

# Prevalence and Predictors of Syphilis in Female Sex Workers in Eastern China: Findings from Six Consecutive Cross-Sectional Surveys

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**Purpose:** Female sex workers play an important role in transmitting HIV and syphilis from high-risk groups to the general population. However, epidemic trends and risk factors for syphilis in Chinese female sex workers (FSWs) remain unclear.

**Methods:** Using convenient sampling methods, 2482 FSWs were interviewed and tested for syphilis from 2014 to 2019, all of them were divided into two groups of high-grade FSWs and low-grade FSWs according to service solicited and clients price there were. Demographic data were collected and logistic regression analysis was used to identify risk factors for syphilis.

**Results:** 43.67% of participants have received free condoms, 76.15% of them engaged in peer education of the 2482 FSWs tested for syphilis, 107 (4.31%) were positive. The prevalence of syphilis in high-grade FSWs was significantly lower than that in low-grade FSWs (3.14% and 5.62%, respectively). The overall prevalence of syphilis increased from 3.19% to 4.47%. The percentage of FSWs received free condoms and engaged in peer education increased significantly. With upgraded awareness of syphilis, the number of FSWs having protected sex also increased significantly. It is also found that low-grade female sex workers are at greater risk of syphilis than those high-grade ones (odds ratio (OR) = 1.76, 95% CI 1.18–2.63,  $p < 0.05$ ).

**Conclusion:** Great awareness of syphilis and the increased utilization of condom did not reduce the prevalence of syphilis, especially in low-grade FSWs group. More effective integrated interventions should be developed for such populations.

**Keywords:** education, risk reduction, health promotion, risk behaviours, syphilis

## Introduction

Syphilis is an infectious disease caused by the spirochete *Treponema pallidum*. Many countries have committed to reducing the rates of adult syphilis, and to eliminating congenital syphilis.<sup>1</sup> The World Health Organization (WHO) “Global Health Sector Strategy on Sexually Transmitted Infections (STIs) 2016–2021” has two syphilis-related targets.<sup>2,3</sup> Between 2012 and 2016, the prevalence of probable active syphilis in women decreased in 54 (41%) of 132 eligible countries; this decrease was substantive in 5 countries.<sup>4</sup> Still the need for increasing investments in national syphilis surveillance and control efforts is to be met.

Syphilis is also common in China as the third most common infectious disease.<sup>5,6</sup> The average annual increase in the incidence of syphilis was as high as 16.3% between 2004 and 2013,<sup>7</sup> which was mainly due to a large commercial sex industry with

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approximately 10 million female sex workers (FSWs).<sup>8</sup> FSWs in China are hard to be reached by conventional health manage and intervention programs.<sup>9</sup> In China, FSWs play an important role in the transmission of STIs from high-risk groups to the general population.<sup>10,11</sup> The prevalence of syphilis among specific high-risk populations including FSWs is monitored by conducting human immunodeficiency virus (HIV) sentinel surveillance surveys.<sup>12</sup> The prevalence of syphilis in FSWs varies in different places.<sup>13,14</sup>

Syphilis is essentially a behavioral related disease and health education has been recognized worldwide as an effective measure to control its spread.<sup>15–17</sup> Lack of knowledge about precautions and high rates of risk behavior are major factors contributing to the expanding epidemic.<sup>18</sup> During the Cultural Revolution in China (1966–1976), STIs were so uncommon that they were removed from standard Chinese medical training curricula.<sup>19</sup> In addition to vaccination and treatment-based strategies for STIs, continued and effective health education and behavioral intervention strategies can reduce the incidence of unprotected sex. However, continuing cross-sectional studies focusing on syphilis are rare in China and data on low-grade FSWs who solicit clients on the street are limited.

In this study, through the analysis of six cross-sectional studies conducted from the same county, we investigated the relationship between awareness of syphilis, risk behaviors and syphilis prevalence in 2482 subjects, aiming to find the prevalence of syphilis in FSWs in different soliciting venues, and identified predictors of infection risk among FSWs.

## Methods

### Study Setting and Sample

Tongxiang, located in eastern China, has approximately 0.8 million residents and a relatively high rate of immigration.<sup>20</sup> Tongxiang has a highly developed economy and FSWs are active in various different venues in the main urban areas.

### Participants and Public Involvement

Using a convenient sampling strategy, about 400 subjects soliciting in various venues were enrolled into the study between March and June of each year from 2014 to 2019; in total, 2482 participants were enrolled. To be eligible for the study, participants had to meet the following requirements: 1) age  $\geq 16$  years; 2) self-reported participation in sex work within the last 3 months; and 3) consent to have their blood tested for syphilis.

We developed a unified protocol and all surveyors received strict training. To ensure the reliability of the research data, the owners or managers of the selected entertainment venues were also invited to participate in the training.

After receiving training from staff members of Zhejiang University and Tongxiang Center for Disease Control and Prevention, field staff completed the sample recruitment, face to face anonymous investigation and blood sampling according to the unified protocol. To protect confidentiality, each subject surveys and collected specimen was assigned a corresponding participant identity number. After provided written informed consent, participants were asked a series of questions regarding to their demographics, interventions undertaken, awareness of syphilis and risk behaviors. Blood samples were collected at the same time. After the data statistics, the results have been disseminated to study participants.

### Data Definition

The participants were divided into four age groups, including  $\leq 20$ , 21–25, 26–30 and  $>30$  years, respectively. According to service solicited and clients price, the participants were divided into high-grade FSWs (usually in hotels, saunas, nightclubs or karaoke venues) and low-grade FSWs (usually on the street or in other public outdoor places). The Risk behavior level was defined as the usage frequency of condoms for all sex activities in the past month. Knowledge awareness was assessed using an 8-item questionnaire designed by the Chinese CDC.<sup>21</sup> Giving six of eight correct answers was defined as correct knowledge. Subjects who engaged in peer education were supported to promote health-enhancing change among their peers.

### Ethics

The study was conducted in accordance with the declaration of Helsinki, the ethical approval for the study was granted by the Ethics Committee of The First Affiliated Hospital at the School of Medicine of Zhejiang University, and the Ethics Committee approved participants under the age of 18 providing informed consent on their own behalf. The objectives, potential risks and benefits of the study were provided to potential participants during recruitment. All the participants completed the consent statement before the study by themselves. Those who were confirmed to have syphilis were enrolled in a syphilis follow-up management system and a cohort study.

## Blood Test

Serum specimens were tested for syphilis with a rapid plasma reagin (RPR) test (Rongsheng Biotech Company, Shanghai, China). Positive samples on the RPR test underwent *Treponema pallidum* particle assay (TPPA) (Livzon Inc., Zhuhai, China). Participants with positive results on both the RPR test and the TPPA were considered as syphilis.

## Data Analysis

All data collected by paper-and-pencil surveys were input manually into a custom-designed database and analyzed using SPSS for Windows Version 16.0. Descriptive statistics were generated for each of the general characteristics variables. We used chi-square tests to compare prevalence among different demographic groups. Logistic regression analysis was performed to test risk factors associated with syphilis. All statistical tests were two-sided with a significance level of 0.05.

## Results

### Demographic Characteristics of Participants

2482 FSWs were enrolled in the study, the number of people included each year was 407, 403, 403, 426, 440 and 403, respectively. 1307 participants (52.66%) were categorized as high-grade FSWs and 1175 (47.34%) as low-grade FSWs. Most of them were single (41.46%) and married (46.58%), and only 8.86% of them received high school education or above, seeing Table 1.

Among the high-grade FSWs, the most common age group was 21–25 years (37.26%) and 46.29% of them were unmarried. The most common age group among the low-grade FSWs was > 30 years and 53.96% were single. Most participants had completed junior school education (61.28% and 55.4% for high- and low-grade, respectively).

### Intervention, Syphilis Awareness, Behavioral Characteristics and Cross-Analysis

Totally, 43.67% of them have received free condoms, 76.15% of which were engaged in peer education. Receipt of free condoms in high-grade FSWs (48.43%) was significantly higher than that in low-grade FSWs (38.55%) ( $p < 0.001$ ), while awareness of syphilis in high-grade FSWs (87.99%) was significantly lower than that in low-grade FSWs (91.91%) ( $p = 0.001$ ).

The percentage of FSWs received free condoms and engaged in peer education increased significantly over the study period (from 46.44% to 56.08% and 7.13% to 37.47%, respectively,  $p < 0.05$ ). Awareness of syphilis and the percentage of FSWs having protected sex also increased significantly (82.06% to 89.33% and 43.73% to 49.38%, respectively,  $p < 0.05$ , Table 2).

### Syphilis Prevalence of Participants

Of the 2482 FSWs samples tested for syphilis, 107 (4.31%) were positive. The prevalence of syphilis in high-grade FSWs was significantly lower than that in low-grade FSWs (3.14% vs 5.62%). Different marital status showed significant differences in prevalence of syphilis among all participants ( $p = 0.002$ ). This trend could also be found in high- and low-grade FSWs people ( $p = 0.034$ ,  $p = 0.025$ ) with the highest level in divorced and widowed status. Also, the prevalence of syphilis was related to the education level. Higher education level may result with lower prevalence ( $p = 0.011$ ), and the same significant trend can be seen in high-grade FSWs ( $p = 0.02$ ). And this level also increased with the upgrade of age, but there was no significant difference can be observed, seeing Table 3.

The overall prevalence of syphilis increased from 3.19% to 4.47% (Table 2) from 2014 to 2019. The prevalence in high-grade FSWs declined from 2.95% to 1.32%, whereas in low-grade FSWs it increased from 3.92% to 6.35%, which was responsible for the observed overall increase. The prevalence of syphilis in high-grade FSWs was significantly lower than that in low-grade FSWs in 2018 and 2019 ( $p < 0.05$ , Figure 1). The results showed that the prevalence of syphilis in participants who received condom was significantly lower than those without receiving condom ( $p = 0.031$ ).

### Risk Associations

Univariate analysis of syphilis-related risk factors showed that, compared with high-grade FSWs, syphilis risk level was greater in low-grade FSWs (odds ratio (OR) = 1.76, 95% CI 1.18–2.63,  $p < 0.05$ ). Compared with those under divorced and widowed status, the single, married and cohabiting FSWs were at lower risk of syphilis (OR = 0.29, 95% CI 0.13–0.62,  $p = 0.001$ ; OR = 0.29, 95% CI 0.19–0.84,  $p = 0.015$ ; OR = 0.2, 95% CI 0.06–0.61,  $p = 0.005$ ; respectively). Similar results can be seen in low-grade FSWs. For high-grade FSWs, compared with the high school or above education group, syphilis risk was higher for those receiving primary school or below and junior school education (OR = 4.39, 95% CI 1.01–19.15,  $p = 0.049$ ; OR = 2.1, 95% CI 0.49–9.02,  $p = 0.321$ ; respectively Table 4).

**Table 1** Demographics of Female Sex Workers (FSWs) in Six Consecutive Cross-Sectional Surveys

		All FSWs n (%)	High-Grade FSWs n (%)	Low-Grade FSWs n (%)
Venues	High-grade places Low-grade places	1307(52.66) 1175(47.34)		
Age (years)	≤20	653(26.31)	343(26.24)	310(26.38)
	21~25	744(29.98)	487(37.26)	257(21.87)
	26~30	479(19.30)	268(20.5)	211(17.96)
	>30	606(24.42)	209(15.99)	397(33.79)
Marital status	Single	1029(41.46)	605(46.29)	424(36.09)
	Married	1156(46.58)	522(39.94)	634(53.96)
	Cohabiting	216(8.70)	135(10.33)	81(6.89)
	Divorced & widowed	81(3.26)	45(3.44)	36(3.06)
Education	Primary school or below	803(32.35)	340(26.01)	463(39.4)
	Junior school	1459(58.78)	808(61.82)	651(55.4)
	High school or above	220(8.86)	159(12.17)	61(5.19)
Receipt of free condoms	Yes	1086(43.76)	633(48.43)	453(38.55)
	No	1396(56.24)	674(51.57)	722(61.45)
Peer education	Yes	1890(76.15)	985(75.36)	905(77.02)
	No	592(23.85)	322(24.64)	270(22.98)
Risk behaviors	Yes	1177(47.42)	622(47.59)	555(47.23)
	No	1305(52.58)	685(52.41)	620(52.77)
Knowledge awareness	Yes	2230(89.85)	1150(87.99)	1080(91.91)
	No	252(10.15)	157(12.01)	95(8.09)
Syphilis	Positive	107(4.31)	41(3.14)	66(5.62)
	Negative	2375(95.69)	1266(96.86)	1109(94.38)

**Table 2** Knowledge, Behavioral, Intervention and Serological Characteristics of Female Sex Workers in Six Consecutive Cross-Sectional Surveys

	2014 (N=407) n (%)	2015 (N=403) n (%)	2016 (N=403) n (%)	2017 (N=426) n (%)	2018 (N=440) n (%)	2019 (N=403) n (%)	p value*	p value for Trend **
Receipt of free condoms	189(46.44)	200(49.63)	219(54.34)	274(64.32)	288(65.45)	226(56.08)	<0.01	<0.01
Peer education	29(7.13)	84(20.84)	105(26.05)	89(20.89)	134(30.45)	151(37.47)	<0.01	<0.01
Knowledge awareness	334(82.06)	353(87.59)	370(91.81)	396(92.96)	417(94.77)	360(89.33)	<0.01	<0.01
Risk behaviors	178(43.73)	237(58.81)	222(55.09)	218(51.17)	251(57.05)	199(49.38)	<0.01	0.326
Syphilis	13(3.19)	15(3.72)	14(3.47)	27(6.34)	20(4.55)	18(4.47)	0.254	0.162

Notes: \*By Chi-square test. \*\*Linear-by-linear association analysis by Chi-square test.

## Discussion

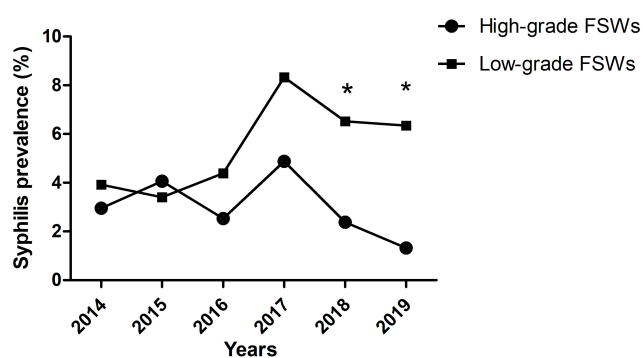
In the present study, the prevalence of syphilis was 4.31%, which is consistent with that in Yunnan but lower than that in Xichang and Shandong Province (15.7% and 7.4%, respectively).<sup>22–26</sup> The prevalence varied significantly between FSW grade, being 3.14% in high-grade FSWs and 5.62% in low-grade FSWs. Previous studies have found

extremely high prevalence of syphilis in low-grade FSWs, ranging from 10% to 38%.<sup>27,28</sup> FSWs working in low-grade venues tend to have a greater number of clients, but infrequently use condoms due to extra payments for unsafe sex;<sup>29</sup> furthermore, low-grade FSWs independently solicit clients either on streets or at construction sites and factories<sup>29</sup> and more frequently vary their working locations.<sup>29–31</sup> From the

**Table 3** Comparison of Demographic and Behavioral Characteristics of Syphilis Positive and Syphilis Negative Female Sex Workers

		All FSWs		High-Grade FSWs		Low-Grade FSWs	
		Syphilis Positive (N=107) n(Prevalence %)	p value	Syphilis Positive (N=41) n(Prevalence %)	p value	Syphilis Positive (N=66) n(Prevalence %)	p value
Age (years)	≤20	22(3.37)	0.059	8(2.33)	0.181	14(4.52)	0.711
	21~25	26(3.49)		12(2.46)		14(5.45)	
	26~30	22(4.59)		10(3.73)		12(5.69)	
	>30	37(6.11)		11(5.26)		26(6.55)	
Marital status	Single	35(3.40)	0.002	16(2.64)	0.034	19(4.48)	0.025
	Married	58(5.02)		22(4.21)		36(5.68)	
	Cohabiting	5(2.31)		0(0.00)		5(6.17)	
	Divorced&widowed	9(1.11)		3(6.67)		6(16.67)	
Education	Primary school or below	48(5.98)	0.011	18(5.29)	0.02	30(6.48)	0.584
	Junior school	54(3.70)		21(2.60)		33(5.07)	
	High school or above	5(2.27)		2(1.26)		3(4.92)	
Receipt of free condoms	Yes	36(3.31)	0.031	15(2.37)	0.123	21(4.64)	0.247
No	71(5.09)	26(3.86)		45(6.23)			
Peer education	Yes	75(3.97)	0.133	30(3.05)	0.741	45(4.97)	0.079
No	32(5.41)	11(3.42)		21(7.78)			
Risk behaviors	Yes	56(4.76)	0.298	20(3.22)	0.877	36(6.49)	0.221
No	51(3.91)	21(3.07)		30(4.84)			
Knowledge awareness	Yes	92(4.13)	0.176	34(2.96)	0.311	58(5.37)	0.216
	No	15(5.95)		7(4.46)		8(8.42)	

analysis of six independent samples, we found that the prevalence of syphilis was 3.19% to 4.47% and exhibited an increasing trend over the study period with no significant difference. The increase in overall prevalence was mainly due to the increase values among low-grade FSWs (from 3.92% to 6.35%); while the prevalence in the high-grade FSWs decreased.



**Figure 1** Syphilis prevalence in female sex workers (FSWs) from 2014 to 2019. **Note:** \*Significant difference ( $p < 0.05$ ) between high- and low-grade FSWs.

Risk behaviors and socio-demographic characteristics of FSWs linked to the sex trade may be associated with risk of syphilis and other STIs.<sup>32,33</sup> In our study, we found that distribution of free condoms and peer education may increase syphilis awareness and reduce high-risk behavior, but these interventions did not reduce the prevalence of syphilis. Cross-analysis showed that preventive measures can affect both cognitive and behavioral factors ( $p < 0.05$ ), but the rate of infection was not significantly reduced ( $p > 0.05$ ), especially in low-grade FSWs. In the low-grade FSWs group, the receipt of free condoms and awareness of syphilis were greater but there was a significant increase in the prevalence of syphilis. From the results of this study, we can assume that subjective cognitive measures do not accurately reflect behaviors. In addition, awareness of the benefits of condom use for the reduction of STI acquisition may not be the determinant for use of condoms. Observational studies have reported that the presence of syphilis and herpes simplex virus 2 infection increased the risk of HIV acquisition 2–3-fold.<sup>34–36</sup>

**Table 4** Odds Ratios (OR) and 95 Confidence Intervals (CI) of Syphilis Among All Female Sex Workers (FSWs) and According to Location of Venues

Items		All FSWs		High-Grade FSWs		Low-Grade FSWs	
		OR(95% CI)	p value	OR(95% CI)	p value	OR(95% CI)	p value
Venues	High-grade places	Ref		–		–	
	Low-grade places	1.76(1.18–2.63)	0.006				
Marital status	Single	0.29(0.13–0.62)	0.001	–		0.24(0.09–0.63)	0.004
	Married	0.4(0.19–0.84)	0.015			0.3(0.12–0.77)	0.012
	Cohabiting	0.2(0.06–0.61)	0.005			0.33(0.09–1.16)	0.084
	Divorced & widowed	Ref				Ref	
Education	Primary school or below	–		4.39(1.01–19.15)	0.049	–	
	Junior school			2.1(0.49–9.02)	0.321		
	High school and above			Ref			

**Notes:** The following potential risk factors were in the full model: venues, age, marital status, education, receipt of free condoms, peer education, knowledge awareness, risk behaviors. Odds ratios and 95 confidence intervals adjusted for the potential risk factors that were statistically significant in the three different logistic models.

**Abbreviations:** OR, odds ratio; CI, confidence interval.

In the present study, regression analysis showed that low-grade FSWs had a high risk of syphilis. A 2006 national survey among men aged 15–49 years indicated that 4.2% had visited FSWs in the previous year. This proportion was 7.2% in urban areas and 1.8% in rural areas, and observations in several areas have suggested that the clients of low-grade FSWs are usually migrants and elder men.<sup>37</sup> Lower education level was also identified as a risk factor for syphilis in our multivariate model. FSWs with poor education may have less access to the information about STIs, knowledge about prevention, safe-sex practices and health-seeking behaviors.

Overall, the study has the following limitations: firstly, some of the data collected were based on self-reports, which made it difficult to obtain accurate information about sexual behavior despite guaranteed anonymity, leading to a possible reporting bias; secondly, using the rapid plasma reagin (RPR) test as the first step may cause false-negative results due to the prozone phenomenon; finally, the cross-sectional nature of the study placed obstacles on determining a causal relationship.

## Conclusion

In conclusion, through continuing syphilis prevention and control strategies in recent years, the prevalence of syphilis has been maintained at a low level with a slightly increasing trend, mainly due to an increase level among low-grade FSWs. Due to the “separation of knowledge and behavior” that we have observed, syphilis did not decline despite the increase of preventive measures and behavioral changes, especially in low-grade FSWs. More effective integrated interventions

should be developed, especially for high-risk populations such as low-grade, elder, divorced and widowed FSWs.

## Data Sharing Statement

The authors are willing to share the entire individual participant data collected during the study, after de-identification. These data will be available beginning 3 months and ending 5 years after article publication. Requests should be directed to tianshengxie@126.com. To gain access, data requestors are needed to sign a data access agreement.

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## Disclosure

The authors report no conflicts of interest in this work.

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