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Complete List of Authors:	Hu, Ling; Chongqing Medical University Lu, Rongrong; Chongqing Center for Disease Control and Prevention Wu, Guohui; Chongqing Center for Disease Control and Prevention, Department of AIDS/STD Control and Prevention Zhu, Hua; Chongqing Medical University Qiu, Hongfang; Chongqing Medical University Jing, Dan; Chongqing Medical University Ye, Mengliang; Chongqing Medical University,
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Changing trends of HIV, syphilis, hepatitis C infections and behavioral factors among female sex workers in Chongqing, China: findings of 6 serial surveillance surveys

Ling Hu[1,2], Rongrong Lu[3], Guohui Wu[3], Hua Zhu[1,2], Hongfang Qiu[1,2], Dan Jing[1,2], and Mengliang Ye[1,2]

[1] Department of Epidemiology and Health Statistics, School of Public Health and Management, Chongqing Medical University, Chongqing 400016, China

[2] Research Center for Medicine and Social Development, Chongqing Medical University, Chongqing 400016, China

[3] Institute for AIDS/STD Control and Prevention, Chongqing Center for Disease Control and Prevention, Chongqing 400042, China

Correspondence to Mengliang Ye, Department of Epidemiology and Health Statistics, School of Public Health and Management, Chongqing Medical University, Chongqing 400016,China; yemengliang@cqmu.edu.cn

ABSTRACT

Objectives: To explore prevalence and changing trends of HIV, syphilis, hepatitis C (HCV) infections and risk behaviors among FSWs, and to provide reference and theoretical basis for formulating targeted interventions.

Design: Six consecutive cross-sectional surveys

Setting: Chongqing, China

Participants: FSWs were included if they 1) were aged ≥16 years; 2) provided commerical sex for money or goods during the previous one month; 3) were willing to participate this survey and could provide verbal informed consent. This study included 13791 of 13810 participants recruited between 2013 and 2018.

Primary and secondary outcome measures: HIV/syphilis/HCV infection status

Results: The six-year average prevalence of HIV/syphilis/HCV was 0.3%, 1.7%, and 0.7%, respectively. HIV and HCV prevalence among FSWs in Chongqing was stable during the study period, but prevalence of syphilis had an increasing trend, particularly among low-tier and middle-tier FSWs. Improvements in AIDS-related knowledge, condom use, injecting drug use and participation in AIDS services were observed, but there was no change in prevalence of drug use. HIV infection was correlated with no condom use in the last commercial sex (aOR=3.43) and syphilis infection (aOR=4.94). Syphilis infection was correlated with inconsistent condom use (aOR=1.30), HIV infection (aOR=5.90), HCV infection (aOR=7.71), and STI diagnosis in the past year (aOR=3.50). HCV infection was associated with injecting drug use (aOR=9.02) and syphilis infection (aOR=7.57).

Conclusions: More comprehensive interventions targeted FSWs to promote condom use and sexual health, to prevent and control HIV, syphilis and other STI, particularly those focus on the low-tier and middle-tier FSWs, should be implemented.

Keywords: Female sex workers (FSWs), HIV, Syphilis, Sexually transmitted infection (STI), China

Strengths and limitations of this study

This study is based on surveillance data for 6 consecutive years, with a large sample size.

The infection status was determined by the health staff of the professional institution.

However, the cross-sectional study design limits interpretation of those trends.

Behavioral data was collected through self-reported questionnaire which may lead to bias.

INTRODUCTION

Worldwide, female sex workers (FSWs) are considered to be one of the most vulnerable groups to HIV infection. A global meta-analysis found HIV prevalence among FSWs was estimated at of 10.4% (95% confidence interval [CI] 9.5–11.5%), and varies across regions.[1] In low and middle-income countries, the estimated prevalence of HIV infection was 11.8% (95% CI 11.6–12.0%), 13.5 times higher than that among the general women.[2] Female sex work leads to a global HIV burden of 15% for women, resulting in more than 100,000 deaths per year.[3] And due to many factors, including multiple sexual partners, low social status, and unprotected sex behaviors, FSWs also bear a disproportionate burden of other sexually transmitted infections (STI) such as syphilis.[4 5] The estimated global prevalence of syphilis among women aged 15–49 years was 0.5% (0.4–0.6%) in 2012.[6] However, WHO reported that the median reported syphilis prevalence among FSWs globally was 3.2% (range 0.0–35.2%), and four countries reported syphilis infection was 20% or higher.[7]

In China, heterosexual sex has becoming the primary transmission mode of HIV which nearly accounting for 70% of newly reported HIV/AIDS cases in 2017;[8] and commercial heterosexual sex networks play a vital role in HIV and other STI epidemics. Since the reform and opening up in the 1980s, sex industry has re-emerged and flourished, and the incidence of STI has risen sharply.[5 9] There are an estimated 4 million FSWs,[10] with a HIV prevalence of 0.6% (0-10.3%) and a rate of positive for at least one STI of 41.5% (13–90.6%).[11] Furthermore, according to a national probability survey, about 6.9% men aged 18–49 years have ever commercial sex during their lifetime.[12]

In response, Chinese Government carried out voluntary counseling and testing (VCT), STI services, condom promotion, and peer education among FSWs through the cooperation

among Centers for Disease Control (CDC), community health services and medical institutions.[13] In 1995, China established the national HIV sentinel surveillance system to active monitor HIV prevalence among high-risk populations (e.g., FSWs, injected drug users) and to guide the development of HIV prevention and control strategies.[14–16] After years of development, the surveillance system has expanded in scope, from 42 sentinel sites in 1995 to 1888 in 2010, and combined biological and behavioral surveillance strategies, which included sero-testing for HIV, syphilis and hepatitis C virus (HCV).[17] Surveillance data can help to understand the epidemic status and trend of AIDS and STI among FSWs, which is necessary for developing HIV or STI prevention programmes.[18] We found that there are some epidemiological studies on FSWs, but little is known about its epidemic trend.

Based on the surveillance data in Chongqing, the first aim of the study was to identify prevalence and changing trends of HIV, syphilis, and HCV infections over time. Moreover, to provide reference for formulating interventions to control AIDS and STI, this study explored trends in sexual behaviours of FSWs, and discussed risk factors for prevalent STI over the 5 year period.

METHODS

Study sites

Chongqing, located in the southwest of China, is one of four Chinese municipalities directly controlled by the central government. It covers an area of about 82400 km^2 and has a population of more than 30 million. It is the political and economic center of western China and a city with obvious urban-rural dual structure. A study using the network scale-up method reported that, FSWs were estimated to account for 0.4% of women aged 15–49 years in Chongqing, and clients of FSWs represented 2% of males aged 15–49 years.[19]

Study design

Sentinel surveillance collects HIV, syphilis and HCV prevalence and high-risk behaviors information through cross-sectional surveys. The data we analyzed in this study were sentinel surveillance data among FSWs in Chongqing from 2013 to 2018.

Participant selection and data collection

The detailed procedures of data collection were following Operational Manual for the Implementation Program of National AIDS Sentinel Surveillance established by NCAIDS. Serial cross-sectional surveys were conducted from April to June each year at seven sentinel surveillance sites in Chongqing (Yuzhong District, Jiulongpo District, Wanzhou District, Dianjiang, Hechuan, Wansheng and Youyang). The sample size of each site was 400 participants. In order to obtain a representative sample of FSWs, the entire sampling process went through the following three steps. First, a distribution map of known commercial workplaces in the monitoring area was drawn to construct a sampling frame, and these locations were categorized into low-, middle- and high-tier venues based on the average price of each sex transaction. Then, those venues in each city were randomly selected by using the proportional sampling selection process. The proportion of low-tier and middle-tier FSWs among all participants was at least 10% and 40%, respectively. FSWs were recruited if they met the inclusion criteria: 1) participants were aged ≥16 years; 2) provided commerical sex for money or goods during the previous one month; 3) were willing to participate this survey and could provide verbal informed consent.

All participants compeleted an anonymous, standard interviewer administered, face-to-face questionnaire. After each interview, 3-5 ml venous blood of each participants were collected for HIV, syphilis and HCV antibody detection. And the blood sample was linked to the questionnaire by a unique identification code assigned to the participant.

Measures

Questionnaire

The questionnaire was used to collect FSWs' socio-demographic characteristics, HIV knowledge and behaviors.

(1) Socio-demographic characteristics, including year of birth, marital status, household registration, ethnicity, and education level were collected.

(2) HIV-related knowledge of participants was assessed by 8 questions with ''yes'', ''no'' or ''don't know'' as answers. Those questions including HIV transmission (e.g., "Does mosquito bite spread AIDS") and means of AIDS prevention (e.g., "Can the correct use of condoms reduce the spread of AIDS"). Those questions were updated from 2016 which took

new drugs and deliberate transmission of AIDS into consideration. Only right responses were scored as 1 point, incorrect responses and "don't know" responses did not earn any points. Cronbach's alpha was 0.706 and 0.739 before and after questions changing.

(3) Participants' behavioral factors were also collected, including questions regarding condom use in last commercial sex, condom use with clients in the past month, drug use during their lifetime, STI diagnose in the last year, and participation in AIDS services. Consistent condom use in the past month, in this study, was defined as always using a condom during commercial intercourse.

Laboratory testing

HIV, syphilis, and HCV infection status were detected among all participants by trained laboratory technician. Initial screening for HIV, syphilis, and HCV antibodies was conducted using Enzyme-linked Immunosorbent Assay (ELISA) method (ELISA-1). If the result was negative, no further re-examination would be carried out, and infection status was recorded as negative. If the result was positive, HIV or HCV infection would be confirmed by another ELISA method (ELISA-2) while syphilis infection confirmed by non-specific detection method - Toluidine Red Unheated Serum Test (TRUST). Positive results can be determined only if both tests were positive.

Data analysis

First, chi-square test was conducted to test the differences of HIV, syphilis, and HCV prevalence by various demographic characteristics and behavioral factors. In addition, changing trends of HIV, syphilis, HCV infections and behavioral factors over time were assessed using Cochran-Armitage trend test. Moreover, multivariate logistic regression was conducted to identify HIV, syphilis, and HCV infection related risk-factors using stepwise elimination. Odds ratios (ORs) and 95% CIs of each significant risk factors were also determined, unadjusted and adjusted for socio-demographic factors. All statistical analyses were carried out by using Statistical Analysis Software, version 9.2 (SAS Institute Incorporated, Cary, North Carolina, USA).

RESULTS

Socio-demographic characteristic

This study included 13791 of 13810 participants recruited between 2013 and 2018. As shown in Table 1, nearly half of participants (46.7%) worked in middle-tier venues, 39.7% in low-tier venues, and 13.6% in high-tier venues. The median age was 28 years and most (87.2%) of them was between 20 and 45 years of age. The majority of participants were local (91.0%) and belong to Han (90.0%). Less than one third of them had high school or above education and half (54.7%) had a junior middle school education. Most participants work in the current loaction 1~6 months (33.0%) and work in current city during the last job (61.3%).

Table 1. Prevalence of HIV, syphilis and HCV infection by demographic and behavioral characteristics among FSWs in Chongqing, China.

Characteristics	%(N)*	HIV		Syphilis		HCV	
		Prevalence % (n/N)	P value	Prevalence % (n/N)	P value	Prevalence % (n/N)	P value
Overall	16791	0.3 (45/16791)		1.7 (291/16791)		0.7 (121/16791)	
95%CI		0.2 - 0.4		1.5 - 1.9		0.6 - 0.9	
Typology							
Low-tier	39.7(6672)	0.4(27/6672)	0.019	2.5(169/6672)	<0.001	1.1(72/6672)	<0.001
Middle-tier	46.7(7835)	0.2(13/7835)	0.025[a]	1.3(100/7835)	<0.001[a]	0.5(43/7835)	<0.001[a]
High-tier	13.6(2284)	0.2(5/2284)		1.0(22/2284)		0.3(6/2284)	
Age group(years)							
<20	6.7(1128)	0.1(1/1128)	<0.001	0.9(10/1128)	<0.001	0.4(5/1128)	0.208
20-45	87.2(14645)	0.2(30/14645)	<0.001[a]	1.7(246/14645)	<0.001[a]	0.8(112/14645)	0.971[a]
>45	6.1(1018)	1.4(14/1018)		3.4(35/1018)		0.4(4/1018)	
Education level							
primary school or below	19.2(3225)	0.7(22/3225)	<0.001	2.9(94/3225)	<0.001	0.7(23/3225)	0.995
junior middle school	54.7(9191)	0.2(19/9191)	<0.001[a]	1.6(147/9191)	<0.001[a]	0.7(66/9191)	0.917[a]
high school or above	26.1(4375)	0.1(4/4375)		1.1(50/4375)		0.7(32/4375)	
Marital status							
Never been married	36.0(6053)	0.1(5/6053)	<0.001	1.0(62/6053)	<0.001	0.5(29/6053)	<0.001
Married	42.7(7168)	0.4(31/7168)		1.9(136/7168)		0.6(40/7168)	
living together as if married	10.4(1751)	0.1(1/1751)		1.9(34/1751)		1.5(26/1751)	

Divorced/Widowed	10.8(1819)	0.4(8/1819)		3.2(59/1819)		1.4(26/1819)	
Household registration(hukou)							
Local	91.0(15274)	0.3(40/15274)	0.821	1.6(247/15274)	<0.001	0.7(112/15274)	0.540
Not local	9.0(1517)	0.3(5/1517)		2.9(44/1517)		0.6(9/1517)	
Ethnicity							
Minority	10.0(1674)	0.2(3/1674)	0.623	0.7(11/1674)	<0.001	0.1(1/1674)	0.001
Han	90.0(15116)	0.3(42/15116)		1.9(280/15116)		0.8(120/15116)	
Local working time							
more than 1 year	26.7(4475)	0.3(14/4475)	0.208	2.3(102/4475)	0.008	1.0(43/4475)	0.035
6~12 months	29.6(4975)	0.2(8/4975)		1.4(70/4975)		0.5(25/4975)	
1~6 months	33.0(5535)	0.3(15/5535)		1.7(92/5535)		0.8(44/5535)	
less than 1 month	10.8(1805)	0.4(8/1805)		1.5(27/1805)		0.5(9/1805)	
Location of previous job							
Other provinces	11.3(1896)	0.1(2/1896)	0.022	1.8(34/1896)	0.602	0.5(9/1896)	0.001
Other cities in Chongqing	16.2(2728)	0.1(2/2728)		2.0(55/2728)		1.3(36/2728)	
Current city	61.3(10297)	0.3(32/10297)		1.7(173/10297)		0.6(65/10297)	
No previous work	11.1(1870)	0.5(9/1870)		1.6(29/1870)		0.6(11/1870)	
HIV knowledge							
<6	13.0(2179)	0.4(8/2179)	0.337	1.9(42/2179)	0.456	0.7(16/2179)	0.936
>=6	87.0(14612)	0.3(37/14612)		1.7(249/14612)		0.7(105/14612)	
Used condom at last commercial sex							
No	15.7(2612)	0.7(19/2612)	<0.001	1.8(48/2612)	0.698	0.4(11/2612)	0.046
Yes	84.3(14050)	0.2(26/14050)		1.7(243/14050)		0.8(110/14050)	
Consistent condom use in the last month							
No	46.3(7703)	0.4(32/7703)	0.001	2.0(155/7703)	0.017	0.6(43/7703)	0.017
Yes	53.7(8921)	0.1(13/8921)		1.5(136/8921)		0.9(78/8921)	
Drug use							
No	96.7(16183)	0.3(45/16183)	0.412	1.7(279/16183)	0.423	0.7(109/16183)	<0.001
Yes	3.3(551)	0.0(0/551)		2.2(12/551)		2.2(12/551)	
STI diagnosis in the last 12 months							
No	97.8(16388)	0.3(45/16388)	0.620	1.6(268/16388)	<0.001	0.7(114/16388)	0.016
Yes	2.2(367)	0.0(0/367)		6.3(23/367)		1.9(7/367)	
Received AIDS prevention services in the last 12 months							

No	10.9(1829)	0.2(3/1829)	0.362	1.3(24/1829)	0.144	0.5(10/1829)	0.352
Yes	89.1(14962)	0.3(42/14962)		1.8(267/14962)		0.7(111/14962)	

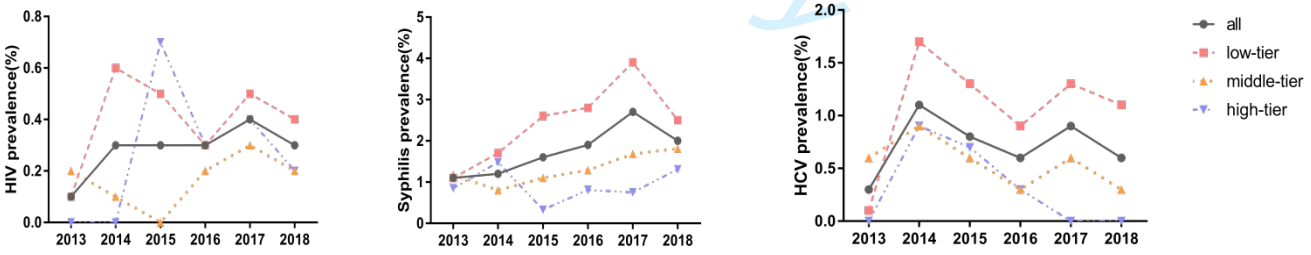
* The sum of numbers in some subgroups was less than 16791 because some participants refused to respond to some questions; [a] p for trend, tested by Cochran-Armitage trend test.

Prevalence and changing trend of HIV infections

As Table 1 showed, the overall prevalence of HIV infection among the study population was 0.3% (95%CI, 0.2%-0.4%). And HIV prevalence had an decreasing trend among FSWs with higher education level, higher tier, and younger age. The prevalence was 0.7% among FSWs with primary school or below, 0.2% among FSWs with junior middle school, and 0.1% among FSWs with high school or above. The HIV prevalence was significantly lower among FSWs used condom in last commerical sex than that among FSWs not using condom (0.2% vs 0.7%, p<0.001). And FSWs who used condom inconsistenely had a higher HIV prevalence than those with consistent condom use (0.4% vs 0.1%, p=0.001).

In addition, we, based on the 6 serial surveillance surveys, tested time trend of HIV, syphilis and HCV prevalence by types of venues among FSWs in Chongqing from 2013 to 2018. The HIV prevalence among FSWs in Chongqing, which ranged from 0.1 % to 0. 4% during the study years, had no significant changes over time (p=0.129). And it is also no significant time trend among low-tier/middle-tier/high-tier FSWs (p=0.498, 0.366, 0.423, respectively) (Figure 1).

Figure 1. HIV, syphilis and HCV prevalence among FSWs from 2013 to 2018 in Chongqing.



Prevalence and changing trend of syphilis infections

Overall, the syphilis prevalence among FSWs was 1.7% (95%CI, 1.5% - 1.9%). The syphilis prevalence also increased among FSWs with less education, lower tier, and older age.

Han FSWs had higher prevalence than ethnic minority FSWs (1.9% vs 0.7%, p<0.001); local FSWs had lower prevalence than FSWs from other places (1.6% vs 2.9%, p<0.001). FSWs who reported STI diagnosis in the last 12 months had a significant higher syphilis prevalence than those who did not report (6.3% vs 1.6%, p<0.001).

In addition, an increasing trend of syphilis prevalence among FSWs in Chongqing was observed (from 1.1 % in 2013 to 2.0 % in 2018, p<0.001). This trend was also found in low-tier FSWs (from 1.1 % in 2013 to 2.5 % in 2018, p<0.001) and middle-tier FSWs (from 1.2 % in 2013 to 1.8 % in 2018, p=0.026), but not in the high-tier group (p=0.713).

Prevalence and changing trend of HCV

The HCV prevalence among FSWs in Chongqing ranged from 0.3 % to 1.1% between 2013 to 2018, and was 0.7% (95%CI, 0.6% - 0.9%) overall. There was not a significant changing trend of HCV infection by year both overall and among subgroups. But HCV prevalence tend to decrease among FSWs in higher-tier venues (p<0.001); low-tier FSWs, middle-tier FSWs, high-tier FSWs had a prevalence of 1.1%, 0.5%, 0.3%, respectively. FSWs of Han ethnicity had a higher prevalence than ethnic minority FSWs (0.8% vs 0.1%, p=0.001). And HCV infection among FSWs who reported drug use, diagnosis of STI higher than those who reported not (2.2% vs 0.7%, p<0.001; 1.9% vs 0.7%, p=0.016, respectively). FSWs who used condom in last commerical sex or used condom consistently had a lower infection rate.

Changing trend of behavioral factors

As table 2 showed, overall more than 80% participants know AIDS knowledge well, and used condom in their last commercial sexual behavior. Nearly 90% received at least one of the following three AIDS services in the last year, including 1)condom promotion and distribution, AIDS counseling and testing, 2) community drug maintenance therapy, clean needle supply/exchange, 3) peer education. In addition, only 50% of participants used condom consistnetly with clients in the last month. Approximately 3% reported drug use and 2% reported had diagnosed STI in the past year.

We also examined the changingtrend of FSWs' behaviors, and found that no significant changes over time was observed in drug use reported by FSWs. However, there were significant improvements over time in AIDS awareness, condom use, participation in AIDS

services and self-reported STI diagnosis in last year among FSWs.

Table 2. Behavioral characteristics of FSWs from 2013 to 2018 in Chongqing

Variables		2013 %(n)	2014 %(n)	2015 %(n)	2016 %(n)	2017 %(n)	2018 %(n)	overall %(n)	P value	P for trend
HIV know-ledge(>=6)	Yes	86.1(2405)	83.6(2338)	91.7(2562)	84.0(2350)	87.6(2457)	89.1(2500)	87.0(14612)	<0.001	<0.001
	No	13.9(388)	16.4(458)	8.3(231)	16.0(449)	12.4(348)	10.9(305)	13.0(2179)		
condom use in the last commercial sex	Yes	79.7(2167)	77.4(2134)	93.8(2604)	83.4(2335)	87.0(2439)	84.5(2371)	84.3(14050)	<0.001	<0.001
	No	20.3(552)	22.6(625)	6.2(171)	16.6(464)	13.0(366)	15.5(434)	15.7(2612)		
CCU in the past month	Yes	41.7(1130)	51.2(1406)	69.7(1925)	60.1(1682)	47.7(1337)	51.4(1441)	53.7(8921)	<0.001	<0.001
	No	58.3(1578)	48.8(1341)	30.3(835)	39.9(1117)	52.3(1468)	48.6(1364)	46.3(7703)		
Drug use	Yes	2.9(81)	4.2(116)	2.7(74)	4.6(129)	2.2(63)	3.1(88)	3.3(551)	<0.001	0.322
	No	97.1(2705)	95.8(2631)	97.3(2718)	95.4(2670)	97.8(2742)	96.9(2717)	96.7(16183)		
Injecting drug use	Yes	1.3(35)	1.2(32)	0.6(18)	1.5(43)	0.7(19)	0.4(11)	0.9(158)	<0.001	0.002
	No	98.8(2754)	98.9(2760)	99.4(2774)	98.5(2756)	99.3(2786)	99.6(2794)	99.1(16624)		
STI diagnosis in the past year	Yes	3.8(106)	3.6(100)	1.5(43)	1.8(50)	1.1(31)	1.3(37)	2.2(367)	<0.001	<0.001
	No	96.2(2671)	96.4(2679)	98.5(2747)	98.2(2749)	98.9(2774)	98.7(2768)	97.8(16388)		
AIDS services	Yes	80.0(2235)	86.0(2405)	94.4(2637)	93.4(2615)	92.7(2600)	88.1(2470)	89.1(14962)	<0.001	<0.001
	No	20.0(558)	14.0(391)	5.6(156)	6.6(184)	7.3(205)	11.9(335)	10.9(1829)		

CCU: consistent condom use.

Correlates of HIV, syphilis and HCV infections

Multivariate logistic regression analysis results (Table 3) showed that, 1) HIV infection was significantly and positively associated with no condom use in the last commerical sex (aOR=3.43, 95% CI, 1.88-6.28) and syphilis infection (aOR=4.94, 95% CI, 1.98-12.34); 2) syphilis infection was significantly and positively associated with inconsistent condom use in the past month (aOR=1.30, 95% CI, 1.02-1.65), STI diagnosis in the past year (aOR=3.50, 95% CI, 2.22-5.50), HIV infection (aOR=5.90, 95% CI, 2.41-14.42) and HCV infection (aOR=7.71, 95% CI, 4.41-13.48); 3) HCV infection was significantly and positively associated with injecting drug use (aOR=9.02, 95% CI, 4.49-18.09) and syphilis infection (aOR=7.57, 95% CI, 4.32-13.27).

Table 3. Associations between behavioral characteristics and HIV, syphilis and HCV infection

Characteristics	HIV		Syphilis		HCV	
	OR	aOR	OR	aOR	OR	aOR

	(95%CI)	(95%CI)	(95%CI)	(95%CI)	(95%CI)	(95%CI)
No condom use in the last commercial sex	3.97(2.19,7.19)***	3.43(1.88,6.28)***	N/A	N/A	N/A	N/A
Inconsistent condom use in the past month	N/A	N/A	1.30(1.03,1.64)*	1.30(1.02,1.65)*	0.63(0.43,0.92)*	N/A
Injecting drug use	N/A	N/A	N/A	N/A	9.21(4.67,18.18)***	9.02(4.49,18.09)***
STI diagnosis in the past year	N/A	N/A	3.75(2.40,5.87)***	3.50(2.22,5.50)***	N/A	N/A
HIV infection	N/A	N/A	9.17(3.84,21.91)***	5.90(2.41,14.42)***	N/A	N/A
Syphilis infection	8.68(3.63,20.74)***	4.94(1.98,12.34)***	N/A	N/A	9.09(5.26,15.71)***	7.57(4.32,13.27)***
HCV infection	N/A	N/A	8.81(5.09,15.25)***	7.71(4.41,13.48)***	N/A	N/A

aOR: Adjusted for socio-demographic characteristic (age, education level, marital status and type of venues); * p<0.05, ** p<0.01, *** p<0.001.

DISCUSSION

FSWs are considered to be at high risk of HIV infection and other STI and contribute disproportionately to the transmission. As an identifiable population, surveillance of STI and risk behaviors among FSWs is of great significance to understanding the potential of spreading HIV to the general population, to assessing and improving interventions targeted at FSWs.[18] Although it is critical to analysis and know prevalence and changing trend of HIV, syphilis, HCV and relevant behaviors among FSWs, few studies reported that in Chongqing, China. In this study, we examined prevalence and changing trends of HIV, syphilis, HCV and behaviors by using sentinel surveillance data of Chongqing FSWs from 2013 to 2018.

Our study shows that HIV prevalence among FSWs in Chongqing was relatively stable with a annual average HIV infection rate of 0.3% from 2013 to 2018, which was similar to 0.22% among Chinese FSWs in 2014,[9] but much higher than China's current estimated national HIV prevalence rate (0.0598%).[20] And HIV infection is associated with not using condoms (aOR = 3.43) and syphilis infection (aOR = 4.94). Consistent condom use is one of the most effective ways to prevent AIDS, and its protection rate can reach 80% based on studies

of persons during heterosexual sex with an HIV-positive partner.[21] The 100% Condom Use Programme (CUP) has been implemented in Chongqing since 2006. This project promoted the condom use of FSW. We also found that more and more FSWs used condoms consistently, but the percentage of FSW who insist on using condoms was less than 60%. This suggests that condoms still need to be promoted among FSWs.

Notably, the results also indicated a worrying upward trend of syphilis infection (from 1.1 % in 2013 to 2.0 % in 2018), particularly among low-tier and middle-tier FSWs. Syphilis, as the third most prevalent notifiable infectious disease in category A and B in China, has been on the rise since the 1990s.[22] The reported total syphilis rate in China increased from 0.2/100,000 in 1993 to 32.86/100,000 in 2013.[22] The reported incidence of syphilis in Chongqing also showed an upward trend, with a reported incidence of 40.38/100,000 in 2014.[23] However, researches found that the increase of reported syphilis cases in Chongqing in recent years is due to the increase of latent syphilis, which may be related to the large-scale screening of syphilis in medical institutions, the training of syphilis diagnosis standards and reporting requirements and the improvement of laboratory conditions and laboratory diagnosis level.[24] The increase of syphilis infection rate in FSW may also be related to the strengthening of syphilis detection, but it still needs attention. FSWs with syphilis were nearly five times more likely to be infected with HIV, and seven times more likely to be infected with HCV than FSWs without syphilis. And syphilis infection was correlated with HIV (aOR = 5.90), HCV infection (aOR = 7.71) and STI infection in last year (aOR = 3.50), which may due to their shared transmission routes, co-risk factors and adverse interaction.[25] So more efforts are in need to strengthen comprehensive and combined intervention of AIDS, syphilis and other STI for key groups.

HCV prevalence was fluctuated from year to year with the six-year average infection rate of 0.7%, but no significant trend was found. This result is in agreement with previous study conducted in Guangxi.[26] But a similar study used national data reported HIV and HCV prevalence among FSWs in China decreased from 2008 to 2012;[27] the differences may be due to differences in scope of study area and study period. Similar to previous study, we showed a strong association between injecting drug use and HCV infection,[28] and the sharing of needles may be the main and underlying route of HCV transmission. Fortunately, the

prevalence of injection drug use among FSWs appears to have decreased, but no significant improvement of drug use was found.

In addition, as previous studies found, lower-tier FSWs bear heavier burden of HIV, syphilis, and HCV than FSWs in higher-tier venues.[27] FSWs with less education, older age also had a higher prevalance of HIV and syphilis. And low-tier FSWs were found to tend to be older women and low education.[29] So low-tier FSWs with low education probably had insufficient knowledge about those diseases, less awareness about sex health, and poor communication skills to condom use.[30] And they may serving more clients who also had low education, had low awareness, and were unwilling to use condom, particularly elderly man.[26] [31] Elderly man in China had a increasing HIV infection rate because of their commerical sex and unwilling to use condom.[32] [33] The two high-risk populations, low-tier FSWs and elderly man, may have an effect on each other and increase HIV infection rates. Thus, future intervention programs should specified and targeted based on the needs of the different tier FSWs, and pay more attention on low-tier FSWs and their clients. What's more, sex work is illegal and highly stigmatized in China, so FSWs face much barriers to participant in HIV/AIDS related services, such as fear of being arrested, fear of discrimination and awkwardness.[34] AIDS intervention services need to cooperate more with NGOs, increase condom promotion, and jointly increase awareness of other STIs such as syphilis.

Our study has several limitations. First, the data we used was based on serial cross-sectional surveillance surveys, therefore we may find trends of HIV, syphilis and HCV infection without exact reasons of those changes. Second, the data were collected mainly through self-reported questionnaire, which raises concern about recall bias, reporting bias and social desirability bias. For example, respondents may conceal the truth when answering sensitive questions, such as drug use, which is illegal in China. Third, considering the acceptability and simplicity of the questionnaire, we did not collect some information that may be relevant to the infection and transmission, such as sexual violence, alcohol use and condom use within non-commercial partnerships.

CONCLUSIONS

In conclusion, HIV and HCV prevalence among FSWs in Chongqing remained stable during the study period, but syphilis had a upward trend among FSWs in low-tier and middle-tier venues. Although factors including knowledge, condom use, injecting drug use and STI diagnosis were improved, nearly half of FSWs used condom inconsistently. Thus, more comprehensive interventions targeted FSWs to promote condom use and sexual health, to prevent and control HIV, syphilis and other STIs, particularly those focus on the low-tier and middle-tier FSWs, should be implemented.

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Contributors GW, RL and MY designed and coordinated the study. GW, RL was involved in the design and conducting of the survey. LH and MY analysed the data. LH, HZ, DJ, and HQ participated in the interpretation of results. LH wrote the first draft of the manuscript. LH HQ, HZ, DJ and MY revised the manuscript. All authors have read and approved the manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This survey was reviewed and approved by the Institutional Review Board of the National Center for AIDS Prevention and Control (NCAIDS), Center for Disease Control (CDC), China, and the medical ethics committee of Chongqing Medical University (IRB number:2017016).

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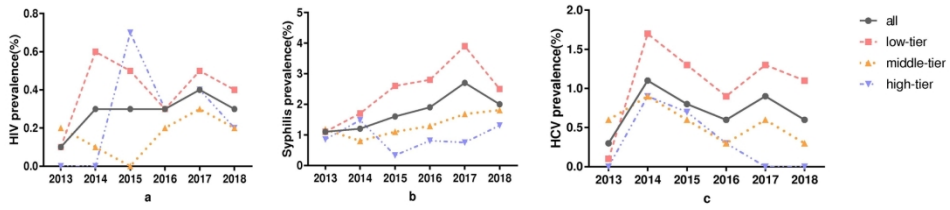

Figure 1. HIV, syphilis and HCV prevalence among FSWs from 2013 to 2018 in Chongqing.

175x47mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	*14*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	--
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	--
		(*e*) Describe any sensitivity analyses	--
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	--
		(c) Consider use of a flow diagram	--
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	--
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10
		(*b*) Report category boundaries when continuous variables were categorized	--
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	--
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Changing trends of HIV, syphilis, HCV infections and behavioral factors among female sex workers in Chongqing, China: findings of 6 serial surveillance surveys

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Changing trends of HIV, syphilis, HCV infections and behavioral factors among female sex workers in Chongqing, China: findings of 6 serial surveillance surveys

Ling Hu[1,2], Rongrong Lu[3], Guohui Wu[3], Hua Zhu[1,2], Hongfang Qiu[1,2], Dan Jing[1,2], and Mengliang Ye[1,2]

[1] Department of Epidemiology and Health Statistics, School of Public Health and Management, Chongqing Medical University, Chongqing 400016, China

[2] Research Center for Medicine and Social Development, Chongqing Medical University, Chongqing 400016, China

[3] Institute for AIDS/STD Control and Prevention, Chongqing Center for Disease Control and Prevention, Chongqing 400042, China

Correspondence to Mengliang Ye, Department of Epidemiology and Health Statistics, School of Public Health and Management, Chongqing Medical University, Chongqing 400016,China; yemengliang@cqmu.edu.cn

ABSTRACT

Objectives: To explore prevalence and changing trends of HIV, syphilis, hepatitis C (HCV) infections and risk behaviors among female sex workers (FSWs), and to provide reference and theoretical basis for formulating targeted interventions.

Design: Six consecutive cross-sectional surveys

Setting: Chongqing, China

Participants: FSWs were included if they (1) were aged ≥16 years, (2) provided commercial sex for money or goods during the previous one month, and (3) were willing to participate this survey and could provide verbal informed consent. This study included 16791 of 16810 participants recruited between 2013 and 2018.

Primary and secondary outcome measures: The prevalence of HIV/syphilis/HCV infection

Results: HIV and HCV prevalence among FSWs in Chongqing was stable during the study period, but prevalence of syphilis had an increasing trend, particularly among low-tier and middle-tier FSWs. Improvements in AIDS-related knowledge, condom use, injecting drug use and participation in AIDS services were observed, but there was no change in prevalence of drug use. HIV infection was correlated with no condom use in the last commercial sex (aOR=3.48) and syphilis infection (aOR=4.88). Syphilis infection was correlated with inconsistent condom use (aOR=1.30), HIV infection (aOR=5.88), HCV infection (aOR=7.68), and STI diagnosis in the past year (aOR=3.81). HCV infection was associated with injecting drug use (aOR=8.91) and syphilis infection (aOR=7.88).

Conclusions: More comprehensive interventions targeted FSWs to promote condom use and sexual health, to prevent and control HIV, syphilis and other STI, particularly those focus on the low-tier and middle-tier FSWs, should be implemented.

Keywords: Female sex workers (FSWs), HIV, Syphilis, Sexually transmitted infection (STI), China

Strengths and limitations of this study

- The study involved six consecutive years of sentinel surveillance among FSWs in Chongqing with a large sample size.
- This study provides valuable information about the prevalence and trends of STIs among FSWs in Chongqing, and helps to formulate and improve relevant intervention strategies.
- However, causality cannot be determined due to the cross-sectional design.
- There may be recall bias and social desirability bias as a result of the use of self-reported measures of condom use, drug use and other behavior.

INTRODUCTION

Worldwide, female sex workers (FSWs) are considered to be one of the most vulnerable groups to HIV, syphilis and other sexually transmitted infections (STI) infection.[1 2] A global meta-analysis found HIV prevalence among FSWs was estimated at 10.4% (95% confidence interval (CI) 9.5–11.5%).[3] WHO reported that the median reported syphilis prevalence among FSWs globally was 3.2% (range 0.0–35.2%), and four countries reported syphilis infection was 20% or higher.[4]

Since China's reform and opening up, sex industry has re-emerged due to economic growth, population migration, and changes in sexual attitudes.[5 6] A large number of rural migrants moved to cities for better job opportunities. But those rural women found that the labor force was saturated or the wages were not high enough, and then sex work with quick financial return became an option.[7] There are an estimated 4 million FSWs;[8] and about 6.9% men aged 18–49 years have ever had commercial sex during their lifetime.[9] Most FSWs in China are mobile, have both commercial and non-commercial sex partners and use condom inconsistently.[6] The incidence of STI such as syphilis has dramatically increased along with the prosperity of the sex trade.[2 10] Heterosexual sex has replaced intravenous drug use (IDU) and commercial blood/plasma collection as the primary transmission mode of HIV in China.[11] Among the newly reported HIV infections from January to October 2019, heterosexual transmission accounted for 73.7%, much higher than other transmission ways.[12] A review also reported that FSWs in China had a median HIV prevalence of 0.6% (0-10.3%) and a rate of positive for at least one STI of 41.5% (13–90.6%).[13]

Sex work is still illegal in China. Thus, much sex work takes place in informal venues and in combination with other work to cover up illegality. There are a variety of forms of sex work venues, usually including karaoke halls (KTV), night clubs, bars, hair salons, saunas, foot massage parlors, and hotels. It was found that different sex work settings are associated with the risk of HIV/STI infection. And the average price of each sex transaction are often used by Chinese researchers to categorize FSWs into high, middle, and low tiers. The size of different-tier FSWs may be related to the local economic level. In Jiangmen City, more than 60% of FSWs was high-tier FSW, while the proportion of low-tier FSWs was less than 10%;[14] but in Jianshui County, the proportion of low-tier FSWs was close to 30%.[15] The proportion of lower-tier FSWs may vary from region to region, but previous studies have shown that they have higher risk of HIV infection than other FSWs.[16 17]

Chinese government has provided voluntary HIV counseling and testing (VCT), STI services, condom promotion, and peer education among FSWs through the cooperation among Centers for Disease Control (CDC), community health services, and medical institutions.[18] The "Four Frees and One Care" policy helps treat AIDS patients with financial difficulties by providing free antiviral drugs. In 1995, China established the national HIV sentinel surveillance system to active monitor HIV prevalence among high-risk populations (e.g., FSWs, injected drug users) and to guide the development of HIV prevention and control strategies.[19–21] After years of development, the surveillance system has expanded in scope, from 42 sentinel sites in 1995 to 1888 in 2010, and combined biological and behavioral surveillance strategies, which included sero-testing for HIV, syphilis and hepatitis C virus (HCV).[22] Surveillance data can help to understand the epidemic status and trend of AIDS and STI among FSWs, which is necessary for developing HIV or STI prevention programmes.[23] According to China's surveillance data, the average prevalence of HIV/syphilis/HCV among FSWs from 2010 to 2015 was estimated at 0.25%, 2.54% and 0.72%, respectively.[24] The prevalence varied from province to province and the southwest province had higher prevalence of STI.[16 25] For example, although HIV prevalence among FSWs was lower than 0.05% in most provinces (such as, Heilongjiang, Hebei) in 2012, it exceeded 1% in the same year in Yunnan and Guangxi.[16]

Chongqing, located in the southwest of China, is one of four Chinese municipalities

directly controlled by the central government. It is geographically close to Yunnan and Guangxi and has large population contacts with Yunnan and Guangxi. It is the political and economic center of Western China and a city with obvious urban–rural dual structure and prosperous sex industry. A study using the network scale-up method estimated that FSWs accounted for 0.4% of women aged 15–49 years in Chongqing, and clients of FSWs represented 2% of men aged 15–49 years.[26] Although HIV prevalence among FSWs in Chongqing, 2012 was estimated at 0.25%, lower than that in other high-risk groups such as men who have sex with men (17.03%) and injecting drug users (7.35%).[27] But since 2007, heterosexual transmission has become the main way of HIV transmission in Chongqing.[28] Of the 6352 newly diagnosed HIV/AIDS cases reported in Chongqing, 2015, 75.08% were infected through heterosexual transmission.[28] Therefore, it is very important to understand the prevalence and trends of STIs among FSWs in Chongqing.

Based on the surveillance data in Chongqing, the first aim of the study was to identify prevalence and changing trends of HIV, syphilis, and HCV infections over time. Moreover, to provide reference for formulating interventions to control AIDS and STI, this study explored trends in sexual behaviors of FSWs, and discussed risk factors for prevalent STI over the 5 year period.

METHODS

Study design

Sentinel surveillance collects HIV, syphilis and HCV prevalence and high-risk behaviors information through cross-sectional surveys. The data we analyzed in this study were sentinel surveillance data among FSWs in Chongqing from 2013 to 2018.

Participant selection and data collection

The detailed procedures of data collection followed the Operational Manual for the Implementation Program of National AIDS Sentinel Surveillance established by the National Center for AIDS Prevention and Control (NCAIDS).[29] Serial cross-sectional surveys were conducted from April to June each year at seven sentinel surveillance sites in Chongqing (Yuzhong District, Jiulongpo District, Wanzhou District, Dianjiang, Hechuan,

Qijiang(Wansheng) and Youyang) (Figure 1). The sample size of each site was 400 participants. The entire sampling process went through the following three steps. First, a distribution map of known commercial workplaces in the monitoring area was drawn to construct a sampling frame, and these locations were categorized into low-, middle- and high-tier venues based on the average price of each sex transaction. Then, those venues in each city were randomly selected by the proportional sampling selection process. The proportion of low-tier FSWs and middle-tier FSWs among all participants was at least 10% and 40%, respectively. FSWs were recruited if they met the inclusion criteria: (1) participants were aged ≥16 years, (2) provided commercial sex for money or goods during the previous one month, and (3) were willing to participate this survey and could provide verbal informed consent.

All participants completed an anonymous, standard interviewer administered, and face-to-face questionnaire. After each interview, 3-5 ml venous blood of each participant was collected for HIV, syphilis and HCV antibody detection. And the blood sample was linked to the questionnaire by a unique identification code assigned to the participant.

Measures

Questionnaire

The questionnaire was used to collect FSWs' socio-demographic characteristics, HIV knowledge and behaviors.

(1) Socio-demographic characteristics, including year of birth, marital status, household registration, ethnicity, and education level were collected.

(2) HIV-related knowledge of participants was assessed by 8 questions with "yes", "no" or "don't know" as answers. Those questions have been updated since 2016 which took new-type drugs and intentional transmission of HIV/AIDS into consideration. Only correct responses were scored as 1 point; incorrect responses and "don't know" responses did not earn any points. Cronbach's alpha was 0.706 and 0.739 before and after questions changing.

(3) Participants' behavioral factors were also collected, including questions regarding condom use in last commercial sex, condom use with clients in the past month, drug use during their lifetime, STI diagnose in the last year, and participation in AIDS services.

Consistent condom use (CCU) in the past month in this study, was defined as always using a condom during commercial intercourse.

Laboratory testing

In all surveys, venous blood samples were tested for HIV, syphilis, and HCV by trained laboratory technician. Initial screening for HIV, syphilis, and HCV antibodies was conducted using Enzyme-linked Immunosorbent Assay (ELISA) method (ELISA-1). If the result was negative, no further re-examination would be carried out, and infection status was recorded as negative. If the result was positive, HIV or HCV infection would be confirmed by another ELISA method (ELISA-2) while syphilis infection confirmed by non-specific detection method - Toluidine Red Unheated Serum Test (TRUST). Positive results can be determined only if both tests were positive.

Quality Assurance

All investigators were strictly trained before the survey to ensure that they were familiar with the questionnaire structure and mastered the unified investigation standards and requirements. After the investigation, the investigator carefully reviewed the questionnaire and promptly corrected the missing items, wrong items, and logical errors. Experts from the Chongqing Center for Disease Control and Prevention went to the investigation site for guidance and inspection to ensure the quality. All laboratory tests were conducted at designated and certified laboratory at local CDC or hospitals.

Data analysis

First, socio-demographic characteristics of participants were presented using descriptive statistics by survey year and overall.. In addition, trends of HIV, syphilis, HCV infections and behavioral factors over time were assessed using Cochran-Armitage trend test. Moreover, multivariable logistic regression was conducted to identify HIV, syphilis, and HCV infection related risk-factors using stepwise elimination. Odds ratios (ORs) and 95% CIs of each significant risk factor were also determined, unadjusted and adjusted for socio-demographic factors. All statistical analyses were carried out by using Statistical Analysis Software, version 9.2 (SAS Institute Incorporated, Cary, North Carolina, USA).

RESULTS

Socio-demographic characteristic

This study included 16791 of 16810 participants recruited between 2013 and 2018. Table 1 depicted all participants' demographic characteristics stratified by year of survey. Among them, nearly half of participants (46.7%) worked in middle-tier venues, 39.7% in low-tier venues, and 13.6% in high-tier venues. The median age was 28 years and most (87.2%) of them was between 20 and 45 years of age. The majority of participants were in Chongqing households (91.0%) and belong to Han (90.0%). Less than one third of them had high school or above education and half (54.7%) had a junior middle school education. Most participants work in the current location 1~6 months (33.0%) and work in current city during the last job (61.3%).

Table 1. Socio-demographic characteristics of female sex workers stratified by survey year (N, %)

Characteristics	2013 N(%)	2014 N(%)	2015 N(%)	2016 N(%)	2017 N(%)	2018 N(%)	Total N(%)
Overall	2793(16.6)	2796(16.7)	2793(16.6)	2799(16.7)	2805(16.7)	2805(16.7)	16791(100.0)
Age group(years)							
<20	285(10.2)	226(8.1)	206(7.4)	228(8.1)	87(3.1)	96(3.4)	1128(6.7)
20-45	2404(86.1)	2451(87.7)	2442(87.4)	2412(86.2)	2521(89.9)	2415(86.1)	14645(87.2)
>45	104(3.7)	119(4.3)	145(5.2)	159(5.7)	197(7.0)	294(10.5)	1018(6.1)
Marital status							
Never been married	1131(40.5)	1143(40.9)	1102(39.5)	1106(39.5)	734(26.2)	837(29.8)	6053(36.0)
Married	1148(41.1)	1104(39.5)	1207(43.2)	1152(41.2)	1279(45.6)	1278(45.6)	7168(42.7)
Living together as if married	275(9.8)	308(11.0)	260(9.3)	307(11.0)	305(10.9)	296(10.6)	1751(10.4)
Divorced/Widowed	239(8.6)	241(8.6)	224(8.0)	234(8.4)	487(17.4)	394(14.0)	1819(10.8)
Household registration(hukou)							
Chongqing	2518(90.2)	2559(91.5)	2533(90.7)	2547(91.0)	2580(92.0)	2537(90.4)	15274(91.0)
Other provinces	275(9.8)	237(8.5)	260(9.3)	252(9.0)	225(8.0)	268(9.6)	1517(9.0)
Ethnicity							
Minority	253(9.1)	266(9.5)	308(11.0)	295(10.5)	280(10.0)	272(9.7)	1674(10.0)
Han	2539(90.9)	2530(90.5)	2485(89.0)	2504(89.5)	2525(90.0)	2533(90.3)	15116(90.0)
Education level							
Primary school or below	512(18.3)	524(18.7)	581(20.8)	506(18.1)	595(21.2)	507(18.1)	3225(19.2)
Junior middle school	1664(59.6)	1570(56.2)	1367(48.9)	1509(53.9)	1635(58.3)	1446(51.6)	9191(54.7)
High school or above	617(22.1)	702(25.1)	845(30.3)	784(28.0)	575(20.5)	852(30.4)	4375(26.1)
Typology							
Low-tier	973(34.8)	955(34.2)	1043(37.3)	1193(42.6)	1347(48.0)	1161(41.4)	6672(39.7)
Middle-tier	1347(48.2)	1504(53.8)	1448(51.8)	1236(44.2)	1192(42.5)	1108(39.5)	7835(46.7)

High-tier	473(16.9)	337(12.1)	302(10.8)	370(13.2)	266(9.5)	536(19.1)	2284(13.6)
Local working time							
More than 1 year	651(23.3)	566(20.2)	751(26.9)	673(24.0)	888(31.7)	946(33.7)	4475(26.7)
6~12 months	635(22.7)	672(24.0)	899(32.2)	1018(36.4)	918(32.7)	833(29.7)	4975(29.6)
1~6 months	1097(39.3)	1204(43.1)	888(31.8)	778(27.8)	814(29.0)	754(26.9)	5535(33.0)
Less than 1 month	409(14.6)	354(12.7)	255(9.1)	330(11.8)	185(6.6)	272(9.7)	1805(10.8)
Location of previous job							
Other provinces	334(12.0)	257(9.2)	354(12.7)	305(10.9)	353(12.6)	293(10.4)	1896(11.3)
Other cities in Chongqing	330(11.8)	569(20.4)	549(19.7)	572(20.4)	356(12.7)	352(12.5)	2728(16.2)
Current city	1699(60.8)	1627(58.2)	1629(58.3)	1576(56.3)	1894(67.5)	1872(66.7)	10297(61.3)
No previous work	430(15.4)	343(12.3)	261(9.3)	346(12.4)	202(7.2)	288(10.3)	1870(11.1)
HIV knowledge							
<6	388(13.9)	458(16.4)	231(8.3)	449(16.0)	348(12.4)	305(10.9)	2179(13.0)
>=6	2405(86.1)	2338(83.6)	2562(91.7)	2350(84.0)	2457(87.6)	2500(89.1)	14612(87.0)

211

Trends of HIV, syphilis, and HCV prevalence

During the study period, the overall prevalence of HIV, syphilis, and HCV infection among the study population was 0.27% (95%CI, 0.19%-0.35%), 1.73% (95%CI, 1.54% - 1.93%), and 0.72% (95%CI, 0.59%-0.85%), respectively. Low-tier FSWs had higher prevalence of HIV, HCV, and syphilis, with the six-year average prevalence of HIV, HCV, and syphilis at 0.40%, 2.53%, and 1.08%, respectively (p=0.019, p<0.001, p<0.001). The HIV prevalence among FSWs in Chongqing, which ranged from 0.14 % to 0.43% during the study years, had no significant changes over time (p=0.129) (Figure 2). And there was also no significant time trend found among low-tier / middle-tier / high-tier FSWs (p=0.498, 0.366, 0.423, respectively) (Table 2). The HCV prevalence among FSWs in Chongqing ranged from 0.32 % to 1.14% between 2013 to 2018, with no significant trend. In each subgroup, no significant changing trend of HCV infection by year was found, too (Figure 3). Unlike HIV and HCV, a total of 1.11%, 1.18%, 1.58%, 1.86%, 2.67% and 2.00% of the respondents were confirmed to be infected with syphilis from 2013 to 2018, showing an upward trend (p< 0.001). This trend was also found in low-tier FSWs (from 1.13 % in 2013 to 2.50 % in 2018, p<0.001) and middle-tier FSWs (from 1.19 % in 2013 to 1.81 % in 2018, p=0.026), but not in the high-tier group (p=0.713).

Table 2. HIV, syphilis and HCV prevalence among FSWs from 2013 to 2018 in Chongqing.

Variables	2013 %(n)	2014 %(n)	2015 %(n)	2016 %(n)	2017 %(n)	2018 %(n)	Total %(n)	P value	P for trend
HIV positive									
All	0.14(4)	0.25(7)	0.25(7)	0.25(7)	0.43(12)	0.29(8)	0.27(45)	0.486	0.128
Low tier	0.10(1)	0.63(6)	0.48(5)	0.25(3)	0.52(7)	0.43(5)	0.40(27)	0.406	0.496
Middle tier	0.22(3)	0.07(1)	0.00(0)	0.24(3)	0.34(4)	0.18(2)	0.17(13)	0.201	0.364
High tier	0.00(0)	0.00(0)	0.66(2)	0.27(1)	0.38(1)	0.19(1)	0.22(5)	0.329	0.423
Syphilis positive									
All	1.11(31)	1.18(33)	1.58(44)	1.86(52)	2.67(75)	2.00(56)	1.73(291)	<0.001	<0.001
Low tier	1.13(11)	1.68(16)	2.59(27)	2.77(33)	3.93(53)	2.50(29)	2.53(169)	<0.001	<0.001
Middle tier	1.19(16)	0.80(12)	1.10(16)	1.29(16)	1.68(20)	1.81(20)	1.28(100)	0.209	0.026
High tier	0.85(4)	1.48(5)	0.33(1)	0.81(3)	0.75(2)	1.31(7)	0.96(22)	0.713	0.713
HCV positive									
All	0.32(9)	1.14(32)	0.82(23)	0.57(16)	0.89(25)	0.57(16)	0.72(121)	0.005	0.86
Low tier	0.10(1)	1.68(16)	1.25(13)	0.92(11)	1.34(18)	1.12(13)	1.08(72)	0.021	0.163

Middle tier	0.59(8)	0.86(13)	0.55(8)	0.32(4)	0.59(7)	0.27(3)	0.55(43)	0.354	0.12
High tier	0.00(0)	0.89(3)	0.66(2)	0.27(1)	0.00(0)	0.00(0)	0.26(6)	0.031	0.249

Changing trend of behavioral factors

Of the whole survey population, more than 80% know HIV-related knowledge well, and used condom in their last commercial sex (Table 3). Nearly 90% received at least one of the following three AIDS-related services in the last year, including (1) condom promotion and distribution, AIDS counseling and testing, (2) community drug maintenance therapy, clean needle supply/exchange, and (3) peer education. In addition, about half of participants used condom consistently with clients in the last month. Approximately 3% reported drug use and 2% reported had diagnosed STI in the past year.

We also examined the changing trends of FSWs' behaviors, and found that no significant change over time was observed in drug use reported by FSWs. However, there were significant improvements over time in HIV-related knowledge, condom use, participation in AIDS services, and self-reported STI diagnosis in last year among FSWs.

Table 3. Behavioral characteristics of FSWs from 2013 to 2018 in Chongqing

Variables		2013 %(n)	2014 %(n)	2015 %(n)	2016 %(n)	2017 %(n)	2018 %(n)	overall %(n)	P value	P for trend
HIV know-ledge (>=6)	Yes	86.1(2405)	83.6(2338)	91.7(2562)	84.0(2350)	87.6(2457)	89.1(2500)	87.0(14612)	<0.001	<0.001
	No	13.9(388)	16.4(458)	8.3(231)	16.0(449)	12.4(348)	10.9(305)	13.0(2179)		
condom use in the last commercial sex	Yes	79.7(2167)	77.4(2134)	93.8(2604)	83.4(2335)	87.0(2439)	84.5(2371)	84.3(14050)	<0.001	<0.001
	No	20.3(552)	22.6(625)	6.2(171)	16.6(464)	13.0(366)	15.5(434)	15.7(2612)		
CCU in the past month	Yes	41.7(1130)	51.2(1406)	69.7(1925)	60.1(1682)	47.7(1337)	51.4(1441)	53.7(8921)	<0.001	<0.001
	No	58.3(1578)	48.8(1341)	30.3(835)	39.9(1117)	52.3(1468)	48.6(1364)	46.3(7703)		
Drug use	Yes	2.9(81)	4.2(116)	2.7(74)	4.6(129)	2.2(63)	3.1(88)	3.3(551)	<0.001	0.322
	No	97.1(2705)	95.8(2631)	97.3(2718)	95.4(2670)	97.8(2742)	96.9(2717)	96.7(16183)		
Injecting drug use	Yes	1.3(35)	1.2(32)	0.6(18)	1.5(43)	0.7(19)	0.4(11)	0.9(158)	<0.001	0.002
	No	98.8(2754)	98.9(2760)	99.4(2774)	98.5(2756)	99.3(2786)	99.6(2794)	99.1(16624)		
STI diagnosis in the past year	Yes	3.8(106)	3.6(100)	1.5(43)	1.8(50)	1.1(31)	1.3(37)	2.2(367)	<0.001	<0.001
	No	96.2(2671)	96.4(2679)	98.5(2747)	98.2(2749)	98.9(2774)	98.7(2768)	97.8(16388)		
HIV-related	Yes	80.0(2235)	86.0(2405)	94.4(2637)	93.4(2615)	92.7(2600)	88.1(2470)	89.1(14962)	<0.001	<0.001

services	No	20.0(558)	14.0(391)	5.6(156)	6.6(184)	7.3(205)	11.9(335)	10.9(1829)

CCU: consistent condom use.

Correlates of HIV, syphilis and HCV infections

Multivariable logistic regression analysis results (Table 4) showed that, (1) HIV infection was significantly and positively associated with no condom use in the last commercial sex (adjusted OR (aOR) =3.48, 95% CI, 1.90-6.37) and syphilis infection (aOR=4.88, 95% CI, 1.95-12.18); (2) syphilis infection was significantly and positively associated with inconsistent condom use in the past month (aOR=1.30, 95% CI, 1.02-1.65), STI diagnosis in the past year (aOR=3.81, 95% CI, 2.40-6.03), HIV infection (aOR=5.88, 95% CI, 2.40-14.41) and HCV infection (aOR=7.68, 95% CI, 4.37-13.49); (3) HCV infection was significantly and positively associated with injecting drug use (aOR=8.91, 95% CI, 4.45-17.86) and syphilis infection (aOR=7.88, 95% CI, 4.49-13.83).

Table 4. Associations between behavioral characteristics and HIV, syphilis and HCV infection

Behavioral characteristics	HIV Positive			Syphilis Positive			HCV Positive		
	OR(95%CI)		aOR(95%CI)	OR(95%CI)		aOR(95%CI)	OR(95%CI)		aOR(95% CI)
	Univariate	Multivariate		Univariate	Multivariate		Univariate	Multivariate	
No condom use in the last commercial sex (yes vs. no)	3.95(2.19,7.15)*	3.97(2.19,7.19)*	3.48(1.90,6.37)*	1.06(0.78,1.45)			0.54(0.29,1.00)		
Inconsistent condom use in the past month (yes vs. no)	2.86(1.50,5.45)*			1.33(1.05,1.67)*	1.30(1.03,1.64)*	1.30(1.02,1.65)*	0.64(0.44,0.93)*	0.63(0.43,0.92)*	0.72(0.49,1.05)
Drug use (yes vs. no)	0.32(0.02,5.24)			1.27(0.71,2.28)			3.28(1.80,6.00)*		
Injecting drug use (yes vs. no)	1.15(0.07,18.91)			1.87(0.76,4.59)			10.05(5.16,19.59)*	9.21(4.67,18.18)*	8.91(4.45,17.86)*
STI diagnosis in the past year	0.49(0.03,7.98)			4.02(2.59,6.24)*	3.75(2.40,5.87)*	3.81(2.40,6.03)*	2.78(1.29,6.00)*		
HIV-related services (yes vs. no)	1.71(0.53,5.53)			1.37(0.90,2.08)			1.36(0.71,2.60)		
HIV positive (yes vs. no)				8.89(3.74,21.17)*	9.17(3.84,21.91)*	5.88(2.40,14.41)*	1.51(0.09,25.29)		
Syphilis positive	8.89(3.73,2	8.68(3.63,2	4.88(1.95,1				9.09(5.30,1	9.09(5.26,1	7.88(4.49,1

(yes vs. no)	1.16)*	0.74)*	2.18)*				5.58)*	5.71)*	3.83)*
HCV positive (yes vs. no)	1.50(0.09,24.83)			9.09(5.30,15.59)*	8.81(5.09,15.25)*	7.68(4.37,13.49)*			

aOR: adjusted odds ratio, adjusted for socio-demographic characteristic (age, education level, marital status, typology and survey year); * p<0.05.

DISCUSSION

FSWs are considered to be at high risk of HIV infection and other STI and contribute disproportionately to the transmission. As an identifiable population, surveillance of STI and risk behaviors among FSWs is of great significance to understanding the potential of spreading HIV to the general population, to assessing and improving interventions targeted at FSWs.[23] Although it is critical to analysis and know prevalence and changing trend of HIV, syphilis, HCV and relevant behaviors among FSWs, few studies reported that in Chongqing, China. In this study, we examined prevalence and changing trends of HIV, syphilis, HCV and behaviors of Chongqing FSWs by using sentinel surveillance data from 2013 to 2018.

Our study showed that HIV prevalence among FSWs in Chongqing was relatively stable with an annual average HIV prevalence at 0.27% from 2013 to 2018, which was similar to 0.22% among Chinese FSWs in 2014,[10] but much higher than China's current estimated national HIV prevalence among general population (0.0598%).[30] And the prevalence of HIV among FSWs in Chongqing is at a relatively high level in China, which is higher than that in most provinces such as Beijing,[31] Liaoning,[32] and Hainan,[33] and lower than in Sichuan,[34] Yunnan,[35] and Guangxi.[36] HCV prevalence was fluctuated between 2013 to 2018 with the six-year average prevalence of 0.72%, but no significant trend was found. This result is in agreement with previous study conducted in Guangxi.[36] However, a previous study using national data reported that from 2008 to 2012, the overall HIV and HCV prevalence among FSWs in mainland China showed a decreasing trend;[16] the differences may due to differences in scope of study area and study period.

Notably, the results also indicated a worrying upward trend of syphilis infection (from 1.11 % in 2013 to 2.00 % in 2018), particularly among low-tier and middle-tier FSWs. Syphilis, as the third most prevalent notifiable infectious disease in category A and B in China, has

been on the rise since the 1990s.[37] The reported total syphilis rate in China increased from 0.2/100,000 in 1993 to 32.86/100,000 in 2013.[37] The reported incidence of syphilis in Chongqing also showed an upward trend, with a reported incidence of 40.38/100,000 in 2014.[38] However, researcher found that the increase of reported cases of syphilis in Chongqing in recent years may be related to large-scale syphilis screening by medical institutions, training on national standards for syphilis diagnosis and reporting, and the improvement of laboratories.[39] The increase of syphilis prevalence among FSWs may also be related to the strengthening of syphilis detection, but it still needs attention. Consistent with previous studies, FSW infected with syphilis has a higher risk of HIV or HCV infection, and HIV or HCV infection is also a risk factor for syphilis infection.[36] FSWs with syphilis were nearly five times more likely to be infected with HIV, and seven times more likely to be infected with HCV than FSWs without syphilis. This may due to their shared transmission routes, co-risk factors and adverse interaction.[40] So more efforts are in need to strengthen comprehensive and combined intervention of AIDS, syphilis and other STI for key groups.

During the study period, the proportion of FSWs who used condoms increased slightly, and condom use was associated with a lower HIV or syphilis infection risk. Consistent condom use is one of the most effective ways to prevent AIDS, and its protection rate can reach 80% based on studies of persons during heterosexual sex with an HIV-positive partner.[41] The 100% Condom Use Programme (CUP) has been implemented in Chongqing since 2006 and has shown a promotion effect. We also found that more and more FSWs practiced consistent condom use, but in 2018 only half of FSWs reported the consistent use of condoms in the last month. This proportion was lower than that in Liaoning and Hainan.[32] [33]Previous studies indicated that clients' low support for and negative norms toward condom use may be the main reason for the inconsistent condom use of FSWs.[42–44] In order to make money or to establish a closer long-term relationship with clients, FSWs often compromise with their clients on condom use. Thus, in addition to raising FSWs' awareness regarding HIV/STI prevention and improving the skills to negotiate condom use, it is also important to promote HIV intervention programs targeting clients and others.

There was no significant increase or decrease trend in drug use among FSWs. The average prevalence of drug use was 3.3%, while the national prevalence among FSWs was

reported at 1.2%.[16] The prevalence of injecting drug use seems to be declining, at 0.4% in 2018. Injecting drug use may exacerbate unsafe sexual behaviors and structural risks, leading to increased risk of HIV and other STI.[45 46] In 2017, the detection rate of HIV, syphilis and HCV among drug users in Chongqing was respectively 5.4%, 5.9% and 44.9%, which was much higher than that of the general population.[47] Compared with FSWs and injecting drug users, FSWs who inject drugs exposed to both sexual and blood transmission routes are at a higher risk of contracting HIV and syphilis.[36 48] Similar to previous study, results showed a strong association between injecting drug use and HCV infection,[49] and the sharing of needles may be the main and underlying route of HCV transmission. Drugs and prostitution are involved relevant laws and ethics, so HIV prevention programs and outreach for FSWs may require more thinking and attention to the individual's external risk environment and risk factors.

In addition, as previous studies found, lower-tier FSWs bear heavier burden of HIV, syphilis, and HCV than FSWs in higher-tier venues.[16] FSWs with less education, older age also had a higher prevalence of HIV and syphilis. And low-tier FSWs were found to tend to be older women and low education.[50] So low-tier FSWs with low education probably had insufficient knowledge about those diseases, less awareness about sex health, and poor communication skills to condom use.[51] And they may serving more clients who also had low education, had low awareness, and were unwilling to use condom, particularly elderly man.[17 36] Thus, future intervention programs should specified and targeted based on the needs of the different tier FSWs, and pay more attention on low-tier FSWs and their clients. What's more, sex work is illegal and highly stigmatized in China, so FSWs face much barriers to participant in HIV/AIDS related services, such as fear of being arrested, fear of discrimination and awkwardness.[52] AIDS intervention services need to cooperate more with Non-Governmental Organizations (NGOs), increase condom promotion, and jointly increase awareness of other STIs such as syphilis.

Our study had several limitations. First, the data we used were based on serial cross-sectional surveillance surveys; therefore we may find trends of HIV, syphilis and HCV infection without exact reasons of those changes. And the survey was anonymous. Respondents who participated in a cross-sectional survey in a certain year may also participate in subsequent cross-sectional surveys, but we have no way to estimate proportion

of FSWs repeatedly participated in our study. Third, the data were collected mainly through self-reported questionnaires, which raise concerns about recall bias, reporting bias and social desirability bias. For example, respondents may conceal the truth when answering sensitive questions, such as drug use, which is illegal in China.

CONCLUSIONS

In conclusion, HIV and HCV prevalence among FSWs in Chongqing remained stable during the study period, but syphilis had an upward trend among FSWs in low-tier and middle-tier venues. Although factors including knowledge, condom use, injecting drug use and STI diagnosis were improved, nearly half of FSWs used condom inconsistently. Thus, more comprehensive interventions targeted FSWs to promote condom use and sexual health, to prevent and control HIV, syphilis and other STIs, particularly those focus on the low-tier and middle-tier FSWs, should be implemented.

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Contributors GW, RL and MY designed and coordinated the study. GW and RL was involved in the design and conducting of the survey. LH and MY analyzed the data. LH, HZ, DJ, and HQ participated in the interpretation of results. LH wrote the first draft of the manuscript. LH, HQ, HZ, DJ, GW, RL, and MY revised the manuscript. All authors have read and approved the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This survey was reviewed and approved by the Institutional Review Board of the National Center for AIDS Prevention and Control (NCAIDS), Center for Disease Control (CDC), China, and the medical ethics committee of Chongqing Medical University (IRB number:2017016).

Data availability statement No additional data available.

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Figure 1. The location of seven sentinel surveillance sites in Chongqing.

Figure 2. Prevalence of HIV, syphilis, and HCV among FSWs in Chongqing by survey year. Bars show prevalence (percent); error bars show 95% confidence intervals.

Figure 3. Prevalence of HIV, syphilis, and HCV among FSWs in Chongqing by typology and survey year.

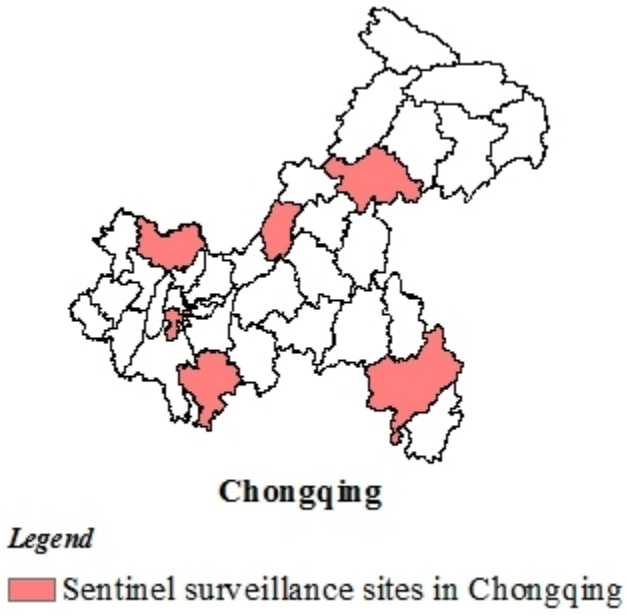

Figure 1. The location of seven sentinel surveillance sites in Chongqing.

60x60mm (139 x 139 DPI)

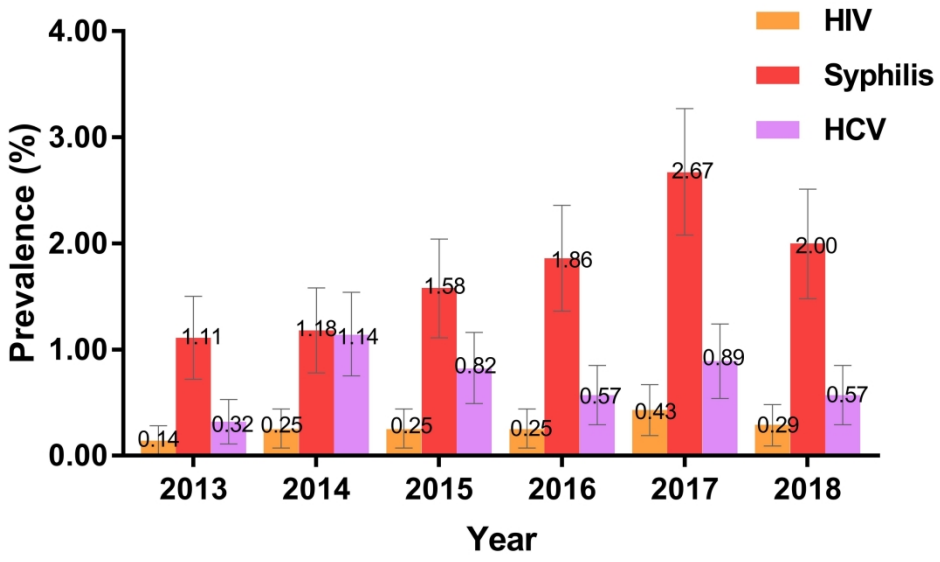

Figure 2. Prevalence of HIV , syphilis, and HCV among FSWs in Chongqing by survey year. Bars show prevalence (percent); error bars show 95% confidence intervals.

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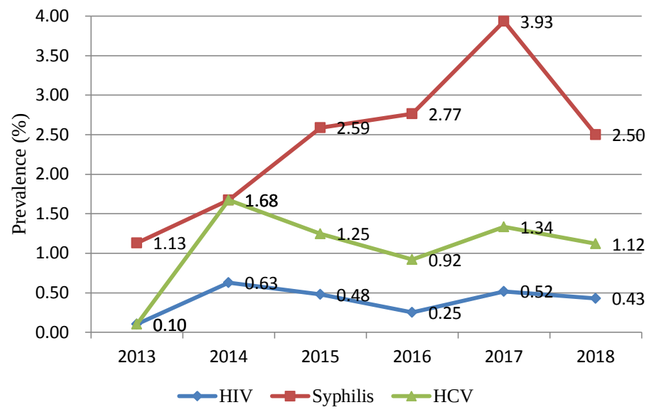
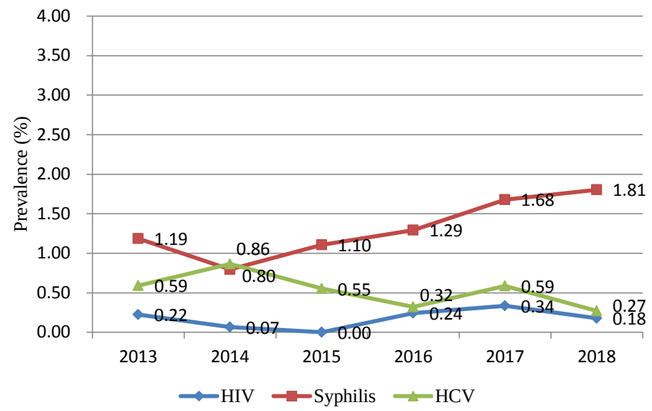
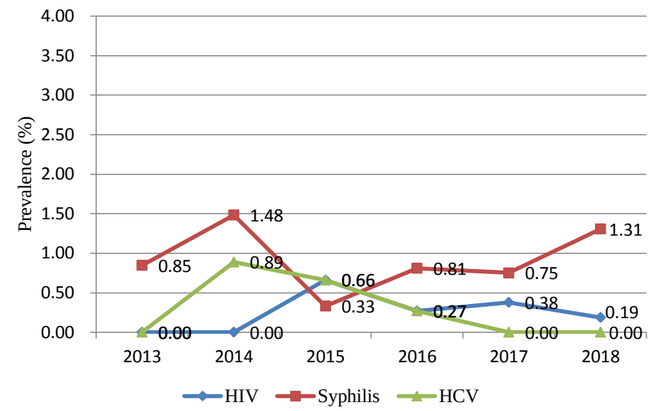


a. Low-tier FSWs



b. Middle-tier FSWs



c. High-tier FSWs

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	*14*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	--
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	--
		(*e*) Describe any sensitivity analyses	--
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	--
		(c) Consider use of a flow diagram	--
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	--
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10
		(*b*) Report category boundaries when continuous variables were categorized	--
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	--
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Changing trends of HIV, syphilis, HCV infections and behavioural factors among female sex workers in Chongqing, China: findings from six serial surveillance surveys

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Changing trends of HIV, syphilis, HCV infections and behavioural factors among female sex workers in Chongqing, China: findings from six serial surveillance surveys

Ling Hu[1,2,*,†], Guohui Wu[3,†], Rongrong Lu[3], Hua Zhu[1,2], Hongfang Qiu[1,2], Dan Jing[1,2], Mengliang Ye[1,2]

[1] Department of Epidemiology and Health Statistics, School of Public Health and Management, Chongqing Medical University, Chongqing 400016, China

[2] Research Center for Medicine and Social Development, Chongqing Medical University, Chongqing 400016, China

[3] Institute for AIDS/STD Control and Prevention, Chongqing Center for Disease Control and Prevention, Chongqing 400042, China

Correspondence to Mengliang Ye, Department of Epidemiology and Health Statistics, School of Public Health and Management, Chongqing Medical University, Chongqing 400016,China; yemengliang@cqmu.edu.cn

† These authors contributed equally to this work.

ABSTRACT

Objectives: To explore the prevalence and changing trends of HIV, syphilis, hepatitis C virus (HCV) infections and risk behaviors among female sex workers (FSWs), and to provide reference and theoretical basis for formulating targeted interventions.

Design: Six consecutive cross-sectional surveys.

Setting: Chongqing, China.

Participants: FSWs were included if they (1) were aged ≥ 16 years, (2) provided commercial sex for money or goods during the previous month, and (3) were willing to participate in the survey and could provide verbal informed consent. This study included 16791 of 16810 participants recruited between 2013 and 2018.

Primary and secondary outcome measures: The prevalence of HIV/syphilis/HCV infection.

Results: The HIV and HCV prevalence among FSWs in Chongqing was stable during the study period, but the prevalence of syphilis had an increasing trend, particularly among low- and middle-tier FSWs. Improvements in HIV-related knowledge, condom use, injecting drug use and participation in HIV-related services were observed. However, no change was found in the prevalence of drug use. HIV infection was correlated with no condom use in the last commercial sex (aOR 3.48, 95%CI 1.90 to 6.37) and syphilis infection (aOR 4.88, 95%CI 1.95 to 12.18). Syphilis infection was correlated with inconsistent condom use (aOR 1.30, 95%CI 1.02 to 1.65), HIV infection (aOR 5.88, 95%CI 2.40 to 14.41), HCV infection (aOR 7.68, 95%CI 4.37 to 13.49), and STI diagnosis in the past year (aOR 3.81, 95%CI 2.40 to 6.03). HCV infection was associated with injecting drug use (aOR 8.91, 95%CI 4.45 to 17.86) and syphilis infection (aOR 7.88, 95%CI 4.49 to 13.83).

Conclusions: Comprehensive interventions targeting FSWs, particularly low- and middle-tier FSWs, should be increasingly implemented to prevent and control HIV, syphilis and other STIs.

Keywords: Female sex workers (FSWs), HIV, Syphilis, Sexually transmitted infections (STIs), China

Strengths and limitations of this study

- The study involved six consecutive years of sentinel surveillance among FSWs in Chongqing with a large sample size.
- This study provides valuable information about the prevalence and trends of STIs among FSWs in Chongqing, and helps to formulate and improve relevant intervention strategies.
- However, causality could not be determined due to the cross-sectional design.
- Recall bias and social desirability bias may be present due to the use of self-reported measures of condom use, drug use and other behaviour.

INTRODUCTION

The HIV/AIDS pandemic, one of the major public health problems all over the world, is highly heterogeneous among different populations and regions. Compared with adult women, female sex workers (FSWs) bear a higher burden of HIV, with an estimated HIV prevalence of 10.4% (95% confidence interval [CI] 9.5–11.5%).[1] They are also considered one of the most vulnerable groups to acquisition of other sexually transmitted infections (STIs) such as syphilis.[2]

After the implementation of reform and opening up in the late 1970s, the sex industry has re-emerged in China due to economic growth, population migration, and changes in sexual attitudes.[3 4] A large number of rural migrants moved to cities for enhanced job opportunities. However, those rural women found that the labour force was saturated or the wages were not high enough; then, sex work with quick financial return became an option.[5] The estimated number of FSWs was 4 million;[6] and approximately 6.9% of men aged 18–49 years have had commercial sex during their lifetime.[7] The incidence of STIs, such as syphilis, has dramatically increased along with the prosperity of the sex trade.[8 9] Heterosexual sex has replaced intravenous drug use and commercial blood/plasma collection as the primary transmission mode of HIV in China.[10] Among the newly reported HIV infections in January-October 2019, heterosexual transmission accounted for 73.7%, much higher than other transmission routes.[11] A review also reported that FSWs in China had a median HIV

prevalence of 0.6% (0%–10.3%) and a rate of positive for at least one STI of 41.5% (13%–90.6%).[12]

As a developing country with a population of 1.4 billion, China faces more challenges in responding to the AIDS and STIs epidemic. The prevalence varies from province to province and Southwest provinces have a higher prevalence of STI.[13 14] For example, although HIV prevalence among FSWs was lower than 0.05% in most provinces (such as Heilongjiang and Hebei) in 2012, it exceeded 1% in the same year in Yunnan and Guangxi.[13] Furthermore, sex work is still illegal in China. Thus, it takes place in informal venues, including night clubs, hair salons, foot massage parlors and hotels, which is always combined with other works to cover up its illegality. This hinders the implementation of related interventions and reduces their effects. Different sex work settings are associated with the risk of HIV/STI infection. The average price of each sex transaction is often used by Chinese researchers to categorise FSWs into high, middle and low tiers. The size of different-tier FSWs may be related to the local economic level. In Jiangmen City, more than 60% of FSWs was high-tier FSW, while the proportion of low-tier FSWs was less than 10%.[15] However, in Jianshui County, the proportion of low-tier FSWs was close to 30%.[16] The proportion of low-tier FSWs may vary from region to region, but previous studies have shown that they have higher risk of HIV infection than other FSWs.[13 17]

The Chinese government has provided voluntary HIV counselling and testing, STIs services, condom promotion and peer education among FSWs through the cooperation of Centers for Disease Control (CDC), community health services and medical institutions.[18] The 'Four Frees and One Care' policy helps treat patients with AIDS who have financial difficulties by providing free antiviral drugs. In 1995, China established the national HIV sentinel surveillance system to actively monitor HIV prevalence among high-risk populations (e.g. FSWs and injecting drug users) and guide the development of HIV prevention and control strategies.[19–21] After years of development, the surveillance system has expanded its scope from 42 sentinel sites in 1995 to 1888 in 2010, and combined biological and behavioural surveillance strategies, which included sero-testing for HIV, syphilis and hepatitis C virus (HCV).[22] Surveillance data could help understand the epidemic status and trend of HIV and STIs among FSWs, which is necessary for developing HIV or STIs prevention programmes.[23]

According to China's surveillance data, the overall prevalence of HIV/syphilis/HCV among FSWs showed a downward trend from 2010 to 2015.[24] However, there may be diverse trends in different geographic regions of China, and there has been less work on understanding trends of STIs among FSWs in underdeveloped southwest areas.

Chongqing, located in Southwest China, is one of the four Chinese municipalities directly controlled by the central government. It is geographically close to Yunnan and Guangxi and it has large population contacts with Yunnan and Guangxi. It is the political and economic centre of Western China and a city with obvious urban–rural dual structure and prosperous sex industry. A study using the network scale-up method estimated that FSWs accounted for 0.4% of women aged 15–49 years in Chongqing, and the clients of FSWs represented 2% of men aged 15–49 years.[25] The HIV prevalence among FSWs in Chongqing in 2012 was estimated at 0.25%, lower than that among other high-risk groups, such as men who have sex with men (17.03%) and injecting drug users (7.35%).[26] However, FSWs can transmit STIs to numerous clients and then to the general population, which pose a great challenge to public health. Heterosexual transmission has become the main route of HIV transmission in Chongqing since 2007.[27] Of the 6352 newly diagnosed HIV/AIDS cases reported in Chongqing in 2015, 75.08% were infected through heterosexual transmission.[27] Therefore, understanding the prevalence and trends of STIs among FSWs in Chongqing is highly important.

On the basis of the surveillance data in Chongqing, this study was aimed to identify the prevalence and changing trends of HIV, syphilis and HCV infections among FSWs over time. This study also explored the trends in sexual behaviours of FSWs and discussed the risk factors for prevalent STIs over a 6-year period in order to provide reference for formulating interventions to control AIDS and STIs.

METHODS

Study design

Sentinel surveillance was conducted collect HIV, syphilis and HCV prevalence and high-risk behaviour information through cross-sectional surveys. The data analysed in this study were sentinel surveillance data among FSWs in Chongqing from 2013 to 2018.

Participant selection and data collection

The detailed procedures of data collection followed the Operational Manual for the Implementation Program of National AIDS Sentinel Surveillance established by the National Center for AIDS Prevention and Control.[28] As shown in Figure 1, serial cross-sectional surveys were conducted from April to June each year at seven sentinel surveillance sites in Chongqing (Yuzhong District, Jiulongpo District, Wanzhou District, Dianjiang, Hechuan, Qijiang [Wansheng] and Youyang). The sample size of each site was 400 participants. The entire sampling process went through the following three steps. First, a distribution map of known commercial workplaces in the monitoring area was drawn to construct a sampling frame and these locations were categorised into low-, middle- and high-tier venues on the basis of the average price of each sex transaction. Then, these venues in each city were randomly selected through proportional sampling. The proportions of low- and middle-tier FSWs among all participants were at least 10% and 40%, respectively. The FSWs were recruited if they met the inclusion criteria as follows: participants (1) were aged ≥ 16 years, (2) provided commercial sex for money or goods during the previous month, and (3) were willing to participate in the survey and could provide verbal informed consent.

All participants completed an anonymous, standard interviewer-administered and face-to-face questionnaire. After each interview, 3–5 mL of venous blood was collected from each participant for HIV, syphilis and HCV antibody detection. The blood sample was linked to the questionnaire by a unique identification code assigned to the participant.

Measures

Questionnaire

A questionnaire was used to collect the socio-demographic characteristics, HIV knowledge and behaviour of the FSWs.

(1) Socio-demographic characteristics, including year of birth, marital status, household registration, ethnicity and education level were collected.

(2) The HIV-related knowledge of participants was assessed using eight questions with 'yes', 'no' or 'don't know' as answers. The questions have been updated since 2016 and took new-type drugs and intentional transmission of HIV/AIDS into consideration. Only

correct responses were scored as 1 point, whereas incorrect responses and 'don't know' responses did not earn any point. The Cronbach's alpha values were 0.706 and 0.739 before and after the questions were changed, respectively.

(3) The participants' behavioural factors were also collected, including questions regarding condom use in last commercial sex, condom use with clients in the past month, drug use during their lifetime, STI diagnosis in the last year and participation in HIV-related services. In this study, consistent condom use (CCU) in the past month was defined as always using condom during commercial intercourse.

Laboratory testing

In all surveys, the venous blood samples were tested for HIV, syphilis and HCV by trained laboratory technicians. Initial screening for HIV, syphilis and HCV antibodies was conducted using Enzyme-linked Immunosorbent Assay (ELISA) method (ELISA-1). When the result was negative, no further re-examination was carried out and infection status was recorded as negative. When the result was positive, HIV or HCV infection was confirmed by another ELISA method (ELISA-2) while syphilis infection was confirmed using a non-specific detection method called toluidine red unheated serum test (TRUST). The results were determined as positive only when both tests were positive.

Quality assurance

All investigators were strictly trained before the survey to ensure that they familiarized the questionnaire structure and mastered the unified investigation standards and requirements. After the investigation, the investigators carefully reviewed the questionnaires and promptly corrected the missing items, wrong items and logical errors. Experts from the Chongqing Center for Disease Control and Prevention went to the investigation site for guidance and inspection to ensure quality. All laboratory tests were conducted at designated and certified laboratories in local CDC or hospitals.

Data analysis

The socio-demographic characteristics of participants were presented using descriptive statistics by survey year. In addition, the trends of HIV, syphilis, HCV infections and behavioural factors over time were assessed using Cochran–Armitage trend test.

Multivariable logistic regression was conducted to identify related risk-factors of HIV, syphilis and HCV infection by using stepwise elimination. The odds ratios (ORs) and 95% CIs of each significant risk factor were also determined, unadjusted and adjusted for socio-demographic factors. All statistical analyses were carried out using Statistical Analysis Software, version 9.2 (SAS Institute Incorporated, Cary, North Carolina, USA).

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

Socio-demographic characteristics

This study included 16791 of 16810 participants recruited between 2013 and 2018. Table 1 depicted all the participants' demographic characteristics stratified by year of survey. Nearly half of the participants (46.7%) worked in middle-tier venues, 39.7% worked in low-tier venues, and 13.6% worked in high-tier venues. The median age was 28 years and most (87.2%) of them were between 20 and 45 years of age. The majority of the participants were in Chongqing households (91.0%) and belong to Han (90.0%). Less than one third of them had high school or above education and half (54.7%) had a junior middle school education. Most participants have worked in the current location for 1~6 months (33.0%).

Table 1. Socio-demographic characteristics of female sex workers stratified by survey year (N, %)

Characteristics	2013 N(%)	2014 N(%)	2015 N(%)	2016 N(%)	2017 N(%)	2018 N(%)	Total N(%)
Overall	2793(16.6)	2796(16.7)	2793(16.6)	2799(16.7)	2805(16.7)	2805(16.7)	16791(100.0)
Age group(years)							
<20	285(10.2)	226(8.1)	206(7.4)	228(8.1)	87(3.1)	96(3.4)	1128(6.7)
20-45	2404(86.1)	2451(87.7)	2442(87.4)	2412(86.2)	2521(89.9)	2415(86.1)	14645(87.2)
>45	104(3.7)	119(4.3)	145(5.2)	159(5.7)	197(7.0)	294(10.5)	1018(6.1)
Marital status							
Never been married	1131(40.5)	1143(40.9)	1102(39.5)	1106(39.5)	734(26.2)	837(29.8)	6053(36.0)
Married	1148(41.1)	1104(39.5)	1207(43.2)	1152(41.2)	1279(45.6)	1278(45.6)	7168(42.7)
Living together as if married	275(9.8)	308(11.0)	260(9.3)	307(11.0)	305(10.9)	296(10.6)	1751(10.4)
Divorced/Widowed	239(8.6)	241(8.6)	224(8.0)	234(8.4)	487(17.4)	394(14.0)	1819(10.8)
Household registration(hukou)							
Chongqing	2518(90.2)	2559(91.5)	2533(90.7)	2547(91.0)	2580(92.0)	2537(90.4)	15274(91.0)
Other provinces	275(9.8)	237(8.5)	260(9.3)	252(9.0)	225(8.0)	268(9.6)	1517(9.0)
Ethnicity							
Minority	253(9.1)	266(9.5)	308(11.0)	295(10.5)	280(10.0)	272(9.7)	1674(10.0)
Han	2539(90.9)	2530(90.5)	2485(89.0)	2504(89.5)	2525(90.0)	2533(90.3)	15116(90.0)
Education level							
Primary school or below	512(18.3)	524(18.7)	581(20.8)	506(18.1)	595(21.2)	507(18.1)	3225(19.2)
Junior middle school	1664(59.6)	1570(56.2)	1367(48.9)	1509(53.9)	1635(58.3)	1446(51.6)	9191(54.7)
High school or above	617(22.1)	702(25.1)	845(30.3)	784(28.0)	575(20.5)	852(30.4)	4375(26.1)
Typology							
Low-tier	973(34.8)	955(34.2)	1043(37.3)	1193(42.6)	1347(48.0)	1161(41.4)	6672(39.7)
Middle-tier	1347(48.2)	1504(53.8)	1448(51.8)	1236(44.2)	1192(42.5)	1108(39.5)	7835(46.7)

High-tier	473(16.9)	337(12.1)	302(10.8)	370(13.2)	266(9.5)	536(19.1)	2284(13.6)
Local working time							
More than 1 year	651(23.3)	566(20.2)	751(26.9)	673(24.0)	888(31.7)	946(33.7)	4475(26.7)
6~12 months	635(22.7)	672(24.0)	899(32.2)	1018(36.4)	918(32.7)	833(29.7)	4975(29.6)
1~6 months	1097(39.3)	1204(43.1)	888(31.8)	778(27.8)	814(29.0)	754(26.9)	5535(33.0)
Less than 1 month	409(14.6)	354(12.7)	255(9.1)	330(11.8)	185(6.6)	272(9.7)	1805(10.8)
Location of previous job							
Other provinces	334(12.0)	257(9.2)	354(12.7)	305(10.9)	353(12.6)	293(10.4)	1896(11.3)
Other cities in Chongqing	330(11.8)	569(20.4)	549(19.7)	572(20.4)	356(12.7)	352(12.5)	2728(16.2)
Current city	1699(60.8)	1627(58.2)	1629(58.3)	1576(56.3)	1894(67.5)	1872(66.7)	10297(61.3)
No previous work	430(15.4)	343(12.3)	261(9.3)	346(12.4)	202(7.2)	288(10.3)	1870(11.1)
HIV knowledge							
<6	388(13.9)	458(16.4)	231(8.3)	449(16.0)	348(12.4)	305(10.9)	2179(13.0)
>=6	2405(86.1)	2338(83.6)	2562(91.7)	2350(84.0)	2457(87.6)	2500(89.1)	14612(87.0)

220

Trends of HIV, syphilis and HCV prevalence

During the study period, the overall prevalence of HIV, syphilis and HCV infection among the study population was 0.27% (95%CI 0.19% to 0.35%), 1.73% (95%CI 1.54% to 1.93%) and 0.72% (95%CI 0.59% to 0.85%), respectively. Low-tier FSWs had higher prevalence of HIV, HCV and syphilis, with 6-year average prevalence rates of 0.40%, 2.53% and 1.08%, respectively ($p = 0.019$, $p < 0.001$, $p < 0.001$). The HIV prevalence among FSWs in Chongqing, which ranged from 0.14% to 0.43% during the study years, had no significant changes over time ($p = 0.129$, Figure 2). No significant time trend was found among low-/ middle-/high-tier FSWs ($p = 0.498$, 0.366 and 0.423, respectively). The HCV prevalence among FSWs in Chongqing ranged from 0.32% to 1.14% between 2013 and 2018, with no significant trend. In each subgroup, no significant changing trend of HCV infection by year was found (Figure 3). Unlike HIV and HCV, a total of 1.11%, 1.18%, 1.58%, 1.86%, 2.67% and 2.00% of the respondents were confirmed to be infected with syphilis from 2013 to 2018, showing an upward trend ($p < 0.001$). This trend was also found in low-tier FSWs (from 1.13% in 2013 to 2.50% in 2018, $p < 0.001$) and middle-tier FSWs (from 1.19% in 2013 to 1.81% in 2018, $p = 0.026$), but not in high-tier FSWs ($p = 0.713$).

Changing trends of behavioral factors

Of the whole survey population, more than 80% exhibited HIV-related knowledge and used condom in their last commercial sex (Table 2). Nearly 90% received at least one of the following three HIV-related services in the last year: (1) condom promotion and distribution and AIDS counselling and testing, (2) community drug maintenance therapy and clean needle supply/exchange, and (3) peer education. In addition, about half of the participants used condom consistently with clients in the last month. Approximately 3% reported drug use, and 2% reported STI diagnosis in the past year.

The changing trends of FSWs' behaviours were also examined, and results showed no significant change over time in drug use reported by FSWs. However, significant improvements over time were found in HIV-related knowledge, condom use, participation in HIV-related services, and self-reported STI diagnosis in the last year among the FSWs.

Table 2. Behavioural characteristics of FSWs from 2013 to 2018 in Chongqing

Variables		2013 %(n)	2014 %(n)	2015 %(n)	2016 %(n)	2017 %(n)	2018 %(n)	overall %(n)	P value	P for trend
HIV know-ledge (>=6)	Yes	86.1(2405)	83.6(2338)	91.7(2562)	84.0(2350)	87.6(2457)	89.1(2500)	87.0(14612)	<0.001	<0.001
	No	13.9(388)	16.4(458)	8.3(231)	16.0(449)	12.4(348)	10.9(305)	13.0(2179)		
condom use in the last commercial sex	Yes	79.7(2167)	77.4(2134)	93.8(2604)	83.4(2335)	87.0(2439)	84.5(2371)	84.3(14050)	<0.001	<0.001
	No	20.3(552)	22.6(625)	6.2(171)	16.6(464)	13.0(366)	15.5(434)	15.7(2612)		
CCU in the past month	Yes	41.7(1130)	51.2(1406)	69.7(1925)	60.1(1682)	47.7(1337)	51.4(1441)	53.7(8921)	<0.001	<0.001
	No	58.3(1578)	48.8(1341)	30.3(835)	39.9(1117)	52.3(1468)	48.6(1364)	46.3(7703)		
Drug use	Yes	2.9(81)	4.2(116)	2.7(74)	4.6(129)	2.2(63)	3.1(88)	3.3(551)	<0.001	0.322
	No	97.1(2705)	95.8(2631)	97.3(2718)	95.4(2670)	97.8(2742)	96.9(2717)	96.7(16183)		
Injecting drug use	Yes	1.3(35)	1.2(32)	0.6(18)	1.5(43)	0.7(19)	0.4(11)	0.9(158)	<0.001	0.002
	No	98.8(2754)	98.9(2760)	99.4(2774)	98.5(2756)	99.3(2786)	99.6(2794)	99.1(16624)		
STI diagnosis in the past year	Yes	3.8(106)	3.6(100)	1.5(43)	1.8(50)	1.1(31)	1.3(37)	2.2(367)	<0.001	<0.001
	No	96.2(2671)	96.4(2679)	98.5(2747)	98.2(2749)	98.9(2774)	98.7(2768)	97.8(16388)		
HIV-related services	Yes	80.0(2235)	86.0(2405)	94.4(2637)	93.4(2615)	92.7(2600)	88.1(2470)	89.1(14962)	<0.001	<0.001
	No	20.0(558)	14.0(391)	5.6(156)	6.6(184)	7.3(205)	11.9(335)	10.9(1829)		

CCU: consistent condom use.

Correlates of HIV, syphilis and HCV infections

Multivariable logistic regression analysis results (Table 3) showed that, (1) HIV infection was significantly and positively associated with no condom use in the last commercial sex (adjusted OR [aOR] 3.48, 95% CI 1.90 to 6.37) and syphilis infection (aOR 4.88, 95% CI 1.95 to 12.18); (2) syphilis infection was significantly and positively associated with inconsistent condom use in the past month (aOR 1.30, 95% CI 1.02 to 1.65), STI diagnosis in the past year (aOR 3.81, 95% CI 2.40 to 6.03), HIV infection (aOR 5.88, 95% CI 2.40 to 14.41) and HCV infection (aOR 7.68, 95% CI 4.37 to 13.49); (3) HCV infection was significantly and positively associated with injecting drug use (aOR 8.91, 95% CI 4.45 to 17.86) and syphilis infection (aOR 7.88, 95% CI 4.49 to 13.83).

Table 3. Associations between behavioural characteristics and HIV, syphilis and HCV infection

Behavioral characteristics	HIV Positive		Syphilis Positive		HCV Positive	
	OR(95%CI)	aOR(9	OR(95%CI)	aOR(95	OR(95%CI)	aOR(95%

	Univariate	Multivariate	5%CI)	Univariate	Multivariate	%CI)	Univariate	Multivariate	CI)
No condom use in the last commercial sex (yes vs. no)	3.95(2.19,7.15)*	3.97(2.19,7.19)*	3.48(1.90,6.37)*	1.06(0.78,1.45)			0.54(0.29,1.00)		
Inconsistent condom use in the past month (yes vs. no)	2.86(1.50,5.45)*			1.33(1.05,1.67)*	1.30(1.03,1.64)*	1.30(1.02,1.65)*	0.64(0.44,0.93)*	0.63(0.43,0.92)*	0.72(0.49,1.05)
Drug use (yes vs. no)	0.32(0.02,5.24)			1.27(0.71,2.28)			3.28(1.80,6.00)*		
Injecting drug use (yes vs. no)	1.15(0.07,18.91)			1.87(0.76,4.59)			10.05(5.16,19.59)*	9.21(4.67,18.18)*	8.91(4.45,17.86)*
STI diagnosis in the past year	0.49(0.03,7.98)			4.02(2.59,6.24)*	3.75(2.40,5.87)*	3.81(2.40,6.03)*	2.78(1.29,6.00)*		
HIV-related services (yes vs. no)	1.71(0.53,5.53)			1.37(0.90,2.08)			1.36(0.71,2.60)		
HIV positive (yes vs. no)				8.89(3.74,21.17)*	9.17(3.84,21.91)*	5.88(2.40,14.41)*	1.51(0.09,25.29)		
Syphilis positive (yes vs. no)	8.89(3.73,21.16)*	8.68(3.63,20.74)*	4.88(1.95,12.18)*				9.09(5.30,15.58)*	9.09(5.26,15.71)*	7.88(4.49,13.83)*
HCV positive (yes vs. no)	1.50(0.09,24.83)			9.09(5.30,15.59)*	8.81(5.09,15.25)*	7.68(4.37,13.49)*			

aOR: adjusted odds ratio, adjusted for socio-demographic characteristic (age, education level, marital status, typology and survey year); * $p < 0.05$.

DISCUSSION

FSWs are considered to be at high risk of HIV infection and other STIs and contribute disproportionately to the transmission. Surveillance of STIs and risk behaviour among FSWs is highly important for the understanding of the potential of spreading HIV to the general population and the assessment and improvement of interventions targeted at FSWs.[23] Although analysing and knowing the prevalence and changing trends of HIV, syphilis, HCV and relevant behaviours among FSWs are critical, only few studies have been reported in Chongqing, China. Thus, in the present study, the prevalence and changing trends of HIV, syphilis, HCV and behaviour of Chongqing FSWs were examined using sentinel surveillance data from 2013 to 2018.

The results showed that the HIV prevalence among FSWs in Chongqing was relatively stable, with an annual average of 0.27% from 2013 to 2018, similar to 0.22% among Chinese FSWs in 2014[9] but much higher than China's current estimated national HIV prevalence among general population (0.0598%).[29] The prevalence of HIV among FSWs in Chongqing is higher than that in most provinces such as Beijing,[30] Liaoning[31] and Hainan,[32] but lower than that in Sichuan,[33] Yunnan[34] and Guangxi.[35] HCV prevalence fluctuated between 2013 and 2018, with a 6-year average of 0.72%, but no significant trend was found. This result was in concordance with that of a previous study conducted in Guangxi.[35] However, a previous study using national data reported that from 2008 to 2012, the overall HIV and HCV prevalence among FSWs in mainland China showed a decreasing trend;[13] the differences may be due to the differences in scope of study area and study period.

The results also indicated a worrying upward trend of syphilis infection (from 1.11% in 2013 to 2.00% in 2018), particularly among low- and middle-tier FSWs. As the third most prevalent notifiable infectious disease in categories A and B in China, syphilis has been on the rise since the 1990s.[36] The reported total syphilis rate in China increased from 0.2/100,000 in 1993 to 32.86/100,000 in 2013.[36] The reported incidence of syphilis in Chongqing also showed an upward trend, with a reported incidence of 40.38/100,000 in 2014.[37] However, researchers found that the increase in reported cases of syphilis in Chongqing in recent years may be related to large-scale syphilis screening by medical institutions, training on national standards for syphilis diagnosis and reporting, and laboratory improvement.[38] The increase in syphilis prevalence among FSWs may also be related to the strengthening of syphilis detection, but it still needs attention. In agreement with previous studies, the FSWs infected with syphilis have a higher risk of HIV or HCV infection, and HIV or HCV infection is a risk factor of syphilis infection.[35] FSWs with syphilis were nearly five times more likely to be infected with HIV, and seven times more likely to be infected with HCV than FSWs without syphilis. This phenomenon may be due to their shared transmission routes, co-risk factors and adverse interaction.[39] Thus, efforts should be increased to strengthen the comprehensive and combined intervention of AIDS, syphilis and other STIs for key groups.

During the study period, the proportion of FSWs who used condoms increased slightly, and condom use was associated with decreased HIV or syphilis infection risk. CCU is one of

the most effective ways to prevent HIV infection, and its protection rate can reach 80% based on studies of persons during heterosexual sex with an HIV-positive partner.[40] The 100% Condom Use Programme has been implemented in Chongqing since 2006 and has shown a promotional effect. The number of FSWs who practiced CCU increased. However, in 2018, only half of FSWs reported consistent use of condoms in the last month. This proportion was lower than that in Liaoning and Hainan.[31 32] Previous studies indicated that clients' low support and negative norms towards condom use may be the main reason for the inconsistent condom use of FSWs.[41–43] FSWs often compromise with their clients on condom use to earn money or establish a closer long-term relationship with clients. Thus, in addition to raising FSWs' awareness regarding HIV/STI prevention and improving their skills to negotiate condom use, promoting HIV intervention programs targeting clients of FSWs and others is also essential.

No significant increasing or decreasing trend in drug use was observed among FSWs. The average prevalence of drug use was 3.3%, while the national prevalence among FSWs was reported at 1.2%.[13] The prevalence of injecting drug use seemed to be declining during the study period. Injecting drug use may exacerbate unsafe sexual behaviour and structural risks, leading to increased risk of HIV and other STIs.[44 45] In 2017, the detection rates of HIV, syphilis and HCV among drug users in Chongqing were 5.4%, 5.9% and 44.9%, respectively, much higher than those among the general population.[46] FSWs who inject drugs are exposed to sexual and blood transmission routes and at a higher risk of contracting HIV and syphilis than other FSWs and injecting drug users.[35 47] Similar to previous studies, the present study showed a strong association between injecting drug use and HCV infection,[48] and sharing of needles may be the main and underlying route of HCV transmission. Drugs and prostitution involve relevant laws and ethics. Thus, HIV prevention programs and outreach for FSWs may require enhanced thinking and increased attention to the individual's external risk environment and risk factors.

In addition, as previous studies have shown, lower-tier FSWs bear heavier burden of HIV, syphilis and HCV than higher-tier FSWs,[13] which may be attributed to the socio-demographic characteristics of lower-tier FSWs and their clients. It's found that low-tier FSWs generally have older age and lower education, which are often associated with higher

prevalence of HIV and syphilis.[49] Low-tier FSWs with low education probably had insufficient knowledge about those diseases, less awareness about sex health, and poor communication skills for condom use.[50] And they may be serving more clients who also had low education, had low awareness, and were unwilling to use condom, particularly elderly man.[17 35] Thus, future intervention programs should be specified and targeted based on the needs of FSWs under different tiers, and pay more attention to low-tier FSWs and their clients. In addition, sex work is illegal and highly stigmatised in China; thus, FSWs face several barriers, such as fear of being arrested, fear of discrimination and awkwardness, to participant in AIDS related services.[51] AIDS intervention services must further cooperate with non-governmental organizations, increase condom promotion, and jointly increase awareness of other STIs such as syphilis.

This study had several limitations. Firstly, the data we used were based on serial cross-sectional surveillance surveys; therefore, trends of HIV, syphilis and HCV infection without exact reasons behind the changes were possibly found. Secondly, the survey was anonymous. Respondents who participated in a cross-sectional survey in a certain year may also participate in subsequent cross-sectional surveys. However, estimating the proportion of FSWs who repeatedly participated in this study was not possible. Thirdly, the data were collected mainly through self-reported questionnaires, which raise concerns about recall bias, reporting bias and social desirability bias. For example, respondents may conceal the truth when answering sensitive questions, such as drug use, which is illegal in China.

CONCLUSIONS

In conclusion, the HIV and HCV prevalence among FSWs in Chongqing remained stable during the study period, but syphilis had an upward trend among FSWs in low- and middle-tier venues. Although factors such as knowledge, condom use, injecting drug use and STI diagnosis were improved, nearly half of FSWs used condom inconsistently. Thus, more effective interventions for promoting CCU among FSWs and their clients are needed to reduce the spread of HIV/STIs, and more attention must be paid to low- and middle-tier FSWs.

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Contributors GW, RL and MY designed and coordinated the study. GW and RL was involved in the design and conducting of the survey. LH and MY analyzed the data. LH, HZ, DJ and HQ participated in the interpretation of results. LH wrote the first draft of the manuscript. LH, HQ, HZ, DJ, GW, RL and MY revised the manuscript. All authors have read and approved the manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This survey was reviewed and approved by the Institutional Review Board of the National Center for AIDS Prevention and Control (NCAIDS), Center for Disease Control (CDC), China, and the medical ethics committee of Chongqing Medical University (IRB number:2017016).

Data availability statement No additional data available.

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Figure 1. The location of seven sentinel surveillance sites in Chongqing.

Figure 2. Prevalence of HIV, syphilis, and HCV among FSWs in Chongqing by survey year. Bars show prevalence (percent); error bars show 95% confidence intervals.

Figure 3. Prevalence of HIV, syphilis, and HCV among FSWs in Chongqing by typology and survey year.

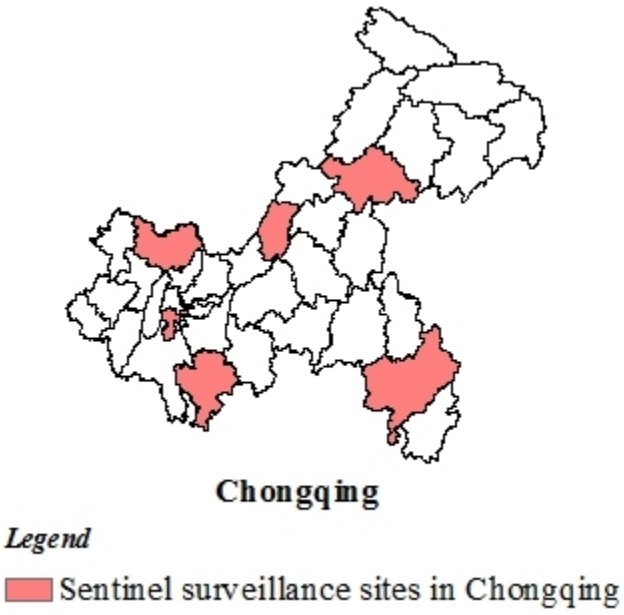


Figure 1. The location of seven sentinel surveillance sites in Chongqing.

60x60mm (139 x 139 DPI)

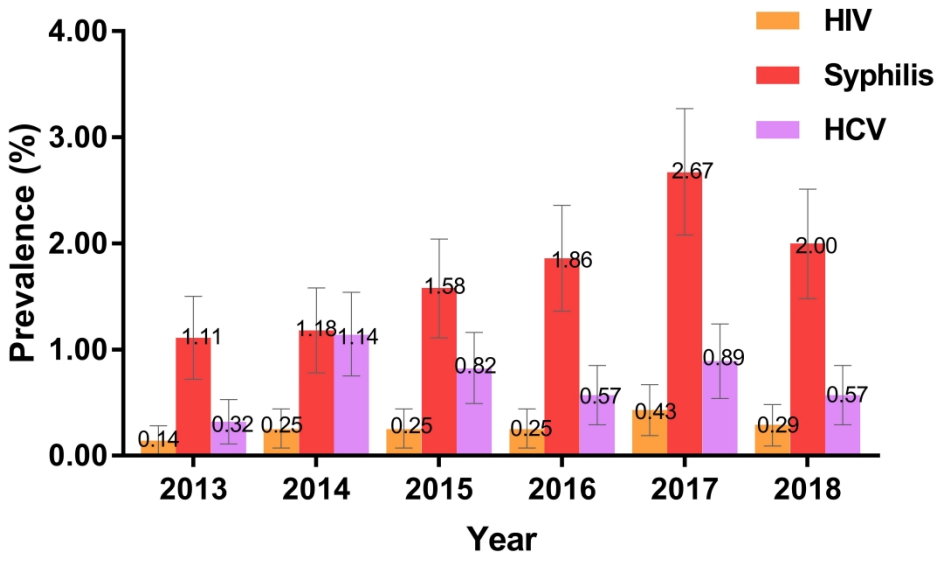
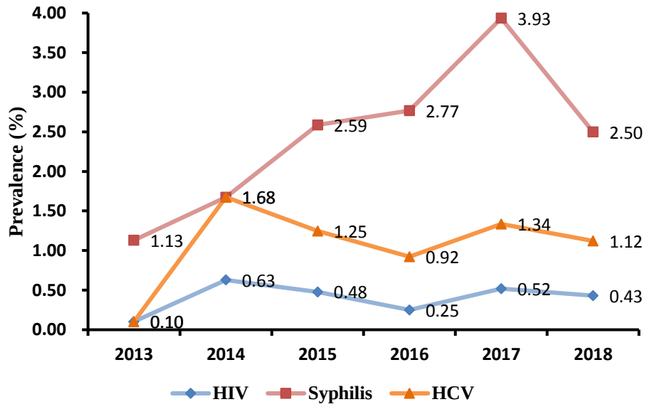
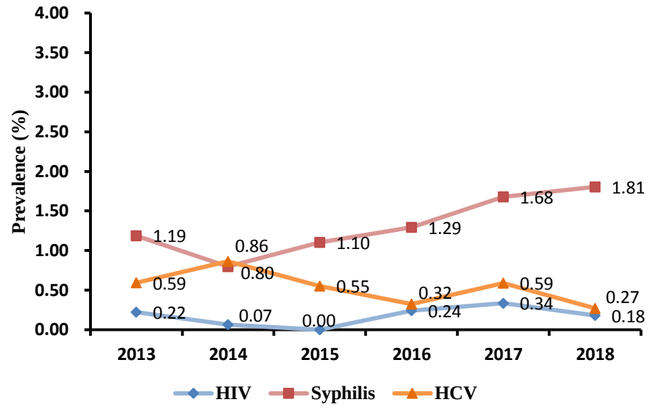


Figure 2. Prevalence of HIV , syphilis, and HCV among FSWs in Chongqing by survey year. Bars show prevalence (percent); error bars show 95% confidence intervals.

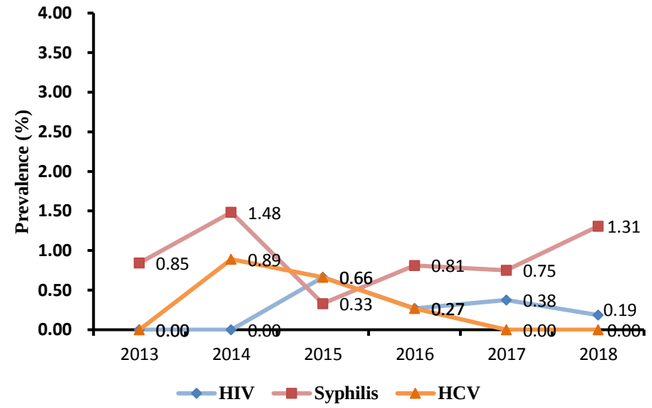
125x76mm (1200 x 1200 DPI)



a. Low-tier FSWs



b. Middle-tier FSWs



c. High-tier FSWs

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6
Bias	9	Describe any efforts to address potential sources of bias	*14*
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	--
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	--
		(*e*) Describe any sensitivity analyses	--
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	--
		(c) Consider use of a flow diagram	--
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	--
Outcome data	15*	Report numbers of outcome events or summary measures	9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10
		(*b*) Report category boundaries when continuous variables were categorized	--
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	--
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.