3.08(1.61,5.89)      | <0.001* | 2.72(1.29,5.76)     | 0.01*   |

N: Total number of FSWs tested for the corresponding disease.

*Indicates p-value less than 0.05.

#: Variable not included in the adjusted model (as p values for the unadjusted association for all categories were >0.2).

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In the current study sample, having other STI (syphilis, NG for CT or CT for NG) was positively associated with risk of acquiring each of these diseases. Similar results were reported in several other studies conducted among FSWs [19]. As all these infections share the similar mechanisms of transmission, infection by one organism offers more potential opportunities for others [3,19].

According to our knowledge this was the first effort in Jiangsu to determine the association of CT and NG infections with their potential predictors. By virtue of its sampling design this study was able to recruit a representative population of FSWs in two cities of Jiangsu. The measured prevalence of HIV and other STIs as well as the observed associations of CT and NG infections with their potential predictor can thus be extrapolated by the policy-makers for the purpose of designing appropriate targeted interventions. Large sample size, use of biological markers, advanced laboratory investigation techniques and following uniform study protocol for extensive training of all study personnel to minimize interviewer bias were major strengths of this study. Moreover, prompt referral

### Table 4. Association of demographic factors, sexual behavior and other STIs with NG infection among selected FSWs in the Yangzhou and Changzhou cities of Jiangsu, China (N = 849).

| Variables                        | Unadjusted OR(95%CI) | p value | Adjusted OR(95%CI) | p value |
|----------------------------------|----------------------|---------|--------------------|---------|
| Age                              |                      |         |                    |         |
| Less than 20                     | 1.21(0.51,2.87)      | 0.67    |                    | #       |
| 20–29                            | Reference            |         |                    |         |
| 30–39                            | 1.00(0.50,1.98)      | 0.99    |                    |         |
| 40 and above                     | 0.37(0.05,2.77)      | 0.33    |                    |         |
| Ethnicity                        |                      |         |                    |         |
| Others                           | Reference            |         |                    | #       |
| Han                              | 2.42(0.54,10.90)     | 0.25    |                    |         |
| Education                        |                      |         |                    |         |
| Illiterate                       | -                    |         |                    | -       |
| Elementary school                | 1.12(0.36,3.45)      | 0.84    | 0.58(0.17,1.97)    | 0.38    |
| Junior High school               | 1.00(0.43,2.33)      | 1.00    | 0.67(0.26,1.71)    | 0.40    |
| Senior high school               | Reference            |         | Reference          |         |
| College and higher               | 3.63(0.66,19.83)     | 0.14    | 7.15(0.88,58.39)   | 0.07    |
| Marital status                   |                      |         |                    |         |
| Never Married                    | Reference            |         |                    | Reference |
| Married                          | 1.73(0.91,3.30)      | 0.09    | 1.84(0.75,4.53)    | 0.25    |
| Divorced/Widowed                 | 4.44(1.17,16.79)     | 0.03*   | 2.55(0.43,15.14)   | 0.30    |
| Living with                      |                      |         |                    |         |
| None                             | Reference            |         | Reference          |         |
| Regular partner                  | 0.61(0.30,1.24)      | 0.17    | 1.06(0.47,2.43)    | 0.88    |
| Casual partner                   | 0.46(0.13,1.59)      | 0.22    | 0.76(0.20,2.85)    | 0.69    |
| Family members                   | 0.34(0.14,0.87)      | 0.02*   | 0.35(0.13,0.93)    | 0.04*   |
| Others                           | 1.35(0.38,4.84)      | 0.64    | 1.63(0.38,6.97)    | 0.51    |
| Resident of (Hukou)              |                      |         |                    |         |
| Cities under study               | Reference            |         |                    | Reference |
| Jiangsu Province                 | 0.76(0.29,2.02)      | 0.59    |                    |         |
| Other Provinces                  | 1.00(0.49,2.06)      | 0.99    |                    |         |
| City                             |                      |         |                    |         |
| Yangzhou                         | Reference            |         |                    | Reference |
| Changzhou                        | 0.25(0.12,0.50)      | <0.001* | 0.13(0.06,0.30)    | <0.001* |
| Venue types                      |                      |         |                    |         |
| High level                       | Reference            |         | Reference          |         |
| Middle level                     | 2.31(1.12,4.75)      | 0.02*   | 2.03(0.83,4.99)    | 0.12    |
| Low level                        | 2.19(0.89,5.42)      | 0.09    | 2.26(0.77, 6.62)   | 0.14    |
| During last sex with client      |                      |         |                    |         |
| Condom used                      | Reference            |         |                    | #       |
| Condom not used                  | 0.87(0.38,1.99)      | 0.74    |                    |         |
| UVI                              |                      |         |                    |         |
| No                               | Reference            |         | Reference          |         |
| Yes                              | 2.05(1.13,3.73)      | 0.02*   | 1.96(0.92,4.18)    | 0.08    |
| Syphilis                         |                      |         |                    |         |
| Negative                         | Reference            |         | Reference          |         |
| Positive                         | 3.02(1.21,7.56)      | 0.02*   | 4.70(1.58,13.98)   | 0.005*  |
| CT                               |                      |         |                    |         |
| Negative                         | Reference            |         | Reference          |         |
| Positive                         | 3.08(1.61,5.89)      | <0.001* | 2.76(1.32,5.81)    | 0.01*   |

N: Total number of FSWs tested for the corresponding disease.
*Indicates p-value less than 0.05.
#: Variable not included in the adjusted model (as p values for the unadjusted association for all categories were >0.2).

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of the FSWs diagnosed with HIV/syphilis/CT/NG to the appropriate treatment/counseling center for proper treatment and follow up can also be considered as an additional benefit from this study.

There were quite a few limitations in our study. Because of the cross-sectional design, temporal ambiguity prevented us from drawing causal inferences based on our results and we recommend that any such interpretation should be made with caution. Vulnerability of the self-reported information to social desirability bias, might lead to misclassification in our study. But we think even if misclassifications were there they were most likely to be non-differential as the STI positivity status of the subjects were not determined at the time of the interview. Although there remained some potential for differential misclassification due to the possibility of the responses by FSWs having symptoms or prior diagnosis of any STI being different from others, we still believe that the magnitude will be negligible. Selection bias and lack of generalizability were other likely shortcomings but they were probably been taken care of by our sampling technique which was planned for recruiting a representative population. Regarding the selection of venues of commercial sex work, although we used probability sampling (probability proportional to size with stratified random sampling), in the next stage we used convenience sampling (all the FSWs present in the venue were recruited). Hence the chances of over-representation of more sexually active FSWs were always there, but we believe that sexual activity of the recruited subjects was less likely to be an important biasing factor. Despite of having a larger overall sample, the size of chosen subsample for CT/NG testing was not sufficient enough for having adequate power of analysis while determining the association of some of the demographic and behavioral factors with CT and NG. As it was not possible for us to have an exhaustive questionnaire while interviewing the FSWs in the sex-work venues, information was collected only on selected sexual behaviors and covariates leading to the possibilities of residual confounding.

Conclusion

Based on the representative sample, despite of all the limitations, it can be concluded that substantial number of STI cases were found to be present among FSWs in Yangzhou and Changzhou and having any STI was highly correlated with the risk of having others. Focused interventions are urgently required for controlling the epidemics of HIV and other STIs among FSWs of Jiangsu province of China, specifically targeting those who are young, divorced/widowed, living alone or with persons other than partners or family members and habitation in unprotected commercial vaginal intercourse.

Author Contributions

Conceived and designed the experiments: WT JP GF. Performed the experiments: NJ HH YY WX NL NZ XH HY GF. Analyzed the data: WT JP GF TM SM. Contributed reagents/materials/analysis tools: WT JP GF TM SM. Wrote the paper: WT TM.

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