

# Application of cumulative odds logistic model on risk factors analysis for sexually transmitted infections among female sex workers in Kaiyuan city, Yunnan province, China

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## ABSTRACT

**Objectives:** To investigate the epidemiology of sexually transmitted infections (STI) among female sex workers (FSW) in Kaiyuan city, Yunnan province, China, and to identify risk factors associated with STI.

**Methods:** A cross-sectional study of 737 FSW was carried out from March to May 2006, with confidential interviews and laboratory tests for STI. A cumulative logit model was used to evaluate the risk factors for STI.

**Results:** The overall prevalence of HIV is 10.3%. The prevalence of syphilis, herpes simplex virus type 2, gonorrhoea, chlamydia and trichomonas was 7.5%, 68.1%, 8.3%, 25.9% and 10.6%, respectively. In multivariate cumulative odds logistic analysis, the factors associated with STI were education level, living in the entertainment location, injection drug use, non-injection drug use, over five clients in the previous week and inconsistent use of condoms with clients.

**Conclusion:** The findings highlight the gravity of the STI epidemic among FSW in China, where sexual transmission has now overtaken unsafe injection practices as the dominant mode of HIV transmission. Targeted intervention programmes for FSW should focus on increasing condom use, strengthening knowledge and awareness of STI/HIV and encouraging routine screening and treatment-seeking behaviours. Reducing the spread of STI also has profound implications for the prevention of HIV.

China's commercial sex industry took off in the early 1990s alongside the rapid economic growth that followed market liberalisation in the late 1980s. One effect of this has been the skyrocketing rates of sexually transmitted infections (STI), with numbers of reported cases of the eight most common STI increasing from 50 cases in 1980, to 16 000 in 1990 and 850 000 by 2000.<sup>1 2</sup> Rates have risen particularly quickly among female sex workers (FSW), which has helped to make STI one of the most common types of infectious diseases in China. By 2000, the Public Security Bureau estimated that there were between four and six million FSW nationwide with STI.<sup>3</sup>

When coupled with these rapidly rising STD prevalence rates, the growth of the commercial sex industry in China is of considerable public health concern. The number of FSW identified by the Public Security Bureau increased from 25 000 in 1986, to 250 000 in 1992 and to 420 000 in 1996.<sup>4</sup> By 2003, an estimated 4–10 million women engaged in commercial sex in mainland China.<sup>5</sup> As a group particularly vulnerable to the contraction

of HIV/STI and also as a core group for secondary transmission to the general population, the prevention and treatment of STI among FSW is of great importance. Insights gained from public health research with these populations can help address the growing public health concern of transmission-related risk behaviours of FSW in China, especially in the light of increasing evidence that primary modes of HIV transmission in China are shifting from intravenous drug users and unregulated commercial blood collection to sexual transmission.

## METHODS

This study was conducted by the Chinese Center for Disease Control and Prevention (CDC) in Beijing in conjunction with provincial and local CDC staff in Yunnan. With approval from both the national and local Yunnan institutional review boards, we conducted a cross-sectional study of all women identified as FSW in Kaiyuan City, Yunnan Province from March to May 2006. The medium-sized industrial city of Kaiyuan in southwestern Yunnan province, with a population of 290 000, is representative of many Chinese cities with a large commercial sex industry. The FSW were recruited by local outreach workers who approached individuals and their bosses in person at various sexual establishments and explained the purpose, procedures, risks and benefits of study participation. Study inclusion criteria were that women had to be aged 16 years or older (legal age of consent in China), self-reported to have sold sex for money within the previous 3 months and were willing to undergo testing and counselling for HIV/STI and illegal drug use. After providing informed consent, participants were asked standardised questions about their demographics, basic medical history and risk behaviours (table 1). Test results and post-test counselling were provided within 4 weeks to all study participants who donated specimens for laboratory testing. HIV/STI-positive subjects were referred to Kaiyuan People's Hospital or the Dermatology Hospital for further evaluation and treatment.

Blood was collected and tested for HIV-1 antibodies (ELISA; Vironostika HIV Uni-Form Plus O; bioMérieux, Boxtel, The Netherlands), herpes simplex virus type 2 antibody (HSV-2; HerpeSelect-2 ELISA IgG; Focus, Cypress, California, USA) and syphilis (rapid plasma reagin test; diagnosis kit; Xinjiang Xindi Company, Xindi,

**Table 1** Univariate cumulative odds logistic regression analysis of demographic factors associated with STI among 737 FSW

Demographic factors	All subjects (n = 737)	No STI No (%)	One STI No (%)	Two or more STI No (%)	OR (95% CI)	p Value
Age, years						0.98
16–25	225 (30.5)	51 (33.1)	98 (28.4)	76 (31.9)	1.0	
26–35	255 (34.6)	52 (33.8)	120 (34.8)	83 (34.9)	1.02 (0.73 to 1.43)	
36–52	257 (34.9)	51 (33.1)	127 (36.8)	79 (33.2)	0.98 (0.70 to 1.38)	
Nationality						
Han	492 (66.8)	113 (73.4)	229 (66.4)	150 (63.0)	1.0	0.04
Minority	245 (33.2)	41 (26.6)	116 (33.6)	88 (37.0)	1.35 (1.01 to 1.80)	
Registered permanent residence						
Kaiyuan city	297 (40.3)	68 (44.2)	142 (41.2)	87 (36.6)	1.0	0.02
Other cities in Yunnan	295 (40.0)	49 (31.8)	137 (39.7)	109 (45.8)	1.44 (1.06 to 1.95)	
Outside Yunnan	145 (19.7)	37 (24.0)	66 (19.1)	42 (17.6)	0.93 (0.64 to 1.35)	
Education level, years						
<9	387 (52.5)	68 (44.2)	177 (51.3)	142 (59.7)	1.0	0.002
≥9	350 (47.5)	86 (55.8)	168 (48.7)	96 (40.3)	0.65 (0.50 to 0.86)	
Marital status						
Married or cohabitating	225 (30.5)	44 (28.6)	115 (33.3)	66 (27.7)	1.0	0.63
Single or separated, divorced, or widowed	512 (69.5)	110 (71.4)	230 (66.7)	172 (72.3)	1.07 (0.80 to 1.44)	
Residence type						
Apartment	491 (66.6)	127 (82.5)	228 (66.1)	136 (57.1)	1.0	<0.001
Family home	59 (8.0)	7 (4.5)	32 (9.3)	20 (8.4)	1.65 (0.99 to 2.75)	
Brothel or other working location	187 (25.4)	20 (13.0)	85 (24.6)	82 (34.5)	2.27 (1.64 to 3.13)	
Duration in Kaiyuan, years						
<5	586 (79.5)	122 (79.2)	272 (78.8)	192 (80.7)	1.0	0.67
≥5	151 (20.5)	32 (20.8)	73 (21.2)	46 (19.3)	0.93 (0.67 to 1.30)	
Entertainment venue						
Lower risk	458 (62.1)	107 (69.5)	224 (64.9)	127 (53.4)	1.0	<0.001
Higher risk	279 (37.9)	47 (30.5)	121 (35.1)	111 (46.6)	1.64 (1.24 to 2.18)	

FSW, female sex worker; OR, odds ratio; STI, sexually transmitted infection.

Xinjiang Province, China). Positive HIV-1 ELISA were confirmed by Western blot (Diagnostics HIV Blot 2.2; Genelabs, Singapore) and positive rapid plasma reagin tests for syphilis were confirmed by the *Treponema pallidum* particle assay test (Serodia-P-PA; Fujirebio, Fuji, Japan). Endocervical swabs were collected and tested for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* by PCR (Amplicor; Roche, Basel, Switzerland). Vaginal swabs were collected and a wet mount prepared to detect *Trichomonas vaginalis*. Finally, urine was collected for opiate screening (MOP One Step Opiate Test Device; Acon Laboratories, San Diego, California, USA). Participants were classified as using illegal drugs if they either self-reported such use or tested urine positive for opiates. All participants were scheduled for a follow-up visit 4–6 weeks later for counselling in a private room.

Statistical tests were performed using SAS 9.1 software. The dependent variable (STI) was classified into three sequence categories according to the number of STI detected, including syphilis, HSV-2, gonorrhoea, chlamydia and trichomonas, which are all transmitted primarily through sexual intercourse. The ordinal dependent variable was coded as “0” if no STI were detected, “1” if one STI was found and “2” if two or more were found.

Work venues were classified into two categories, low and high risk. Higher risk venues included beauty salons, temporary sublets and public spaces (street corners); these venues attracted relatively less wealthy and less educated clients. Lower risk venues included karaoke clubs, night clubs, saunas and hotels, which attracted a wealthier, better educated clientele. “Regular sexual partner” was defined as a man with whom FSW had regular sexual relations without compensation, such as a boyfriend or spouse.

The correlations between STI and the number of clients in the previous week and earnings per client were evaluated with the  $\chi^2$  test for linearity. Univariate associations between risk factors and STI were evaluated using a cumulative logit model. Adjusted odds ratios (OR) were calculated through a multivariate cumulative logit model, which included only the factors found to be significant in univariate analysis ( $p < 0.05$ ). The model proportional odds assumption for the cumulative logit analysis was tested and met.

## RESULTS

We approached 756 FSW and 100% of them enrolled and gave their consent to participate. A very small fraction was excluded from the final analysis: four (0.5%) refused specimen collection and 15 (2%) withdrew from the study when confronted with sensitive questions. Of the 737 FSW included in the study, 393 (53%) returned for test results and post-test counselling.

### Prevalence of HIV/STI

The prevalence of HIV-1 infection was 10.3% (76/737), compared with 7.5% (55/737) for syphilis, 8.3% (61/737) for *N gonorrhoea*, 25.9% (191/737) for *C trachomatis*, 10.6% (78/737) for *T vaginalis* and 68.1% (502/737) for HSV-2. In terms of multiple infections, 345 (46.8%) FSW were infected with only one type of STI (except HIV), 176 (23.9%) had two STI and 62 (8.4%) had three or more STI.

### Demographics of the study population

FSW were primarily of Han ethnicity (67%), permanent residents of Yunnan province (80%), with ages ranging from 16 to 52 years (median, 23 years; interquartile range 20–28 years). Regarding the

**Table 2** Univariate cumulative odds logistic regression analysis of behavioural characteristics associated with STI among 737 FSW

Behavioural characteristics	All subjects (n = 737)	No STI No (%)	One STI No (%)	Two or more STI No (%)	OR (95% CI)	p Value
Tooth extracted or filled						
No	614 (83.3)	131 (85.1)	280 (81.2)	203 (85.3)	1.0	0.73
Yes	123 (16.7)	23 (14.9)	65 (18.8)	35 (14.7)	0.93 (0.65 to 1.35)	
Blood transfusion						
No	714 (96.9)	150 (97.4)	330 (95.7)	234 (98.3)	1.0	0.44
Yes	23 (3.1)	4 (2.6)	15 (4.3)	4 (1.7)	0.74 (0.34 to 1.60)	
Drug use (ever)						
Non-drug user	617 (83.7)	144 (93.5)	287 (83.2)	186 (78.2)	1.0	<0.001
Non-injection drug user	51 (6.9)	4 (2.6)	26 (7.5)	21 (8.8)	1.93 (1.12 to 3.31)	
Injection drug user	69 (9.4)	6 (3.9)	32 (9.3)	31 (13.0)	2.12 (1.32 to 3.41)*	
Drinking alcohol						
No	183 (24.8)	20 (13.0)	80 (23.2)	83 (34.9)	1.0	<0.001
Yes	554 (75.2)	134 (87.0)	265 (76.8)	155 (65.1)	0.45 (0.32 to 0.61)	
Heard of STI						
No	86 (11.7)	23 (14.9)	29 (8.4)	34 (14.3)	1.0	0.73
Yes	651 (88.3)	131 (85.1)	316 (91.6)	204 (85.7)	0.93 (0.61 to 1.41)	
Perceived as vulnerable to STI						
No	389 (52.8)	92 (59.7)	174 (50.4)	123 (51.7)	1.0	0.20
Yes	348 (47.2)	62 (40.3)	171 (49.6)	115 (48.3)	1.20 (0.91 to 1.57)	
Lower abdominal pain past year						
No	505 (68.5)	107 (69.5)	232 (67.3)	166 (69.8)	1.0	0.85
Yes	232 (31.5)	47 (30.5)	113 (32.7)	72 (30.2)	0.97 (0.73 to 1.30)	
Unusual vaginal discharge past year						
No	412 (55.9)	92 (59.7)	185 (53.6)	135 (56.7)	1.0	0.73
Yes	325 (44.1)	62 (40.3)	160 (46.4)	103 (43.3)	1.05 (0.80 to 1.38)	
Painful or burning when urinating past year						
No	629 (85.4)	128 (83.1)	292 (84.6)	209 (87.8)	1.0	0.18
Yes	108 (14.6)	26 (16.9)	53 (15.4)	29 (12.2)	0.77 (0.52 to 1.13)	
Age of first sex, years						
≥18	450 (61.1)	102 (66.2)	220 (63.8)	128 (53.8)	1.0	0.007
<18	287 (38.9)	52 (33.8)	125 (36.2)	110 (46.2)	1.47 (1.11 to 1.95)	
Regular partner						
No	354 (48.0)	68 (44.2)	152 (44.1)	134 (56.3)	1.0	0.007
Yes	383 (52.0)	86 (55.8)	193 (55.9)	104 (43.7)	0.69 (0.52 to 0.90)	
Use condom with regular partner every time						
Yes	61 (15.9)	17 (19.8)	30 (15.5)	14 (13.5)	1.0	0.24
No	322 (84.1)	69 (80.2)	163 (84.5)	90 (86.5)	1.36 (0.81 to 2.29)	
Age of engaging in commercial sex work, years						
≥20	471 (63.9)	103 (66.9)	228 (66.1)	140 (58.8)	1.0	0.07
<20	266 (36.1)	51 (33.1)	117 (33.9)	98 (41.2)	1.30 (0.98 to 1.73)	
Duration of commercial sex works, years						
<1	248 (33.7)	66 (42.9)	100 (29.0)	82 (34.5)	1.0	0.41
1–2	284 (38.5)	52 (33.8)	145 (42.0)	87 (36.5)	1.15 (0.83 to 1.58)	
≥3	205 (27.8)	36 (23.3)	100 (29.0)	69 (29.0)	1.27 (0.89 to 1.79)	
No of clients past week						
1	190 (25.8)	56 (36.4)	90 (26.1)	44 (18.5)	1.0	<0.001
2–4	330 (44.8)	71 (46.1)	156 (45.2)	103 (43.3)	1.53 (1.09 to 2.14)	
≥5	217 (29.4)	27 (17.5)	99 (28.7)	91 (38.2)	2.56 (1.77 to 3.72)	
Use condom with client every time						
Yes	616 (83.6)	137 (89.0)	292 (84.6)	187 (78.6)	1.0	0.005
No	121 (16.4)	17 (11.0)	53 (15.4)	51 (21.4)	1.69 (1.17 to 2.45)	
Earnings per client, yuan						
≤50	109 (14.8)	10 (6.5)	44 (12.7)	55 (23.1)	1.0	<0.001
50–100	360 (48.8)	77 (50.0)	162 (47.0)	121 (50.8)	0.46 (0.30 to 0.69)	
>100	268 (36.4)	67 (43.5)	139 (40.3)	62 (26.1)	0.32 (0.21 to 0.49)	
Vaginal douching						
No	117 (15.9)	22 (14.3)	54 (15.6)	41 (17.2)	1.0	0.43
Yes	620 (84.1)	132 (85.7)	291 (84.4)	197 (82.8)	0.86 (0.59 to 1.25)	

FSW, female sex worker; OR, odds ratio; STI, sexually transmitted infection. \* p&lt;0.05%.

**Table 3** Multivariate cumulative odds logistic regression analysis of variables associated with STI (n = 737)

Risk factors	Adjusted OR (95% CI)	p Value
Schooling <9 years	1.0	
Schooling ≥9 years	0.64 (0.48 to 0.84)	<0.001
Living in apartment	1.0	
Living in family home	1.43 (0.84 to 2.42)	0.1893
Living in location of sex work	1.93 (1.38 to 2.70)	<0.001
No drug use	1.0	
Injection drug use	1.71 (1.03 to 2.83)	0.0365
Non-injection drug use	1.89 (1.08 to 3.29)	0.0254
No of clients past week 1	1.0	
No of clients past week 2~4	1.29 (0.92 to 1.82)	0.1448
No of clients past week ≥5	1.83 (1.23 to 2.72)	0.0027
Consistent condom use with clients	1.0	
Inconsistent condom use with clients	1.48 (1.01 to 2.17)	0.0437

OR, odds ratio; STI, sexually transmitted infection.

likelihood of STI, FSW of Han ethnicity, who were registered permanent residents of cities other than Kaiyuan, who lived in brothels and those who worked in higher risk venues were significantly more likely to have at least one STI. In contrast women with nine or more years of formal education were significantly less likely to have an STI.

### Behavioural characteristics and association with STI

Table 2 describes the relationship between STI status and STI/HIV transmission-related behavioural characteristics. A total of 120 FSW (16.3%) either self-reported the use of illegal drugs or had a positive urine drug test. Non-injection drug users were 1.9 times more likely to be infected with one or more STI than non-drug users, this risk for intravenous drug users was 2.1 times that of non-drug users. Among all FSW, the median duration of commercial sex work was 19.4 months and the median number of paid clients in the preceding week was three. The outcome variable measuring the number of STI significantly increased as the number of clients ( $p<0.001$ ) in the preceding week increased; whereas the number of STI was inversely related to the earnings per client ( $p<0.001$ ).

Regarding those subjects who reported having a regular partner, 52% reported having a "regular sexual partner". The prevalence of STI was significantly lower in those who had a regular partner. Of those subjects, 84% said they did not use condoms routinely with their regular partner; however, there was no association between these condom use rates and the likelihood of a STI. Among the 297 FSW who had regular sex partners and were also infected with at least one STI, only 44 (14.8%) reported consistent condom use with their regular partners in the previous week. By contrast, 479 (82.2%) of the 583 FSW who had at least one STI said they had used condoms with all paying sex partners in the previous week. The overall STI prevalence was significantly lower in those reporting consistent condom usage with clients.

Regarding STI symptoms in the past year, 232 (31.5%) FSW reported having lower abdominal pain, 325 (44.1%) reported unusual vaginal discharge and 108 (14.7%) reported pain or a burning sensation while urinating. There was no significant relationship between these reported symptoms and STI prevalence.

### Multivariate analyses

Table 3 displays the results from a multivariate cumulative logit model of STI, which was verified using the common odds

assumption test. After adjusting for the risk and host factors significant in univariate analyses, the following risk factors for STI were found to be statistically significant: injection drug use; non-injection drug use; living in their location of sex work (as opposed to in an apartment); inconsistent use of condoms with clients and over five clients in the previous week. Having more than 9 years of education was associated with a significantly lower risk of STI.

### DISCUSSION

Our study confirmed that rates of STI are high among FSW in Yunnan, China. The prevalence of any STI in FSW (79%) in our study was much higher than the national STI prevalence (0.054% in 2005)<sup>6</sup> but similar to another study of FSW in Yunnan examining the same STI (84%).<sup>7</sup> In our study, *C trachomatis* was the most common bacterial STI followed by *T vaginalis* then *N gonorrhoea*, and the trend was similar among FSW in Yunnan (58.6%, 43.2% and 37.8%, respectively) and Guangzhou (32%, 12.5% and 8%).<sup>7,8</sup> Geography, study dates and sampling methods may account for some differences; for example, subjects were also recruited from STI clinics in the Yunnan study, yielding a slightly higher rate.

We found that having over five clients in the previous week was a significant risk factor for each STI when controlling for other key variables. This suggests that numbers of partners per

### Key messages

- ▶ Their vulnerability to HIV/sexually transmitted infection (STI) contraction and role as core transmitters to the general population make STI prevention among female sex workers (FSW) a public health priority.
- ▶ STI rates among Chinese FSW have reached epidemic proportions with herpes simplex virus 2 at 68.1%, chlamydia at 25.9% and HIV-1 at 10.3%.
- ▶ Application of the cumulative logit regression analysis method facilitates this kind of analysis to reflect the reality of STI conditions within FSW in China.
- ▶ Multivariate analysis finds education level, type of residence, drug use, weekly numbers of clients and condom use with clients all to be associated with STI.



week is the key sexual predictor for STI because of their greater exposure to sexual situations in which the virus can be transmitted. In terms of socioeconomic characteristics, FSW with fewer years of education were found to be at greater risk of STI. These findings are consistent with the results of other studies.<sup>9</sup> Less education may lead to a lower awareness of STI and prevention methods as well as a lower perceived risk, which could be associated with less frequent or less proficient condom use. Living in their location of sex work was also a significant risk factor for STI, possibly due to the increased accessibility of FSW to potential clients who can visit them at any hour.

Not surprisingly, the inconsistent use of condoms was a significant risk factor for STI in FSW in our study, but we also found that compared with their use rates with paying clients FSW reported that they rarely used condoms with boyfriends and spouses. This poses considerable challenges for controlling the spread of STI to the general population, particularly if regular male partners also have other sexual partners. Such trends can also serve as early warning indicators for HIV transmission, particularly as the 2007 national HIV estimates found that the proportion of new infections transmitted sexually may have overtaken the share spread through needle-sharing behaviours.<sup>10</sup> These findings emphasise the need to promote more frequent screening and STI treatment among FSW, as well as greater outreach to encourage consistent and correct condom use with all sexual partners, including regular partners. These results are consistent with other studies of FSW in China, which suggest that they are a major reservoir for expanding STI in China.<sup>11</sup>

Another key risk factor for STI was illegal drug use, which raises important questions for the indirect role of illegal drug use in transmitting STI. In most cases in which sex work is the primary source of income, FSW may need to have more clients to generate enough money to buy drugs, as evidenced by the comparative numbers of clients in the past week (6.7 vs 4.1,  $p < 0.01$ ). In addition, as Ostrow *et al*<sup>12</sup> note, there are possible “biological explanations” as to why illegal drug use might lead to a greater likelihood of infection: “illegal drug use either causes transient immune suppression that increases the likelihood of infection given a particular exposure, or can make it easier for infected semen to cross the rectal mucosa and enter the bloodstream of the receptive partner. Acute immunosuppressive effects of illegal drug use had been reported in support of these possible mechanisms.”<sup>12</sup>

We found that FSW living in brothels or other working locations had more clients but a lower charge per client. It is possible that FSW who live at their workplace are more accessible to clients who can seek services at irregular hours. As for higher earnings per client, it is possible that many FSW who work at higher-end establishments such as karaoke halls where clients pay more, also tend to live there.

Past research on risk factors for STI have usually focused on an analysis of single diseases;<sup>13–15</sup> however, many studies that analysed risk factors for the simultaneous infection of multiple STI usually dichotomised as infected with any STI versus no infection. The application of the cumulative logit model facilitates this kind of analysis to reflect the reality of STI conditions within our population better. Were our study to focus on only one type of STI, for example, subjects infected with the STI in question would be classified as positive, whereas those without that particular infection but perhaps with many other STI would be considered a negative observation. This would invariably misrepresent the risk factors of such subjects and obscure the true relationship between risk behaviours and

STI status. In the risk factors analysis of multiple STI, it was also not appropriate to dichotomise subjects as infected with any STI or no infection, as this would assume that subjects infected with only one STI were effectively the same as those infected with two or more STI. Our analysis methods were adopted as a way in which to assess more comprehensively and accurately the behaviours of study subjects. To our knowledge, this is the first application of a cumulative logit model for use in the investigation of multiple STI.

This study has several limitations. Given that data on STI are not inherently ordinal, classification of the primary response variable as such required that we assume that the comparative risks of each of the five types of STI are commensurate and that the various risk factors had similar associations with each STI. In order to use this model we made certain the model passed the validity test for the common odds assumption, which assumes that odds ratios can be interpreted as constant across all possible cut points of the outcome. However, due to variations in probabilities of transmission, pathogen infectivity and other unobserved factors, this assumption has some weaknesses. Although estimates of STI transmission rates have been documented, such estimates can vary widely; for example, Warner *et al*<sup>16</sup> found that the probability of transmission of gonorrhoea per unprotected sex act can range from 0.20 to 0.50. Factors such as pathogen infectivity or modes of infection (eg, transmitted through penile fluids versus those through skin or mucosal surfaces) can explain some of this variation; however, as results of random sample studies the results are not a reliable source on which to score the transmission rates of various STI. In order to address these concerns we would need to obtain more information on STI prevalence rates in the sexual partners of FSW (clients and regular partners) in order to infer relative probabilities of the transmission of each STI in this specific population—information we do not have at this point.

In addition, because many of the risk factors were self-reported variables such as condom use and illegal drug use, they may be subject to reporting and/or recall bias. To minimise recall bias, we asked questions about recent events, such as condom use in the previous week, and conducted objective tests of risk factors as much as possible, such as urine testing for opiates. Finally, this study was only representative of FSW in Kaiyan City, Yunnan, and results may or may not be generalised to other FSW in China.

Importantly, no difference in STI rates was found between symptomatic and asymptomatic FSW, and in some cases asymptomatic patients were found to have more STI. This highlights the fact that many STI are asymptomatic or have non-specific symptoms, and intervention programmes must be careful to point this out so as to encourage regular screening and better health-seeking behaviours.

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**Competing interests:** None.

**Ethics approval:** This study received approval from both the national and local Yunnan institutional review boards.

**Patient consent:** Obtained.

**Contributors:** NW was the principal investigator for the study, HW was the lead author for the paper; NW, HW, GW, GD, MJ and LL contributed to the design of the

study; HW performed all the statistical analyses; NW, HW, AB, GW, GD, MJ and LL supervised the conduct of the survey on site and all the authors contributed to the write up.

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## Application of cumulative odds logistic model on risk factors analysis for sexually transmitted infections among female sex workers in Kaiyuan city, Yunnan province, China

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